Republic of the Philippines

Data Collection Survey on the Insurance Mechanism for Incentivizing Disaster Resilient Public Infrastructures In Metro Manila Republic of the Philippines

Final Report

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Japan International Cooperation Agency (JICA)

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Abbreviation

AIR	AIR Worldwide
BTr	Bureau of Treasury
CATDDO	Catastrophe-Deferred Drawdown Option
COA	Commission on Audit
DBM	Department of Budget and Management
DILG	Department of Interior and Local Government
DepEd	Department of Education
DOF	Department of Finance
DOST	Department of Science and Technology
DOTr	Department of Transportation
DPWH	Department of Public Works and Highway
DREAM	Disaster Risk and Exposure Assessment for Mitigation
DRF	Disaster Risk Financing
DRFI	Disaster Risk Financing and Insurance
DRR	Disaster Risk Reduction
FEMA	Federal Emergency Management Agency
EO	Executive Order
GIIS	General Insurance Information System
GIS	Geographic Information System
GMMA READY	Enhancing Greater Metro Manila's Institutional Capacities for Effective Disaster/Climate Risk Management towards Sustainable Development Project
GMMA RAP	Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area Project
GSIS	Government Service Insurance System
HAZUS	Hazards United States
IAC	Inter Agency Committee
IAR	Industrial All Risk Policy
IC	Insurance Commission
ITV	Insurance-to-Value
IRR	Implementing Rules and Regulations
JCM	Joint Coordinating Meeting
JICA	Japan International Cooperation Agency
LDRRMF	Local Disaster Risk Reduction and Management Fund
LGUs	Local Government Units
LiDAR	Light Detection and Ranging Technology
MIAA	Manila International Airport Authority
MMEIRS	Study for Earthquake Impact Reduction for Metropolitan Manila in the Republic of the Philippines
MRT	Metro Rail Transit System

NAIA	Ninoy Aquino International Airport
NAMRIA	National Mapping and Resource Authority
NDRRMC	National Disaster Risk Reduction and Management Council
NDRRMF	National Disaster Risk Reduction and Management Fund
NDRRMP	National Disaster Risk Reduction and Management Plan
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCRAM	Philippines Catastrophe Risk Assessment and Modeling
PGM	President and General Manager
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PIRA	Philippine Insurers and Reinsurers Association
PIRA, Ltd.	Philippines Insurance rating association, Ltd.
PCIC	Philippines Crop Insurance Corporation
PPP	Public-Private Partnerships
PPR	Plan de Prevention des Risques Naturels Previsible
QS	Quantity Surveyor
RA	Republic Act
RMS	Risk Management Solutions
SVP	Senior Vice President
UP	University of the Philippines
TA	Technical Assistance
VP	Vice President

1 Study Outline

1.1 Background

The Philippines is a country which receives disaster strikes most frequently in the Southeast Asia region throughout the year. In particular, the impacts brought by various natural hazard events give significant damages on human life as well as economy of the Philippines every year. The metropolitan area of Manila, which is the subject of this study, is expected to have more than 20 million people in the daytime, and development agencies including government agencies and JICA have shown realistic and serious disaster scenarios such as vulnerability to typhoons and floods, Magnitude 7.2 epicentral seismic risk due to the West Valley fault. Under such circumstance, the Philippine government has been undertaking to reduce vulnerability against natural disaster in line with Republic Act (RA) No. 10121.

The government has been actively involved in developing a disaster risk financing strategy and mechanism as well to cope with financial protection needed at the time of disaster. The risk financing policies were prepared under the Hyogo Framework for Action (HFA), and stipulated in its "The Strategic National Action Plan (SNAP[1]) for Strengthening Disaster Risk Reduction" adopted by an Executive Order No. 888[2] and "The National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028" based on RA10121 of 2010. SNAP includes such priority programs and projects as establishment of disaster response funds, securing funds for disaster response at local governments, and utilization of disaster insurance. In addition, NDRRMP aims in "Outcome 5" out of the 24 outcomes to enable communities in the Philippines to utilize effective and appropriate disaster risk financing and insurance. Key performance indicators include government assets to be insured; and disaster risk financing to be an option for disaster response measures available to the local government. Being led by the Department of Finance (DOF), these actions correspond to the ASEAN Roadmap for Disaster Risk Financing and Insurance (DRFI)[3].

The Second Disaster Risk Management Development Policy Loan with a Deferred Drawdown Option (CAT DDOII)[4] signed in January 2016 by the Philippine government and the World Bank also stipulates disaster risk financing as the efforts the government to work on. The development of risk financing strategy (referred to as DRFI (Disaster Risk Financing and Insurance) in the World Bank) tailored to each level of central government, local government, and households; and establishment of a concrete DRFI program as a whole financial protection measure to natural disaster are in progress. In order to realize concrete DRFI program, the implementation of the framework of finance and insurance tailored to each level of central / local government, enterprises, and households has been promoted mainly by DOF[5].

In the Third UN World Conference on Disaster Risk Reduction which was held in Sendai in March 2015, it was discussed that a comprehensive approach has to be taken in order to materialize "Build Back Better" by providing loan finance to increase resilience against natural disaster considering importance of investment in DRR. Also, utilization of index insurance, which

1 The Strategic National Action Plan 2009-2010, National Disaster Coordinating Council, adopted by Presidential Decree No. 888
2 Executive Order No. 888, http://www.gov.ph/2010/06/07/executive-order-no-888-s-2010/
3 Implementing the ASEAN DRFI Roadmap, ASEAN Secretariat, April, 2015
http://mddb.apec.org/Documents/2015/FMP/SEM1/15_fmp_sem1_011.pdf
4 http://documents.worldbank.org/curated/en/970931468283749399/pdf/RAD150646572.pdf
5 Strategic priorities of the department of financing in managing disaster risk ASEAN Policy Forum on DRFI in the Philippines – Department of Philippines. February 2-3, 2017

can make an immediate payment after disaster occurrence, as well as property insurance, which can cover the needs to source large scale finance, is regarded as elements of the comprehensive approach[6].

In this series of efforts and discussion in the international arena for risk financing against natural disaster, the Government Service Insurance System (GSIS), a property insurance agency providing property insurance coverage for public assets targets to develop the capacity to calculate premium rates against natural disaster as one of the issues to be addressed[7]. There are background factors: GSIS has no means to systematically set premium and coverage extent in line with natural disaster risk; Premium for large public infrastructures has mainly been determined by following to market condition, and thus, premium may not be adequate to address the natural disaster risk.

In this background, JICA has received a request of cooperation from GSIS to improve and formulate a method to calculate premium rates against natural disaster based on the actuarial science for GSIS property insurance (hereinafter referred to as "public property insurance") for such public infrastructures as public elementary / junior high schools and other infrastructures managed by the Department of Transportation (DOTr)[8]. Upon the request, this data collection study (the Study) is formed by JICA with an aim to collect necessary data and information to examine the method to support GSIS, considering the limited efforts by JICA in this field.

1.2 Study Objectives

The purpose of this study is to consider and make proposals for the realization of public property insurance incorporating an incentive system to encourage investment in DRR to strengthen public infrastructure. As a concrete approach, the study team considers a mechanism to promote investment in DRR and make recommendations based on the introduction of the premium rate according to natural disaster risks as described below.

a. Considering the Introduction of Risk-based Premium Rates for Natural Disasters

This study conducts trial calculation of the pure premium rate using actuarial science for public property insurance to such public infrastructures as public elementary / junior high schools and other infrastructures managed by DOTr, based on the analysis of natural disaster hazard in the study areas and that of vulnerability of building structure, and development of measures to reduce damages brought by disasters. Based on the results, information gathering and issue analysis will be undertaken on the feasibility of setting the premium rate in the public property insurance which reflects the resilience of public infrastructures in Metro Manila (or "MM") to natural disasters.

b. Review of proposals on the program to promote investment in DRR through introduction of risk-based premium rate

This study shall also examine whether the activities mentioned above in (a) can provide an appropriate incentive that would promote prior investment to strengthen resilience of public

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[6] Working Session 16: Economic Aspects of Disaster Risk Reduction at the third UN World Conference on Disaster Risk Reduction
https://www.jica.go.jp/topics/feature/2014/150320_02_report01.html

[7] Based on an interview with GSIS in May 2015

[8] It was renamed from the Ministry of Transport and Communication (DOTC) according to Republic Act No. 10844 dated May 23, 2016.

infrastructure facilities for government organizations administrating such facilities, and that would result in increasing resilience of public infrastructures against natural disasters by analyzing collected data. Then, the study will present an implication including the incremental capacity development plan to the GSIS in order to overcome challenges faced by the GSIS.

1.3 Implementation Policy and Work Procedures

1.3.1 GSIS' Intention

Based on the above objective, the study team confirmed the intention of GSIS for this study as follows, in the first field survey conducted in April 2016.

a. Responding to the Basic Issues of Public Property Insurance

1) GSIS is entrusted with providing insurance for all insurable government assets and interests[9] as per RA 656 promulgated in 1951. Meanwhile, there is room for improvement as public property insurance designed to transfer risks of natural disasters, for there are still many facilities uninsured on a practical level. (Uninsured issue)

2) There are some cases of being underinsured[10] that sum insured is less than the actual replacement cost[11]. Basis of indemnity of GSIS standard policy is replacement cost at the time of loss, and when a loss occurs, the insurance payout will be the cost to replace the damaged or destroyed property with new property of like kind and quality without any deduction for depreciation or obsolescence. Therefore, sum insured must be based on replacement cost. However, in practice, many of insured carries acquisition price in past or book value of the facility with depreciation as sum insured. In these cases, insurance payment is reduced by the average clause in the policy because sum insured is less than replacement cost at the time of a loss. There is room for improvement in property insurance provision, because such payout may lead to a shortage in restoration funds.

   Among large-scale pieces of infrastructure, the sum insured of Metro Rail Transit System Line 3 (MRT3) completed in 1999 is based on the acquisition cost back then, which is presumed to be considerable underinsured situation, and GSIS has not been able to grasp the reasonable replacement cost. Sub-limits for liability in the insurance policy against natural disasters are imposed in insurance policies; however, there is no provision of data to prove it to be rational because the replacement cost is unclear. In the situation where the adequacy of the sum insured is uncertain, GSIS has difficulty in annual negotiation with reinsurers. (Underinsured issue)

3) GSIS understands well the intent of the Study, such as a public infrastructure strengthening scheme by utilizing property insurance, and the necessity of mechanism to promote prior investment in DRR. However, the study should be pushed forward with while taking into consideration those fundamental problems to be solved in the public property insurance.

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9 Assets of Municipalities (town) of class 2 or lower are not subject to compulsory insurance.

10 Underinsurance means that the sum insured is less than the actual value of the buildings and facilities covered. The sum insured is set based on cash value, replacement cost, agreed value etc., while in GSIS insurance policy, it is based on "replacement cost".

11 The replacement cost is the amount necessary to newly build or purchase property of like kind and quality regardless of the year of acquisition. There is no reduction for depreciation. The Institutes, an education and research organization in the insurance industry in the United States, defines the replacement cost as follows. "The cost to repair or replace property using new materials of like kind and quality with no deduction for depreciation."

b. Scalability of Risk-Based Premium Rate Calculation Tool

Many of the public schools under DepEd's jurisdiction are uninsured. The risk-based premium rate calculation tool for MM, one of the Study's products, is expandable to fit in areas outside MM. So, it should become an upgraded tool to encourage public schools on the Eastern Seaboard, vulnerable to natural disasters, to take out insurance. If it becomes possible to assess the risk of schools located in broader regions and to underwrite insurance contracts, GSIS will be able to disperse disaster risks even in such areas prone to natural disaster as the Eastern Seaboard. This will enable GSIS to reduce the premium rate and then increase the ratio of the insured facilities.

c. Improvement of Awareness about Insurance Roles and Functions

GSIS's company regulations mandate GSIS to transfer a portion of insurance risks they underwrote beyond its retained amount to reinsurance markets. Thus, the public property insurance performs a vital function to support the disaster risk financing, a mechanism to transfer disaster risk of government assets to overseas, ultimately; however, each government agency, the insured party has insufficient awareness of the role and function of insurance. GSIS expects that such awareness should be raised through the Study.

1.3.2 Consideration of the Study Plan

The result of the first field survey revealed such issues in the public property insurance as uninsurance and underinsurance. GSIS expects further study to be conducted considering this finding. While the Study considers incorporating risk control function which can help strengthen facilities by prior investment in DRR in public property insurance as a risk transfer function, it is necessary to optimize insurance by correcting uninsurance and underinsurance. Based on the intention of GSIS which was clarified as a result of the first field survey, the recognition of the study team was organized as follows as to the implementation of work reflecting the state of insurance not covered by public property insurance and underinsurance.

a. Consideration of the Study Plan in Keeping with GSIS' Intention

1) For uninsured conditions described in 1.3.1a, the government has been gradually implementing measures, allowing local governments to allot Local Disaster Risk Reduction and Management Fund (LDRRMF) to insurance premium, etc. Meanwhile, there are many local governments taking the public property insurance without natural disaster coverage, i.e. fire and lightning only. This situation is similar to underinsurance and needs to be improved. (Response to uninsurance)

2) To correct the condition of underinsurance, insured parties (insurance applicants) must provide replacement cost as the sum insured. In deciding the the replacement cost, it is not fair that GSIS, an insurer who conducts insurance underwriting, sets the level. It should be done by an insured party or a third party entrusted by them. Meanwhile, it is also necessary to set appropriate insured value in order to develop and test out the risk-based premium rate calculation tool for the Study. The maximum loss amount derived from the Tool can be used to set limits of liability in designing insurance. Therefore, as part of this study, the replacement costs of the surveyed facilities were evaluated. The scope covered MRT3, Terminal 3 of Manila International Airport (NAIA T3), and public school buildings, all of which, unlike general commercial buildings, were difficult to assess. Utilization by GSIS of the results and method of the assessment obtained through the Study will help calculate appropriate insured value. (Response to underinsurance)

b. Scalability of Risk Rate Calculation Tool

The facilities on which GSIS underwrites insurance are located throughout the Philippines. By enhancing the tool, GSIS will be able to calculate premium rates for the east coast region where the typhoon risk is high, and perform pooling management of the underwriting risk based on risk assessment. Although a risk premium rate calculation tool will be developed to cover Metro Manila in this study, a tool capable of incorporating data concerning hazards and the vulnerability of facilities throughout the Philippines in the future, according to GSIS's intentions, can be designed and developed.

c. Efforts to Raise Awareness about the Role and Function of Insurance

Raising awareness of the role of public property insurance in the insured as agencies concerned is also important to establish the disaster risk financing scheme the Government of the Philippines has been working on. The study team believed that taking advantage of the Study and its tool met the objective of the Study which aimed at a higher goal for strengthening public infrastructure by utilizing a public property insurance system. This study provided for the occasion of holding JCM (Joint Coordinating Meeting) as a good opportunity to make known the importance of GSIS's public property insurance through information sharing.

1.3.3 Arranging Work Procedures

Following the above, the work procedures for achieving business objectives were organized as follows.

1) STEP 1: Evaluation of uninsured and underinsured situation (Setting the appropriate replacement cost)

Despite the preservation of property insurance with public infrastructure assets as stipulated by RA656, in reality there is a state of uninsurance and underinsurance that the sum insured is less than the asset value (replacement cost). Here, as a task for considering the use of property insurance for resilience of public infrastructure, the study team grasps the situation of uninsured, and clarifies the current state of underinsurance by evaluating the replacement cost.

2) STEP 2: Development of Risk-based Premium Rate Calculation Tool

The study team tries to calculate premium rate as benchmark based on actuarial science, according to the information and evaluation results of natural disasters analysis of the region, of vulnerability analysis of the target structure, and on such development status as a loss prevention measure. This study also aims to examine feasibility whether GSIS will be able to set premium rate which reflects the resilience of public infrastructures in future.

3) STEP3: Optimization of insurance, consideration of risk-based premium rates

The study team reviews measures to optimize public property insurance based on the result of evaluating uninsurance and underinsurance status. In addition, based on the trial result described in STEP 2 above, information gathering and issue analysis on whether introducing the risk-based premium rate give an appropriate incentive to the government agency having jurisdiction over the public infrastructure subject to the Study to increase resilience against natural disasters, and to contribute to overcoming vulnerability to natural disasters.

Based on the work of STEP 1 through 3 above, the study team recommends a step-by-step capacity building plan to resolve the issue in the use of property insurance for resilience of public infrastructure, and to pursue prior investment promotion mechanisms including the introduction of effective financial mechanisms.

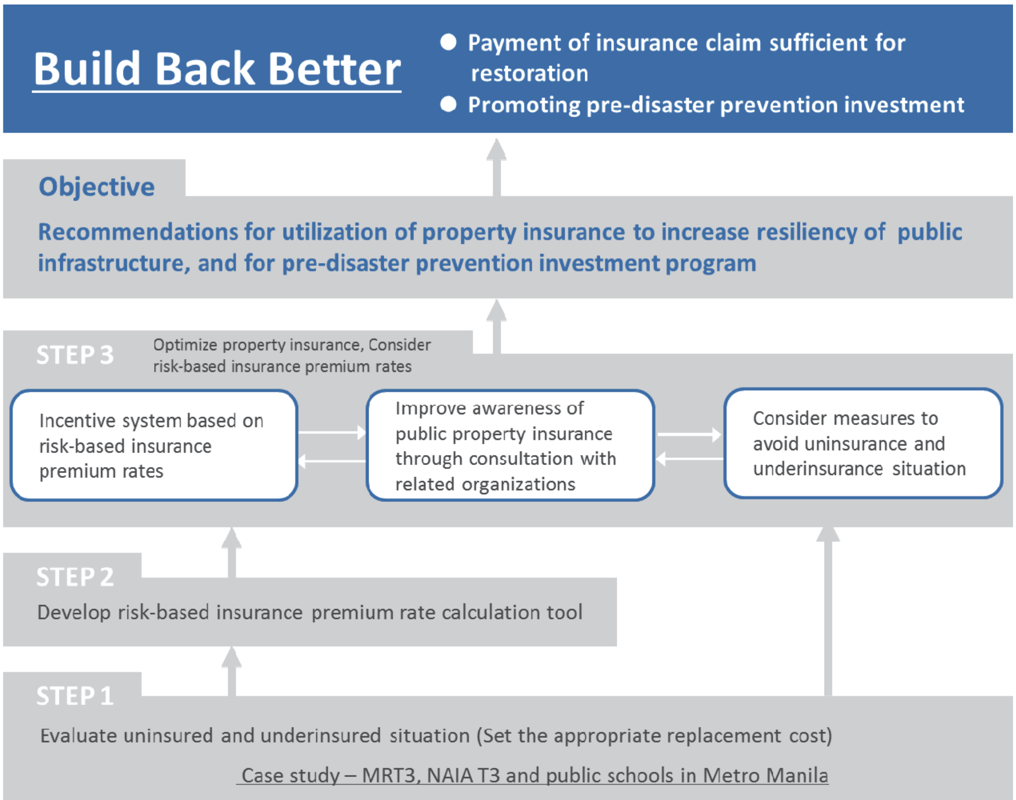


Figure 1-1 Workflow and Goal of the Study

1.4 Scope of the Study and Institutions Concerned

This study was conducted on the Metro Manila in the Philippines in cooperation with GSIS as an implementation agency. Other relevant originations were DOTr, the Department of Education (DepEd), the Philippine Atmospheric, the Geophysical and Astronomical Services Administration (PAGASA), the Philippine Institute of Volcanology and Seismology (PHIVOLCS). In addition, the Manila International Airport Authority (MIAA), the National Mapping and Resource Authority (NAMRIA), MRT3, the University of the Philippines (UP), and the Department of Public Works and Highway (DPWH) also provided data and documents on hazards and vulnerability assessment.

1.5 Study Team

The composition of the study team members is as follows.

Table 1-1 Study Team Members

Expertise	Name
Team leader, Insurance and disaster risk financing 1	Mr. Takeshi Kuwabara
Sub-leader, Insurance and disaster risk financing 2	Dr. Hiroyuki Fujii
Structure vulnerability assessment（Public schools）	Mr. Ichiro Kono
Disaster risk analysis (Wind and flood damage)	Dr. Kazuyoshi Nishijima

Expertise	Name
Structure vulnerability assessment（Transport infrastructure）	Mr. Kensuke Sakai
Disaster risk analysis (Seismic disaster)	Mr. Shinji Yamada
Data collection and GIS	Mr. Kazutoshi Masuda
Structure vulnerability assessment	Mr. Kazushiro Sugimoto
Seminar planning	Ms. Shio Kuwabara

1.6 Study Schedule

Due to a partial change in the procedures for the Study based on GSIS' intention, the study team separated the Study into two phases and reviewed the implementation schedule. Main tasks of the first phase, ending in September 2016, were to collect information on trends in disaster risk financing; GSIS public property insurance in the Philippines; hazard information about types of disaster covered by the Study; information for use in vulnerability assessment of the facilities; information including drawings to evaluate the replacement cost of facilities, to evaluate the replacement cost, to develop a prototype of the risk-based premium rate calculation tool, and to collect technical information necessary for the development of the tool in order to assess hazards of assumed disasters and the vulnerability of target facilities. The second phase focused on the development of a finalized version of an insurance calculation tool; the potential application of an incentive scheme, including premium rate, to GSIS' public property insurance; the solution to improve GSIS' capacity with regards to grasping appropriate insured value, risk-based premium rate assessment model, and an incentive scheme, all of which GSIS regarded as challenges.

In addition, in November 2016, the first JCM was held at GSIS Headquarters to provide an overview of the risk-based premium rate calculation tool, uninsured and underinsured situation of public property insurance as an interim report to the relevant agencies. In the second JCM held in March 2017, the result of the survey on the policy of incentives for promoting DRR investment with risk-based premium rate in public property insurance, and the program plan to increase resilience of facilities was reported. (For details see Annex A Minutes of Meeting of the first and second JCM)

An Inter Agency Committee was established in November 2018 by the administrative order of 2017/No.4 issued in August 2017 in order to formulate necessary policies and rules to ensure key government properties and assets are insured comprehensively and adequately. The outcome of the Study was presented at the IAC session on May 10, 2017.

2 Current Situation of the Disaster Risk Financing in the Philippines

2.1 Disaster Risk financing in the Philippines

For the outline and challenge of disaster risk financing in the Philippine government, refer to the summary (see Annex B). This section describes the current situation of disaster risk financing conducted by the Philippine government to the extent that the Study is involved.

An enormous loss due to tropical storm Ondoy and typhoon Pepeng led the Government of the Philippines to shift its focus of disaster-prevention policy from restoration-oriented measures to mitigation control. In 2010, RA10121 was enacted, and the National Disaster Risk Reduction and Management Council (NDRRMC) was established. NDRRMC's responsibility includes the development of a mechanism to transfer disaster-induced contingent liability and the enhanced use of disaster provident fund in DRR[12].

The government intends to prevent the emergence of contingent liability from imposing an excessive impact on the budget by implementing a scheme by which local governments and agencies have a direct access to overseas insurance and financial markets. It aims to build a comprehensive disaster risk financing (DRF) scheme by combining optimal risk financing methods, for impacts of a natural disaster vary depending on each level of the central government, local government, household, poverty level, etc. To build an effective DRF scheme, it is vital to comprehend a natural disaster scenario that assumes the maximum loss amount and grasp annual expected loss through a quantitative evaluation of loss that may occur in the future[13] [14]. While many countries have been working on DRF based on a maximum damage scenario only, the Government of the Philippines with a technical support of the World Bank has focused on the development of a damage prediction model, "Philippines Catastrophe Risk Assessment and Modeling" (2014) and utilized it for its DRF strategy. Thus, the government's efforts for DRF are leading those of other nations. Unlike disaster restoration efforts or disaster-prevention measures, DRF is a disaster-prevention policy in which DOF can play a leading role. Thus, DOF works to drive the policy forward in coordination with the World Bank.

As mentioned above, the Government has been pushing forward with a comprehensive DRF mechanism, while strengthening efforts for disaster prevention/reduction. It is designed to combine credit lines and insurance programs for each layer in order to respond promptly to the needs for funds which vary from layer to layer. The table below outlines the overview of DRF initiatives of each layer and shows whether each DRF has been established as institution.

[12] Republic Act No. 10121 Section 6 (f), Section 21, http://www.gov.ph/2010/05/27/republic-act-no-10121/
[13] DOF Purisima Official letter on development policy from the Secretary to the World Bank (November 4, 2015) http://documents.worldbank.org/curated/en/807991468327417071/pdf/RAD881922199.pdf
[14] Disaster Risk Financing and Insurance Strategy in the Philippines http://mddb.apec.org/Documents/2015/FMP/SFOM13/15_sfom13_023.pdf

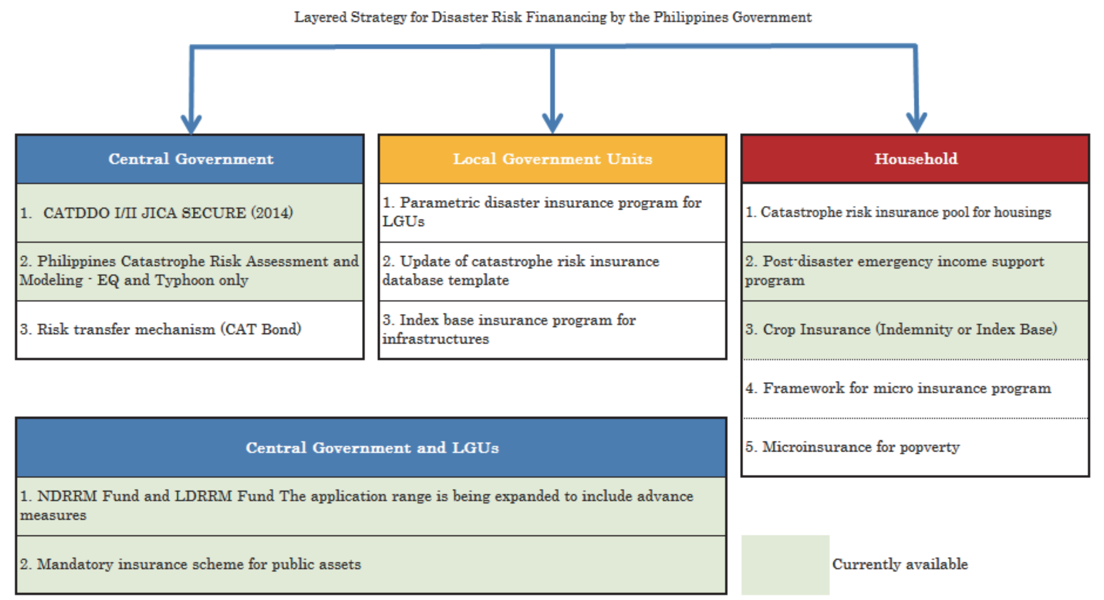


Figure 2-1 A Layered Strategy and Progress Status for Disaster Risk Financing by the Philippine Government

One of disaster risk financing mechanisms has been focused by the Philippine government is a contingent credit facility to secure loan commitment for an emergency funding needs immediately after a large disaster in the future. Both CAT DDOI/II[15] and the Stand-by loan for natural disaster recovery provided by JICA fall under this category. CAT DDO is a product of the World Bank to secure a credit line that provides liquidity to developing countries in the aftermath of a natural disaster. CAT DDO provides credit with a limit of USD 500 million or 0.25% of GDP, whichever is lower. A loan is available on condition that a developing country’s government issues a catastrophe declaration in the aftermath of a disaster. Financing can be obtained in a short span of time after the declaration is made. The introduction of CAT DDO was available on a precondition that such government worked on administrative disaster risk management, which was stipulated to be monitored by the World Bank. The Government of the Philippines had a contract of CAT DDOII (USD 500 million) as of January 2016; the following itemized efforts should be made by the Government as to its own disaster risk management.

[15] http://treasury.worldb,ank.org/bdm/pdf/Handouts_Finance/CatDDOProductNote_2015.pdf

Table 2-1 Disaster Risk Management Implemented by the Philippine Government

Pillar A: Strengthen risk reduction investment planning and regulations	
A1	Development of a methodology for national-level risk-informed planning
A2	Disaster risk reduction measures are integrated in revisions to the National Building Code of the Philippines
A3	Development of provincial commodity investment plans (PCIP) using expanded vulnerability and suitability assessment (eVSA)
A4	Policy framework development for post-disaster shelter assistance through recovery and reconstruction phases
A5	Multi-hazard vulnerability assessment of priority cultural heritage site
Pillar B: Enhancing the financial capacity to manage natural disaster risk	
B1	Development of a joint catastrophe risk insurance program for Local Government Units
B2	Development of disaster risk financing and insurance strategy by number of line agencies
B3	Design of property catastrophe risk insurance pool for homeowners by DOF, IC and PIRA
B4	Program development and commencement for post-disaster emergency income support
B5	Catastrophe risk insurance database template updated and adopted by IC

Source: The World Bank – CAT DDO II Project document. February 2015[16]

The evaluation item consists of two different aspects, the development plan and regulation to reduce vulnerability to natural disaster; and enhancing the financial capacity to manage natural disaster risk, in line with outcomes of NDRRMP. CAT DDO was one of risk financing products, and at the same time, it was the program enhancing disaster prevention level and disaster risk financing capacity of a developing country. According to the World Bank, CAT DDO has the advantage as well in that it can be more involved in the disaster management policy in those countries through the framework of CAT DDO.

Nevertheless, as show in Figure 2-1, not all components in the disaster risk financing program in the Philippines have not achieved to date. Some of components such as Philippines Catastrophe Risk Assessment and Modeling, DDO II and parametric disaster insurance program for Local Government Units (LGUs) were delivered while the catastrophe risk insurance pool for housing are still to be in place.

2.2 The Role of GSIS in Disaster Risk Financing

GSIS is the government's sole insurance organization, and fulfills key roles for the disaster risk finance the Philippine government is promoting. Firstly, it serves as the only insurance underwriting institution for the government's assets. GSIS indemnifies the damage suffered by government assets as the result of a disaster, and supply recovery fund as insurance payouts to the

[16]http://documents.worldbank.org/curated/en/989761468196182551/pdf/96587-PGD-P155656-R2015-0243-1-Box393264B-OUO-9.pdf

government agencies that are the insured parties. Through the insurance mechanism, the risk of loss on assets held by each government agency is transferred to GSIS. Then, GSIS transfers a portion of the risk it has underwritten as an insurer to the private insurance market – that is, away from the Philippine government – through reinsurance. In this way, GSIS provides a mechanism to transfer disaster risks that the Philippine government is exposed to the insurance market.

Disaster Risk Financing Strategy of the Philippines Source： DOF/ ASEAN DRFI Forum 2/2/2017

Objectives		○ Maintain sound fiscal health ○ Develop sustainable financing mechanisms ○ Reduce the impact on the poorest and most vulnerable; shield the near poor		
Strategic priorities		Central government	Local governments (LGUs)	Individuals, SME
	goals	Improve the financing of post-disaster emergency response, recovery, and reconstruction needs	Secure funds for post disaster restoration needs	Empower poor and vulnerable households and owners of small and medium-sized enterprises
1	Key step	Quantification of central government's contingent liabilities due to disasters	Development of natural disaster insurance scheme for local governments	Expansion of property insurance and micro insurance of private property
	Initiative	●Philippines CAT Risk Model ●Risk assessment	●Local disaster resilience insurance fund	●Potential residential insurance pool
2	Key step	Contingent credit lines to protect against moderate disasters	Pooling local governments' calamity funds	Linking disaster risk financing and social protection
	Initiative	●CAT-DDO (WorldBank) ●SECURE (JICA)		
3	Key step	Using risk transfer to access international private reinsurance and capital markets	Improving insurance of public assets	
	Initiative			

The role of GSIS as an insurance body of the government

Figure 2-2 Role of GSIS in Philippine government disaster risk financing

Source： ASEAN DRF Forum, February 2017. Created by the study team based on the documents of DOF presentation

The other is a role as an insurer for a local governments' insurance program that GSIS and DOF have been developing to meet the financial need of LGUs when a natural disaster strikes. The program is intended to establish a direct access for LGUs to an insurance market, instead of depending on national government, for an emergency fund required to response a natural disaster. The World Bank has been supporting the development of this insurance program (LGUs insurance program) to be adopted. Behind this background is that the central government intends to reduce its excessive impact on the fiscal condition, such as the redistribution of annual budget in order to raise funds for LGUs meanwhile a local government asks the central government for support if its calamity fund cannot cover contingency fund after disaster. LGUs insurance program aims to mitigate an impact a disaster has on the central government's financial health, insure disaster risks of LGUs and transfer them directly to overseas markets. According to GSIS, this insurance program was not realized although its framework had been drawn in 2015 due to no consent obtained from LGUs on the premium burden. The government budgeted PHP 1 billion for the NDRRM Fund in 2017 to purchase natural disaster insurance on government assets, entrusting DOF, DBM and GSIS to make a spending decision. This led to the fund to be used for the LGUs insurance program, and to the program with 25 state governments participating started on 28th July 2017[17].

The LGUs insurance program is a parametric type program that pays a predetermined payment when the level of damage predicted by the Catastrophe model, PCRAM developed by the

[17] Some of the damage occurred at the central government is also insured.

government with the support of World Bank reaches a preset payment condition. Unlike the insurance of government assets under GSIS being the actual loss indemnity method, this program does not require loss adjusting process of the damaged facilities. Then, this insurance program pays out for a given insurance policy within three weeks in the aftermath of a disaster. Meanwhile there is a potential that the amount of actual damages LGUs suffered and the insurance amount payable greatly differs since payment of insurance claim is triggered by the result of a loss estimation model. It covers loss caused by an earthquake, typhoon, and typhoon-fed flooding; the river flood is not covered.

The LGUs insurance scheme is designed to meet the need for emergency response funds immediately required in the aftermath of a disaster. Meanwhile, the existing public property insurance GSIS has provided cannot meet such need for emergency response funds, for it takes substantial time to loss adjusting process and receive required documents from insured parties. However, as long as the insurance is carried properly, all cost needed to repair or replace will be paid by GSIS without incurring additional cost[18]. In this regard, both insurance programs do not compete; each has an important role as DRF.

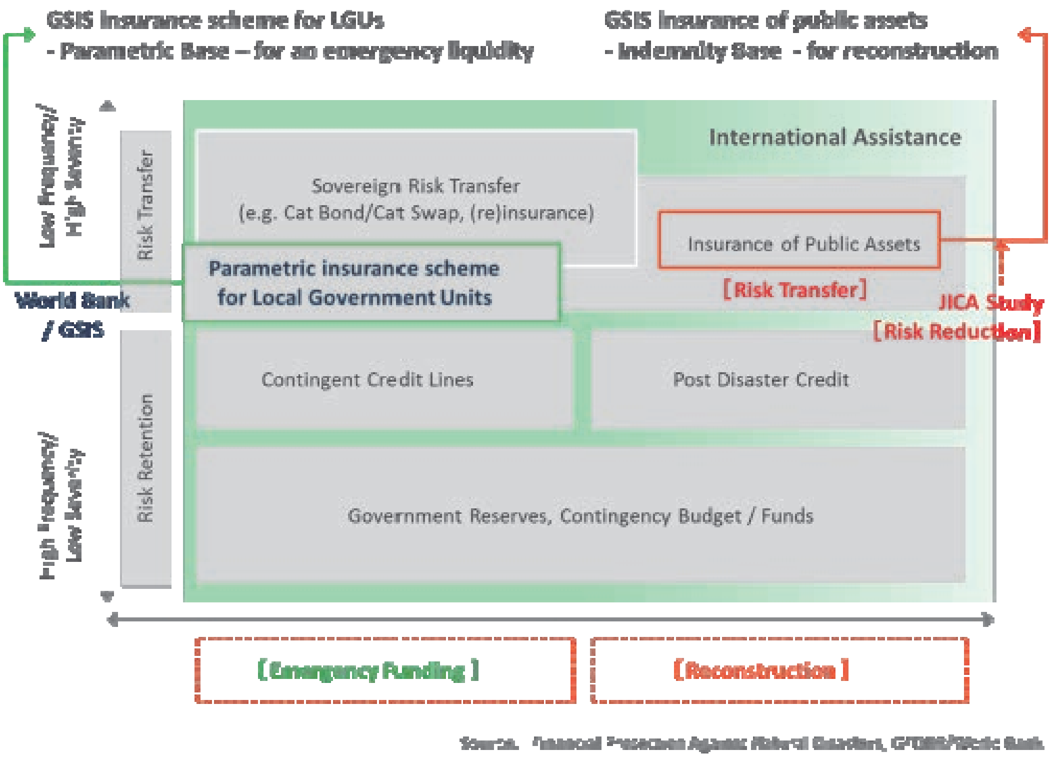


Figure 2-3 Relationship between the timing of funding needs, public property insurance and insurance programs for LGUs

[18] Deductible amount stipulated in insurance policies (Under GSIS's policy, the deductible for damage caused by natural disasters is prescribed as 2% of the cash value of the affected buildings and facilities)

3 The Government Service Insurance System (GSIS)

3.1 About GSIS

3.1.1 Outline

GSIS is an organization founded as per Commonwealth Act No. 186 adopted on November 14, 1936 (as amended by Republic Act No. 8291, June 24, 1997)[19]. It constitutes an annuity fund for public servants, handling life insurance, workers' compensation insurance, unemployment insurance, funeral expense insurance, etc. as the benefits of the annuity[20]. It runs the loan business including loans and mortgages for members. GSIS also operates property insurance for government assets and interests, liability insurance, reinsurance, builders' risk insurance, performance guarantee, fire insurance incidental to home equity loans, and the like; it underwrites these predominantly. GSIS is the largest company of property insurance/reinsurance industry in the Philippines.

3.1.2 Organization

GSIS is run by the Board of nine trustees appointed by the President of the Philippines. The President and General Manager (PGM) is appointed by the President, and performs its tasks under the control of the Board. In response to the political transition in the Philippines, there has been a reshuffle of most of the Board members, except for PGM. As of the end of April 2017, there are eight trustees, and the remaining one position, PGM, have not been filled. Under the control of the Board, nine Senior Vice President (SVP) members and a total of nineteen Vice President (VP) members, who are respectively assigned to each department, supervise and perform the operations of each respective department.

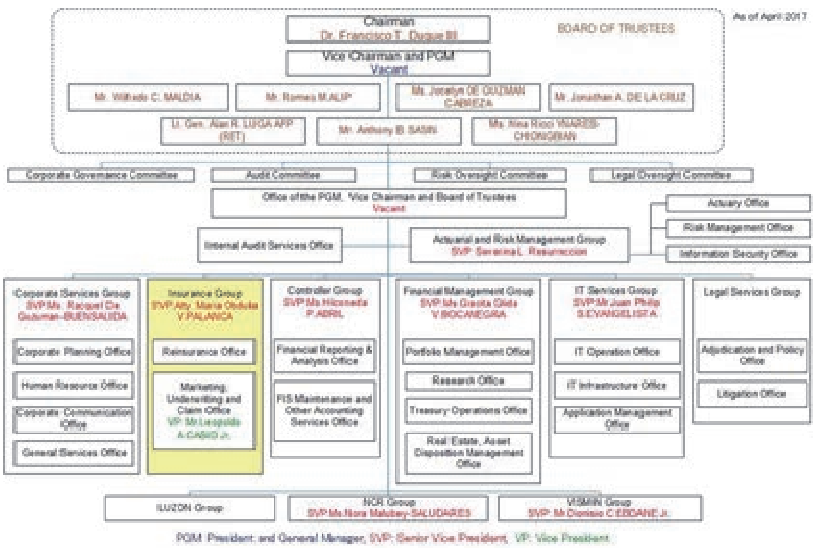


Figure 3-1 Overall Organization Chart of GSIS (as of April 2017)

[19] Website of GSIS http://www.gsis.gov.ph/about-us/gsis-mandate-and-functions/
[20] http://www.mhlw.go.jp/wp/hakusyo/kaigai/14/dl/t5-06.pdf

Insurance Group[21] is responsible for non-life insurance lines, which are subject to this study. Their operations are supervised by SVP Atty. Maria Obdulia V. Palanca and VP Mr. Leopoldo A. Casio Jr.. Insurance Group consists of SVP Office (OSVP) and VP Office (OVP). OVP is responsible for practical operations involved in underwriting, sales and claims payment. OVP has three departments, namely Marketing, Underwriting and Claims, and a departmental manager is assigned to each of these departments. The organizational structure of the Insurance Group is as shown in Figure 3-2. In this study, the study team assumed that the head of Insurance Group, SVP Atty. Palanca, is the chief counterpart, and VP Mr. Casio of OVP who oversees Marketing, Underwriting and Claim Office in the Group is the counterpart. GSIS has a total of 3,104 staff members, and a half of them are working at their head office in Manila. It has 42 local offices across the Philippines.

GSIS is engaged in a wide range of property insurance business lines which include not only the lines of normal fire insurance and natural disaster insurance, but also Engineering Insurance such as Contractors All Risks (CAR), Erection All Risks (EAR), Machinery Breakdown, Electronic Equipment Insurance (EEI), Civil Engineering Completed Risks (CECR), Property Floater, Marine Insurance to include Cargo, Hull and Liability, Aviation Hull and Liability and Aviation Liability, Motor Vehicle Insurance, Personal Accident Insurance (Group and Individual) Miscellaneous Casualty lines such as Comprehensive General Liability, Fine Arts Insurance, Money Securities Payroll and Robbery Insurance, Banker's Blanket Bond, Directors and Officers Liability (DOLI, Bonds such as Bidders, Performance and Surety. Their underwriting manual is reviewed and updated, and stipulates provisions on underwriting processes and approval authority, which are explained clearly in writing and by using flow diagrams. The underwriting authority of each post is also stipulated clearly. All insurance policy data are embedded in General Insurance Information System (GIIS), which allows access to insurance policy data from a terminal device. Account information includes location data and, in the case of property insurance, it is possible to see the location on the Google map from a terminal device.

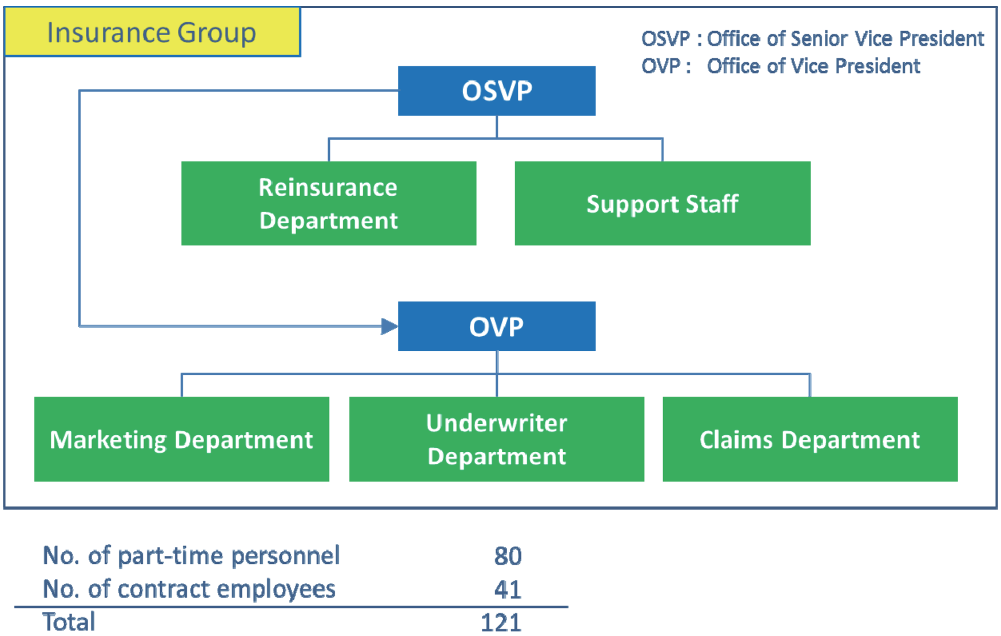


Figure 3-2 Organizational Structure of GSIS Insurance Group

[21] Among the basic units of GSIS, "group" is the largest, followed by office and department under it.

Besides Insurance Group, IT Group and Risk Management Group are also involved in property insurance operations. An IT Department is assigned to Insurance Group and administers the IT system of the entire GSIS, and is involved in building and administering GIIS, which is an underwriting management system of Insurance Group. Risk Management Office plays the role to manage the risks of the entire GSIS as a social insurance agency. Risk Management Office cooperates with Insurance Group in the process of purchasing (ceding) reinsurance by monitoring and assessing the amount of reinsurance ceded to reinsurers. Risk Management Office is not responsible for managing the accumulation of natural disaster risks and analyzing portfolios, but is responsible for managing the credit exposure to reinsurers by monitoring the total amount ceded to each reinsurer.

3.1.3 Financial Situation

a. Entire Business of GSIS

In 2014, GSIS posted an operating revenue (include underwriting income and investment income) of approximately PHP 140 billion from its entire business, including social insurance line, and an operating expense (include underwriting expenses, investment expenses, and general and administrative expenses) of approximately PHP 93 billion. Therefore, it posted an ordinary income of approximately PHP 47.9 billion and a net income of approximately PHP 48.3 billion. As a result, the return on asset was 4.9% while the operating revenue to ordinary income ratio was 33.5%, and these are the indicators of corporate performance.

b. Property Insurance Line

The following is an abstract from the accounting audit report of GSIS, showing the income and expenditure from property insurance lines for the period of 2012 to 2014.

Table 3-1 Income and expenditure from the property insurance lines of GSIS (2012-2014)

Statements of Financila Position – General Insurance Section Only			Php in Million	
	2012	2013	2014	2015
ASSETS				
Cash and cash equivalents	5,753	5,025	9,817	5,707
Premiums and loans receivables – net	965	949	474	551
Financial assets	10,769	13,907	17,619	22,121
Other receivables – net		12,074	5,096	4,869
Investment property	2,877	3,008		
Property and equipment – net				
Other assets	5,733	320	216	216
TOTAL ASSETS	26,097	35,283	33,222	33,464
LIABILITIES				
Insurance liabilities	5,690	13,399	10,627	7,722
Other liabilities	227	676	527	492
Deferred liabilities	813	667	581	1,372
TOTAL LIABILITIES	6,730	14,742	11,735	9,586
SURPLUS				
Appropriated	4,685	10,558	9,456	9,849
Unappropriated	14,682	7,474	11,871	13,869
	19,367	18,032	21,327	23,718
Revaluation surplus		2,509	160	160
TOTAL NET WORTH	19,367	20,541	21,487	23,878
TOTAL LIABILITIES AND NET WORTH	26,097	35,283	33,222	33,464

Profit and Loss Statement	2012	2013	2014	2015	計
REVENUE					0
Revenue from insurance	4,173	4,452	3,407	3,723	15,755
Revenue from loans					0
Revenue from financial assets	239	2,494	1,619	547	4,899
Revenue from investment property	19	152	25		196
Other revenues	18	31	(38)	(18)	(7)
	4,449	7,129	5,013	4,252	20,843
EXPENSES					0
Calims and benefits	650	1,684	266	(16)	2,584
Investment expenses				2	2
Insurance expenses	2,425	2,380	1,984	1,192	7,981
Personal expenses					0
Operating expenses	327	96	1		424
	3,402	4,160	2,251	1,178	10,991
					0
OPERATING INCOME/(LOSS) BEFORE GSIS FEES AND COMMISSION	1,047	2,969	2,762	3,074	9,852
GSIS FEES AND COMMISSION					
Management fee					
Administration fee	(170)	(176)	(125)	(227)	(698)
Marketing commission	(339)	(352)	(249)	(455)	(1,395)
	(509)	(528)	(374)	(682)	(2,093)
NET OPERATING INCOME/(LOSS)	538	2,441	2,388	2,392	7,759

Source: The study team based on GSIS data

The total revenue from insurance for the period of four years between 2012 and 2015 was PHP 15.8B, while the claims paid was PHP 2.6B, the amount of reinsurance commission fees and expenses was PHP 8.0B, and the amount of commission fees paid was PHP 2.1B. As a result, a total four-year income amounted to PHP 7.8B. The study team can say that, as one of the features, the amount of claims paid is small, and they maintained a positive profit balance during 2013 to 2014, despite the occurrence of large natural disasters such as the super typhoon Yolanda and Bohol earthquake. For retained risks, the following factors contributed to steady income at GSIS: the large number of facilities with low fire risks because of the type of occupancy and structures of the insured buildings; the fact that tariff-based premium rates are applied; the fact that there have been no major earthquakes in urban areas, where insured facilities are concentrated; and income obtained through reinsurance commissions from contracts transferring risks to reinsurance (reinsurance contracts related to individual insurance contracts and portfolios).

3.2 Outline of the Public Property Insurance for Public Infrastructures

3.2.1 Legal Basis

The following table provides laws that regulate GSIS' business. Such laws were established based on RA656, otherwise known as the Property Insurance Law. GSIS is mandated to provide property insurance coverage for the assets and interests of the central government and of the first class municipalities or above. As an insurance agency, it has been gradually expanding the scope of its underwriting service (all insurance and reinsurance lines) and the scope of assets that can be covered. GSIS is the sole state insurance institution providing property insurance coverage for public assets in the Philippines.

Table 3-2 GSIS' Legal Basis as Government Insurance Facility

	Law / Order	Date	Description
1	Republic Act No.656 (Property insurance law)	June 16, 1951	- Established a Property Insurance Fund in order to indemnify or compensate the Government for any damage to, or loss of, its properties due to fire, earthquake, storm or other casualty; - Every government, except a municipal government below first class, is hereby required to insure its properties against any insurable risk. - A municipal government below first class may, upon application, insure its properties with the Fund.
2	Presidential Decree 245 (Amending RA656)	July 13, 1973	- Power and authority of GSIS, among others, is to engage in the business and operation of all kinds of insurance and reinsurance.
3	Administrative order 33	August 24, 1987	- It specifies the properties in which the government has an insurable interest.
4	Administrative order 141	August 12, 1994	- Properties insured expanded to include insurance risks of the government in privatized corporations as well as Build Operation and - Transfer scheme projects.
5	Administrative order 4/2017	August 7, 2017	- Creation of Inter Agency Committee (IAC) for insuring the government assets. A terminal report including the proposals on revising the current laws/regulations to be submitted to the president within 1 year after the committee has been convened.

3.2.2 Insurance Underwriting Method

Regarding GSIS' public property insurance for public schools, MRT3 and NAIA T3, the study team sorted out the insurance underwriting methods as follows:

a. Insurance Underwriting Method – Policy Form

Insurance for public schools uses a "Standard Fire Policy" form, which covers fire and lightning as basic named perils. "Industrial All Risk Policy" form applies to large public infrastructures such as MRT3 and NAIA T3 in this study. The standard fire policy provides coverage only fire and lightning as a base policy, and coverage of natural perils – typhoon, flood, earthquake, and extended coverage. Insurance claims will be paid when the cause of the loss is included in the induced perils. The Industrial All Risk Policy provides covers each and every loss except for those specifically excluded. This policy form handles physical damage as an insured loss that was caused on an insured facility in the scope of property insurance principle of "unpredictable/sudden accident," provided that the cause of loss is not specifically excluded in the form. Accordingly, in the Named Peril method, an insured party must prove that the cause of an accident falls within itemized insurance coverage. For industrial all risk policy, an insurer must prove that the cause of loss is listed in the exclusion if they intend to deny insurance claim.

The public schools that GSIS covers are partially under the jurisdiction of DepEd, while other schools and buildings are owned by local governments. There may also be school buildings under jurisdiction of DepEd and the local government within the same school. For the insurance underwriting of local government-owned public schools, many are covered in combination with other public buildings such as city government offices under a blanket method. As insurance underwriting is based on the Named Peril method, a special agreement other than a basic guarantee against fire/lightning varies depending on local governments. In the Metro Manila area, for example, an insurance program in Quezon and Makati covers only fire/lightning, while it includes fire/lightning, earthquake, flood, typhoon and other coverage in Manila; thus, the coverage carried varies from insured to insured. As far as natural disaster risk is concerned, most of the properties are uninsured even in Quezon, where earthquake and flood risks are reported to be higher.

Meanwhile, assets are also insured against machinery breakdown and general liability associated with the operations of MRT3 and NAIAT3; however, the study team does not discuss them in this report, for they are not closely connected with insured loss due to natural disasters.

b. Indemnity Method

In this insurance, actual cash value, replacement cost, agreement value, etc. are used to set the insured value of an insured facility. For the target facilities in the Study the sum insured and indemnity method are all based on "replacement costs." Under an insurance contract based on "replacement costs," a compensation amount shall cover the actually paid cost to restore a facility damaged by an accident to an equivalent state, regardless of the amount required to build it. Therefore, if an appropriate sum insured is carried in the policy, the insured may restore a facility to its original state without bearing any additional expense (except for deductibles) when insured loss is occurred. On the other hand, although the insurance policy is set as an indemnity method, the sum insured is considered to be much lower than the actual replacement costs. Various problems arise for underinsurance contracts, but in addition to the problem of uninsured against natural disaster risks, Chapter 4 will describe the tasks and countermeasures based on the results of this study.

c. Retention Limit and Cession Method

According to the internal rules of GSIS, the maximum retention of insurance risks should not exceed PHP 2B per risk. All insurance policies covering a risk that exceeds such maximum retention per risk are ceded as reinsurance. Since GSIS is a public agency, it must procure reinsurance coverage through public procurement procedures. For example, there are insurance programs for large infrastructure facilities subject to this study such as MRT3, Manila International Airport, Philippine Ports Authority, National Power Corporation, UP and Build-Operate-Transfer (BOT)-based power stations.

d. Summary of the Current Insurance Program on the Selected Public Facilities in the Study

Summary of the current insurance program on the selected public facilities in the Study is shown in the table below.

Table 3-3 Summary of the Current Insurance Program on the Selected Public Facilities in the Study

Facility		Public school	MRT3	NAIAT3
Program		Included in LGU combined policy	MRT3 program	Included in NAIA program
Procurement method		Retain	Public bid	Public bid
Policy type		Per peril	All risk policy	All risk policy
Insured peril		Fire / Lighting	Industrial All risk (IAR)	Industrial All risk (IAR)
Endorsement		Flood / EQ / Typhoon		
Basis of Valuation		Replacement cost	Replacement cost	Replacement cost
Other coverage		No	CGL	CGL
		No	Sabotage, Terrorism	Sabotage, Terrorism
		No	BI – 12 months	BI – 12 months
		No	Machinery breakdown	Machinery breakdown
Deductible	Fire / Lighting	No	Php 3.5 million	Php 500 million
	Natural perils	2% of affected item	2% of affected item	2% of affected item
	M&B	-	Php15 million	Php 3.5 million
	BI	-	15 calendar days	-
Average clause		Yes	Yes	Yes
Total sum insured		-	Php 25,168 million	Php 7,880 million
Sub-limits		-	Php 5,500 million	Php 1,500 million

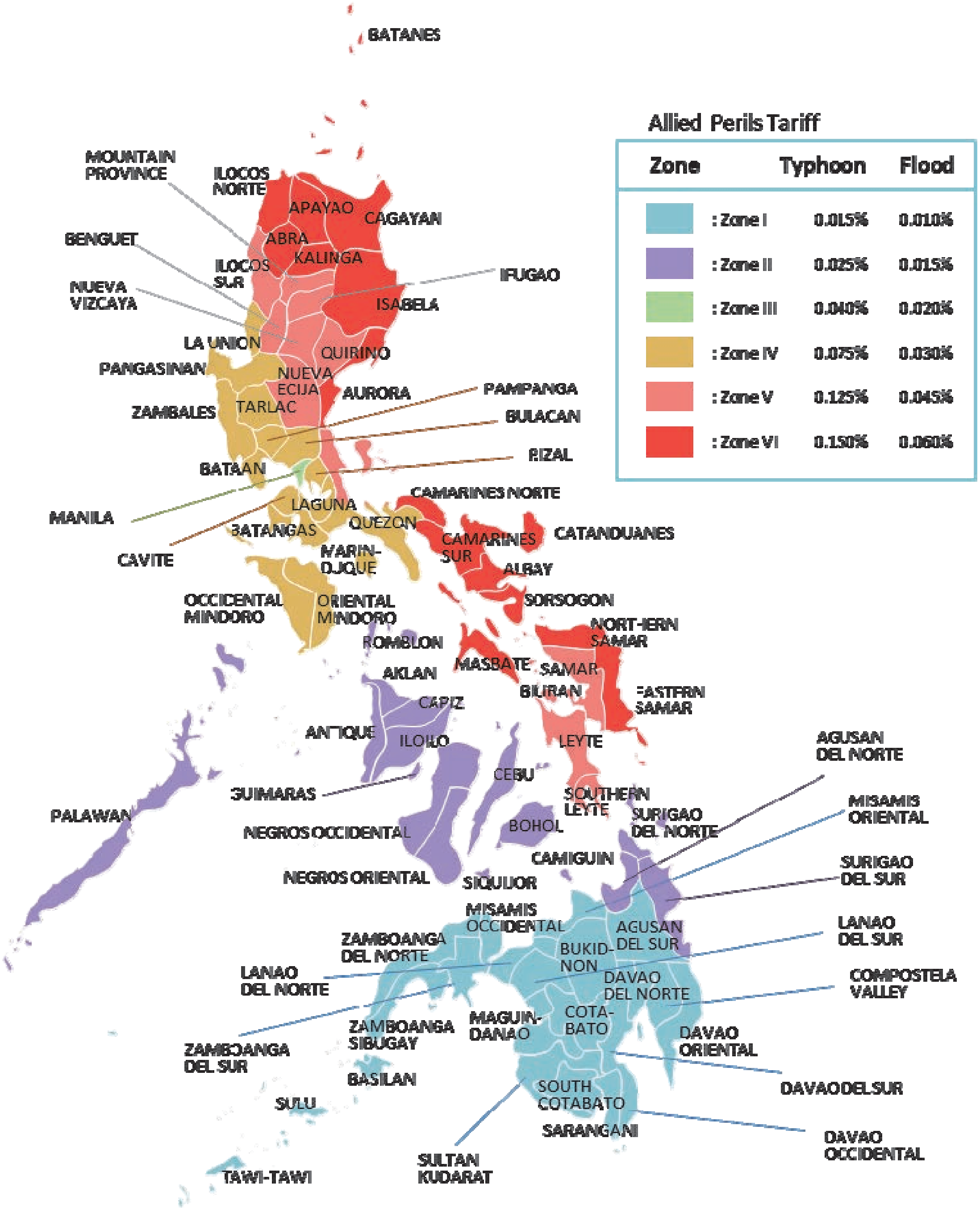
3.2.3 Premium Rate

The premium rate is a combination of the annual expected damage rate and the loading charge. The annual expected loss ratio is based on the damage rate of the facility caused by the situation of the natural disaster hazard at the location of the target facility and the strength of the facility against the hazard. In the Philippines, there is a premium rate (tariff rate) approved by the government's insurance commission (IC). Most recently, the minimum premium rate to be adopted when an insurance company undertakes natural disaster insurance is presented from the IC, and private insurance companies are required to comply with this. Meanwhile, GSIS is not under the jurisdiction of the IC, and is not obligated to use the tariff rates approved by IC and can set risk-based premium rates. However, in the current operating procedure, GSIS uses a market rate, for risks beyond the retention of GSIS wherein the maximum amount is the bid contract price or the Approved Budget for the Contract (ABC) when obtaining reinsurance through public procurement procedure. For risks within the capacity of the GSIS, it utilizes tariff rates in the policy conditions for the vast majority of accounts.

With natural perils coverage being incidental to fire insurance, the Philippines Insurance Rating

Association (PIRA, Ltd.) tariff rate stipulates premiums for earthquake perils, flood perils, and typhoon perils, based on facility structure type and location and, in the case of earthquakes, the number of building floors. In this respect, premiums are decided according to the natural disaster hazard and strength of the facility, but as shown in the following table, the hazard classification and structural classification are limited and do not necessarily show the individual facility risk sufficiently. (For the Zone/Area see the figure below.)

Typhoons and windstorms are divided into six zones, and there is a large difference in the premiums between zones; Zone III applies only to the Metro Manila, and within Metro Manila the premiums do not differ by location. There also is no difference in the premium based on building structure.



Source: The study team based on the tariff rate of PIRA, Ltd.

Figure 3-3 Tariff rate for each zone

Table 3-4 Classification of tariff rate against natural disaster risk

Peril	Area	Zone I	Zone II	Zone III	Zone IV	Zone V	Zon VI
Typhoon		0.015%	0.025%	0.040%	0.075%	0.125%	0.150%
Flood		0.010%	0.015%	0.020%	0.030%	0.045%	0.060%

EQ	Floor number	1/2F	3/4F	5-8F	9-12F	13-16F	17-20F	21F<
AREA I		0.144%	0.192%	0.240%	0.288%	0.336%	0.384%	0.432%
AREA II		0.144%	0.240%	0.288%	0.336%	0.384%	0.432%	0.480%

Metro Manila area

There are two area classifications for earthquakes, with Metro Manila classified in AREA I. There is no difference in premium based on building structure; the premium is determined according to building height. The following table compares PIRA, Ltd. tariff and Risk-based Premium Rate Calculation Tool for hazard classification to specify applied premium rate and vulnerability consideration by facility structure.

Table 3-5 Hazards[22] and vulnerability of facilities classified by tariff rate of PIRA, Ltd.

Peril	Earthquake			Tyhpoon, Flood		
Rate base	PIRA, Ltd.		Tool*	PIRA, Ltd.		Tool*
Classification	Nationwide	Metro Manila	Metro Manila	Nationwide	Metro Manila	Metro Manila
Hazrd classification	2 areas	1 area	Hazard model	6 areas	1 area	Hazard model
Vulnerability of facility	Only floor number considered		UP vulnerability curve	Not considered		UP vulnerability curve

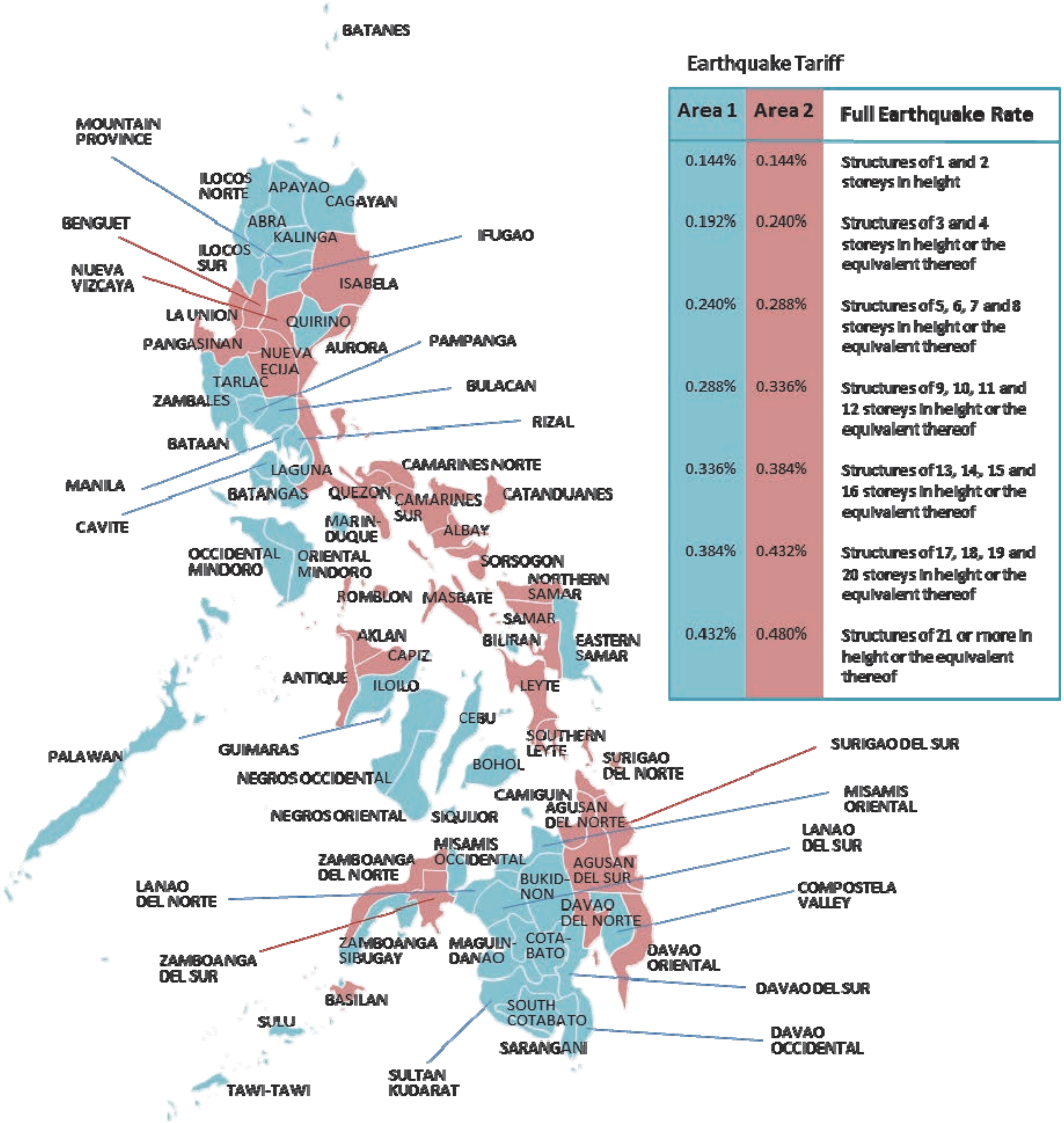
*Risk-based premium rate caltulation tool

Hazard model: Please refer to an annotation below and Chapter 5 The development of Risk-Based Premium Rate Calculation Tool.

As described in Figure 3-4 below, while the existing tariff reflects hazard level of natural perils including earthquake, Typhoon and flood into its premium pricing on province base, no consideration is given for vulnerability of the building except for difference in earthquake premium due to number of building story. Buildings built in different year may have adapted different building code. While an older code may show poor performance during the earthquake and result larger damage, the existing premium pricing does not consider such difference. The premium rate system does not include a mechanism for urging disaster retrofitting (seismic retrofitting in case of an earthquake) to be implemented to satisfy the new standards in buildings built on the old standards.

In Japan, insurance companies autonomously decide premium rates for natural disaster compensation clauses. As an example of general practice, the below chart shows how premium rates are calculated by classifying into small categories the strength of disaster hazards and the damage to insured facilities; these categories are then combined and adjusted. (Fig. 3-6)

22 Hazard model: as a tool for calculating risk-based premium rates, which were developed using these survey tools; the hazard model was developed to incorporate hazard strength in consideration of the frequency of incidents at each location. See Chapter 5.



Earthquake Tariff

Area 1	Area 2	Full Earthquake Rate
0.144%	0.144%	Structures of 1 and 2 storeys in height
0.192%	0.240%	Structures of 3 and 4 storeys in height or the equivalent thereof
0.240%	0.288%	Structures of 5, 6, 7 and 8 storeys in height or the equivalent thereof
0.288%	0.336%	Structures of 9, 10, 11 and 12 storeys in height or the equivalent thereof
0.336%	0.384%	Structures of 13, 14, 15 and 16 storeys in height or the equivalent thereof
0.384%	0.432%	Structures of 17, 18, 19 and 20 storeys in height or the equivalent thereof
0.432%	0.480%	Structures of 21 or more in height or the equivalent thereof

Source: The study team based on the tariff rate of PIRA, Ltd.

Figure 3-4 Earthquake Tariff

Table 3-6 An example of calculating premium rates for natural disaster insurance（An example of premium rate factors used in Japan）

Premium rate	Item	Windstorm	Flood	Storm surge	Earthquake
Basic rate	Location	6 categories	-	12 categories	7 categories
	Structure	4 categories	4 categories	4 categories	5 categories
	Floor height	-	Considered separately	12 categories	-
	Rivers affecting	-	3 categories	-	-
Adjustment factor for premium rate Discount, Increased		Local circumstances	Floor height	Seawall	Fire risk
		Building height	Disaster history	Surge	Risk of spreading damage
		Roof structure	-	The number of stories	Fire spread risk
		Others	-	Basement	-

4 Fundamental Issues in Public Property Insurance, Their Impact and the Direction of Solutions

In order to encourage investments in DRR it is necessary to incorporate the incentive to reduce the premium by applying the premium rate according to the natural disaster risk to each facility. Also, governmental involvement, incorporation of a mechanism other than reducing the premium, besides adjustment of the premium rate, are considered to lead to the incentives to encourage investment in DRR, as shown in Chapter 7 with examples of natural disaster insurance in other countries. Moreover, an effective financing mechanism is also needed to implement a disaster prevention plan. However, there are 'fundamental issues' in public property insurance which this study targeted, such as the existence of government agencies and municipal governments that are subject to compulsory coverage but have not carried public property insurance (uninsured issue), and improper calculation of the replacement cost that will form the basis of the insurance underwriting (underinsurance issue), when applying the premium rate according to risks and introducing an incentive mechanism to encourage investment in DRR.

While the public property insurance does function properly as a risk transfer instrument by way of insurance for the Properties of Government it has faced with challenges mentioned above. The problem of being uninsured or underinsured can be attributed to the limited understanding of natural disaster risks and effectiveness of property insurance among government agencies and the facilities. In addition, there is inadequate enforcement mechanism in the existing regulations. In order to strengthen public infrastructure and utilize property insurance to improve its resiliency, these fundamental issues, measures and challenges in solving them shall be sorted out.

4.1 Uninsured

4.1.1 Actual State of Being Uninsured

Although RA656 (Property Insurance Law) requires GSIS to insure all insurable assets and interests of the central government and of the first class municipalities or above through property insurance, 25.8% (262 out of 1,014 institutions) of public institutions that are subject to compulsory coverage have not carried fire insurance. As of December 2016, the number of public institutions across the nation by category of insured or uninsured by property insurance is shown in the table below. The insured ratio (i.e.subscription ratio or insurance penetration ratio) includes institutions that have carried fire insurance only and are not insured against natural disaster risks.

Table 4-1 Obligation to carry public property insurance by public institutions and uninsured rate

As of December 2016

Public Institutions	RA656 Public Property Insurance	Total	Property Insurance on facilities			
			Insured	%	Uninsured	%
1ST CLASS MUNICIPALITIES	compulsory coverage	331	194	58.6%	137	41.4%
CITIES	compulsory coverage	144	127	88.2%	17	11.8%
PROVINCES	compulsory coverage	81	58	71.6%	23	28.4%
OTHER MUNICIPALITIES	voluntary	1,159	340	29.3%	819	70.7%
Subtotal	compulsory coverage	**1,715**	**719**	**41.9%**	**996**	**58.1%**
NATIONAL GOV'T.AGENCIES						
GOCCs	compulsory coverage	60	52	86.7%	8	13.3%
NATIONAL OFFICIES	compulsory coverage	285	246	86.3%	39	13.7%
STATE COLL. & UNIV.	compulsory coverage	113	75	66.4%	38	33.6%
Subtotal	compulsory coverage	**458**	**373**	**81.4%**	**85**	**18.6%**
TOTAL with Other Municipalities	All	**2,173**	**1,092**	**50.3%**	**1,081**	**49.7%**
TOTAL without Other Municipalities	compulsory coverage only	**1,014**	**752**	**74.2%**	**262**	**25.8%**

Source: The study team processed, Original: Documents obtained from the insurance group of GSIS

With respect to the public schools subject to this study in Metro Manila, four of the total 16 municipal governments do not carry insurance, three have fire insurance only without coverage against natural perils, and nine have both fire and natural perils coverages including earthquakes.

Table 4-2 Covered perils provided for public schools in Metro Manila

	Location	# of school			Policy coverage for natural hazard			
		Total	Insured	Not insured	Fire Lighting	Earth-quake	Typhoon	Flood
1	Manila	106	85	21				
2	Quezon	142	140	2				
3	Pasay	32	28	4				
4	Caloocan	88	11	77				
5	Mandaluyong	29	5	24				
6	Marikina	31	0	31				
7	Makati	37	35	2				
8	Pasig	40	39	1				
9	San Juan	9	8	1				
10	Paranaque	32	4	28				
11	Las Pinas City	32	0	32				
12	Valenzuela City	58	18	40				
13	Malabon	40	0	40				
14	Navotas	21	0	21				
15	Taguig	44	10	34				
16	Muntinlupa	26	18	8				
	Total	767	401	366				

Source: The study team processed, Original: GSIS Underwriting information received from JICA and GSIS in March 2016 and March 2017 respectively

Of the total of 767 schools including public schools in Metro Manila that are under the jurisdiction of DepEd, 366 (47.7%) have property insurance, and a further 518 (67.5%) are not insured against natural disaster risks.

From the above, it is surmised that many institutions have property insurance with basic coverage for fire and lightning strikes, but no natural disaster extension such as earthquakes, typhoons and floods.

4.1.2 Uninsured Issues

Property insurance is for the insured to secure funds to restore a damaged facility when fire or a natural disaster strikes. Since there is a high possibility that multiple facilities in a certain area range will be damaged all at once in a natural disaster, unlike in a fire, public institutions will be asked to promptly restore many facilities. Therefore, substantial funds will be required, but in the case of not carrying natural disaster insurance coverage, a municipal government with a small budget cannot cover a large amount of funds for restoration and will result in dependence on uncertain support, such as from the central government. If restoration funds cannot be secured, restoration cannot proceed. A way to allot restoration funds is not only through property insurance, but it is common to utilize property insurance as the most certain way possible to secure funds in advance.

Especially from the standpoint of the ability to bear financial burden when a disaster occurs, the smaller the municipal government is the more desirable it is that they transfer in advance to insurance the financial burden risks possible in a natural disaster. On the other hand, according to the current RA656, a small-sized municipal government is not subject to compulsory coverage of property insurance, so it is voluntary coverage. Consequently, if municipal governments across the nation that are not subject to insurance coverage by RA656 are included, approximately half of public institutions (49.7%) have not carried property insurance.

Maintaining compulsory coverage also serves to eliminate “adverse selection” from insurance schemes that protect against natural disaster hazards, and adverse selection is encouraged if participation is not properly enforced. Adverse selection is the tendency for persons who face more risk to seek greater insurance coverage than those who face less risk. In the case of natural disasters such as floods, earthquakes, and typhoons, adverse selection leads to an accumulation of risk that hinders the risk dispersion necessary to ensure proper functioning of the insurance system.

As stated in Chapter 2, the government of the Philippines is advancing the formulation of disaster risk financing. Disaster insurance for government assets is also a part of the strategy, but if the legally required compulsory coverage is not taken, the public property insurance system cannot fully serve its function and consequently, this will lead to the disaster risk financing strategy not functioning as planned.

4.2 Underinsurance

4.2.1 Definition of Underinsurance-Related Terms

Definitions of terms related to underinsurance are as follows.

Table 4-3 Definitions of terms related to underinsurance

Terms	Definitions
Sum insured	The maximum amount of coverage under an insurance policy.
Replacement cost	The amount required to repair or replace a damaged facility using equivalent new materials of the same kind. No deduction is made for depreciation.
Insured value	The appraised monetary value of the facility covered. GSIS policies require this value to equal the replacement cost.
Coinsurance / Underinsurance	A policy under which the sum insured is less than the actual value (insured value) of the insured items (buildings, household effects, etc.). The term refers to a policy under which the sum insured of each of the insured facilities is less than the replacement cost.
Appraisal / Valuation	The task of assessing the insured value of the property to be covered. GSIS policies use the replacement cost as a basis of valuation.
Deductible	The portion of the cost of damage borne by the policyholder.
Underwriting (U/W)	The examination, acceptance, or rejection of an insured risk, and classification of that risk in order to charge an appropriate premium (if accepted).
Blanket policy	An insurance policy covering multiple properties in a single or some different locations.
Sub-limit	One of the clauses in insurance policy, a limitation in an insurance policy on the amount of coverage available to cover a specific type of loss.

Source: created by the Study team based on the information of the websites of Sompo Japan Nipponkoa Insurance Inc., Loss Adjusters Association of Japan (LAAJ) and The Institutes

4.2.2 Provisions for Underinsurance in the Insurance Policy Conditions

Another fundamental issue is underinsurance. In property insurance, the insured tends to try to reduce the premium by purchasing insurance with an sum insured lower than the replacement cost, since an insured loss in which the facility has been a total loss occurs less frequently. In this case, the premium has not reached the amount corresponding to that required for the actual sum insured. This kind of situation is called "underinsurance", and a state of being underinsured is often revealed when an insured loss occurs, except in a state of being extremely underinsured. An insurance contract includes a contractual clause, such as “Co-Insurance,” or “Average Clause,” that reduces the insurance amount payable in such a situation. This is a method to reduce the insurance amount payable according to the underinsured rate (the insurance value / replacement cost), and is the concept that the insurance coverage corresponding to the insufficient premium portion is self-insurance by the insured.

The Standard Fire Policy of GSIS property insurance stipulates adjustment of the insurance amount payable in the event of being underinsured as follows, in paragraph 20.

(Paragraph 20) If the property hereby insured shall, at the breaking out of any fire, be collectively of greater value than the sum insured thereon, then the Insured shall be considered as being his own insurer for the difference and shall bear a ratable proportion of the loss accordingly. Every item, if more than one, of the Policy shall be separately subject to this condition.

Even the Industrial All Risk Policy (IAR) that GSIS uses for property insurance of large infrastructure facilities is similarly defined as follows.

(Average Clause)

If the Reinstatement Value of Property Insured shall at the time of any loss destruction or damage be collectively of greater value than the Sum Insured thereon, then the Insured shall be considered as being his own Insurer for the difference between the Reinstatement Value and the Sum Insured and shall bear a ratable proportion of the loss accordingly. Every Item if more than one on the Policy shall be separately subject to this Condition.

The amount of the insurance payable is adjusted based on the following formula[23].

$$\text{Amount Payable} = \left(\frac{\text{Sum Insured}}{\text{Replacement Cost}} \times \text{Loss} \right) - \text{Deductible}$$

4.2.3 Actual State of Being Underinsured (Calculation of Replacement Cost of public schools, MRT3 and NAIA T3)

In order to understand the actual condition of underinsurance, this survey evaluated the replacement cost of public schools, MRT 3, and NAIAT 3. The replacement cost for each insured facility was calculated by the following evaluation method and compared with the amount of GSIS insurance to understand the state of underinsurance.

Table 4-4 Calculation of the replacement cost for each insured facility and the method to evaluate underinsurance

Insured Facility		Calculation of the replacement cost and the method to evaluate underinsurance
1	Public schools (in Metro Manila)	The replacement cost per unit of total floor area, classroom, and floor number was estimated based on the standard school drawing and the estimate of construction cost for each class obtained from DPWH. Data on building size etc included in the school facility database of DepEd was applied to calculate the replacement cost for the facility GSIS insured and compared with the sum insured for each school.
2	MRT3	The approximate construction quantity for each facility type was obtained based on the drawing provided by MRT3, then the unit construction cost of similar facility was applied to calculate the replacement cost for the insured facility. The replacement cost was compared with the sum insured of GSIS.
3	NAIA T3	The approximate construction quantity for each facility type was obtained based on the drawing provided by NAIA, then the unit construction cost of similar facility was applied to calculate the replacement cost for the insured facility. The replacement cost was compared with the sum insured of GSIS.

[23] In case of overinsurance (replacement cost > sum insured), sub-limit for liability is sum insured.

a. Replacement Costs (Public Schools)

a.1 Available Data for Calculating Replacement Costs

The following data was utilized for calculating total floor area of public schools in Metro Manila (MM). Standard design for public schools by the Department of Public Works and Highway (DPWH): Standard design drawings for public schools which were prepared by the DPWH in 2008. These drawings include single-storey to four-storey buildings, which cover single classrooms to 20 class rooms. The drawings can be obtained from the following address.

http://www.dpwh.gov.ph/schoolbldg/index.htm

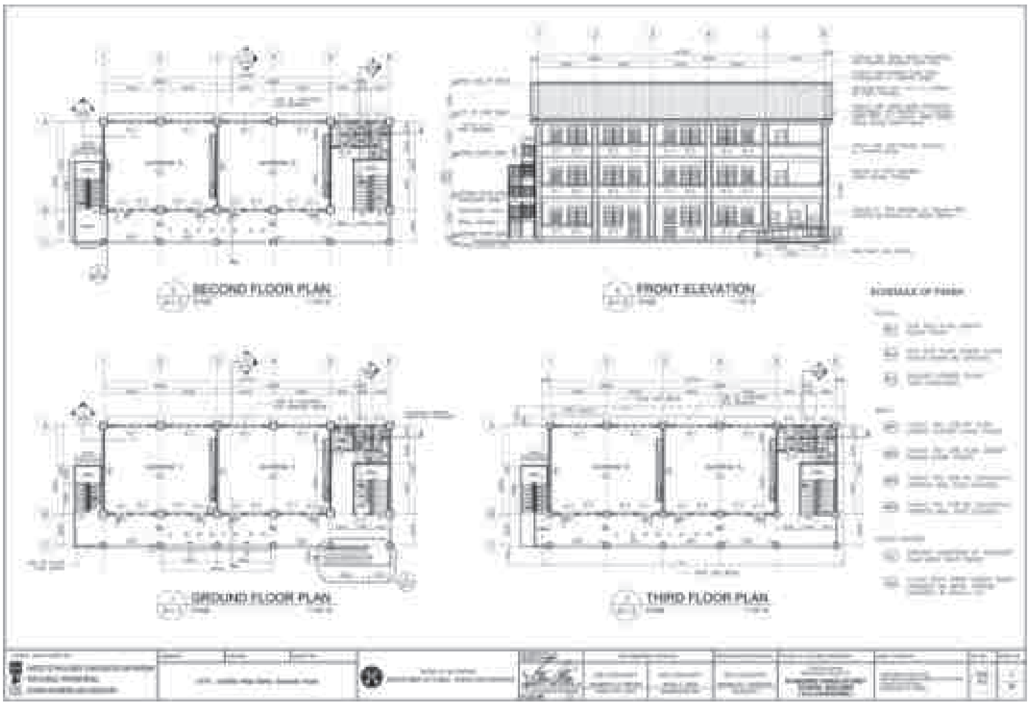


Figure 4-1 Example of DPWH standard design drawing for public school

Source : Various DPWH Proposed Projects; Standard Three-storey School Building, DPWH

Construction costs of standard design school buildings as of March 2016 were estimated by the Education Facility Division of DepEd based on the DPWH standard design drawings, as shown below.

Table 4-5 Cost Estimation of School Buildings by DepEd

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF EDUCATION

DepED DEPARTMENT OF EDUCATION

Cost Comparison of School Buildings

SINGLE STOREY SCHOOL BUILDING		
SINGLE STOREY	DepED COST (5% VAT, 22% IC)	PAGCOR DESIGN COST
1 classroom	1,012,049.65	
2 classrooms	1,814,740.17	3,045,822.85
3 classrooms	2,640,828.12	4,182,436.13
4 classrooms	3,464,886.58	5,313,780.76
5 classrooms	4,273,392.24	6,333,226.22
6 classrooms	5,036,544.64	7,357,880.62
TWO STOREY SCHOOL BUILDING		
TWO STOREY	DepED COST (5% VAT, 17% IC)	PAGCOR DESIGN COST
2 classrooms	4,422,048.49	No Data Available
4 classrooms	6,160,708.08	8,452,340.56
6 classrooms	8,075,291.28	10,814,623.08
8 classrooms	10,813,386.61	14,744,047.17
10 classrooms	12,723,662.56	17,031,301.39
12 classrooms	14,447,404.35	No Data Available
THREE STOREY SCHOOL BUILDING		
THREE STOREY	DepED COST (5% VAT, 17% IC)	PAGCOR DESIGN COST
3 classrooms	6,869,914.85	No Data Available
6 classrooms	10,360,088.48	No Data Available
9 classrooms	15,458,157.20	23,207,431.54
12 classrooms	18,660,225.43	27,766,227.66
15 classrooms	21,923,943.03	32,458,050.94
18 classrooms	25,497,559.98	37,073,257.77
FOUR STOREY SCHOOL BUILDING		
FOUR STOREY	DepED COST (5% VAT, 17% IC)	PAGCOR DESIGN COST
8 classrooms	14,819,916.37	No Data Available
12 classrooms	22,107,847.77	28,618,646.52
16 classrooms	26,678,453.91	33,871,440.32
20 classrooms	31,099,362.44	39,084,503.88
24 classrooms	35,613,164.12	44,513,497.44
28 classrooms	40,105,307.06	No Data Available
32 classrooms	44,590,061.86	No Data Available
Source: Educational Facilities Division (EFD) as of March, 2016		

Source： Education Facility Division of DepEd

a.2 Unit Construction Costs (PHP/m2)

The unit construction costs for each storey were calculated based on DPWH standard design and DepEd standard construction costs. First, the total floor areas for each scale—number of storeys and classrooms—of school buildings were calculated based on the DPWH standard design drawings. The following table gives a comparison between classroom area and total floor area.

Table 4-6 Relation between Number of Classrooms and Total Floor Area

Number of Stories	Number of Classrooms	Classroom Area (m^2)	Total Floor Area from DPWH Drawings (m^2)	Ratio
1	1	63	82	1.31
	2	126	159	1.26
	3	189	241	1.28
	4	252	325	1.29
	5	315	402	1.28
	6	378	478	1.27
2	2	126	292	2.32
	4	252	463	1.84
	6	378	634	1.68
	8	504	867	1.72
	10	630	1,038	1.65
	12	756	1,209	1.60
3	3	189	435	2.30
	6	378	691	1.83
	9	567	1,039	1.83
	12	756	1,295	1.71
	15	945	1,552	1.64
	18	1,134	1,808 *	1.59
4	8	504	920	1.83
	12	756	1,374	1.82
	16	1,008	1,716	1.70
	20	1,260	2,058	1.63
	24	1,512	2,400 *	1.59
	28	1,764	2,742 *	1.55
	32	2,016	3,084 *	1.53

* Estimated due to unavailability of DPWH design

Source: The study team based on DPWH standard desig drawings

Next, the unit construction costs (for unit floor areas) were calculated based on the DepEd cost estimations of school buildings by number of storeys and classrooms.

In addition to the construction cost, replacement cost includes mechanical and electrical costs (M&E), which contain desks, chairs, furniture, light fixtures, IT equipment and so on, and are assumed to be 10% of the building construction costs.

As a result, total costs per unit floor area (Php/m^2) are shown below.

Table 4-7 Total Cost per Unit Floor Area in each type of School Building

Number of Stories	Number of Classrooms	Construction Cost (PHP)	M&E Cost (PHP) (10% of Const. Cost)	Total Cost (PHP)	Total Floor Area (m^2)	Const. Cost per Unit Floor Area (PHP/m^2)	M&E Cost per Unit Floor Area (PHP/m^2)	Total Cost per Unit Floor Area (PHP/m^2)
1	1	1,012,050	101,205	1,113,255	82	12,303	1,230	13,533
	2	1,814,740	181,474	1,996,214	159	11,431	1,143	12,574
	3	2,640,828	264,083	2,904,911	241	10,957	1,096	12,053
	4	3,464,887	346,489	3,811,375	325	10,655	1,065	11,720
	5	4,273,392	427,339	4,700,731	402	10,638	1,064	11,702
	6	5,036,545	503,654	5,540,199	478	10,532	1,053	11,586
2	2	4,422,048	442,205	4,864,253	292	15,122	1,512	16,634
	4	6,160,708	616,071	6,776,779	463	13,294	1,329	14,623
	6	8,075,291	807,529	8,882,820	634	12,729	1,273	14,001
	8	10,813,387	1,081,339	11,894,725	867	12,479	1,248	13,727
	10	12,723,663	1,272,366	13,996,029	1,038	12,264	1,226	13,490
	12	14,447,404	1,444,740	15,892,145	1,209	11,955	1,195	13,150
3	3	6,869,915	686,991	7,556,906	435	15,785	1,579	17,364
	6	10,360,088	1,036,009	11,396,097	691	14,993	1,499	16,492
	9	15,458,157	1,545,816	17,003,973	1,039	14,882	1,488	16,370
	12	18,660,225	1,866,023	20,526,248	1,295	14,407	1,441	15,848
	15	21,923,943	2,192,394	24,116,337	1,552	14,129	1,413	15,542
	18	25,497,560	2,549,756	28,047,316	1,808	14,101	1,410	15,511
4	8	14,819,916	1,481,992	16,301,908	920	16,102	1,610	17,713
	12	22,107,848	2,210,785	24,318,633	1,374	16,093	1,609	17,702
	16	26,678,454	2,667,845	29,346,299	1,716	15,549	1,555	17,104
	20	31,099,362	3,109,936	34,209,299	2,058	15,113	1,511	16,625
	24	35,613,164	3,561,316	39,174,481	2,400	14,840	1,484	16,324
	28	40,105,307	4,010,531	44,115,838	2,742	14,628	1,463	16,090
	32	44,590,062	4,459,006	49,049,068	3,084	14,460	1,446	15,906

Source: The study team

The results of the table given above show that the more storeys the higher the construction cost per unit floor area. Moreover, as seen in table range for the same number of storeys, the more classrooms the lower construction cost.

The number of storeys and classrooms are specified from the above table, so that the replacement cost per unit floor area can be calculated.

In addition, the following relationship is proposed to more easily calculate the replacement cost based only on the number of storeys of a school. This summarizes the respective costs by simply averaging all of the various costs for each number of storeys.

Table 4-8 Summary of Replacement Cost per unit Floor Area by DPWH Standard Design

Number of Floor	Construction Cost (PHP/m2)	M&E Cost (PHP/m2)	Total Unit Cost (PHP/m2)
1 Storey	11,000	1,100	12,200
2 Storeys	13,000	1,300	14,300
3 Storeys	14,700	1,500	16,200
4 Storeys	15,300	1,500	16,800

Source: The study team

a.3 Comparison with Sum Insured by GSIS (PHP/m2)

Originally, the amount covered by insurance should be based on the replacement cost, but the actual sum insured carried is set considerably lower than that. The figure below compares the unit floor area of the sum insured by Muntinlupal City[24] in the capital area of Manila to GSIS and the unit floor area based on the replacement cost estimated above.

[24] The information of Muntinlupa City was used as the policy paper of this city shows the insurance amount for each school building (including the number of floors and classroom number information).

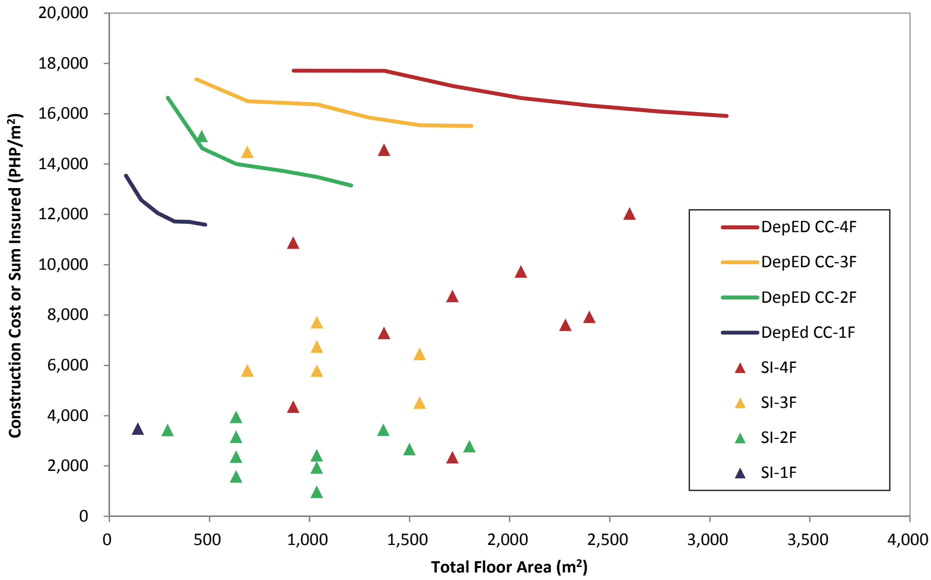


Figure 4-2 Comparison of Construction Cost per Unit Floor Area based on the replacement cost and that of sum insured

Source: The study team

The line in the figure plots the relationship of the replacement cost per unit floor area per building floor number and the triangle mark is the relationship of the sum insured per unit of floor area of the public school building in Muntinpula City. In addition, blue, green, yellow, red indicate that they are one- story, two-story, three-story, and four-story buildings respectively.

From the figure it turned out that the sum insured in the currentl policy is set lower than the replacement cost. According to GSIS, this trend can be seen not only in Muntinlupa city but also in other municipalities.

a.4 Calculation of Replacement Costs for the School Buildings which were insured by GSIS

A list of public schools in MM was extracted and prepared from the DepEd database, “National Schools Building Inventory”. Information on each school building, such as school ID, number of storeys, size of classrooms, number of classrooms, construction year and so on, was extracted. The following table shows a sample list of public schools in MM.

Table 4-9 Sample List of Public Schools in Metro Manila (colored parts refers to different buildings and floors of the same school)

Division Name	School ID	Building Type	Dimension	W	L	Year Constructed	Building No	Storey No	Classrooms
Manila	136418	3 Storey Reinforced Building Type 1	7x6	7.0	6.0	0	1	1	5
Manila	136418	3 Storey Reinforced Building Type 1	7x6	7.0	6.0	0	1	2	7
Manila	136418	3 Storey Reinforced Building Type 1	7x6	7.0	6.0	0	1	3	7
Manila	136419	Deped School Building (Standard)	7x9	7.0	9.0	2014	1	1	3
Manila	136419	Deped School Building (Standard)	7x9	7.0	9.0	2014	1	2	3
Manila	136419	Deped School Building (Standard)	7x9	7.0	9.0	2014	1	3	3
Manila	136419	Practice House	8x10	8.0	10.0	1989	2	1	1
Manila	136419	Hele Building	7x8	7.0	8.0	2003	3	1	3
Manila	136419	Hele Building	7x8	7.0	8.0	2003	3	2	3
Manila	136419	Hele Building	7x8	7.0	8.0	2003	3	3	3
Manila	136419	Rc Building	7x9	7.0	9.0	1976	4	1	13
Manila	136419	Rc Building	7x9	7.0	9.0	1976	4	2	18
Manila	136419	Rc Building	7x9	7.0	9.0	1976	4	3	18
Manila	136419	Rc Building	7x9	7.0	9.0	1976	4	4	5
Manila	136419	Reading Center	5x10	5.0	10.0	2003	5	1	1
Manila	136419	Mtbl Building	7x8	7.0	8.0	1989	6	1	3
Manila	136419	Mtbl Building	7x8	7.0	8.0	1989	6	2	3
Manila	136419	Mla. Jaycees Building	6.5x8.5	6.5	8.5	2003	7	1	1
Manila	136419	Mla. Jaycees Building	6.5x8.5	6.5	8.5	2003	7	2	1
Manila	136419	Ptca Building	7x7	7.0	7.0	1996	8	1	1
Manila	136420	Deped School Building (Standard)	7x9	7.0	9.0	0	1	1	25
Manila	136420	Deped School Building (Standard)	7x9	7.0	9.0	0	1	2	18
Manila	136420	Deped School Building (Standard)	7x9	7.0	9.0	0	1	3	17
Manila	136420	Deped School Building (Standard)	7x9	7.0	9.0	0	1	4	14
Manila	136421	Deped School Building (Modified)	7x9	7.0	9.0	0	1	1	7
Manila	136421	Deped School Building (Modified)	7x9	7.0	9.0	0	1	2	7
Manila	136421	Deped School Building (Modified)	7x9	7.0	9.0	0	1	3	8

Source : National School Buildings Inventory Data received from DepEd on 21st Jun 2016.

The following table shows the summary of public schools in MM.

Table 4-10 Summary of Public Schools in Metro Manila

	Division	Total Number of Schools	Total Number of Buildings	Total Number of Storeys	Total Number of Classrooms
1	Manila	106	479	1,193	7,069
2	Quezon City	142	858	2,055	7,098
3	Pasay City	32	195	405	1,817
4	Caloocan City	88	554	1,216	3,798
5	Mandaluyong City	29	112	329	1,830
6	Marikina City	31	126	310	1,438
7	Makati City	37	64	233	2,245
8	Pasig City	40	265	1,022	3,672
9	San Juan City	9	52	95	416
10	Paranaque City	32	108	273	1,280
11	Las Piñas City	32	150	333	1,108
12	Valenzuela City	58	251	590	1,889
13	Malabon City	40	204	343	999
14	Navotas	21	128	211	641
15	Taguig	44	288	616	1,902
16	Muntinlupa City	26	193	399	1,275
	Grand Total	**767**	**4,027**	**9,623**	**38,477**

a.5 List of Public Schools Insured by GSIS

The following list of schools insured by GSIS among public schools in Metro Manila was obtained by GSIS. It contains sum insured, types of perils (risks), premium rate, premium amount and geocode of schools. A part of the list is shown below while the whole list is attached in Annex D A List of Public Schools in Metro Manila.

Table 4-11 List of Public Schools insured by GSIS in Metro Manila and the insured value (Sample)

								GEOCODE	
	INSURED	LINE OF INSURANCE	TERM OF POLICY	SUM INSURED (MATERIAL DAMAGE, BUSINESS INTERRUPTION, CGL, S&T	PERILS (IAR, F/L, EQ, TYP, FLD, EC, RSMD, OTHERS	PREMIUM RATE	PREMIUM	LATITUDE	LONGITUDE
	QUEZON CITY GOVERNMENT								
	PUBLIC ELEMENTARY SCHOOL	FIRE	2014-2015						
1	BALINGASA ELEMETARY SCHOOL			11,040,000.00	F/L	0.0736%	8,125.44	14° 39′7″N	121° 0′4″E
2	DEMETRIO TUAZON ELEMETARY SCHOOL			3,680,000.00	F/L	0.0736%	2,708.48	14° 37′45″N	120° 59′57″E
3	RAMON MAGSAYSAY ELEMETARY SCHOOL			31,100,000.00	F/L	0.0736%	22,889.60	14° 37′44″N	120° 59′54″E
4	SAN JOSE ELEMETARY SCHOOL			29,600,000.00	F/L	0.0736%	21,785.60	14° 38′23″N	120° 59′36″E
5	PAG-IBIG SA NAYON ELEMETARY SCHOOL			3,800,000.00	F/L	0.0736%	2,796.80	14° 38′47″N	120° 59′47″E
6	DALUPAN ELEMETARY SCHOOL			7,000,000.00	F/L	0.0736%	5,152.00	14° 38′40″N	121° 0′47″E
7	CONG. R.A. CALALAY ELEMETARY SCHOOL			8,700,000.00	F/L	0.0736%	6,403.20	14° 38′18″N	121° 0′53″E
8	MASAMBONG ELEMETARY SCHOOL			29,000,000.00	F/L	0.0736%	21,344.00	14° 38′22″N	121° 0′26″E
9	SAN FRANCISCO ELEMENTARY SCHOOL			4,750,000.00	F/L	0.0736%	3,496.00	14° 38′26″N	121° 0′51″E
10	BAYANIHAN ELEMENTARY SCHOOL			13,500,000.00	F/L	0.0736%	9,936.00	14° 38′42″N	121° 1′17″E
11	BUNGAD ELEMENTARY SCHOOL			2,750,000.00	F/L	0.0736%	2,024.00	14° 39′4″N	121° 1′29″E
12	ESTEBAN ABADA ELEMENTARY SCHOOL			62,462,278.13	F/L	0.0736%	45,972.24	14° 39′14″N	121° 1′27″E
13	PALTOK ELEMENTARY SCHOOL			15,459,639.88	F/L	0.0736%	11,378.29	14° 38′34″N	121° 1′20″E
14	SINAGTALA ELEMENTARY SCHOOL			8,000,000.00	F/L	0.0736%	5,888.00	14° 39′7″N	121° 0′59″E
15	BAGO BANTAY ELEMENTARY SCHOOL			29,110,000.00	F/L	0.0736%	21,424.96	14° 39′37″N	121° 1′22″E
16	SAN ANTONIO ELEMENTARY SCHOOL			41,261,000.00	F/L	0.0736%	30,368.10	14° 39′22″N	121° 1′2″E
17	TORO HILLS ELEMENTARY SCHOOL			67,925,367.02	F/L	0.0736%	49,993.07	14° 39′54″N	121° 1′14″E

The following table shows the summary of public schools in each city which are insured by GSIS. There are 409 public schools in MM insured by GSIS, and the types of perils (risks) covered by the insurance are different depending on the city. The premium rate also differs from 0.0736% per year to 0.444% per year depending on the city.

The average premium rate for the 409 schools is 0.205% per year.

Table 4-12 Summary of Public Schools insured by GSIS[25]

	Name of City	Type of School	No	Sum Insued	Premium	Premium Rate	Perils
				Php	Php/year	%	
1	MANILA	Public Elementary School	63	1,017,952,740	3,792,790	0.3726%	F/L, FE,T,F,EC
		Public High School	22	290,226,153	1,081,354	0.3726%	F/L, FE,T,F,EC
2	QUEZON	Public Elementary School	95	4,663,491,246	3,432,330	0.0736%	F/L
		Public High School	45	3,206,700,798	2,360,132	0.0736%	F/L
3	PASAY	Public Elementary School	19	671,168,200	2,141,027	0.3190%	F/L, FE, T, Flood
		Public High School	9	742,170,645	2,367,524	0.3190%	F/L, FE, T, Flood
4	CALOOCAN	Public Elementary School	5	24,616,250	90,342	0.3670%	F/L, FE, T, F
		Public High School	6	43,367,240	159,158	0.3670%	F/L, FE, T, F
5	MANDULYONG	Public Elementary School	5	179,484,728	658,709	0.3670%	F/L, T, Flood FE
6	MARIKINA						
7	MAKATI	Public Elementary School	30	2,499,891,821	6,639,713	0.2656%	F/L, FE,
		Public High School	13	1,283,973,687	3,410,234	0.2656%	F/L, FE
8	PASIG	Elementary School	31	942,536,265	4,047,469	0.4294%	F/L,T/F,FE,EC
		Public High School	8	333,770,277	1,394,519	0.4178%	F/L,T/F,FE,EC
9	SAN JUAN	Public Elementary School	8	275,000,000	202,400	0.0736%	F/L,
10	PARANAQUE	Public Elementary School	2	26,848,000	30,875	0.1150%	F/L,
		Public High School	2	69,576,000	80,012	0.1150%	F/L,
11	LAS PINAS						
12	VALENZUELA	Public Elementary School	9	163,038,699	410,957	0.2521%	F/L, FE, T, F
		Public High School	9	373,096,322	1,260,720	0.3379%	F/L, FE, T, F
13	MALABON						
14	NAVOTAS						
15	TAGUIG	Public Elementary School	10	92,320,870	67,948	0.0736%	F/L, FE,T,F,EC
16	MUNTINLUPA	Public Elementary School	13	209,055,000	928,204	0.4440%	F/L, EQ, TYP, FLD
		Public High School	5	178,000,000	790,320	0.4440%	F/L, EQ, TYP, FLD
Total		Elementary School	290	10,765,403,820	22,442,764	0.2085%	
		High School	119	6,520,881,122	12,903,973	0.1979%	
		Total	409	17,286,284,942	35,346,737	0.2045%	

Note: F/L: Fire & Lightning FE: Full Earthquake EQ: Earthquake T or TYP: Typhoon
F or FLD: Flood EC: Extended Coverage (Falling aircraft, vehicle impact and so on)

Source: The study team processed, Original was GSIS Underwriting Information received through JICA in March 2016 and March 2017, respectively.

a.6 Link with DepEd and GSIS School List

The GSIS school list does not contain building information, such as size and number of classrooms, construction year and so on; therefore, the study team tried to link the data in GSIS database to the DepEd database.

As a result of attempting to combine the databases of both schools on condition that the school names match, 378 out of 401 schools in the GSIS list could be linked with the DepEd database. Therefore, the study team decided to further analyze about 378 schools.

Though Quezon City has the highest rate of schools covered by insurance, at 99%, there are 4 cities that local governments do not carry any insurance. However, this high figure must be taken with caution as these schools are only insured for fire and lightening damage, which has the lowest premium rate among the cities in Metro Manil.

[25] The study team reaffirmed the list of schools insured by GSIS in June 2016, but analyzed this time based on the data received from JICA in March 2016 as necessary information such as the policy was not submitted.

Table 4-13 The Number of Schools that can be confirmed by the school list of DepEd among schools in MM and those insured by GSIS

Name of LGUs		Number of Schools			
		Total	With GSIS Insurance		Without GSIS Insurance
1	Manila	106	83	78%	23
2	Quezon City	142	140	99%	2
3	Pasay City	32	26	81%	6
4	Caloocan City	88	9	10%	79
5	Mandaluyong City	29	5	17%	24
6	Marikina City	31	0	0%	31
7	Makati City	37	35	95%	2
8	Pasig City	40	31	78%	9
9	City of San Juan	9	8	89%	1
10	Paranaque City	32	4	13%	28
11	Las Piñas City	32	0	0%	32
12	Valenzuela City	58	11	19%	47
13	Malabon City	40	0	0%	40
14	Navotas	21	0	0%	21
15	Taguig	44	8	18%	36
16	Muntinlupa City	26	18	69%	8
	Total	767	378	49%	389

Source: The study team, Original: GSIS

a.7 Calculation of Replacement Costs for Public Schools in MM

The following conditions are set to calculate replacement costs of public schools in MM.

- Unit construction costs (PHP/m2) in each of the buildings with a different number of storeys shown below are based on DepEd standard construction cost divided by building floor area.

Table 4-14 Unit Construction Costs of Public Schools[26]

Stories	Cost per m2		Total Unit Cost
	Building	M&E	
1 story	11,100	1,100	12,200
2 stories	13,000	1,300	14,300
3 stories	14,700	1,500	16,200
4 stories	15,300	1,500	16,800
5 and above	15,300	1,500	16,800

Source: The study team, Original: Education Facility Division of DepEd

[26] The study team assumed that more than 5 stories are the same as 4 stories

- Coefficient to convert classroom area to total floor area is calculated and shown below based on the DPWH standard design drawings.

Table 4-15 Coefficient to Convert Classroom Area to Total Floor Area

Stories	Coefficient
1 Story	1.279
2 Stories	1.800
3 Stories	1.819
4 Stories	1.664
5 and above	1.500

Source: The study team processed, Original: DPWH

Based on the above conditions, replacement costs for school buildings in 767 public schools in Metro Manila were calculated and are shown below. The complete set of calculation sheets is shown in Annex E.

Table 4-16 Calculation of Replacement Costs of Public Schools in MM (Sample)[27]

SI No	Division Name	School Name	W	L	Year Constructed	Number of Buildings	Building No.	Number of Storey	Number of Rooms	Unit Room Area	Total Room Area	Con. Factor	Estimated Total Floor Area	Estimated Replacement Cost by Bldgs (PHP)
1	Manila	A. C. Herrera Elementary School	7.0	6.0	-	1	1	3	21	42	882	1.82	1,604	25,987,046
2	Manila	Barrio Obrero Elementary School	7.0	9.0	2014	8	1	3	9	63	567	1.82	1,031	16,705,959
			8.0	10.0	1989		2	1	1	80	80	1.28	102	1,247,937
			7.0	8.0	2003		3	3	9	56	504	1.82	917	14,849,741
			7.0	9.0	1976		4	4	72	63	4,536	1.66	7,549	126,822,330
			5.0	10.0	2003		5	1	1	50	50	1.28	64	779,961
			7.0	8.0	1989		6	2	6	56	336	1.80	605	8,650,911
			6.5	8.5	2003		7	2	2	55	111	1.80	199	2,845,017
			7.0	7.0	1996		8	1	1	49	49	1.28	63	764,362
3	Manila	F. G. Calderon Integrated School	7.0	9.0	-	1	1	4	100	63	6,300	1.66	10,485	176,142,127
4	Manila	Lapu-Lapu Elementary School	7.0	9.0	-	1	1	3	24	63	1,512	1.82	2,750	44,549,221
5	Manila	Antonio Luna Elementary School	7.0	9.0	1945	2	1	2	12	63	756	1.80	1,361	19,464,550
			6.0	8.0	1984		2	3	18	48	864	1.82	1,571	25,456,698
6	Manila	Mariano Ponce Elementary School	7.0	7.0	1988	3	1	2	20	49	980	1.80	1,764	25,231,825
			6.0	5.0	2000		2	1	1	30	30	1.28	38	467,977
			7.0	7.0	1990		3	2	20	49	980	1.80	1,764	25,231,825
7	Manila	Melchora Aquino Elementary School	7.0	9.0	1959	1	1	3	36	63	2,268	1.82	4,125	66,823,837
8	Manila	Plaridel Elementary School	7.0	7.0	1994	5	1	3	9	49	441	1.82	802	12,993,523
			7.0	9.0	2002		2	4	20	63	1,260	1.66	2,097	35,228,423
			8.0	7.0	2001		3	1	1	56	56	1.28	72	873,556
			8.0	7.0	1995		4	1	2	56	112	1.28	143	1,747,112
			7.0	9.0	1995		5	3	21	63	1,323	1.82	2,406	38,980,570
9	Manila	Francisco Benitez Elementary School	7.0	9.0	1999	7	1	3	12	63	756	1.82	1,375	22,274,610
			7.0	9.0	2001		2	4	16	63	1,008	1.66	1,678	28,182,738
			7.0	9.0	1999		3	4	44	63	2,772	1.66	4,613	77,502,534
			7.0	9.0	2002		4	3	15	63	945	1.82	1,719	27,843,264
			7.0	9.0	2007		5	1	2	63	126	1.28	161	1,965,501
			7.0	9.0	2014		6	2	2	63	126	1.80	227	3,244,092
			7.0	9.0	2014		7	1	1	63	63	1.28	81	982,751

Source： The study team processed, Oiginal: the DepEd school list

The table below gives a summary of the replacement costs for each school and a comparison of the replacement cost with sum insured by GSIS. If the cell is blank, the school is not insured by GSIS.

[27] The design is calculated using the DPWH standard design, construction unit price is calculated using DepED's standard construction unit price.

Table 4-17 Comparison of Replacement Costs and Sum Insured by GSIS[28]

No	Division Name	School Name	Total Replacement Cost by Schools (PHP)	Sum Insured by GSIS (PHP)	%
1	Manila	A. C. Herrera Elementary School	25,987,046	16,149,518	62%
2	Manila	Barrio Obrero Elementary School	172,666,219	12,952,282	8%
3	Manila	F. G. Calderon Integrated School	176,142,127	3,130,714	2%
4	Manila	Antonio Luna Elementary School	44,921,248	3,297,507	7%
5	Manila	Mariano Ponce Elementary School	50,931,626	9,753,332	19%
6	Manila	Plaridel Elementary School	89,823,184	16,446,000	18%
7	Manila	Francisco Benitez Elementary School	161,995,490	7,848,595	5%
8	Manila	Lakan Dula ES	111,253,925	294,570	0%
9	Manila	Gregoria de Jesus ES	95,685,520	11,766,807	12%
10	Manila	Librada Avelino ES	29,660,267	11,407,604	38%
11	Manila	T. Paez Integrated School (Elem.)	111,085,230	9,552,906	9%
12	Manila	J. P. Rizal Elementary School	161,465,857	13,945,945	9%
13	Manila	Gen. Vicente Lim Elementary School	196,965,861	56,101,147	28%

The results of summary of replacement costs and sum insured by GSIS in each city are shown below.

Table 4-18 Summary of Comparison of Replacement Costs and Sum Insured by GSIS

	Name of LGUs	Number of Schools			Replacement Cost (PHP)		Sum Insured (PHP)	%
		Total	w/ GSIS Insurance	w/o GSIS Insurance	All Schools	Schools w/ Insured		
1	Manila	106	83	23	13,923,104,379	11,166,006,154	1,289,950,930	11.6%
2	Quezon City	142	140	2	12,047,106,608	12,001,498,861	7,859,420,237	65.5%
3	Pasay City	32	26	6	3,405,833,368	2,985,694,508	1,319,737,147	44.2%
4	Caloocan City	88	9	79	6,262,852,863	573,176,277	67,983,490	11.9%
5	Mandaluyong City	29	5	24	3,285,781,008	660,908,619	179,484,728	27.2%
6	Marikina City	31	0	31	2,402,620,785	0	0	-
7	Makati City	37	35	2	4,322,120,141	3,761,752,024	3,013,523,113	80.1%
8	Pasig City	40	31	9	6,099,722,276	4,359,855,903	1,022,383,144	23.4%
9	City of San Juan	9	8	1	759,231,018	589,435,401	258,832,924	43.9%
10	Paranaque City	32	4	28	2,382,531,317	655,538,244	96,424,000	14.7%
11	Las Piñas City	32	0	32	1,803,390,524	0	0	-
12	Valenzuela City	58	11	47	3,131,265,862	683,527,359	536,135,022	78.4%
13	Malabon City	40	0	40	1,540,540,028	0	0	-
14	Navotas	21	0	21	938,776,268	0	0	-
15	Taguig	44	8	36	3,211,800,327	691,277,984	75,061,827	10.9%
16	Muntinlupa City	26	18	8	2,313,456,625	1,869,588,917	387,055,000	20.7%
	Total	**767**	**378**	**389**	**67,830,133,397**	**39,998,260,251**	**16,105,991,562**	40.3%

Based on the above calculation, the replacement costs for all the public schools (767 schools) in Metro Manila is estimated to be around 67.8 Billion PHP. Hence the replacement costs for 378 public schools, which reinsured by GSIS, are around 40.0 Billion PHP. Total sum insured of GSIS

[28] According to GSIS, regarding the amount of insurance, there is no breakdown by school building. Depending on the school, the school building built by LGU is insured, but for schools built by DepEd it may not be insured (based on an interview held on July 2016). Therefore, it is necessary to note that the insurance amount may not cover all the school buildings.

policy for the Metro Manila public schools is 16.1 Billion PHP. Thus, 389 schools, equivalent to 41% for replacement cost for entire public schools in Metro Manila, are not covered by public property insurance. Total sum insured for 378 public schools is only 60% of total replacement cost. In summary, only 24% of replacement cost of entire public schools in Metro Manila is covered by the public property insurance program.

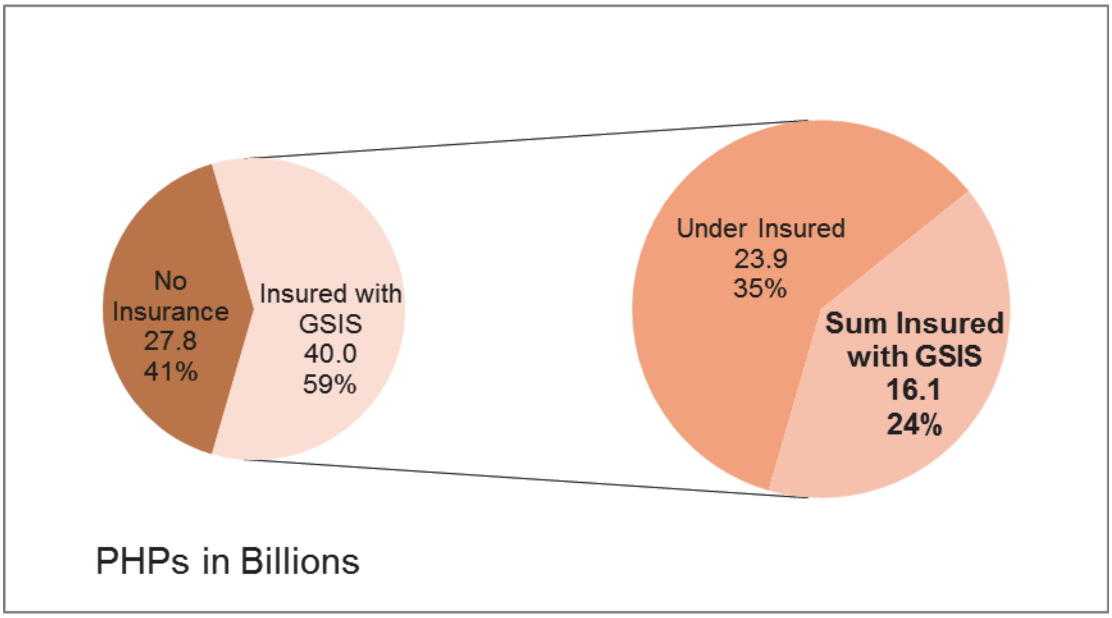


Figure 4-3 Uninsured, underinsured situation based on replacement cost

Unit: Billion PHP

b. MRT Line 3

The following table provides draft replacement costs.

Table 4-19 Replacement Costs Summary (MRT3)

Item	Description	OVERALL COST Total Cost (Php)
A	Build Value	
1	**Original Construction Cost**	
1.1	Stations	3,790,179,576
1.2	Track Sections	18,606,542,222
1.3	Depot Maintenance Building	5,150,119,618
1.4	Viaducts and Guideways	366,537,248
1.5	Terminal Head House (CFA 148, 696m2)	420,333,897
1.6	Trains	8,596,041,668
		36,929,754,229
2	**Retrofitting and Refurbishment Cost**	
2.1	Retrofitting and Refurbishment Works	162,600,000
	SUB TOTAL (Php)	**37,092,354,229**
	Contingencies (10%)	3,709,235,423
	Additional Cost Allowances (Design, Consultancy and Professional Fees) (10%)	3,709,235,423
	TOTAL (Php)	**44,510,825,075**
	Track Length (km)	16.9
	TOTAL COST / Track Length (Php/km)	**2,633,776,632**
	TOTAL (USD)	**947,038,831**
	Track Length (km)	16.9
	TOTAL COST / TRACK LENGTH (USD/km)	**56,037,801**

The comparison with the sum insured defined in the existing insurance policy is as given in the following table; the current sum insured is approximately 54% of the replacement cost. In addition, the current insurance policy sets a sub-limit for liability of [29]PHP 5.5 billion (approx. USD 115 million) per accident in MRT3. According to GSIS, because the great gap between the replacement cost and sum insured carried was expected, and a sub-limit for liability was not rationally calculated, a previous insurance condition was followed. With the premium rate calculation tool and the renewal of replacement cost, an evaluation can be made as to setting an appropriate sub limit for loss caused by natural perils.

Table 4-20 Comparison between Current Sum Insured and Replacement Cost（MRT3）

Item / Unit		Current Policy	Replacement Cost	Difference	underinsurance %
Sum Insured	Php	23,958,144,000	44,510,825,075	20,552,681,075	54%
Truck Length	km	-	16.9		
Unit Cost	Php/km	-	2,633,776,632		
	USD/km	-	56,037,801		

[29] Regarding MRT 3, it is a sub-limit for liability for accidents caused by natural disasters

c. NAIAT3

The following table provides draft replacement costs.

Table 4-21 Replacement Costs Summary（NAIAT3）

Item	Description		OVERALL COST Total Cost (Php)
	Build Value		
1	**Original Construction Cost**		
1.1	Preliminaries (10%)		2,059,832,914
1.2	Site Development	B. SUM	408,789,872
1.3	Terminal North Concourse (CFA 17,472 m2)	C. SUM	997,550,095
1.4	Terminal South Concourse (CFA 28,710m2)	D. SUM	1,589,246,467
1.5	Terminal Head House (CFA 148, 696m2)	E. SUM	7,600,201,758
1.6	Multi-Level Carpark (CFA 44,580m2)	F. SUM	744,766,906
1.7	G. Specialty Systems		5,897,884,532
1.8	H. Airside Infrastructure		1,998,032,119
1.9	I. Landside Infrastructure		1,361,857,392
			22,658,162,054
2	**Retrofitting and Refurbishment Cost**		
2.1	Retrofitting and Refurbishment Works	2. SUM/1……	3,213,521,269
		SUB TOTAL (Php)	**25,871,683,323**
	Contingencies (10%)		2,587,168,332
	Additional Cost Allowances (Design, Consultancy and Professional Fees) (10%)		2,587,168,332
		TOTAL (Php)	**31,046,019,988**
		CFA/ Construction Floor Area (m^2)	239,458
		TOTAL COST / CFA (Php/m^2)	**129,651**
		TOTAL (USD)	**660,553,617**
		CFA/ Construction Floor Area (m^2)	239,458
		TOTAL COST / CFA (USD/m^2)	**2,759**

CFA: Construction Floor Area (m2)

The comparison with the sum insured defined in the existing insurance policy is as given in the following table; the current sum insured is approximately 25% of the replacement cost. In addition, the current insurance policy sets a sub-limit for liability of PHP 1.5 billion[30] (approx. USD 32 million) per accident in NAIA T3. According to GSIS, this is because the reinsurer recognized the great gap between the replacement cost and sum insured carried, so it was not possible to negotiate with the reinsurer to lift the T3's sub-limit for liability. With the premium rate calculation tool and the renewal of replacement cost, an evaluation can be made as to setting an appropriate sub limit for loss caused by natural perils.

Table 4-22 Comparison between Current Sum Insured and Replacement Cost

Item / Unit		Current Policy	Replacement Cost	Difference	Underinsurance %
Sum Insured	Php	7,880,530,246	31,046,019,988	23,165,489,742	25%
Total Floor Area	m2	-	239,458		
Unit Cost	Php/m2	-	129,651		
	USD/m2	-	2,759		

[30] For NAIA T3, it is sub-limit for liability per accident for all T3 accidents that fall under the insured loss.

Comparisons with similar airport terminal buildings are shown in the table below.

Table 4-23 Unit Cost of Airport Terminal Buildings in the Philippines

No.	Description - Airport	CFA(m2)	Total Cost	Unit Cost	Total Cost	Unit Cost
		(m2)	(Php)	(Php/m2)	(USD)	(USD/m2)
1	NAIA Terminal 3	239,458	31,046,019,988	129,651	660,553,617	2,759
2	Proposed New Manila International Airport	942,252	100,437,121,895	106,593	2,136,960,040	2,268
3	Macatan Ceby International Airport	137,610	9,155,904,421	66,535	194,806,477	1,416
4	Proposed Caticlan International Airport	66,475	12,074,511,391	181,640	256,904,498	3,865
5	Bacolod Airport	15,319	1,694,827,000	110,636	36,060,149	2,354
6	Cagayan Airport	30,194	2,952,292,000	97,777	62,814,723	2,080
7	Davao Airport	37,697	4,050,509,000	107,449	86,181,043	2,286
8	Iloilo Airport	28,987	2,876,894,000	99,248	61,210,511	2,112
9	Bohol Airport	6,059	1,042,622,000	172,078	22,183,447	3,661

PHP 47 = 1USD 0.0212766

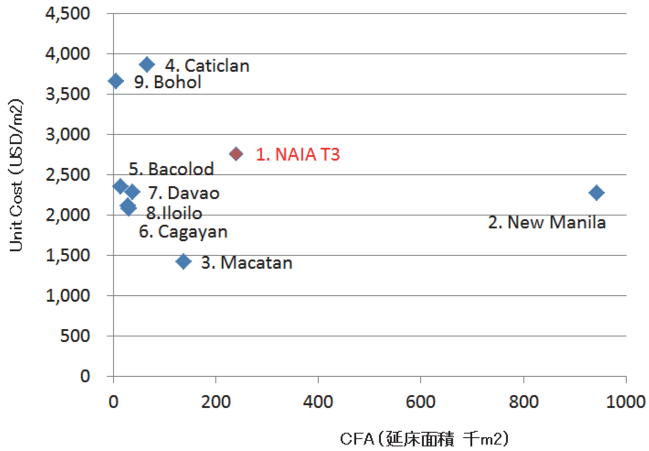


Figure 4-4 Comparison among Unit Cost of Airport Terminal Buildings in the Philippines

Source : ARCADIS Asia Limited

d. Summary of Replacement Cost and Actual Situation of Underinsurance

The state of being underinsured in MRT3, NAIAT3 and the public schools in Metro Manila that this study targeted is as shown in the table below. With respect to public schools, it shows an average of 358 schools that GSIS insures in Metro Manila. The underinsured rate for each municipal government ranges widely, from 11.6% in Manila to 80.1% in Makati City, but all are in the underinsured state.

Table 4-24 Underinsured rate of the facilities investigated

Insured	Replacement Cost	Sum Insured	Underinsurance (Insurance to Value)
MRT3	44,510,826	23,958,144	53.8%
NAIA T3	31,958,371	7,880,530	24.7%
Public schools*	40,000,000	16,100,000	40.3%

*) for 378 schools insured by GSIS

NAIAT3 is a project implemented with the public–private partnership (PPP) method, and a dispute occurred among the government, operator, and Construction Company before completion. For this reason, the operating cost has not been determined. The cause of the current significant underinsurance is that the value of the airport terminal, which was used during the process of the dispute, was used as the sum insured. This is a special case. On the other hand, the figures used for MRT3 and public schools are on the basis of the acquisition cost at the time of construction, or the figures that reflect depreciation based on it. It is considered that facilities with an old acquisition year have a larger divergence.

4.2.4 Issues Arising from Underinsurance

The following lists issues arising from underinsurance in terms of the insurance system and disaster risk financing function.

a. Insurance System

For an insurance contract whose indemnification base is the replacement cost, a large divergence between the sum insured and replacement cost means that the insurance company does not receive a premium on the basis of underwriting risk, which will result in overturning the basis for the given premium rate. Since the insurer tries to raise the premium rate if the actual premium falls short of an appropriate premium, the premium rate is calculated on the premise that the sum insured is appropriate according to insurance payment conditions (compensation standard of public property insurance is the replacement cost), and the premium rate system is established. For this reason, leaving inappropriate sum insured can also be a cause of impeding the fair insurance market.

b. Disaster Risk Financing Function

- In the event of an accident, the insured cannot receive the payment of the insurance amount necessary to restore the damaged facility, and must procure funds by themselves if they are underinsured.
- If the insurance scheme under insurance contracts is not understood in advance, it requires time to reach an agreement of the insurance amount payable among the insurer, GSIS, the insured (government agency) and the reinsurer, and there is a possibility of delay in payment of the insurance claim and of a lawsuit, after an insured loss occurs,.
- Insurance for large-scale facilities such as MRT3 may set a sub-limit for liability for natural disaster risk. This is aimed at facilitating procurement of insurance and controlling an increase in insurance premiums by establishing sub-limit for liability for natural disaster risk which is difficult to obtain substantial compensation payouts from the insurance market. Sub-limit for liability is set by discussion between the insurers and insured based on an estimated maximum loss to be caused by natural disasters. Where the state of a significant underinsurance is estimated, that is, if the sum insured itself falls below the replacement cost, the insurance amount payable is adjusted. There is a potential that the sub-limit for liability

set without regard for underinsurance at the time of signing the policy becomes irrelevant as insurers reduce their pay-out in proportion to the amount underinsured when the insured loss occurs.

In the US, which uses similar conditions in insurance policies as those in the Philippines, if the sum insured is more than 80% of the replacement cost (20% allowance) when an insured loss occurs, the insurance payout is not subject to underinsurance adjustment in general[31]. Conversely, under the policy condition GSIS uses for public schools, MRT3 and NAIAT3, this allowance clause is not included. The insurance amount payable will be reduced according to the difference between the sum insured and replacement cost.

In this way, underinsurance will not only affect the property insurance system established on the basis of a given premium rate for the insurance product, but also the government agency that is the insured will not be able to receive the insured amount necessary to restore the facility. Since this will lead to a situation in which the public property insurance system cannot fulfill its role in disaster risk financing, as in the case of being uninsured, it is necessary to properly address this.

4.3 Fundamental Challenges and Organizing Measures

Public property insurance has fundamental issues, such as those of the uninsured and underinsured, and it is considered that the fundamental causes and challenges for these issues are 1) government agencies and facility owners have little understanding of natural disaster risks and public property insurance, and 2) the existing public property insurance regulation does not have adequate enforcement mechanism to improve compliance. As for past efforts by the government and GSIS, and future measures to solve the issues, the items for which GSIS can contribute have been described here. Details are shown in Annex F, but the following table shows whether or not the efforts are made, and the items for which contributions towards future measures are possible.

[31] Provisions of standard policy conditions of ISO (Insurance Services Office), which issues standards for insurance policies in the US.

Table 4-25 Extraction of fundamental causes, classification, past efforts, future measures

Classification of assumed causes				Results corresponding to causes		Past efforts			Future measures			Ref. No.
Major groups	Sub-major	Minor	Examples	No insurance	Under insurance	Gov't	GSIS	Examples	On-going	Added	Examples	
Lack of awareness and understanding by the government	Insufficient awareness of natural disaster risks	Insufficient awareness of natural disaster risks		✓		✓		NDRRMP, Development of the Philippine CAT model		✓	Provide information on natural disasters and loss evaluation using the risk based premium tool to the facility owner and NDRRMC	①
		No sense of damage that might occur		✓		✓				✓		②
	Lack of understanding on public property insurance program	Lack of understanding on the value of natural disaster insurance	Receiving a payment of insurance claim after a disaster is a long and complex process	✓			✓	GSIS Insurance Promotion Caravan	✓	✓		③
			As in the past, will somehow cope without coverage	✓			✓	GSIS Insurance Promotion Caravan	✓	✓	Consider revision of deductible provision concerning natural disasters	④
			Expect to obtain central government funding for restoration after a disaster, and more advantageous to use this funding	✓		✓	✓	NDRRMP, GSIS Insurance Promotion Caravan	✓	✓		⑤
		Poor understanding of premium payment	Belief that LDRRM Fund cannot be used for premiums	✓		✓		RA10121 (Use of LDRRM fund), Premium for Natural dsaster approved in the 2017 Government budget	✓			⑥
			Adjustment of replacement costs would increase insured amount and result in higher premiums even if premium rate is unchanged		✓					✓	Reduce premium rates by adopting risk-based premium rate	⑦
		Poor understanding of underinsurance	No awareness that policies can reduce claims paid due to underinsurance		✓		✓	Explain a term, "Average clause" and its effects and recommend cost valuation in insurance underwriting and renewal	✓	✓	Promote an understanding of insurance coverage by the natinowide Insurance Promotion Caravan	⑧
			Belief that coverage is sufficient, even if underinsured, due to low frequency of total loss		✓		✓		✓	✓		⑨
			Want minimum necessary insurance		✓					✓	Use a risk calculation tool to design natural disaster coverage	⑩
Public property insurance program not functioning properly	Compulsory coverage of public infrastructure not properly enforced	Some facilities not required by law to have compulsory coverage	RA No. 656 property insurance act covers only central government and LGU (1st class and above) facilities	✓		✓	✓	RA656 amendment RA10121 amendment	✓	✓	Prepare Implementing Rules and Regulations (IRR) after amendment	⑪
			RA 656 Property Insurance Act does not define the scope of assets subject to insurance coverage	✓					✓	✓	Specify compulsory insurance for natural disaster risk in the revised IRR	⑫
	Legal compliance inconsistent	Legal compliance inconsistent		✓		✓	✓	Audit by COA Notice sent by DILG	✓	✓	GSIS to monitor the coverage rate for natural perils endorsement and the status of improvement, and to prepare a list of uninsured government agencies	⑬
		No proper list of uninsured agencies and local authorities		✓			✓	List of uninsured agencies and LGUs updated by GSIS	✓	✓		⑭
		No arrangements for penalizing uninsured agencies and LGUs		✓		✓		RA656 amendment		✓	Provide for guidelines on appraising replacement costs in IRR when RA656 is amended	⑮
	Replacement costs not calculated properly	No requirements or regulations concerning appraisal of replacement costs			✓		✓	Promote periodic replacement cost valuation every three years at insurance renewal	✓	✓	Promote giving incentives to insurance policies for resolving underinsurance	⑯
		No system for keeping track of replacement costs			✓					✓	GSIS to confirm the replacement cost	⑰
		No budget for assessing replacement costs			✓					✓	The insured to conduct evaluation of the replacement cost	⑱

4.4 Major Efforts by GSIS and Relevant Institutions to Solve the Uninsured Issue

4.4.1 Past Effort Remedy the Situation of Being Uninsured

In order to remedy the situation of not being uninsured in public property insurance, major efforts made by GSIS so far and relevant institutions are listed as follows, in reverse chronological order.

a. DRR initiatives under the National Disaster Risk Reduction and Management Plan 2011-2028 (NDRRMP) (Table 4-25, ①, ②)

One of the responsibilities of the National Disaster Risk Reduction and Management Commission (NDRRMC) under Section 6 (d) of RA10121 is to "ensure a multi-stakeholder participation in the development, updating and sharing of a Disaster Risk Reduction and Management Information System and Geographic Information System-based national disaster risk map as policy, planning and decision-making tools." Diverse disaster hazard and risk assessments have been conducted based on this by the Philippine government, universities, and research institutes[32]. Under the NDRRMP, technological service institutes such as PHIVOLCS and PAGASA have been given responsibility for a range of tasks, including the compilation of information on natural disaster hazards and risks throughout the Philippines, and improving access to data on natural disaster risks using online tools. A Philippine disaster risk assessment model for quantitatively evaluating the cost of damage caused by typhoons and earthquakes was also introduced in 2014 by DOF with the assistance of the World Bank.

b. Nationwide Insurance Promotion Caravan by GSIS (Table 4-25, ③, ④, ⑤, ⑧, ⑨)

Regardless of the presence or absence of an enacted RA656 amendment, it is important to improve government agencies' awareness of public property insurance and GSIS's role. Therefore, the GSIS insurance division implements a PR caravan six times annually. The purpose of this is to promote public property insurance to government agencies. A lecture is offered in the morning and a seminar style Q&A session is conducted in the afternoon, by soliciting participation of relevant institutions in a place to visit and its neighborhood. The targets are all public institutions, including central government, municipal government and the military. In 2016, caravans were held in Cebu, Baguio, Davao, etc. A meeting about insurance underwriting is also conducted from time to time. Caravans are continuously conducted hereafter for the purposes of promoting government agencies' awareness about property insurance, and proceeding with GSIS promotion.

GSIS needs to continue the activities of national caravans to inform the significance and utilization of insurance.

c. DILG Sent to Responsible Officials in Municipal Governments a Memorandum Circular With a List of Municipal Governments Not Covered by Public Property Insurance (Table 4-25, ⑥, ⑬, ⑭)

According to the GSIS's record of the uninsured agencies, the Department of the Interior and

[32] Data collection survey for strategy development of disaster risk reduction and management sector in the Republic of the Philippines : final report. (February 2017)

Local Government (DILG) sent a notification to heads or administrators of municipal governments, asking them to comply with RA656. The notification requested their compliance with RA656 and that they budget for the premium in the 2017 municipal governments' budget. It also added that the budget of the premium in the municipal government's LDRRMF Fund is allowed by RA10121.

DILG, which manages local governments, needs to continue encouraging local governments to take out insurance with notifications letters sent to the head of municipal government based on the record of GSIS.

d. Notification Concerning Strengthened Confirmation for Compliance with RA656 in the Audit of COA (December 2016) (Table 4-25, ⑬)

The audit agency, Commission on Audit (COA) issued a memorandum (No. 2016-024) to auditors on December 14, 2016 asking them to check that central government agencies and LGUs comply with RA656 during the audit of government agencies. This mandates that it is one of the RA656 compliance items in the COA audit for institutions, including municipal governments. The memorandum is a COA's internal notice to COA auditors and supervisors. As a result, the compliance status of institutions is checked by COA auditors during the 2016 audit, and therefore, the study team can expect that highlighted institutions will remedy their uninsured status in the 2018 budget.

It is considered necessary for GSIS in the future to continuously understand the results of the audit and encourage the uninsured institutions to buy insurance.

e. Strengthen Supervision of Risk Transfer Mechanism and Compulsory Coverage By the Deliberation of RA10121 (Disaster Risk Reduction and Management Act) Amendment Bill (Table 4-25, ⑪)

A sunset review (that is, a review for the purpose of evaluating the validity of law and efficacy by the supervisory board of Congress; Article 27 of the said law stipulates that the review should be implemented within 5 years of enforcement, or when the need arises) has been conducted for the "Disaster Risk Reduction and Management Act" (May 2010) that established a basic framework of disaster risk reduction and enhanced disaster management upon which the Government of the Philippines has been working. As the contents that are directly related to public property insurance, Article 21 stipulates that the LDRRM Fund can be used for disaster preparation in advance, the cost of which includes payment of a premium for disaster insurance.

The RA10121 amendment bill includes, Article 21, a) Authority supervises risk transfer mechanism and other initiatives to protect government assets and human life from disasters; Article 21, b) Authority forces all the central government's and affiliated institutions' assets to be covered by the government insurance system (GSIS public property insurance). Also, the bill includes Article 21; c) Authority encourages municipal governments to have municipal governments' assets insured by using the LDRRM Fund for the premium.

The obligation of the central government and all affiliated institutions to be covered by insurance is stipulated by the current RA656. It is expected that the insured status will be supervised under the NDRRM Act through the RA10121 amendment bill. As a result, it is expected that the coverage against natural perils of the central government and affiliated institutions will be promoted. Also, the insurance coverage of municipal governments is likely to be encouraged more than ever under the framework of the NDRRM Act. It is necessary for GSIS to monitor the progress of the improvement of the subscription rate resulting from the revision of the law.

f. Entactment of a Bill for Revising RA656 (Property Insurance Law) and Creation of An Inter-Agency Committee on Government Property (Table 4-25, ⑪, ⑮)

The amendment bill to RA656, the law that is the basis for public property insurance, was presented by Mr. Ting, District Representative of Cagayan at the 17th Congress. The said amendment is intended to include the second class municipal governments or lower, which are not currently subject to compulsory coverage by RA656, in the compulsory coverage range of RA656.

As of January 16, 2017, it was in the stage of the process in which GSIS, which is the competent authority of the bill, was preparing a comment for the bill. The legislative process[33] has just started for the amendment bill in the 17th Congress of the Philippines. Once this bill is enacted, it is possible that more towns which have a high risk of natural disasters and are financially vulnerable will be covered by natural disaster insurance. Of the 1,715 total municipal governments in 2017, 1,159 towns are second-class municipal governments or lower, and are not subject to compulsory coverage. Among these towns, some do not have any insurance transactions with GSIS number 228, but those not covered by fire insurance number 819. In addition, many more municipal governments are covered by fire insurance but not insured against natural disaster risks.

If the amended act is enacted, the number of those towns covered by fire insurance can be expected to increase significantly. The rate covered by natural disaster insurance can also be improved if GSIS explains natural disaster risks during insurance application procedures. According to GSIS, they fully expect that this bill will be passed in the Congress and approved by the President in the move towards the RA10121 (Disaster Risk Reduction and Management Act) amendment, and as a response to natural disasters in recent years, and they will start preparing for enactment of the bill. Although the status of the bill remains unchanged, an Inter-Agency Committee (IAC) is created by the Administrative order 4/2017 dated 7th August 2017. The committee shall consider the followings: the revision of legislative measures for the government assets to be adequately and properly insured; appropriate monitoring of the implementation of the rules; and use of the General Insurance Fund (GIF), in addition to putting together the proposals on such a legal system to ensure that key properties of the government are insured without fail. Chaired by the Department of Finance (DOF) and comprised of the Office of the Executive Secretary (OEC), DBM, IC and GSIS, the committee shall submit a terminal report to the president on its consideration and formulation of necessary rules within one year as stipulated by the Administrative order.

g. PHP One Billion Approved as Natural Disaster Premium in the 2017 Government Budget (DBM Issued on 12/29/2016, Official Gazette – General Appropriations Act 2017 XL. NDRRM Fund), and natural disaster insurance system for LGUs started (Table 4-25, ⑥)

Of the government approved budget of PHP 15,755 million for National Disaster Risk Reduction Management (NDRRM) in 2017, PHP one billion was allocated for the cost of purchasing natural

[33] http://www.congress.gov.ph/legisinfo/?l=process#PREPARE

disaster insurance for government facilities. The underwriting insurance agency is specified as GSIS, and they are to follow the guidelines prepared by the Department of Budget and Management (DBM), DOF and GSIS for its use. The discussions held between institutions concerned resulted in this budget for insurance premium to be used for natural disaster insurance program for LGUs which has been developed. As a result, a parametric insurance program was launched, which uses estimated loss triggers in the event of typhoons and earthquakes for the payment of insured amount, covering 25 provincial governments. Coverage is effective for one year beginning July 28th 2017 to July 27th 2018. This program provides USD 206 million worth of aggregate coverage.

With respect to the above measure upon which GSIS and relevant institutions are working to promote coverage by public property insurance, the actions GSIS should take in the future and relevant institutions with which GSIS cooperate are shown in the table below.

Table 4-26 Initiatives taken by GSIS and relevant agencies to solve the uninsured issue

	Initiativesa now underway	Status	Future actions required by GSIS	Relevant agencies						
				GSIS	DOF	DBM	COA	DILG	NDRRM	Congress
a	DRR Initiatives under the National Disaster Risk Reduction and Management Plan 2011-2028 (NDRRMP)	Underway	Continue DRR activities		○				●	
b	Nationwide Insurance Promotion Caravan by GSIS	Ongoing	Continue promotion, Develop the implementation plan for 2017	●						
c	DILG sent a memorandum circular to responsible officials in municipal governments asking them to comply with RA656	Done	Continue monitoring uninsured agencies	○				●	○	
d	Notification requesting strict review of compliance with RA656 in the audit of COA	Underway	Confirm audit result Continue promoting insurance	○			●	○	○	
e	Promotion of risk transfer by RA10121amendment, monitoring insurance enrollment status, expanding compulsory requirement	Under Discussion	Involve in the process of making laws, Monitor enrollment status	○	○				●	●
f	Expanding the scope of compulsory coverage by RA656 amendment and discussion at Inter Agency Committee	Under Discussion	Proposal to enhance RA656	●	●	●			○	○
g	Php 1B allocated for the insurance premium on government assets in 2017 government budget	Done	Develop budget guidelines	●	●	●			○	○

●: Lead agency, ○: Partner agency

4.4.2 Proposal of Additional Measures

a. Provide Information on Natural Disaster Risk and Loss Evaluation to The Insured with the Risk-based Premium Calculation Tool (Table 4-25, ①, ②)

The risk-based premium calculation tool (The Tool) developed in this study enables to visually review natural hazard level on a map and conduct loss evaluation of target facilities. It is recommended to use the Tool when underwriting and renewal process of the insurance contract. The Tool may also enhance for the awareness of the facility owners about natural disaster risks during the insurance promotion caravans by GSIS.

b. Consider Revision of Deductible Provision Concerning Natural Disasters (Table 4-25, ④)

For cause of loss attributable to natural disasters, the deductible amount in GSIS policy conditions is set at 2% of the cash value of the facility affected by natural disasters in both the Industrial All Risk (IAR) policy and standard fire policy with natural perils endorsement. While this is typical as a deductible provision for natural disaster insurance policies, when a facility or building reaches a certain size, no payment will be made for small-scale damage including restoration of damaged parts of the roof because of large deductible in the case of large facilities.

Property insurance is perceived as a representative method of risk transfer in risk financing techniques, but insurance conditions are also devised to reduce risks. For example, obligations to comply with building standards, to immediately repair and restore damaged portions of a roof, and to conduct a statutory inspection, etc. are included. With respect to the area directly related to the premium, there is a way to encourage motivation to prevent damage by increasing the deductible amount, which is within the scope of responsibility of the insured.

Introduction of large deductibles for natural disasters may increase the insured's risk awareness and lead to encouragement of loss prevention activities because the insured cannot be indemnified for minor loss. On the other hand, because insurance payout is not available for the loss below the deductible, the insured may not repair, or temporary repair, the damaged part of the facility. Such cases may increase vulnerability to subsequent natural disasters.

The small deductible plan can lead to appropriate restoration of the damage by the insured as they receive insurance payout for relatively minor loss, thus it reduces financial burden to the insured. However, the small deductible plan may prevent the insured to develop their awareness on investment in DRR. It may also make them rely more on insurance. The small deductible plan should also increase operation costs of GSIS in addition to increase of expected loss frequency. This may lead to increase of premium rate.

As for the earthquake peril which can lead to a massive damage even if it occurs less frequently, it is recommended to transfer the financial risk of the insured to insurance, keeping the current deductible provision. For typhoons and floods which often occur resulting in less damage than the earthquake, making insurance payouts for smaller scale accidents by reducing the deductible amount is recommended. This will help reduce the vulnerability of facilities, by encouraging the use of insurance payouts to make appropriate repairs of the small-scale damage to facilities caused by typhoon and flood disasters. Furthermore, the more the insured have an opportunity to receive an insurance payment, the more property insurance as a mechanism to transfer risks becomes attractive to them, raising the awareness of insurance as something that is needed daily.

Along with setting premium rates, GSIS has the authority to modify the wording of insurance policy conditions. It is therefore feasible for GSIS to change the deductible amount. The premium rate calculation tool has a mechanism to calculate insurance premiums based on the deductibles set. We propose that GSIS establish deductibles (and set insurance premiums corresponding to this) according to the needs of the insured.

Because a deductible reduction will be accompanied by an increase in insurance premium appraisal projects, any reductions will have to be decided based on a study of the entire premium rate scheme, to link the reduction to an increase in GSIS's management fee and increases in the insurance premiums themselves. The risk-based premium calculation tool developed this time can also evaluate changes in insurance premiums based on the change in the deductible.

c. Compulsory Coverage for Natural Disaster Risk to be Specified in the Revised IRR, Implementing Rules and Regulations, of RA 656. (Table 4-25, ⑫)

Of all the 767 public schools in Metro Manila subjected to this study, 401 schools (52.3%) have property insurance, of which 249 schools (32.5%) only have natural disaster insurance. As it is thought compulsory requirement of RA 656 does not specify extent of the coverage, it is suggested that automatically endorsement requirement of coverage for natural perils should be placed in the proposed Implementing Rules and Regulations (IRR) by GSIS upon the revision of RA656.

d. Monitoring of the Covering Rate of Natural Disaster Insurance by GSIS (Table 4-25, ⑬, ⑭)

In order to reduce number of uninsured, GSIS and relevant agencies have conducted various approaches as shown in Table 4-26. The initiatives taken include as follows: (a) national disaster risk reduction management plans; (b) insurance promotions carried out by GSIS; (c) promotion of voluntary cover through RA656 observation notices; (d) strengthening of executive management in current RA656 through COA audits; (e, f) strengthening of regulations through legal amendments to RA656/RA10121; and (g) recording of government budgets for insurance cover.

According to GSIS, in the example of public schools in Metro Manila, the level of cover for fire insurance is just 52.3% (401 out of 767 schools), and the level of cover for natural disaster compensation is just 32.5% (249 out of 767 schools).(See Table 4-2).

For all government agencies in the Philippines nationwide, the fire insured rate is 50.3% (1,093 agencies out of 2,173) as shown in Table 4-1. The rate for natural peril coverage is unclear with no monitoring mechanism, but that is believed to be even lower based on the example of public schools in Metro Manila.

The current monitoring system does not segregate standard fire coverage with and without natural peril endorsement. According to GSIS, it can be managed separately on the GIIS (General Insurance Information System) which is the insurance contract management system of GSIS, but it has not been done so far. In addition to the current monitoring practice for insured / noninsured account for fire coverage, it is suggested to monitor coverage rate for natural perils endorsement as well.

4.5 Initiatives of GSIS for Resolving Underinsurance Issues and Proposed Measures

Based on the results of interviews with JCM and relevant organizations and the amount of experience of GSIS, the root cause is considered to be lack of recognition of insurance system and lack of replacement cost evaluation. In addition, as one of the other causes, public property insurance is considered to have poor systems and incentives to encourage correction of underinsurance.

In insurance contracts that suppress underinsurance, there is a term called “Average clause” that insurers are allowed to reduce their pay-out in proportion to the amount underinsured when the insured loss occurs, but the insured will not know the impact as reduced amount of the claim until their claim is actually adjusted. Though GSIS explains the regulations and effects of underinsurance to the insured and make efforts to promote periodic replacement cost valuation every three years at insurance contract renewal to address the underinsureance issue, the state of underinsurance still remains to be corrected as mentioned above (Table 4-25, ⑧, ⑨, ⑯). The coverage of underinsured policies is based on replacement cost, but the payment of insurance claim does not meet the fund required for restoration. Thus, underinsurance will result in the situation partly equivalent to not having insurance coverage. The study team considers that our next step is to also focus on addressing underinsurance while working to address the problem of uninsurance.

While an appropriate sum insured is presented in principle when an insured owning a facility/ authority applies for an insurance contract, having the ability of GSIS as an insurer to judge the adequacy of the sum insured in the insurance underwriting process helps to resolve underinsurance contracts. The next section shows future measures to be taken by GSIS and relevant agencies for correcting underinsurance in addition to existing ones taken by them.

4.5.1 Proposal for Future Measures

a. Embed incentives in an insurance policy to encourage elimination of underinsurance (Table 4-25, ⑯)

A situation where ITV (Insurance-to-Value), the ratio of insured value (the sum insured) to facility replacement when an accident occurs, is less than 100% corresponds to underinsurance. Under a GSIS policy, when ITV falls below 100%, even if only a little, the policy is administered as underinsurance corresponding to the ratio, and the insurance payment amount will be reduced. When evaluating replacement cost, it is difficult for ITV to equal 100%, because the valuation is performed when an accident occurs, not when the insurance policy is entered, and some allowance is needed. Although GSIS's policies have no such allowance, standard policies in the United States, which are similar to those of GSIS, stipulate that the insured value is the limit of liability and insurance payouts are not reduced for underinsurance if the ITV exceeds 80%. Even under Japan's previous fire insurance system of normal fire insurance agreements, the partial insurance payment insurance adjustment threshold was set at ITV 80%. In addition, the system of discounting insurance premiums when the threshold under the policy is 90% instead of 80% also acts as an incentive to bring ITV close to 100%.

As an incentive to cure underinsurance, for GSIS policies as well we propose incorporating a policy stipulation that the reduction adjustment provision (average clause) based on underinsurance will not be applied when the ITV is 80% or higher, contingent on the insured having implemented a replacement cost assessment (a simplified assessment or assessment by an outside specialist, recognized by GSIS).

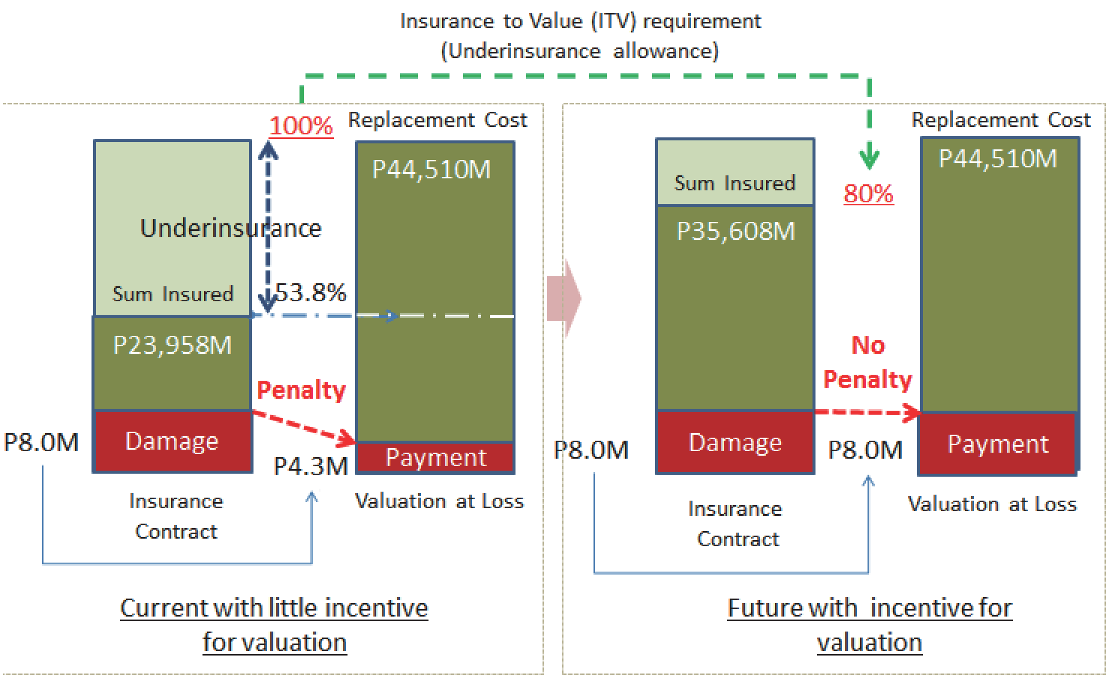


Figure 4-5 Mechanism of incentive to appraise the replacement cost by setting allowance for underinsurance provision

b. Confirmation of the Replacement Cost by GSIS (Table 4-25, ⑰)

GSIS is the state own insurance institution. Under the compulsory coverage insurance system, an application for insurance coverage from the insured cannot be refused by GSIS. On the other hand, it is impossible to confirm the adequacy of declared sum insured as information obtained on a facility to be insured comprises the insured amount declared, location, name, the type of building structure and the number of floors, etc., in the current insurance underwriting procedures, except in the case of a large insurance program that issues reinsurance through public bidding procedures.

If it is possible to verify the adequacy of the declared sum insured at underwriting insurance, it will lead to suppression of underinsurance. Thus, it is proposed that verification of whether the sum insured is appropriate according to indemnity method of the insurance contract (replacement cost for GSIS's insurance) is included in the part of insurance underwriting and renewal process. Specifically, in the case of large-scale public infrastructure, whether there is an appraisal report by an external organization is verified, and for general buildings such as schools and offices, whether the amount is reasonable based on the desk-top valuation database described in the preceding paragraph is verified. If the coverage amount is substantially less than the replacement cost, the underwriting process should include a request for a valuation implemented by the insured.

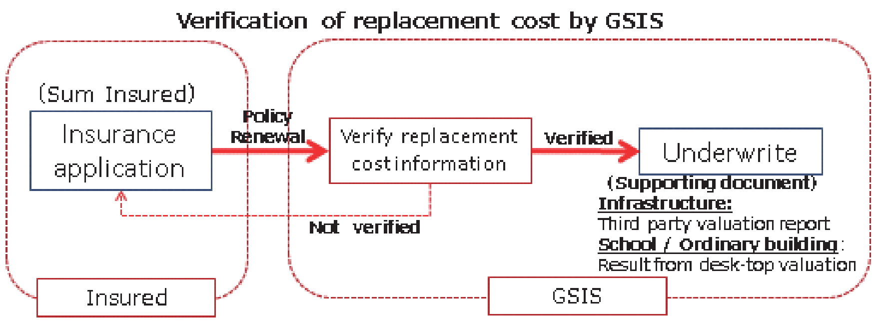


Figure 4-6 Process for verification during insurance underwriting or renewal whether coverage amount is reasonable

c. Replacement Cost Valuation by the Insured (Large Public Infrastructure) (Table 4-25, ⑱)

According to MRT3 and NAIA, the transport infrastructure management institutions, neither institution has an in-house evaluation function, and both considers there is no merit in conducting an in-house evaluation. On the other hand, there is no obstacle to asking an outside appraiser to appraise the insured value every three years, as recommended by GSIS. It is possible to place an order with an outside institution and to provide materials for evaluation. There is no problem in securing the appraisal cost in the annual budget. Budgeting outsourcing costs is necessary if the costs are required for appraising the sum insured at the replacement cost. According to an interview with DBM, if it can be proved that the appraisal fees are essential for insurance contracts, it is possible to treat them similarly as insurance premiums.

Although this study included above two institutions only, a regular appraisal of the insured value has been conducted by an outside institution for a privatized power generation facility etc., which GSIS insures. Conducting a regular appraisal is considered to be possible for other large public infrastructure, such as a harbor.

Currently, the appraisal is only recommended to the insured, but as a means to urge them to periodically conduct the appraisal, making it their duty (Warranty) should be considered. In addition, when implementing appropriate appraisal, giving incentives in particular not to apply some insurance clause should also be considered, which will be described in e.

Consultation between MRT 3 and GSIS has been underway based on the result of the replacement cost of MRT 3 presented at the 1st JCM conducted in November 2016. The intention of MRT 3 is (1) to outsource the appraisal to an external institution in addition to this evaluation by the same organization, (2) to change the insured value if the obtained result is similar[34].

d. Replacement Cost Valuation by the Insured (Public School) (Table 4-25, ⑱)

With respect to public schools, DepEd has set the construction cost for school buildings on the basis of the DPWH standard class, so it is possible to evaluate and declare replacement cost on its basis. As mentioned above, replacement cost can be estimated on the basis of the number of classrooms, number of stories and building area based on a standard class.

DepEd is currently conducting the 2017 inventory survey of public schools throughout the nation

[34] Based on an interview with GSIS on February 17th, 2017

(DepEd Order No. 1 2017). Survey items include the information necessary for appraisal the replacement cost, such as school campus layout, building structure, year built, area, number of classrooms, number of stories, and adjoining facilities. These are aggregated to the DepEd's database by March 2017, with evaluation as of January 16, 2017. Based on this information, the DepEd's engineering division can conduct a desktop evaluation of the replacement cost. It is also possible for GSIS to understand a summary of underinsurance by comparing the existing contract's insured amount with the school size (total floor area, etc.) based on these data. Since an ID number is allocated to each school, a comparison table can be created in the IT division of GSIS.

Currently, public schools under DepEd's jurisdiction are uninsured[35], while public schools under the jurisdiction of 12 LGUs out of 16 have insurance provided by GSIS, renewing the policy every year. The use of DepEd's data and confirmation of the replacement cost by GSIS is recommended when the policy is renewed in the second half of 2017.

e. Replacement Cost Valuation by the Insured (General Office Building Owned by Public Institution) (Table 4-25, ⑱)

Although application to custom-made transport infrastructure and civil engineering structures is difficult, according to the list of the government and municipal governments to which GSIS provides insurance, the majority of the facilities are low-rise office buildings in Metro Manila. According to DPWH, it is possible for DPWH, which has a role in the building's construction, to establish a system to conduct evaluation of the replacement cost of these buildings, but there is no organization that can currently handle this.

There are two ways to evaluate the replacement cost as follows:

(1) A method to calculate replacement cost through the application of adjustment factors, such as inflation on the basis of an acquisition cost;

(2) A method to estimate replacement cost based on the current construction cost of a similar building.

Because of the anticipated difficulties in obtaining the drawings and numerical tables used when the office buildings that account for the majority of government agency facilities were constructed or acquired, and the fact building structures are easily converted to standardized patterns, we believe it reasonable to apply valuation methodology (2). In valuation methodology (2), buildings are classed using patterns according to the structure, size, number of stories and underground floors, use, and location, and the replacement cost is assessed based on the unit construction cost for buildings of the same class type.

For schools or office buildings for which an average construction cost can be calculated easily, we propose having the DPWH or DepEd prepare standard average unit costs based on building type or application and converting this into a database (desk-top valuation database) in cooperation with GSIS, and determining insured values based on this.

[35] Based on an interview with DRRM section of DepEd, they recognize insurance to be necessary; nevertheless, they can neither conduct loss evaluation of many schools and buildings nor know those premium rates, asking the final report of this study to be shared with them. (February 17th, 2017)

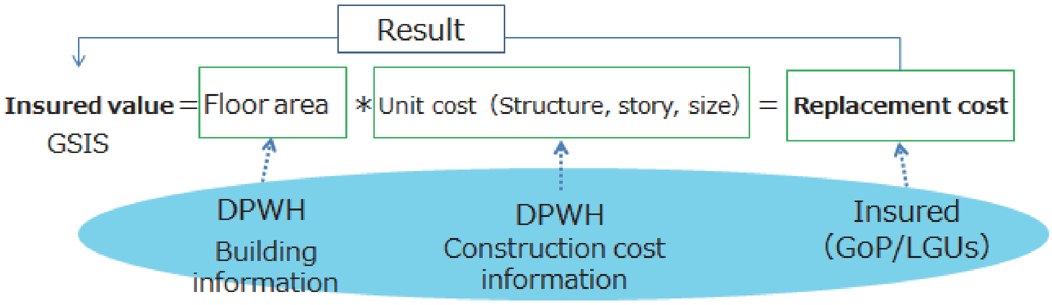


Figure 4-7 Creation of a replacement cost desk-top valuation system by related organizations

Table 4-27 Proposed measures and necessary actions that should be taken to resolve underinsurance, and Responsible institutions

Future measures that should be taken		Action required		Responsible agencies						
		GSIS	The insured	GSIS	DPWH	DepED	MRT	NAIA	IC	DBM
a	Embed incentives in an insurance policy to encourage elimination of underinsurance	Insurance to Value allowance, Premium discount	-	●					△	
b	Confirmation of the Replacement Cost by GSIS	Review of insurade value should be a part of underwrting process. Develop a database (DB) for replacement cost	-	●	○	○	○			
c	Replacement cost valuation by the insured (Large public infrastructure)	Changes in insurance policy (Responsibility of appraisal)	Outsource the replacement cost valuation Preare a budget	○			●	●	△	○
b	Replacement cost valuation by the insured (Public school)	Changes in insurance policy (Responsibility of appraisal)	Conduct a desktop valuation of the replacement cost	○		●			△	○
e	Replacement cost valuation by the insured (General office building owned by public institution)	Changes in insurance policy (Responsibility of appraisal), prepare a desk-top valuation DB	Prepare a desk-top valuation DB	○	●				△	○

●: Lead agency, ○: Cooridnation,

△: To be consultated with for amending the policy form.

4.6 Summary of Current Uninsured and Underinsured Situation, Issues, Causes, and Measures

The current situation of the uninsured and underinsured, issues causes and principal response measures (ongoing and proposed) are summarized in the

. It is necessary for GSIS to monitor improvements resulting from these initiatives in the future.

Table 4-28 Summary of present condition, issues, causes, and measures of uninsurance and underinsurance

	Uninsurance			Underinsurance		
current status		Rate of institutions subject to compulsory coverage without fire insurance at 25.8% (nationwide)			Public schools in Metro Manila on average at 40.1%	
		Rate of institutions including those not subject to compulsory coverage without fire insurance at 49.7% (nationwide)			Transportation infrastructure: MRT3 at 53.8%, NAIA T3 at 24.7%	
		Rate of uninsured public schools in Metro Manila at 47.7% (Fire), at 72.1% (Natural disaster)			-	
Issues		Cost for facility restoration in the event of disaster is not covered			Cost for facility restoration in the event of disaster is partly covered in proportion to underinsured level	
		Violation of laws stipulating compulsory coverage			Contrary to the insurance policy which indemnification base is replacement cost	
		Inhibit DRF strategy promoted by the Philippines government			Inhibit DRF strategy promoted by the Philippines government	
Causes		Inadequate compliance with laws and regulations, lack of mechanism to encourage corrective action	A		Insufficient recognition of insurance system (Reduction of payment of insurance claim in case of underinsurance)	E
		Small local governments (second class and lower) are not subject to compulsory coverage	B		Lack of mechanism to enhance appraisal of replacement cost	F
		Priority of payment of insurance premium is low	C		Lack of mechanism to grasp the status of being underinsured	G
		Insufficient awareness of natural disaster risks	D		No budget for assessing replacement costs	H
Measures	Ref. No.	Outline of uninsurance measures	respones to causes	Ref. No.	Outline of unidernsurance measures	respones to causes
	4.4.1 a.	DRR initiatives under the National Disaster Risk Reduction and Management Plan 2011-2028 (NDRRMP)	D	4.4.1 b.	Nationwide insurance promotion caravan by GSIS	E
	4.4.1 b.	Nationwide Insurance Promotion Caravan by GSIS	D	4.5.1	Periodic replacement cost valuation every three years in insurance renewal	F
	4.4.1 c.	DILG sent to responsible officials in municipal governments a memorandum circular with a list of municipal governments not covered by public property	A	4.5.1 a.	Embed incentives in an insurance policy to encourage elimination of underinsurance	F
	4.4.1 d.	Notification concerning strengthened confirmation for compliance with RA656 in the audit of COA (December 2016)	A	4.5.1 b.	Confirmation of the replacement cost by GSIS	G
	4.4.1 e.	Strengthen supervision of risk transfer mechanism and compulsory coverage by the deliberation of RA10121 amendment bill	B	4.5.2 c.	Replacement cost valuation by the insured (Large public infrastructure)	F
	4.4.1 f.	Strengthen compulsory coverage by deliberation of RA656 amendment bill	B	4.5.2 d.	Replacement cost valuation by the insured (Public school)	F/H
	4.4.1 g.	PHP 1 Billion approved as natural disaster insurance premium in the 2017 government budget	C	4.5.2 e.	Replacement cost valuation by the insured (General office building owned by public institution)	F/H
	4.4.2 a.	Provide information on natural disaster risk and loss evaluation to the insured with the risk-based premium calculation tool	D			
	4.4.2 b.	Consider revision of deductible provision concerning natural disasters	C			
	4.4.2 c.	Compulsory Coverage for natural disaster risk to be specified in the IRR, Implementing Rules and Regulations, of revised RA 656	D			
	4.4.2 d.	Monitoring of the coverage rate of natural disaster insurance by GSIS	A			

Current measures and initiatives

Future measures considered to be implemented

4.6.1 Other Issues and Measures Associated with Correcting Underinsurance

a. Impact on the Premium by Correcting Underinsurance

a.1 Issue

The premium may increase significantly when underinsurance is corrected. This is to correct the premium to a proper amount, but the insured may see this as a rise in the premium, which may prevent the increase of insurance subscription rate.

a.2 Measure

It will be necessary to provide an adequate explanation to the insured by GSIS for the insured's budget compilation for 2018. It will be necessary to consider making the entire public property insurance program appropriate and attractive, such as underwriting insurance at a risk-based premium rate, introduction of a maximum liability limit, a system of deductible from penalty for underinsurance (reduce the insurance payout) by conducting an evaluation and change in the method of setting the deductible in the case of a natural disaster.

b. Accumulation risk management of GSIS for Catastrophe loss

b.1 Issue

In a region struck by natural disasters as variously as the Philippines, accumulating management of underwriting risk is critical for an insurance program. GSIS is addressing risk management by measures such as transferring underwriting risk above a certain amount to the reinsurance market by purchasing reinsurance. On the other hand, GSIS does not perform quantitative accumulation management of risk in house using a loss model such as one developed by this study. Substantial risk related to earthquake peril is aggregated in Metro Manila, where numerous government assets are concentrated. Because of the government’s efforts, the enrollment rate in public infrastructure insurance is expected to increase in the future. This means risk pooling management will become more important.

b.2 Measure

Accumulation management of underwriting risk can be implemented by using the risk-based premium rate calculation tool developed by this study. For an example, in Metro Manila, where many government assets are concentrated and the earthquake peril from the West Valley Fault is high, it is possible to verify whether sufficient payment funding resources can be ensured using the current premium rates. Because the natural disaster accumulation loss reinsurance program applies to underwriting risk for the Philippines as a whole and not just Metro Manila, however, extension of the tool to accumulation risk assessment is required. Implementation by an outside organization is feasible.

5 Development of Risk-Based Premium Rate Calculation Tool

By incorporating facilities' resilience against natural disasters into the premium rate calculation scheme, the study team considered it will provide a relevant incentive to facilitate prior investment in DRR for strengthening them. To that end the study team developed a premium rate calculation tool to present natural disaster risk in a quantitative manner.

In a property insurance sector, a premium rate for property such as buildings and their contents is normally calculated according to the strength of the location or building. As a premium rate calculation method, tools provided by Risk Management Solutions (RMS) or AIR WORLDWIDE (AIR) are widely used to assess natural disaster risk. However, their license fees are expensive, and the tools are not so effective as to analyze premium based on the minute differences in strength. Thus, the study team developed a new tool, limiting to the Metro Manila, which can reflect the strengthening measures in the premium rate so that GSIS may continuously use the tool without charge.

5.1 Overview of Risk-Based Premium Rate Calculation Tool

5.1.1 View of Premium and Scope of the Operation

Normally, property insurance premium is comprised of (1) pure premium and (2) loading charge. Each premium implies as follows:

① Pure premium: Annual average paid premium. In the case of a long-term insurance policy, yearly premium is different from year to year; the pure premium is an average of the total. In other words, an insurance firm goes into the red in a long run, unless it sets an amount higher than the pure premium.

② Loading charge: Since pure premium does not include office cost and other expenses, an insurance firm cannot be sustained by pure premium alone. So, a firm adds a loading charge, which is composed of the administrative fee needed for business operations (corporate expenses), commission fees for insurance agents (agency fee), and profit.

Pure premium has a breakdown that depends on insurance coverage. In GSIS' insurance for schools, for example, it covers fire, earthquake, typhoon, flood, etc., and the breakdown is itemized as pure premium against fire, pure premium against earthquake and so on.

Among those pure premiums, the study covers earthquake (tremor), strong winds and flooding from typhoon, tsunami, and typhoon-induced storm surge. In typical overseas natural disaster risk transactions, the risks of an earthquake (tremor) and typhoon are quantified in a model, but most of the other disasters are not. For flooding caused by a long spell of monsoonal precipitation and rainfall-induced landslides, and liquefaction, which are out of the Study's scope, the study team sorted them out as a future subject, since the study team has insufficient information as to how to conduct a quantitative assessment.

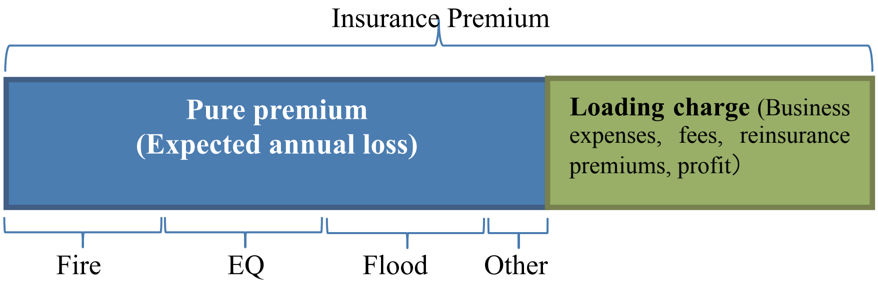


Figure 5-1 Component of Insurance Premium

5.1.2 Structure of Tool

The Risk-based Premium Rate Calculation Tool is roughly made up of a Hazard Module for analyzing the strength of a natural disaster (seismic intensity, wind velocity, etc.), a Vulnerability Module for defining the correlation between the strength of a natural disaster and the level of property damage, and a Financial Module for applying the insurance deductible, payment limit and underwriting rate.

By inputting exposure data, or insurance policy data, into the respective modules[36], the tool can analyze an insurance loss based on pure premium or annual exceedance probability.

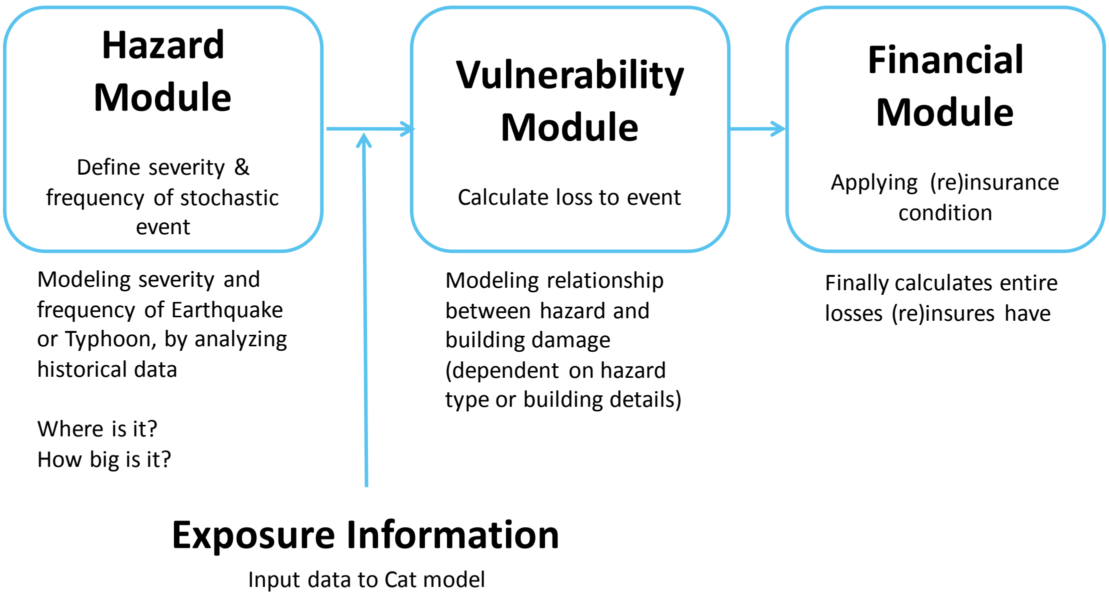


Figure 5-2 Concept of a Risk Based Premium Rate Calculation Tool

The following figure shows the specific images of Hazard Module and Vulnerability Module in a model of typhoon-induced strong winds. In this model, the tool virtually generates thousands to ten thousand typhoon events based on the database regarding the birthplace and pathway of typhoons that developed over the Pacific Ocean. Each typhoon event is allotted with an annual probability of occurrence. Then the tool analyzes wind speed when a typhoon event occurs. The

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[36] Here we refer to the risk assessment system for calculating risk-based premium rates as a "model", and we refer to the parts that make up the model as "modules".

second chart below shows the analysis result of wind speed distribution generated by a typhoon event that hit Japan. For each generated typhoon event, the tool analyzes wind speed distribution at each site and stores the result in the model. At this point, the above-mentioned insurance policy data (exposure data) is input into the model to extract wind speed at each insured facility. The Vulnerability Module which has an input of the relationship between the hazard of a natural disaster and property loss can predict the damage rate of each facility. As exposure data contains the replacement cost of property, the tool can calculate the loss amount by multiplying replacement cost by damage rate.

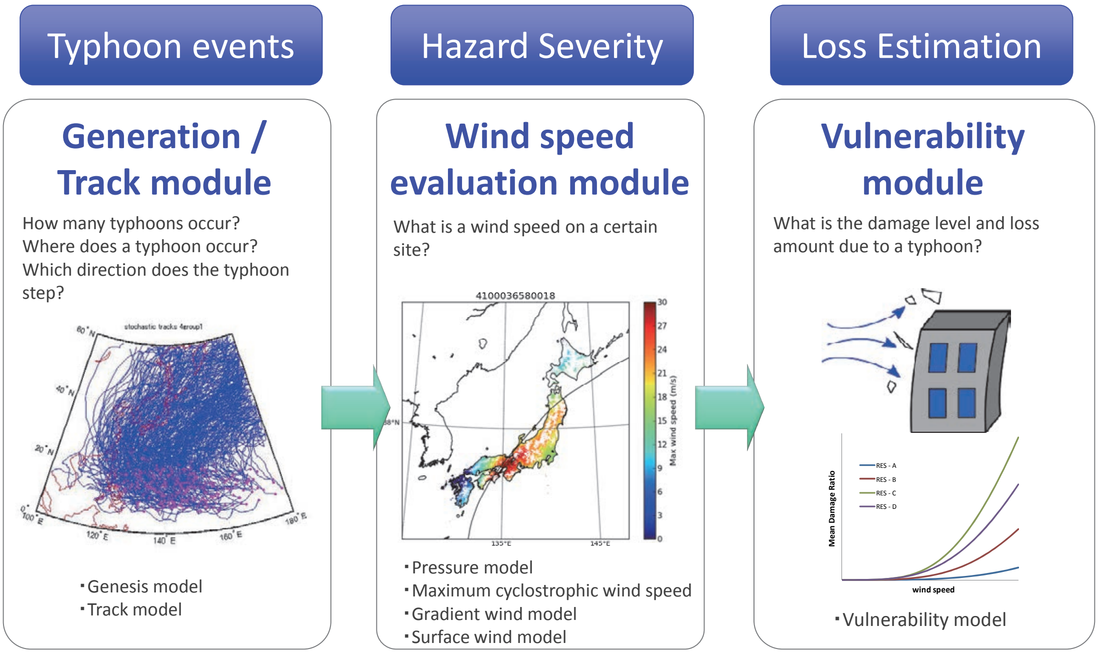


Figure 5-3 Concept of a Risk Based Premium Rate Calculation Tool

Procedure for calculating premium rates for insured facilities (in the case of one facility)

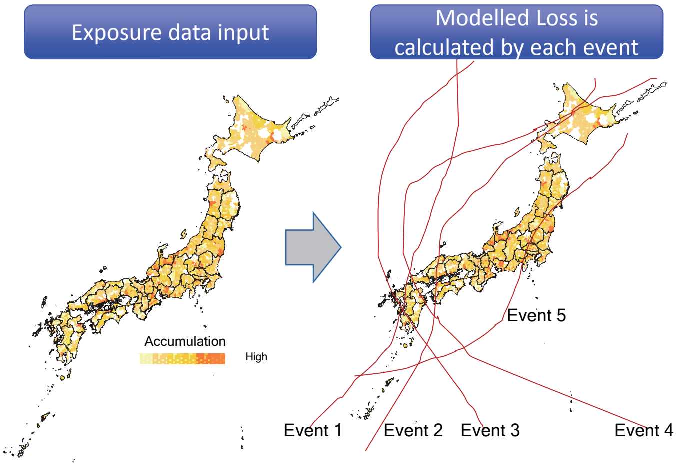
(1) Input the location of the insured facility, and use the Hazard Evaluation module to obtain external phenomena (events), such as typhoons, occurring at the location and the frequency;

(2) Use the Vulnerability module to obtain the damage rate to the insured facilities for each event;

(3) Calculate the damage rate for each annual excess probability by collating the occurrence frequencies for each event in order of the largest damage rate. The damage rate is converted into an expected damage value using the input replacement value;

(4) Calculate the net premium rate by totaling the damages, as calculated by multiplying the occurrence probability and expected damage amount for each event.

The total loss amount at each typhoon event can be compiled in a list by calculating the loss amount of the entire portfolio for each event. This list is called an event loss table. In the event loss table, the probability of typhoon occurrence and expected loss (mean loss) are provided for each virtual typhoon event. The aforementioned pure premium can be calculated by summing up all the loss amounts derived by multiplying the probability of typhoon occurrence by expected loss for each event.



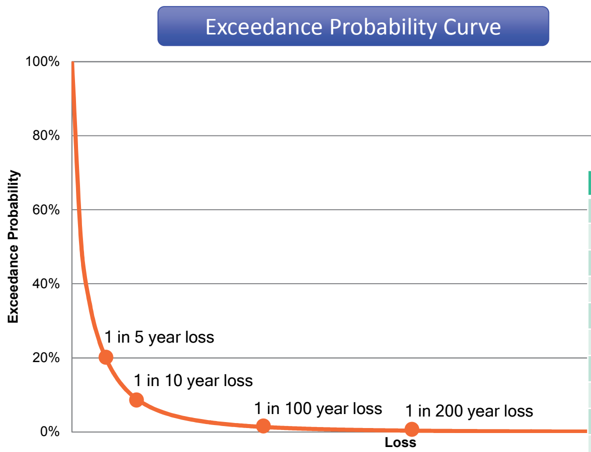
Event Loss Table (ELT)

Event ID	Freq.	Mean Loss	Standard Deviation
1	0.00050	1,000,000	1,005,000
2	0.00250	500,000	170,000
3	0.00020	2,000,000	1,365,000
4	0.00015	3,000,000	1,875,000
5	0.00010	5,000,000	2,085,000
6	...	...	...
7	...	...	...

Figure 5-4 Development of an Event Loss Table

Moreover, the annual exceedance probability for each loss amount can be also provided by sorting out the event loss tables in descending order and summing up the occurrence of typhoon events in descending order. The exceedance probability curve and list are shown below. Based on the analysis of relationship with insurance loss (Value at Risk: VaR) for each clarified pure premium and exceedance probability, an insurance firm arranges a premium and reinsurance.

Exceedance Probability curve (EP curve) can be generated by arranging Event Loss Table in descending order.



Value at Risk Table

Return Period(Year)	VaR(PHP)
10000	500,000,000
5000	450,000,000
1000	300,000,000
500	250,000,000
250	190,000,000
200	160,000,000
100	120,000,000
50	95,000,000
20	55,000,000
10	35,000,000
Typhoon pure premium	**14,000,000**
Standard Deviation	**30,000,000**

(**)**Value at Risk** is defined as the threshold value such that the probability that the loss over the given time horizon exceeds this value.

(*) Return period: 1/exceedance probability

Figure 5-5 Exceedance Probability Curves and Value at Risk Table

5.2 Technical Data Collection for Risk-Based Premium Calculation

The study team has collected data necessary to develop a risk-based premium rate calculation tool such as list of public schools, topography data, hazard data, and land cover data, which have been owned by relevant organizations. The table below shows a list of the data collected. In addition, the natural hazard curve, showing the relationship between the severity of natural disaster (such as seismic intensity / acceleration in terms of earthquake, and wind velocity as for strong winds) and annual exceedance probability, was purchased from AIR worldwide as mentioned above.

Table 5-1 List of the Collected Data and sources for Risk-based Premium Rate Calculation Tool

No	Type of Data	Organization	Data Format
1	List of insured public schools	GSIS	Excel
2	List of public schools	DepEd	Excel
3	Seismic Hazard Map	PHIVOLCS	Image and GIS Data
4	Fault Rupture Hazard Map		
5	Tsunami Hazard Map		
6	Landslide Hazard Map		
7	Liquefaction Hazard Map		
8	Digital Elevation Data	NAMRIA	Image Data
9	Surface Data		
10	Orth photo Imagery Data		
11	Land Cover Data	PAGASA	Image Data

5.2.1 Hazard Data

a. Data Collection

a.1 Data Obtained from the Philippine Government

The PHIVOLCS provided the hazard map of earthquake, Tsunami, Landslide, and Liquefaction which had been developed under the Enhancing Greater Metro Manila's Institutional Capacities for Effective Disaster/Climate Risk Management towards Sustainable Development Project (GMMA READY Project). The study team has sorted them out as GIS data in order to visually confirm them with the risk-based premium rate calculation tool.

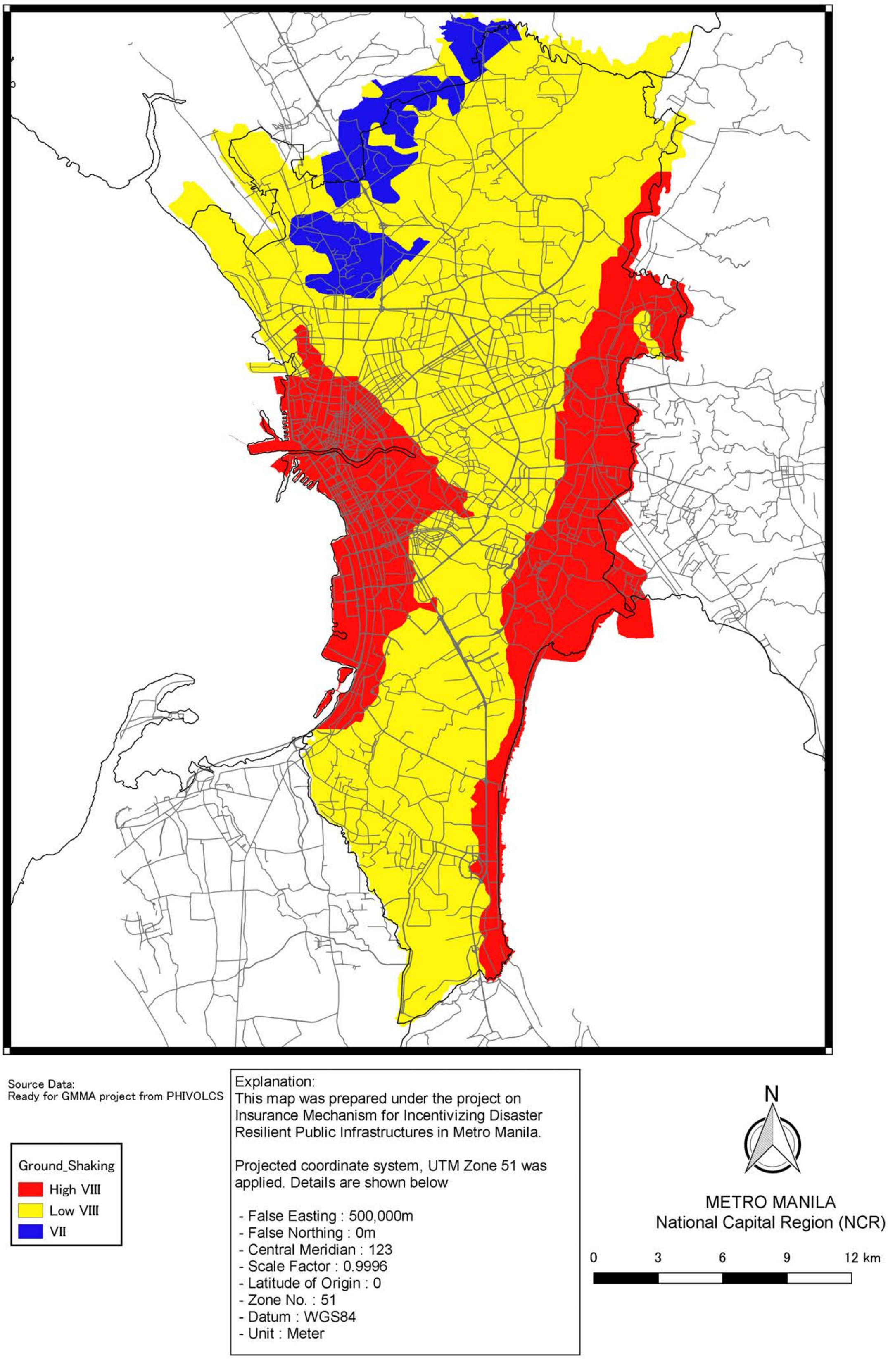


Figure 5-6 Earthquake hazard map（2014）

Source： GMMA READY, PHIVOLCS

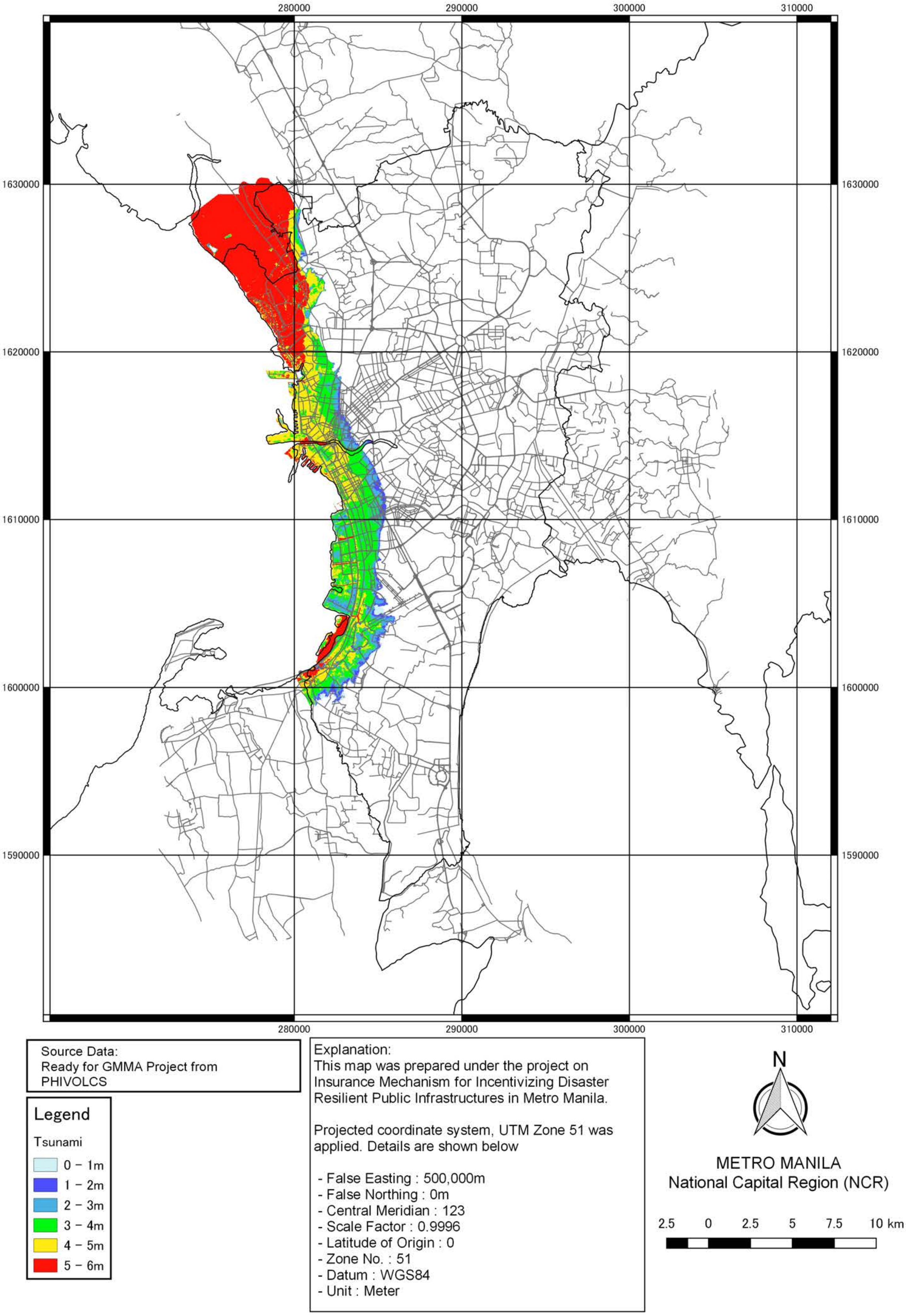


Figure 5-7 Tsunami hazard map（2014）

Source： GMMA READY, PHIVOLCS

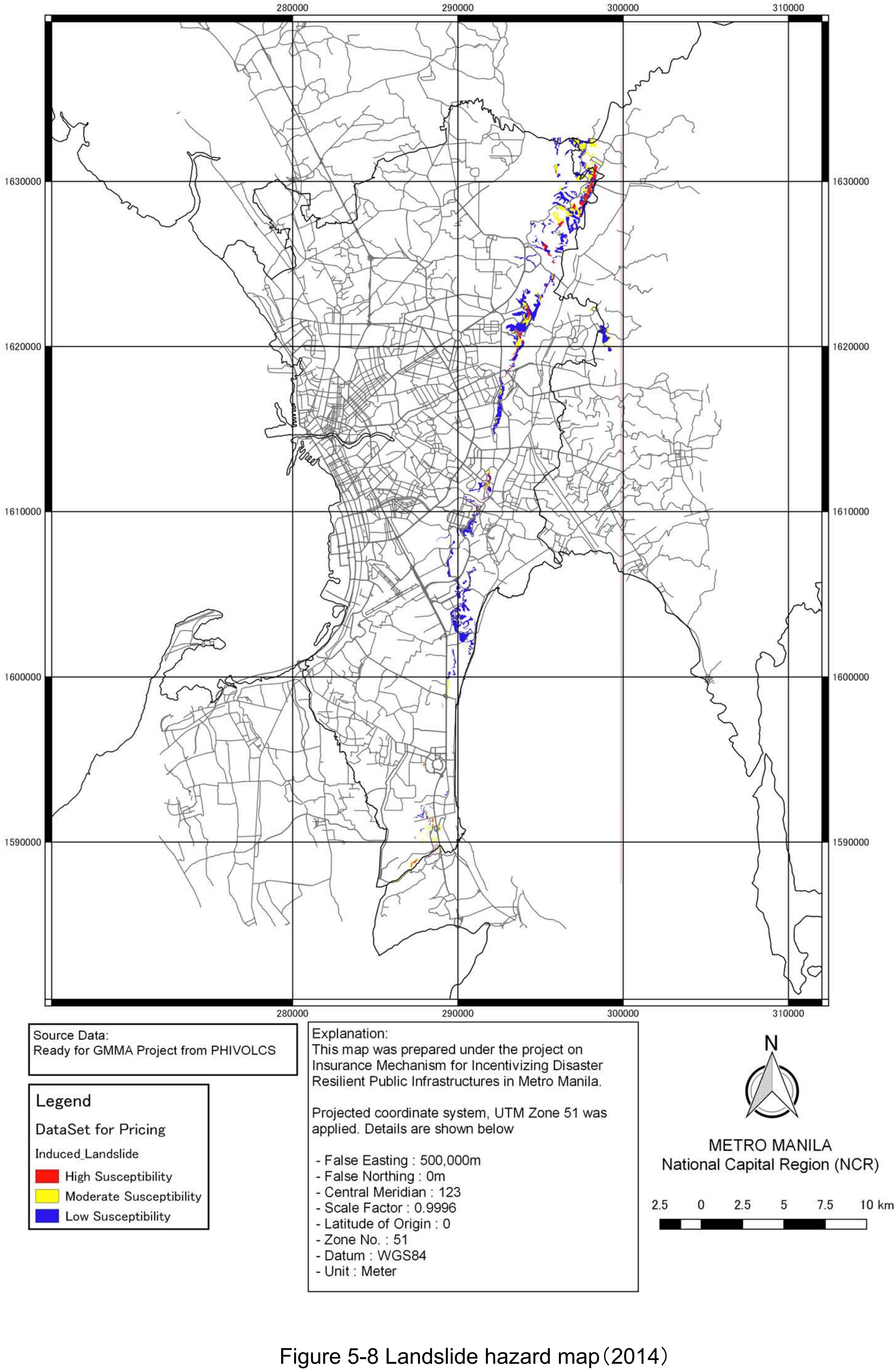


Figure 5-8 Landslide hazard map（2014）

Source： GMMA READY, PHIVOLCS

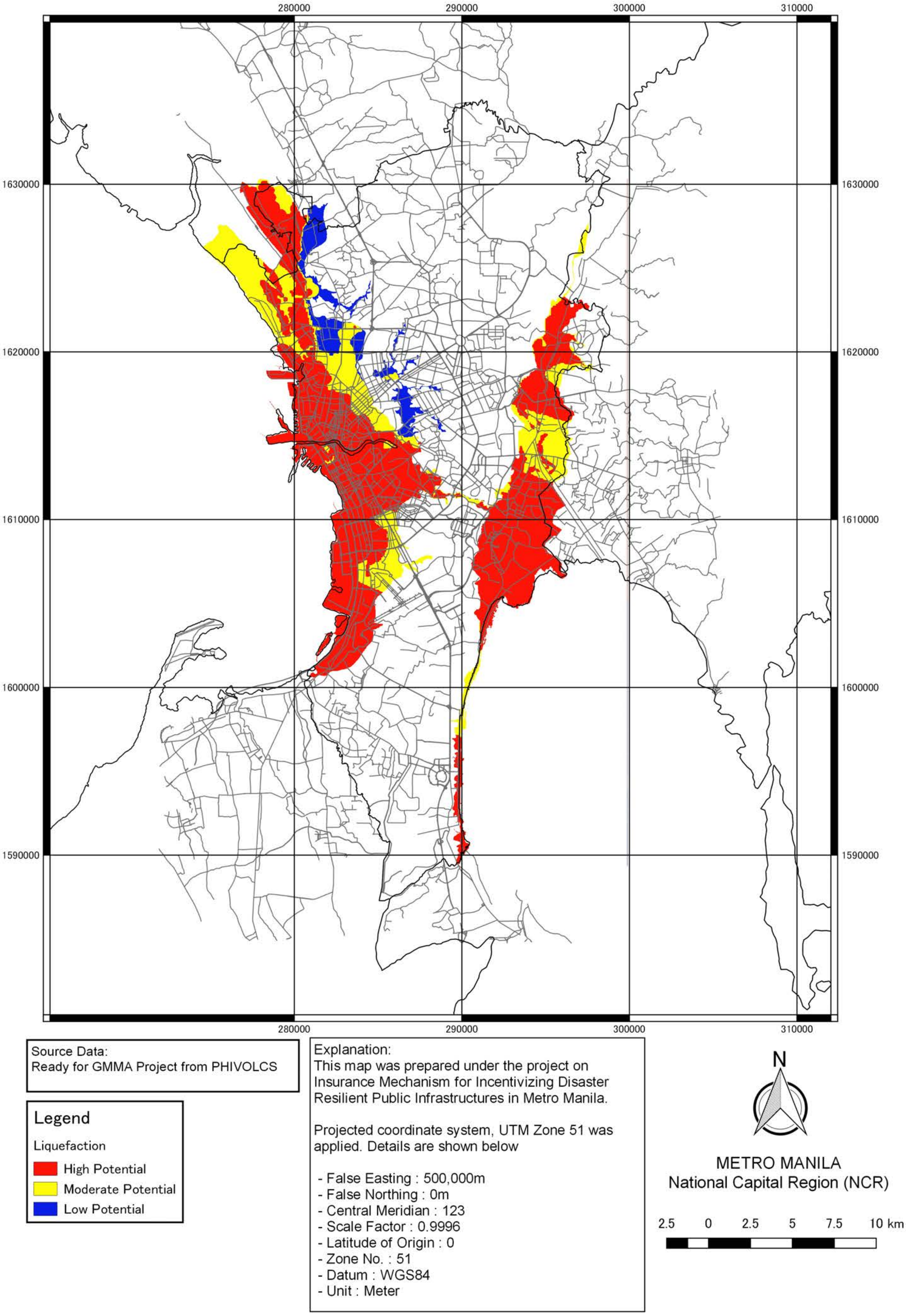


Figure 5-9 Liquefaction hazard map（2014）

Source： GMMA READY, PHIVOLCS

a.2 Data Acquired from AIR WORLDWIDE

To comprehend natural disaster hazards in MM, the study team obtained the hazard information below from AIR. Because the hazard information available from local agencies was not exhaustive one with various hazard patterns necessary to calculate a premium.

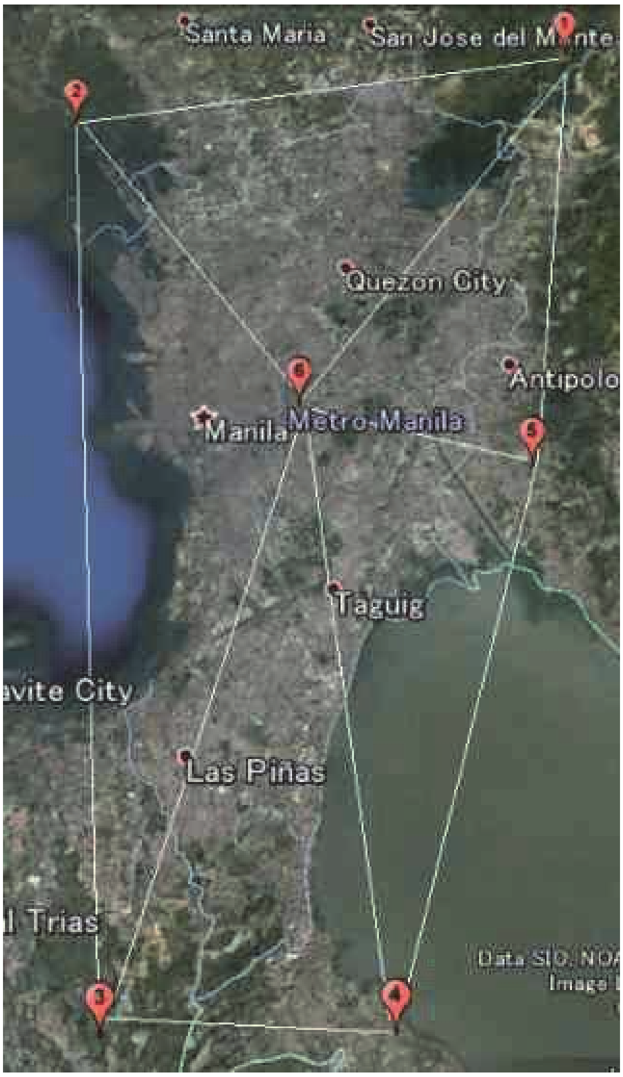
Table 5-2 List of Hazard Information Purchased from AIR

Item	Description
Seismic hazard	Seismic peak ground acceleration or spectral acceleration (at base rock level) for six points in Manila area
Typhoon / Wind storm	Typhoon maximum wind speeds for six points in Manila
Tsunami Hazard	Tsunami ocean surge height for four points on Manila's coast line
Typhoon / Storm surge Hazard	Typhoon storm surge height for four points on Manila's coast line

During the first field survey, the study team visited UP, PAGASA and PHIVOLCS to investigate how far they have reviewed hazards, and found they have some hazard maps regarding earthquake and flooding. For example, PAGASA's windstorm hazard map has information about wind speed observed every 20, 50, 100 and 500 years. It may be developed for use in assuming damage, developing countermeasures, designing structure, etc. Be that as it may, to calculate a premium, the study team must take into consideration even smaller windstorms that occur every two years as well as a large-scale disaster that may occur only once in 1,000 years. In short, the study team confirmed that the existing hazard maps do not provide sufficient information to develop a prototype risk-based premium rate calculation tool.

AIR has already developed a premium calculation tool and a loss evaluation tool, and shares hazard information necessary for premium calculation. Moreover, AIR's model has been widely used in Asian insurance markets, and thus AIR has accumulated information that meets the objective of the Study to calculate a premium. The study team is able to carry out a hazard assessment in a technical sense; however, considering the time and cost as planned, the study team decided to buy the aforementioned hazard data from AIR, which enabled the Study to develop a better premium calculation tool in a more efficient manner.

The following graph shows the annual exceedance probability curve based on the purchased hazard data.



Source : The study team (Back ground map: Google Map)

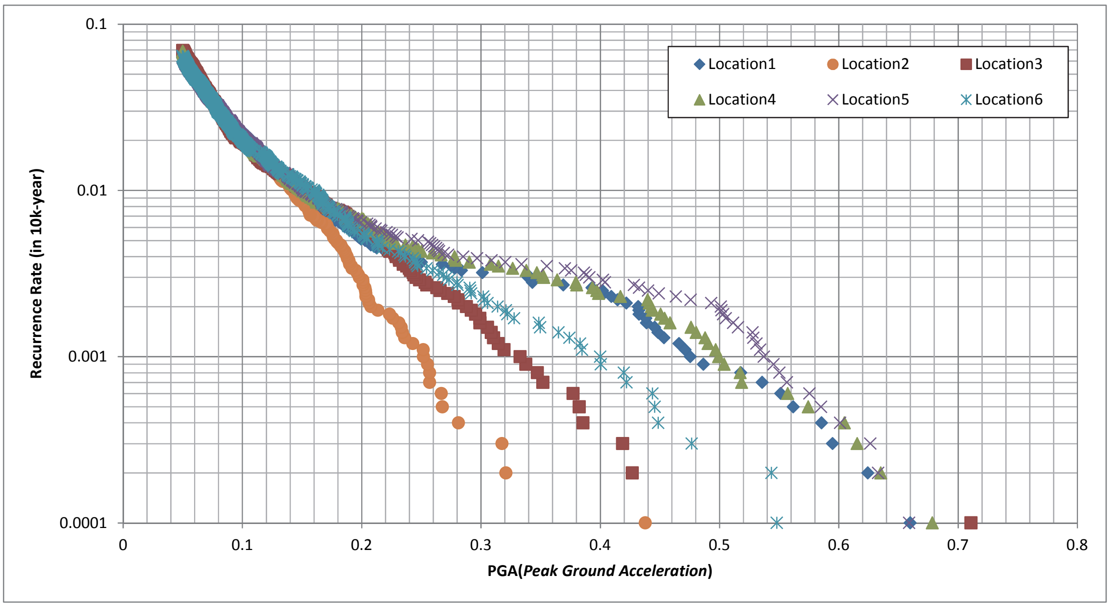


Figure 5-10 Annual Exceedance Probability Curves for EQ hazard based on PGA (g) at Ground Level

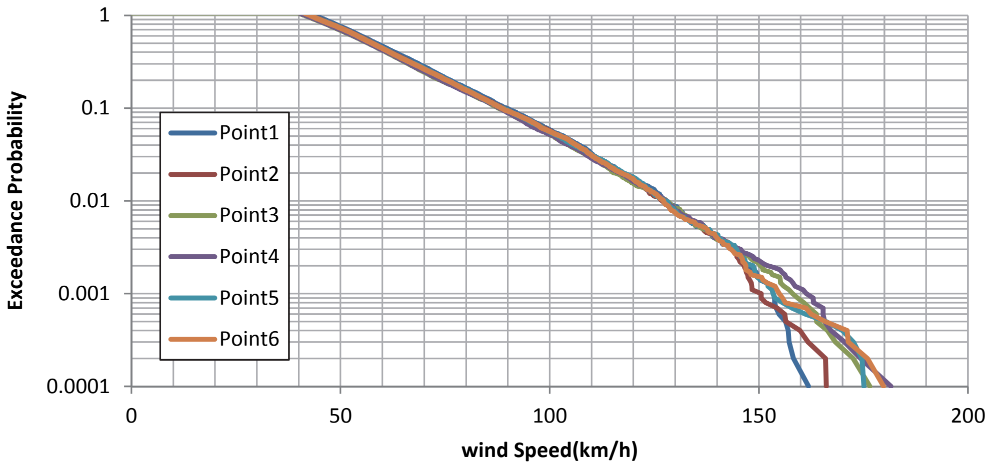
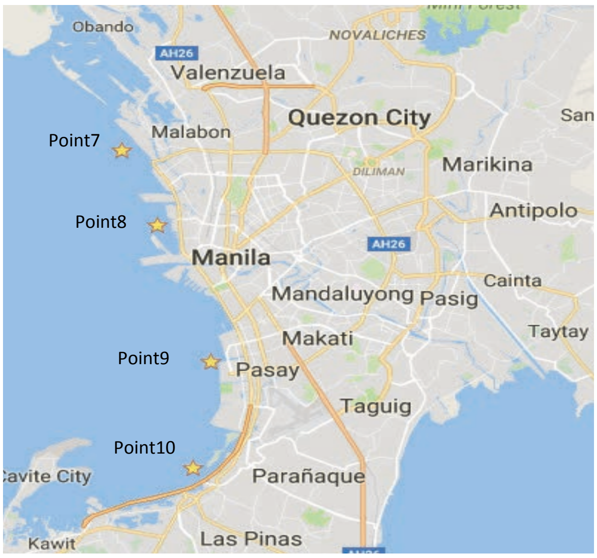


Figure 5-11 Annual Exceedance Probability Curves for Typhoon hazard. (Wind Velocity at the elevation of 10 m, unit: km/hour, roughness length: 20 mm)



Source : The study team (Back ground map: Google Map)

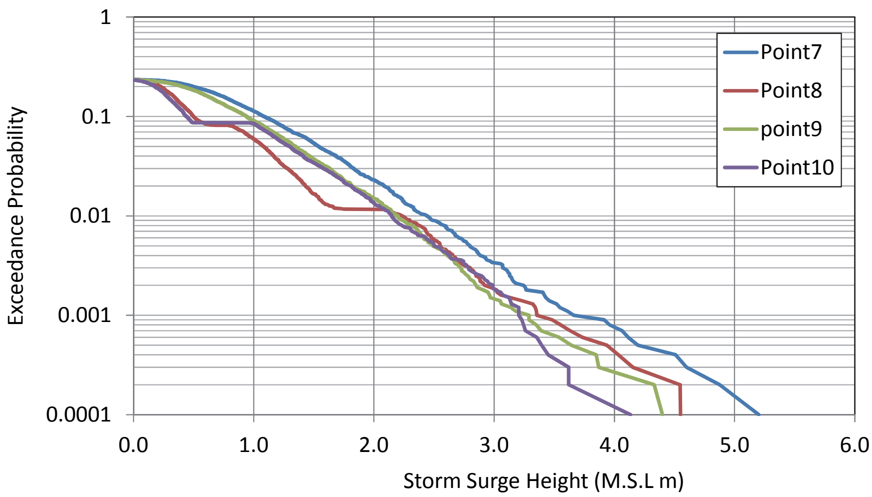


Figure 5-12 Annual Exceedance Probability Curves for Storm Surge at Mean Sea Level at Manila Gulf, Surge height (Unit: m)

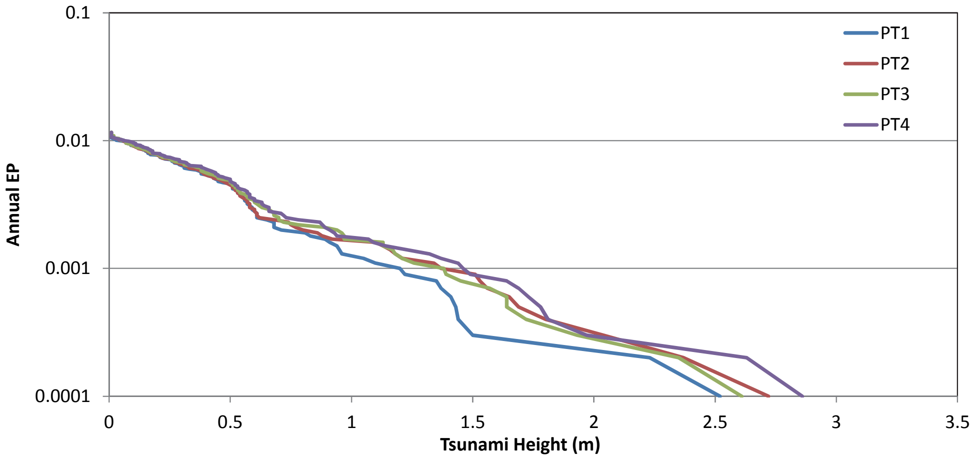


Figure 5-13 Annual Exceedance Probability Curves for Tsunami at Mean Sea Level at Manila Gulf (Unit: m)

a.3 Data Acquired from UP (Flood Hazard)

During the first field survey, the study team confirmed that UP has worked on the development of a flood model to assess flood risk. The study team also confirmed that a flood hazard map for each return period can be created by providing UP with our input data (e.g., river data) and precipitation data for each return period, prepared through the Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area (GMMA RAP) project in 2014. The return period in the hazard map created through GMMA RAP was limited and insufficient for premium calculation. Therefore, the study team outsourced to UP the task of enhancing the return period in the hazard map so that it may become suitable for premium calculation.

The study team entrusted UP with aerial survey data of GMMA RAP (LiDAR data with a lateral resolution of 1 m) to create a flood hazard map using detailed topography data. However, the lateral resolution for simulation shall be 10 m, for it costs much to perform a detailed flood analysis simulation. The analysis can be said to be highly accurate compared with a resolution of 50 m used in ordinary hazard maps published by Japanese local governments.

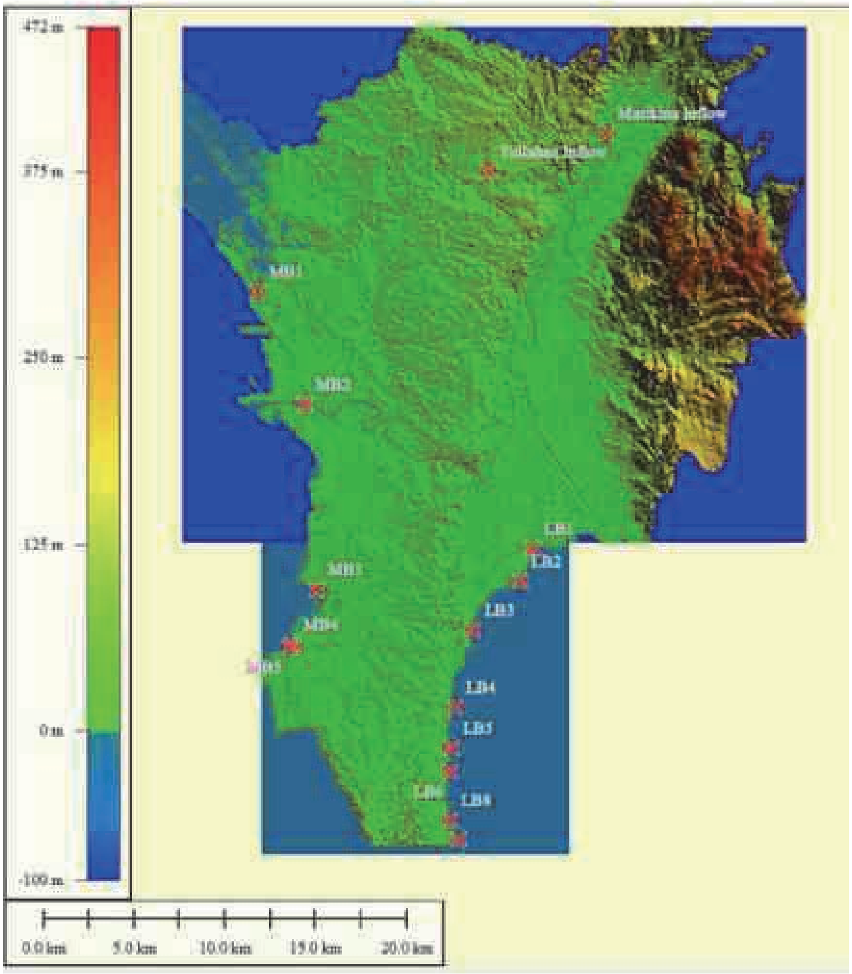


Figure 5-14 Topography Map per the Aerial Survey

Source : GMMA RAP LiDAR, Original: NAMRIA

The study team verified the relevance of UP's model by reproducing the Typhoon Ondoy-fed flood in 2009. Figure below shows a flood inundation map generated by numerical simulation.

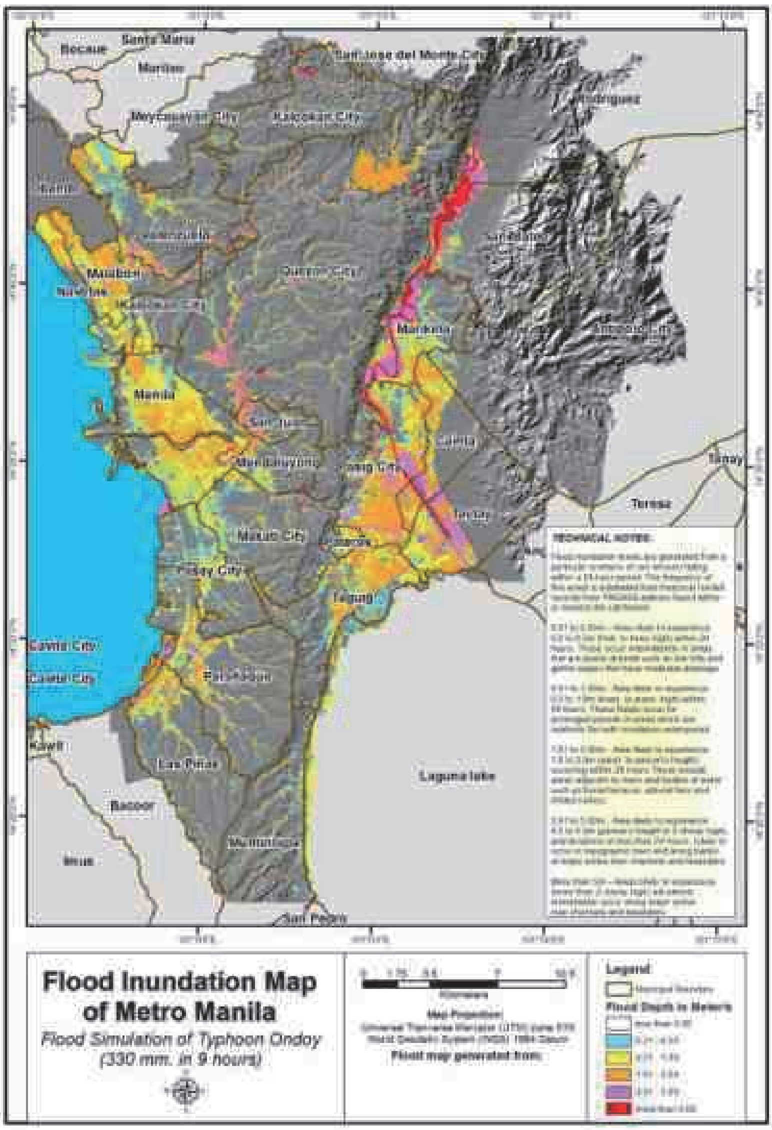


Figure 5-15 Flood Simulation of Typhoon Ondoy – Flood Area and Simulated Flood Depth

Figure below is designed so that the circle symbols get together along the 45-degree angle line when measurement values and simulation inundation depth are similar, and get larger when there are many inundations of similar depth. Larger circle symbols get together along that line, which proves that the simulation successfully reproduced an equivalent depth of inundation to the actual measurement. Using the simulation model verified in this way, the study team generated hazard maps for each return period.

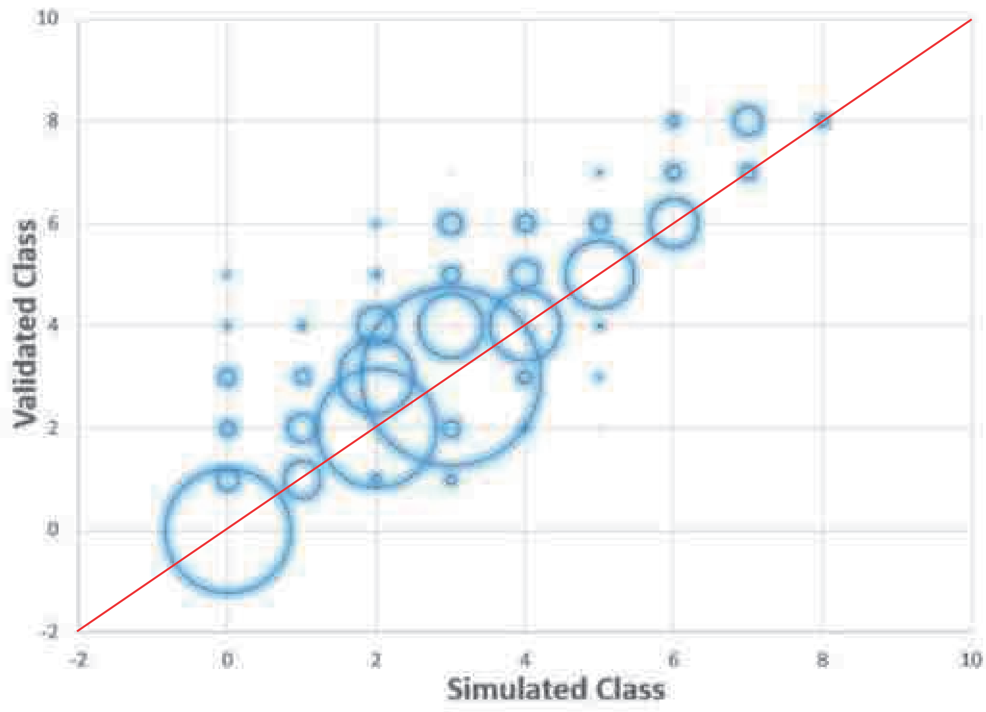


Figure 5-16 Difference between Simulation Result and Actual Flood Depth Observed in Past (Unit: m)

Table below provides return periods for which hazard maps were created, total precipitation, peak rainfall, and peak discharge from the Marikina River during each period. In addition to the Marikina River, this model took into account the flooding of the Tarahan River. Moreover, not only external water flooding from rivers, but also inland flooding caused by severe rainstorms in urban areas was also considered. For the simulation, external forces were set for each return period based on data obtained from rain gauges located in BosoBoso and PAGASA Science Garden. Rainfall data includes precipitation due to typhoons and monsoons. For details of loss modeling, see the University of the Philippines report in the Annex P.

Table 5-3 Rainfall and Peak Discharge at Marikina River per Recurrent Return Period applied in Hazard Map

RRP	Total Precipitation (mm)	Peak rainfall (mm/10min)	Peak discharge (m3/s)
1.11	99.56	18.96	733.5
1.25	123.08	23.45	1027.6
1.33	132.43	25.24	1146.1
2	177.82	33.90	1744.9
3	212.66	40.55	2209.3
4	234.95	44.81	2510.7
5	251.46	47.96	2734.4
10	300.22	57.27	3390
20	346.99	66.20	4018.8
25	361.82	69.03	4220.9
50	407.53	77.76	4838
75	434.09	82.83	5195.4
100	452.89	86.42	5449.2
150	479.34	91.47	5803.9
200	498.09	95.05	6054.6
250	512.62	97.83	6246.9
475	554.39	105.80	6805.3
500	557.72	106.44	6851.6
1000	602.79	115.04	7448.7

RRP: Rain Return Period

The figure shown below provides a flood inundation map for each return period. All the hazard maps created were compiled in the tool.

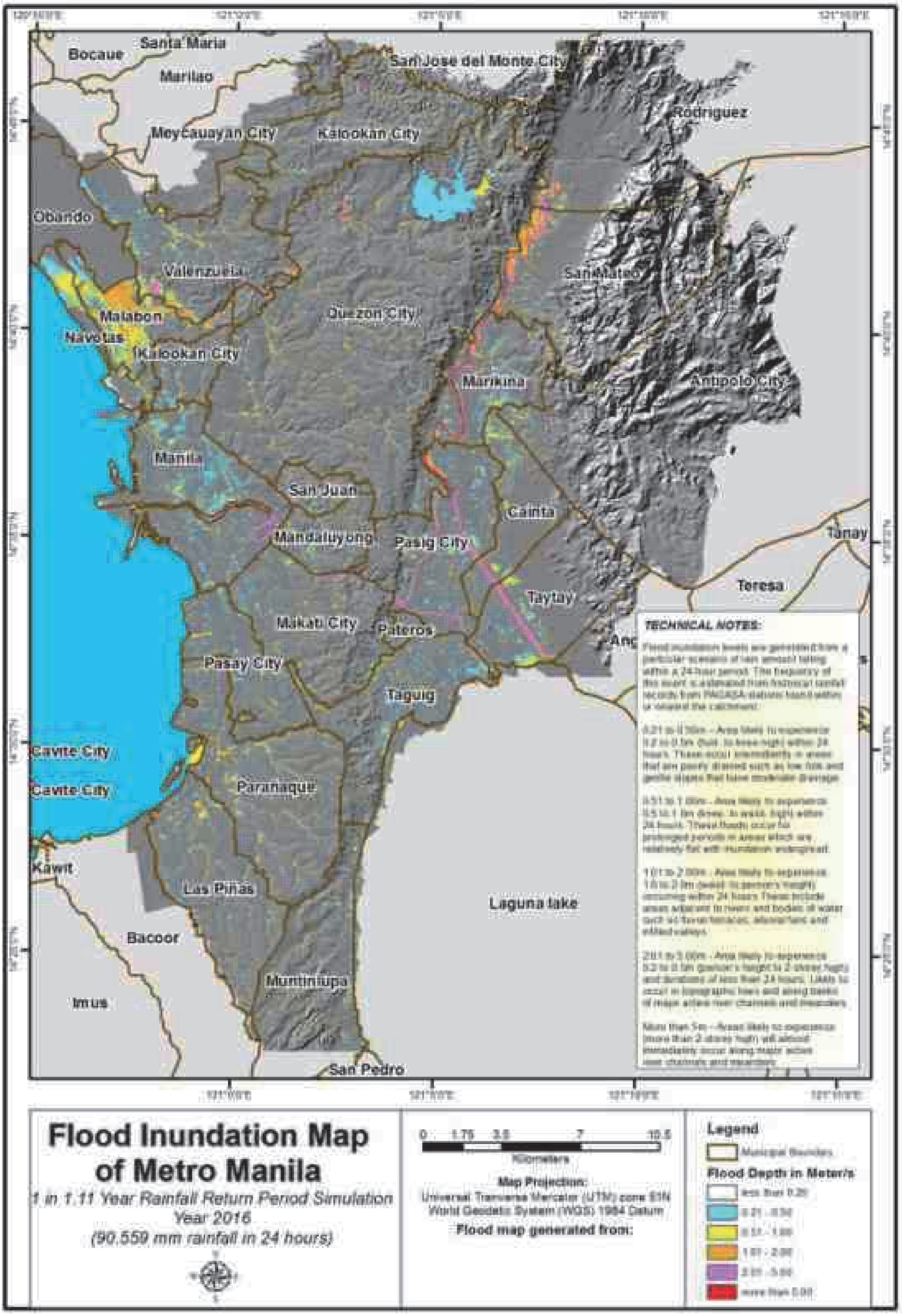


Figure 5-17 Flood Inundation Map of Metro Manila (1 in 1.1 year rainfall return period simulation)

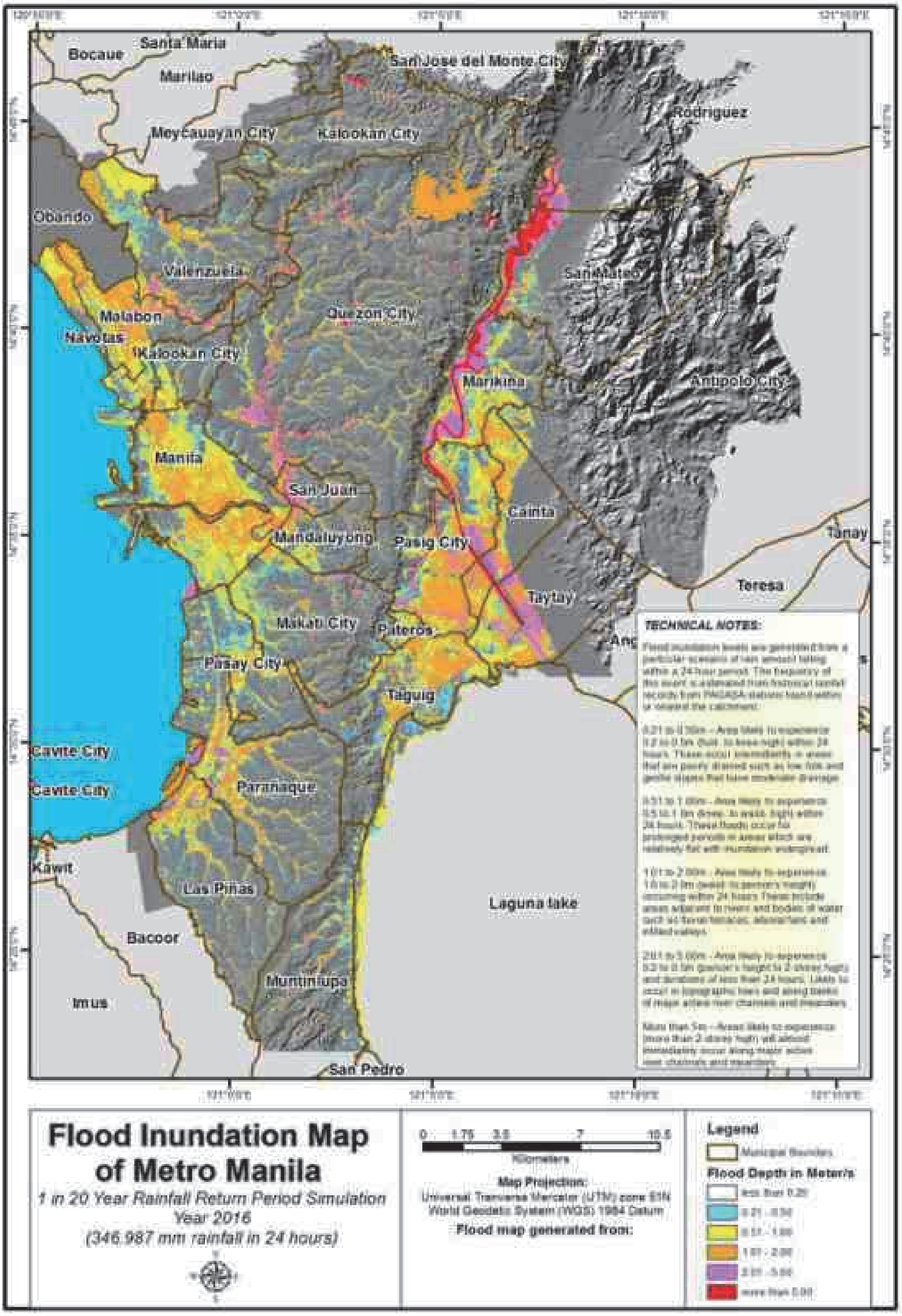


Figure 5-18 Flood Inundation Map of Metro Manila (1 in 20 year rainfall return period simulation)

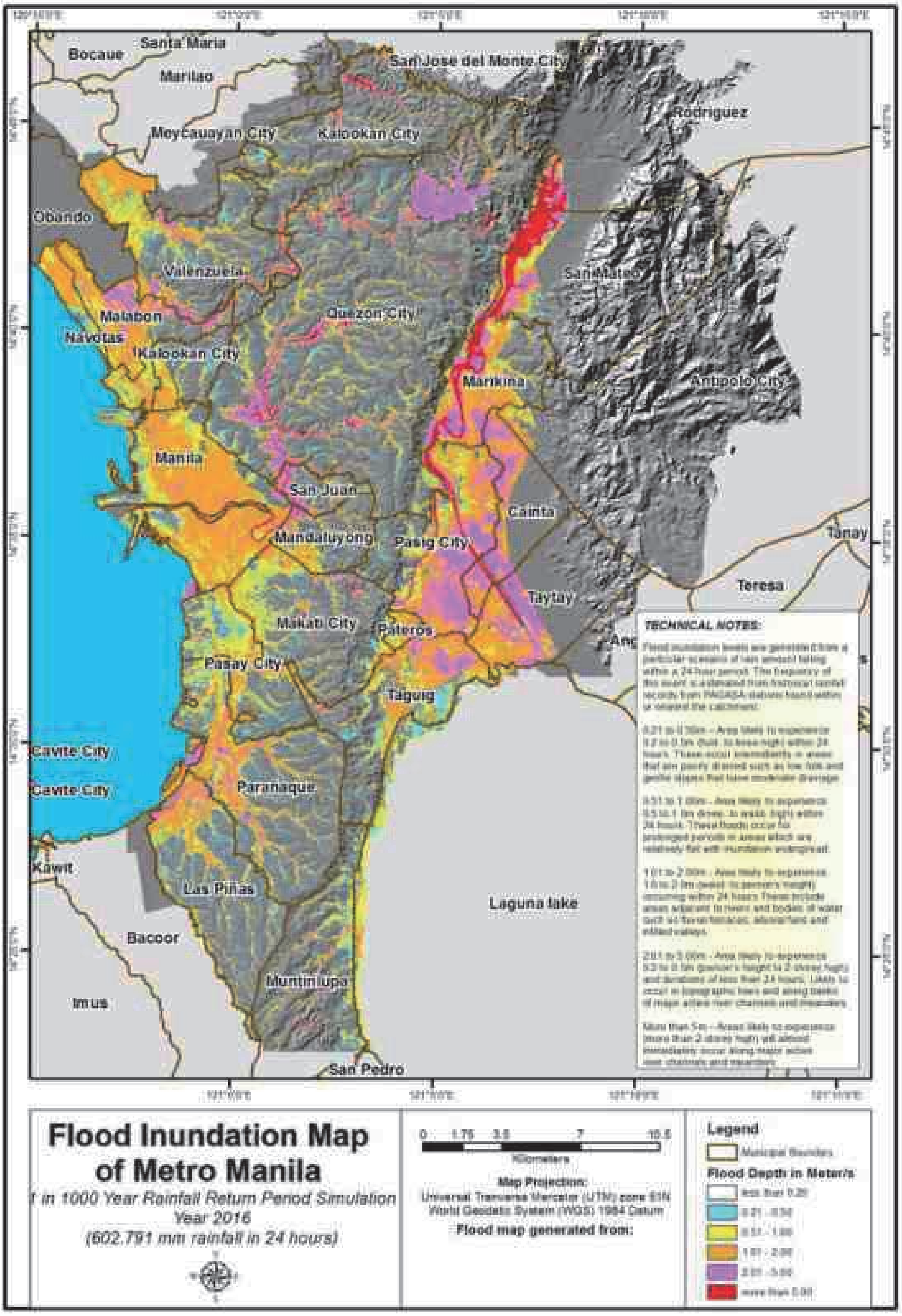


Figure 5-19 Flood Inundation Map of Metro Manila (1 in 1000 year rainfall return period simulation)

b. Zoning in Metro Manila

The study team used the collected data to create zoning in Metro Manila (MM) corresponding to the degree of natural disaster risk.

b.1 Earthquake

One confirmed active fault on the outskirts of Metro Manila is the Malikina fault, and there are other earthquakes having hypocenters in the Manila Trench off Manila Bay. A JICA study conducted in 2004 found that although earthquakes causing damage occur approximately once a decade, such damage has been caused not by the Malikina fault but by earthquakes with previously unidentified hypocenters. It was therefore decided to conduct a seismic hazard zoning study focusing on ground properties.

When the study team confirmed the VS30[37] subsurface layer that will determine the earthquake amplification characteristics from the bedrock level to the surface level, the area in a north-south direction at the center of MM where the VS30 value is large expands in a broad band. The VS30 value becomes larger because this area lies at a high altitude and there has been little weak strata sedimentation caused by rivers and ocean transgression and regression. Because seismic ground motion is typically amplified in weak ground, amplification of an earthquake from the subsurface layer is thought to be comparatively small in an area such as this, where the VS30 is large.

On the other hand, the weak ground in the low-lying areas around Manila Bay and the northern areas of Laguna de Bay are deposited thickly with sediment, and the VS30 value is small. In ground such as this, where the VS30 is small, seismic ground motion will be amplified in the subsurface strata, and there is a high probability of damage as the result of seismic motion.

Ground liquefaction is a phenomenon likely to occur in loose, sandy ground. Given the high probability of loose, sandy ground being distributed in low-lying areas where rivers can easily flood, low-lying areas are thought to be areas where the liquefaction danger is significant. Moreover, because artificially reclaimed land is frequently created with landfill materials where liquefaction can occur, zones such as reclaimed land in seaside areas are also considered to be areas where the danger of liquefaction is high. In the hazard maps collected from PHIVOLCS as well, the study team could confirm that low-lying areas with a low VS30 and reclaimed land are regions with a high liquefaction risk.

Landslide danger zones are scattered in a north-south direction along the western side of the Marikina Valley Fault System.

[37] Vs30 is the average shear-wave velocity between 0 and 30-meters depth of sub-soil. The softer the ground soil is, the smaller the value gets.

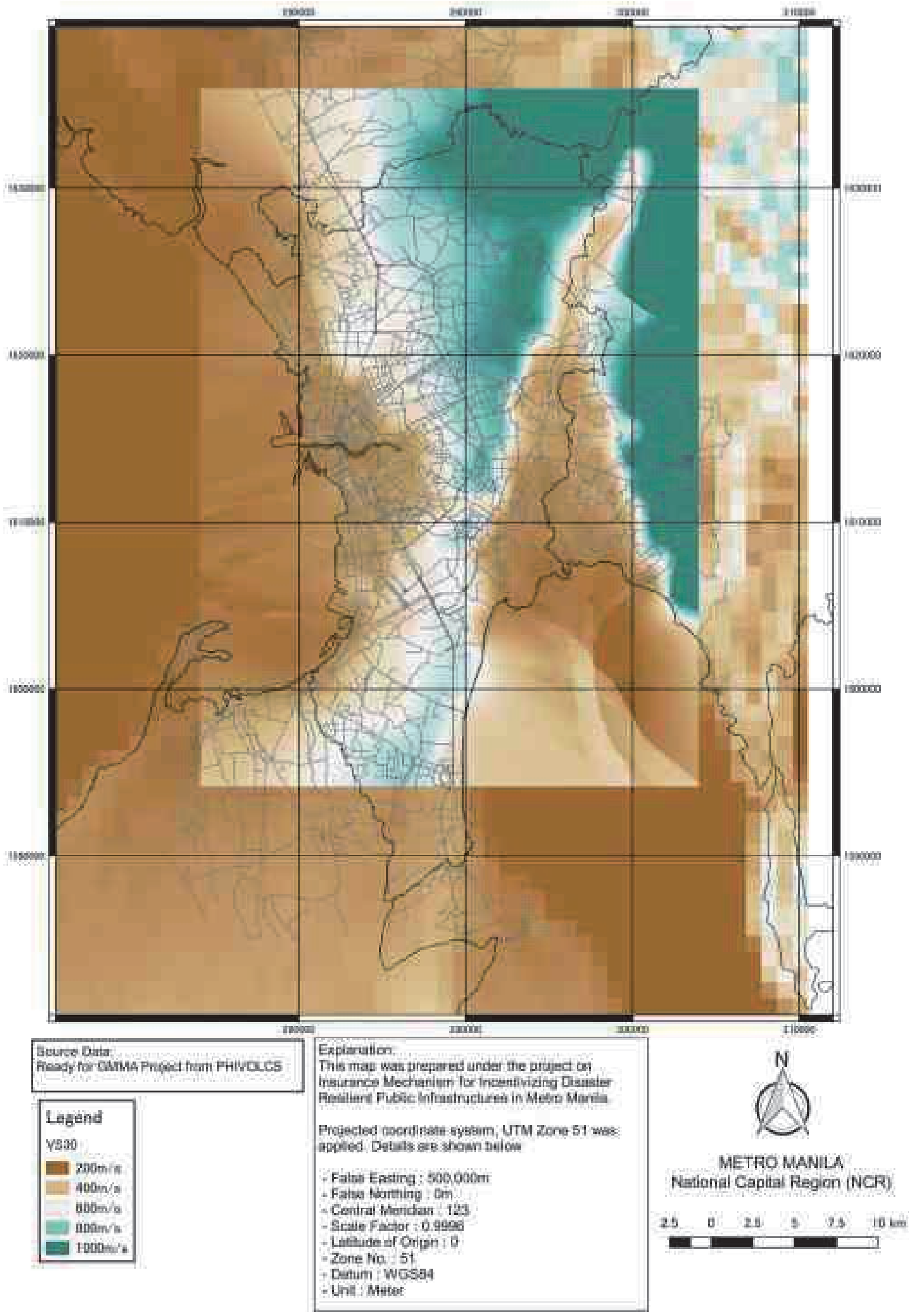


Figure 5-20 Vs30: Mean S wave velocity from the earth's surface to a depth of 30m

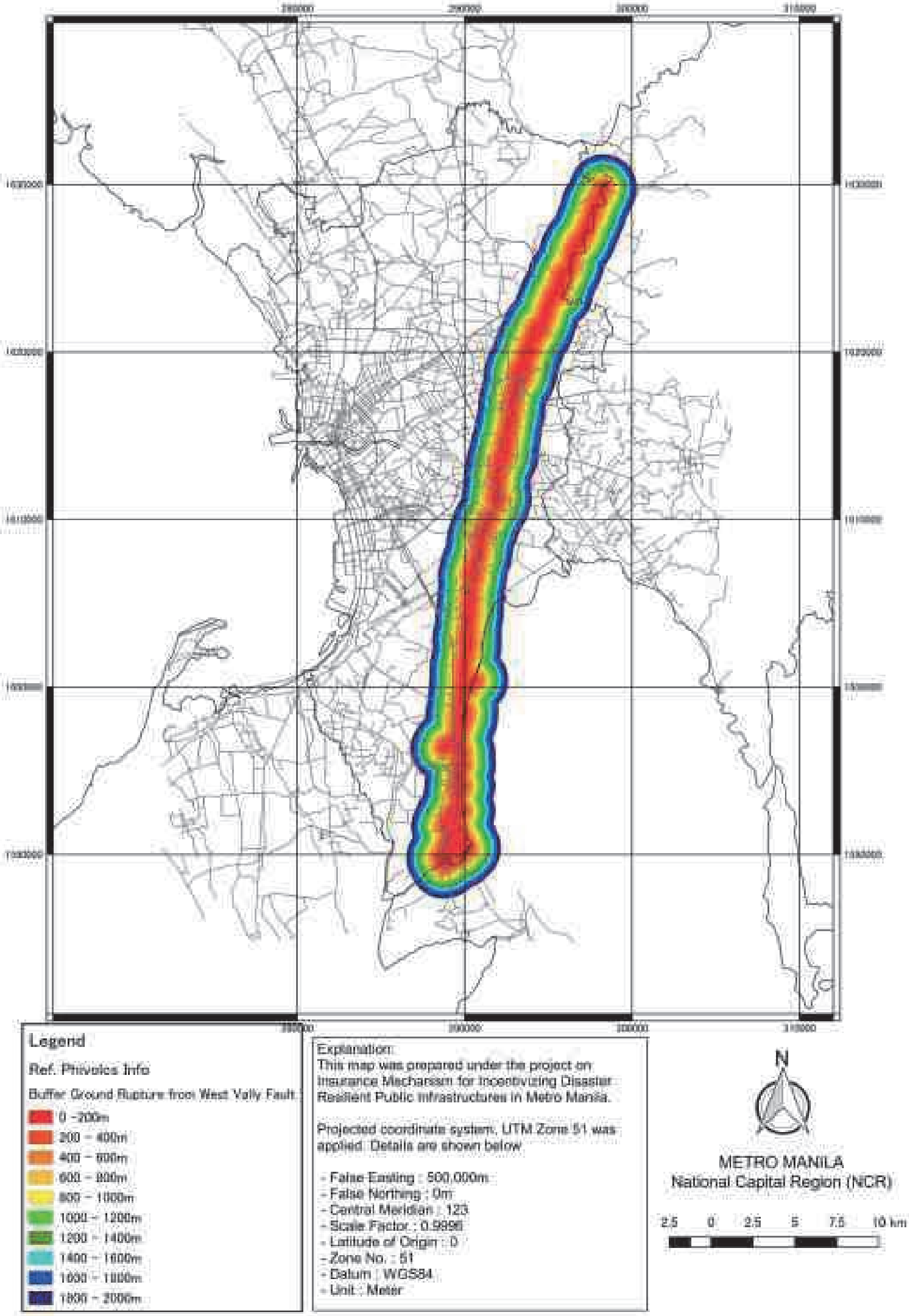


Figure 5-21 Distribution of distance from the West Valley Fault

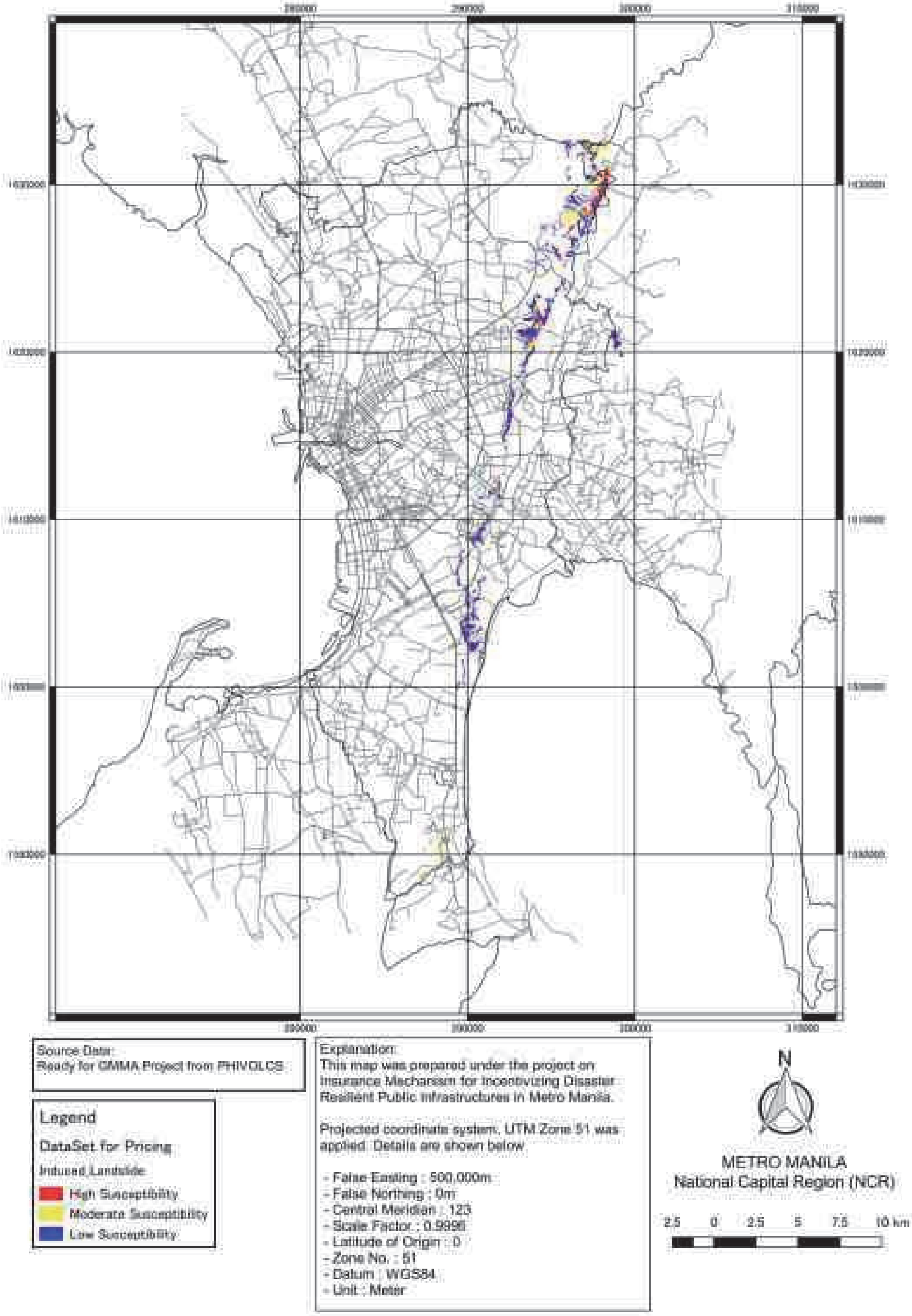


Figure 5-22 Earthquake-produced landslide hazard zones

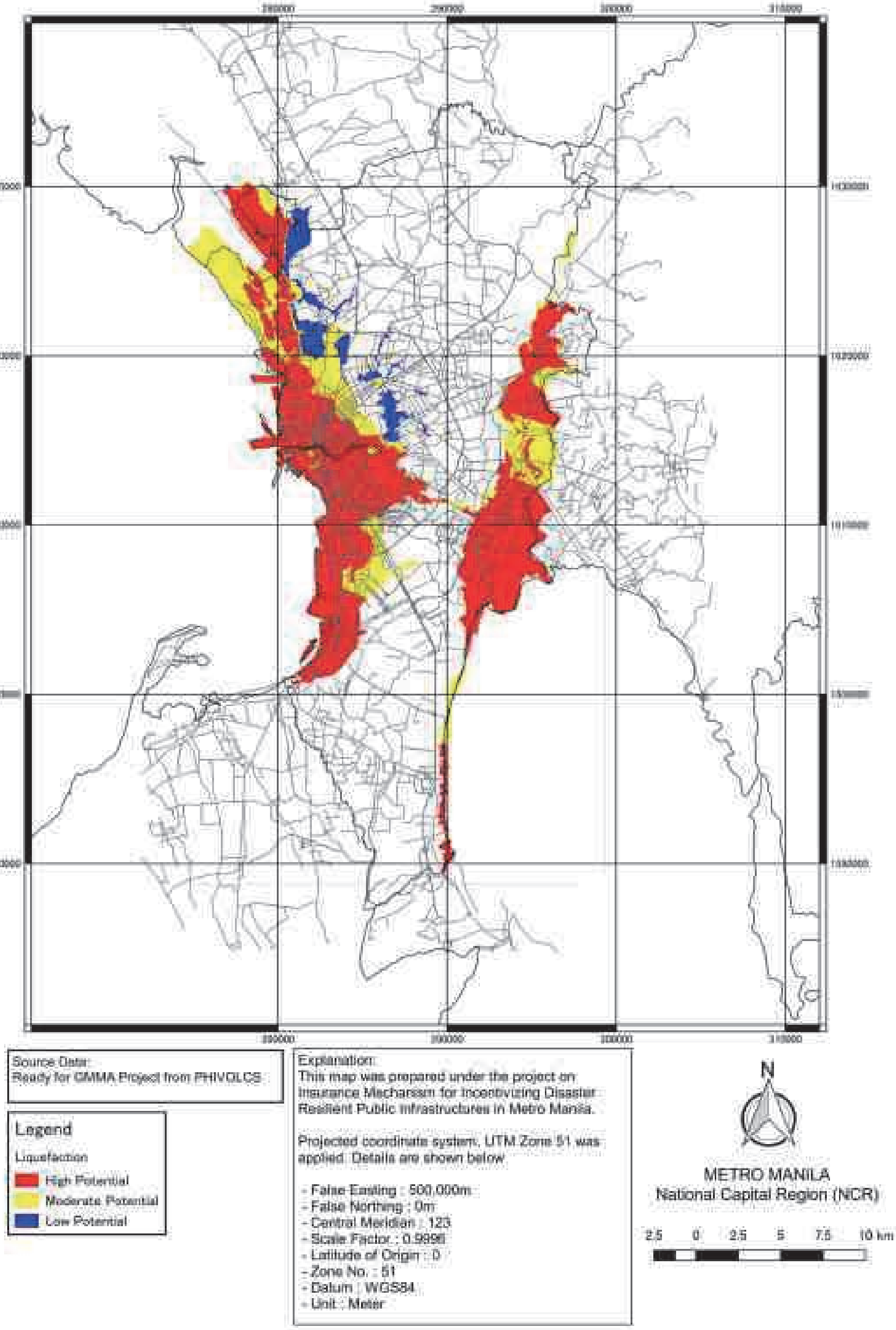


Figure 5-23 Liquefaction hazard zones

b.2 Wind Storm

Because wind strength varies depending on land use conditions, zoning is possible for wind storms as a function of land use conditions. Nearly all of MM is designated as a high-density, urban land use district, however, and from the viewpoint of land use in relation to strength against natural disasters, no large differences among districts can be seen. The risk-based premium rate calculation tool detailed later is used to analyze risk exposure by converting wind speed data purchased from Air Worldwide to wind speeds according to land use as shown in the figure below.

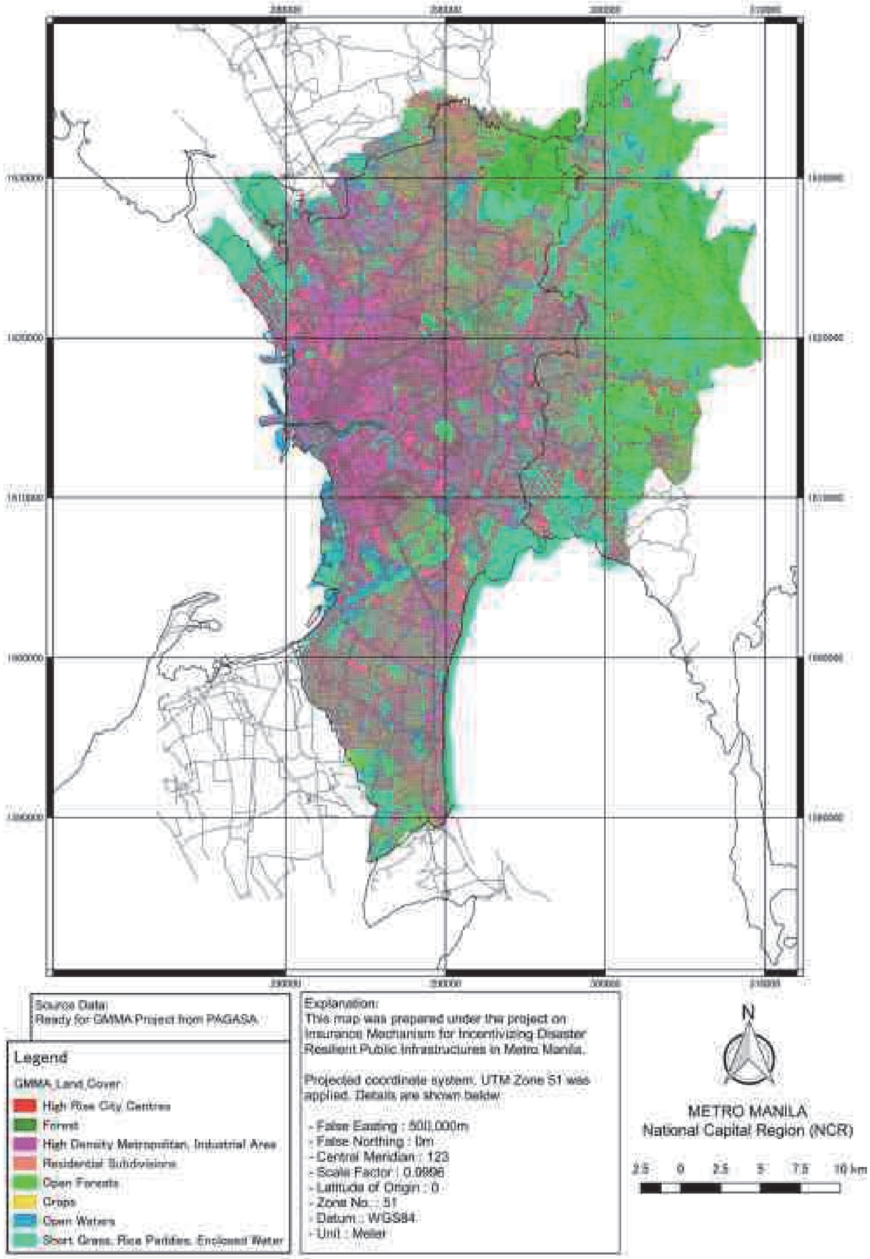


Figure 5-24 Land use

b.3 Water Damage

As described above, in MM low-lying land is spread throughout the areas around Manila Bay and the northern part of Laguna de Bay. Because the Manila Bay coast can be expected to bear the brunt of tsunamis and storm surges, the risk of flood damage from the ocean in these low-lying areas is high. The risk is particularly high in the 0m zone (where the ground surface is below sea level) along the northern part of the coast. Because of countermeasures such as coastal levees that are currently being implemented, the storm surge and tsunami risk in this area is expected to be mitigated in the future.

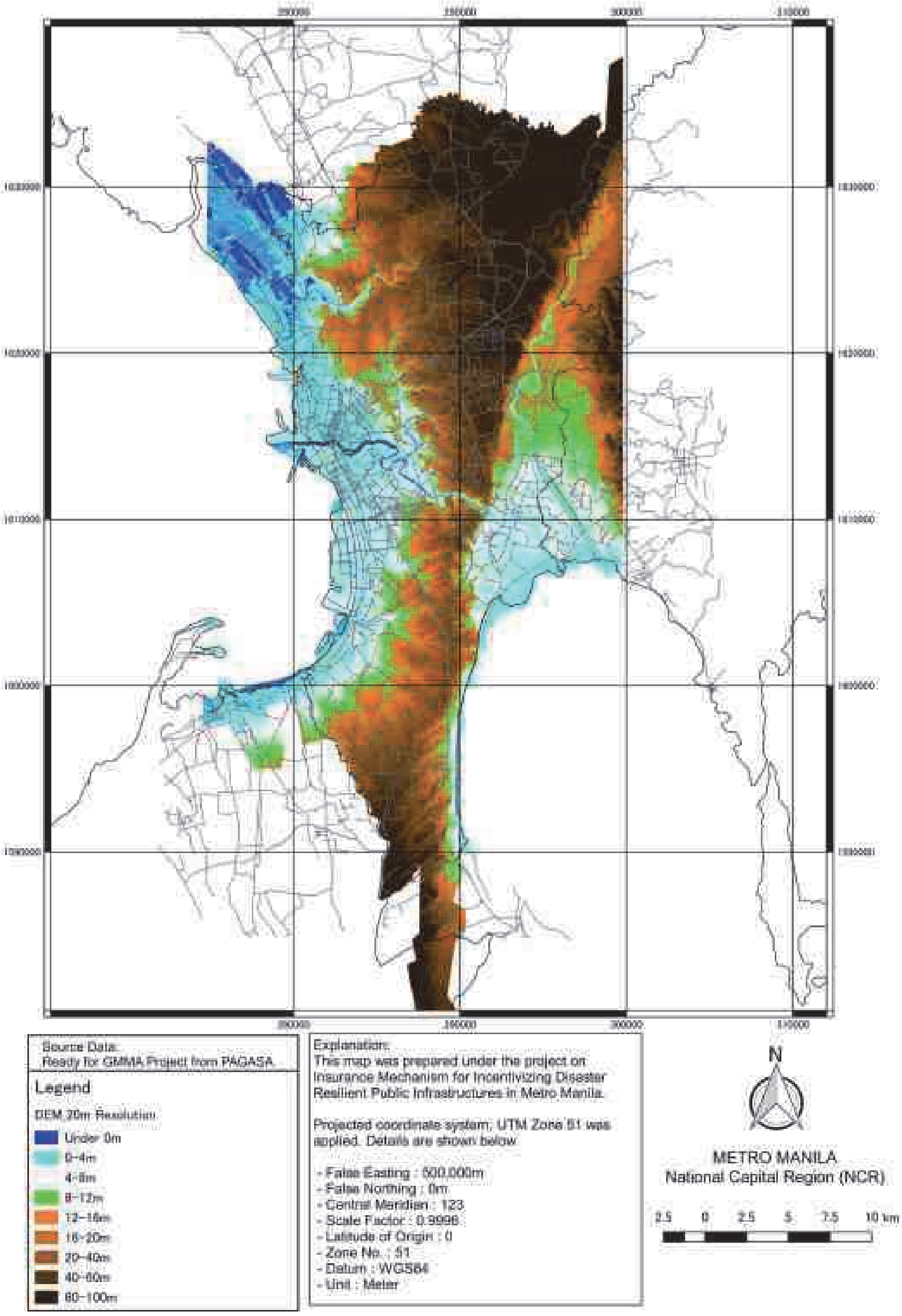


Figure 5-25 Distribution of elevation above sea level

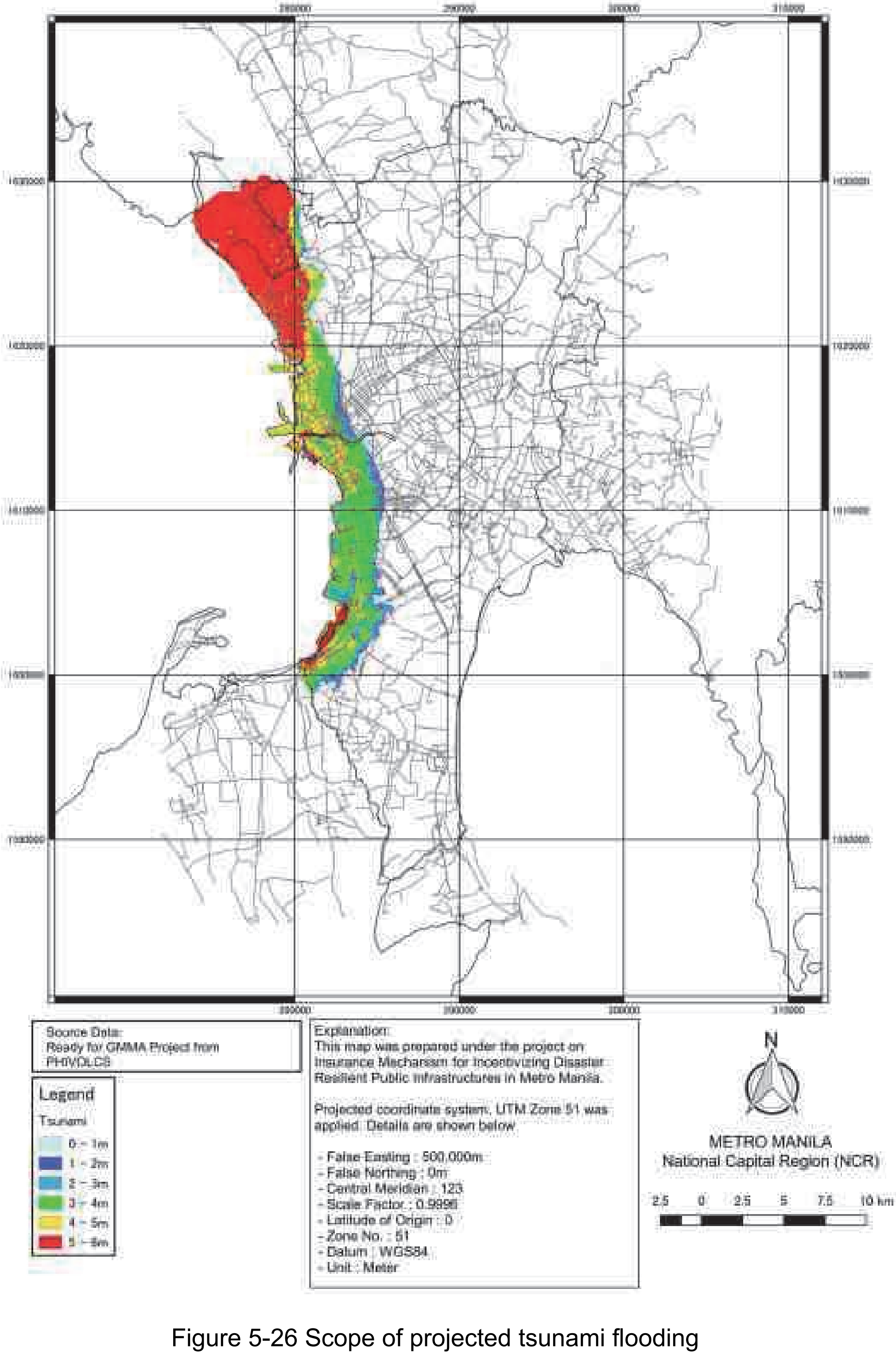


Figure 5-26 Scope of projected tsunami flooding

In the inland areas of MM, the flood risk from overtopping of small rivers is high because this area encompasses not only the Marikina River but numerous small rivers as well. The occurrence of flooding in the vicinity of these small rivers and in the low-lying areas less than 4m above sea level that lie distributed in the eastern and western sectors of MM could be confirmed as well from the results of flood simulations UP performed at the time of Typhoon Ondoy. The flood simulation results are as described above.

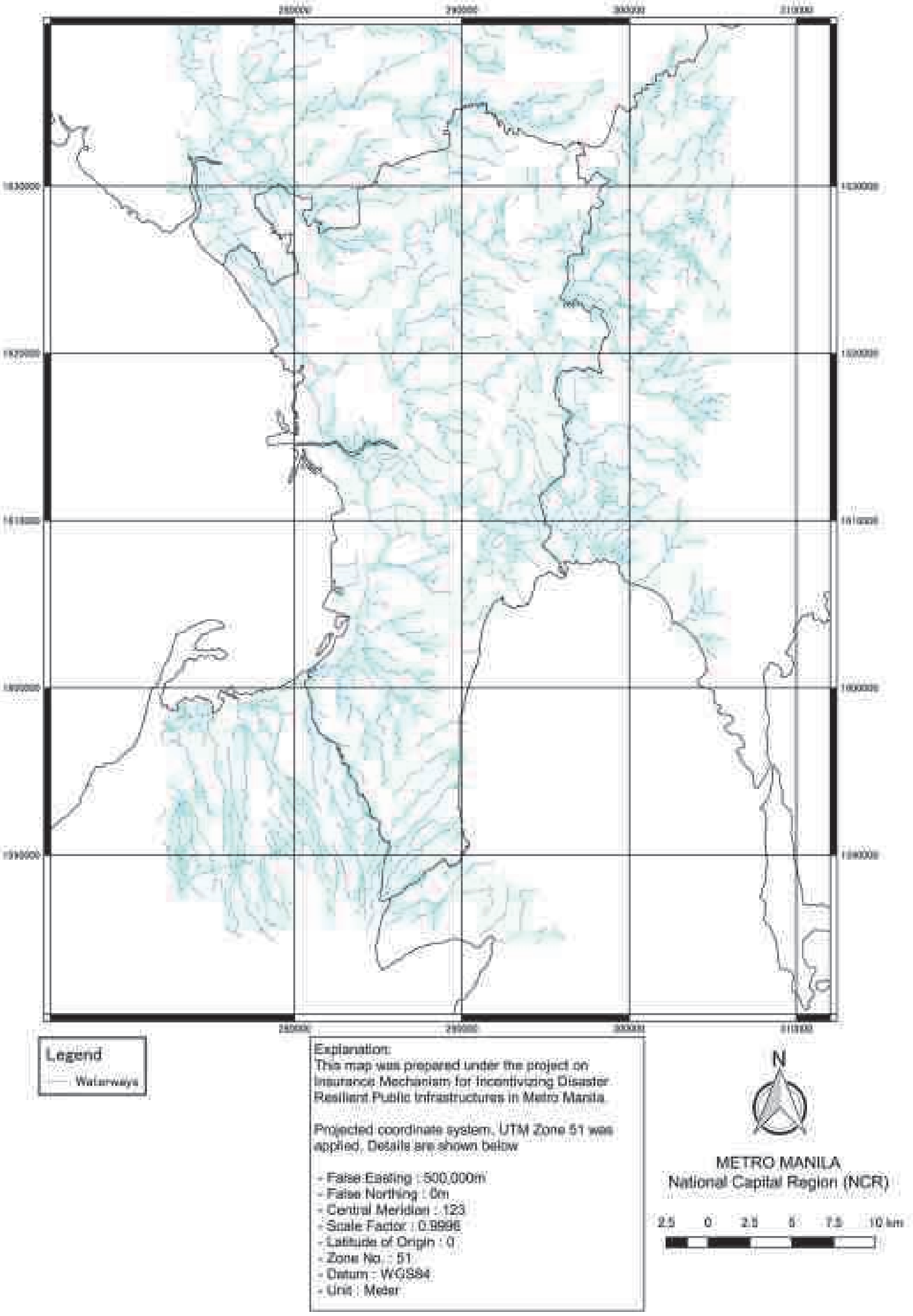


Figure 5-27 River distribution conditions

b.4 Result of Zoning

Based on the information marshalled above, the study team can classify MM into three zones: a low-lying Manila Bay coast zone, a high-elevation zone distributed along a north-south orientation in MM, and a low-lying zone around the northern part of Laguna de Bay. Each of the characteristics has been reorganized to create the following table. Moreover, by purchasing the above-mentioned hazard data from AIR, so that it includes MM, the hazard for each point can be evaluated as well, while taking into consideration the characteristics of each of the following zones.

Table 5-4 Characteristics of each zone in MM

	Low-lying zone along the coast of Manila Bay	High-altitude zone along the north-south direction in metropolitan Manila	Low-lying zone in the north of Laguna de Bay
Earthquake Damage	This is a region where the ground is soft and earthquake vibration is amplified. The risk of liquefaction is high.	This is a region where the ground is hard and earthquake vibration is not amplified much. The risk of liquefaction is low due to the hard ground.	This is a region where the ground is soft and earthquake vibration is amplified. The risk of liquefaction is high. In the event of an earthquake, there is a risk of landslide in the west side region of the Marikina Fault.
Wind Damage	There is not a significant difference in terms of land usage, and the scale of wind damage is not significantly different among regions.		
Water Damage	The altitude is low, and hence the risk of flood is high. As it is facing Manila Bay, there are also tsunami and tidal wave risks. The altitude in the north area along the coast is below 0m, which means that the risk will continue to be high until the ongoing sea embankment project is complete.	There are maze-like small rivers, and therefore the area along the small rivers is exposed to the risk of water damage. However, since the altitude of the area is high overall, it is unlikely that a flood will affect a large area. The altitude is over 4m, and therefore the risk of flood is low even in the event of the worst expected loss from tsunami and tidal wave.	The altitude is low, and hence the risk of flood is high. However, the area is very far from Manila Bay, and therefore is not exposed to the risk of tsunami and tidal wave.

5.2.2 Vulnerability Curves

According to the TOR for this Study, the vulnerability curves are to be generated after grouping in terms of vulnerability of buildings based on the data on payment of insurance claim from GSIS.

However, interviews with GSIS showed the scarcity of actual payment of claim for natural disaster in MM. This made it impossible to generate vulnerability curve statistically based on the characteristics of categorized vulnerability group derived from actual payment records.

Vulnerability curves of key building types in MM have been developed by the research team led by UP under GMMA RAP project supported by AusAID. The results of this project are available in "Development of Vulnerability Survey of Key Building Type in the Greater Metro Manila Area Philippines, 2014". The vulnerability curves were therefore collected and generated referring to the existing research undertaken by UP etc. for the Greater Metro Manila Area.

a. Grouping of Vulnerability Curve

The vulnerability grouping has been undertaken in the said research in which buildings are categorized by structural type, year of construction and height. This is generally consistent with the grouping system for calculation of premium rate of property insurance.

Buildings in MM were firstly categorized as in the following table.
However, these are limited to general buildings, and special structures such as railroads, airports, ports, etc. have not been studied. For this reason, MRT 3 and NAIAT 3 subject to consideration in this Study are to be used separately from the results of the another study of the United States. Details will be described later. When UP creates vulnerability curves, it has approached in three ways. Specifically, methods using computer simulation (Computational Method), statistical methods using disaster records so far (Empirical Method), and methods based on interviews with experts are used (Heuristic Method). Finally, the study team proposed a vulnerability curve recommended as GMMA RAP by selecting one from the vulnerability curves developed by these three methods. The importance of updating them on a continuous basis after accumulating actual damage data is clearly stated in the future.

Table 5-5 Structural Type of Buildings

Material	Type	Sub-Type	Description	Year of Construction: Pre-1972	Year of Construction: 1972-1992	Year of Construction: Post-1992
Wood	W1*	W1-L	Wood Frame with Area ≤ 500 sq. m (1-2 storeys)		✓	
	W2*	W2-L	Wood Frame with Area > 500 sq. m (1-2 storeys)		✓	
	W3	W3-L	Bamboo (1-2 storeys)		✓	
	N	N-L	Makeshift (1-2 storeys)		✓	
Masonry	CHB	CHB-L	Concrete Hollow Blocks (1-2 storeys)		✓	
	URA	URA-L	Adobe (1-2 storeys)		✓	
	URM*	URM-L	Brick (1-2 storeys)		✓	
	RM1*	RM1-L	Flexible Diaphragm (1-2 storeys)		✓	
	RM2*	RM2-L	Rigid Diaphragm (1-2 storeys)		✓	
		RM2-M	Rigid Diaphragm (3-7 storeys)		✓	
	MWS	MWS-L	Half-Masonry/Half-Wood/Metal (1-2 storeys)		✓	
Concrete	CWS	CWS-L	Half-RC Frame/Half-Wood/Metal (1-2 storeys)		✓	
	C1*	C1-L	Moment Frame (1-2 storeys)		✓	
		C1-M	Moment Frame (3-7 storeys)	✓	✓	✓
		C1-H	Moment Frame (8-15 storeys)	✓	✓	✓
	C2*	C2-L	Shear Walls (1-2 storeys)		✓	
		C2-M	Shear Walls (3-7 storeys)	✓	✓	✓
		C2-H	Shear Walls (8-15 storeys)	✓	✓	✓
	C4	C4-M	Shear Walls and Frames (3-7 storeys)	✓	✓	✓
		C4-H	Shear Walls and Frames (8-15 storeys)	✓	✓	✓
		C4-V	Shear Walls and Frames (16-25 storeys)	✓		✓
		C4-E	Shear Walls and Frames (26-35 storeys)	✓		✓
		C4-S	Shear Walls and Frames (36+ storeys)	✓		✓
	PC1*	PC1-L	Precast Tilt-up (1-2 storeys)	✓	✓	✓
	PC2*	PC2-L	Precast Frame (1-2 storeys)	✓	✓	✓
		PC2-M	Precast Frame (3-7 storeys)	✓	✓	✓
Steel	S1*	S1-L	Moment Frame (1-2 storeys)	✓	✓	✓
		S1-M	Moment Frame (3-7 storeys)	✓	✓	✓
		S1-H	Moment Frame (8-15 storeys)	✓	✓	✓
	S2*	S2-L	Braced Frame (1-2 storeys)	✓	✓	✓
		S2-M	Braced Frame (3-7 storeys)	✓	✓	✓
		S2-H	Braced Frame (8-15 storeys)	✓	✓	✓
		S2-V	Braced Frame (16-25 storeys)	✓	✓	✓
		S2-E	Braced Frame (26-35 storeys)	✓	✓	✓
		S2-S	Braced Frame (36+ storeys)	✓	✓	✓
	S3*	S3-L	Light Metal (1-2 storeys)		✓	
	S4*	S4-L	Frame w/ Cast-in-place Shear Wall (1-2 storeys)			✓
		S4-M	Frame w/ Cast-in-place Shear Wall (3-7 storeys)			✓
		S4-H	Frame w/ Cast-in-place Shear Wall (8-15 storeys)			✓
		S4-V	Frame w/ Cast-in-place Shear Wall (16-25 storeys)			✓
		S4-E	Frame w/ Cast-in-place Shear Wall (26-35 storeys)			✓
		S4-S	Frame w/ Cast-in-place Shear Wall (36+ storeys)			✓

* - very similar to a HAZUS-MH Model Building Type with the same label (e.g. W1)

Source : Institute of Civil Engineering, University of the Philippines Diliman (2014)

a.1 Typhoon (Wind)

Following table shows the status of vulnerability curve development. Analytical approach was applied for most of structural types. In this method with numerical simulations, buildings' damage rate was evaluated simulating their behaviors under severe wind situation by computer employing computational fluid dynamic (CFD) theory. To assess proof stress, proof stress limits are set for each component and degree of damage is determined from a comparison of wind speed and proof stress derived by simulation.

Table 5-6 Methodologies applied for Recommended Vulnerability Curves for Wind

Material	Type	Sub-type	Method for Recommended Curve			Remarks
			Computational Method	Empirical Method	Heuristic Method	
Wood	W1	W1-L	O	O		Combination of computational (for small damage portion) and empirical (severe damage portion) methods
	W3	W3-L			O	
	N	N-L	O			Adjusted based on computational method
Masonry	MWS	MWS-L-W	O			
		MWS-L-S	O			
	CHB	CHB-L-W	O			
		CHB-L-S	O			
Concrete	CWS	CWS-L-W	O			
		CWS-L-S	O			
	C1	C1-L-W	O			
		C1-L-S	O			
		C1-M	O			
Steel	S1	S1-L	O			
		S1-M	O			
	S3	S3-L	O			

Table 5-7 Examples of threshold values for each material

Material	Threshold values (Pa)	Reference
Roof nail	1200	Lee and Rosowsky, 2005
Roof screw	4300	Baskaran, Ko and Molleti, 2009
Glass windows	3332	Cope, 2004

a.2 Flood

Building up damage for provisional calculations and heuristic methods are applied for development of vulnerability curves for flood. Heuristic method is recommended for wooden structures, while Build-up method is recommended for other structures. In the computational method, rehabilitation costs of building elements (costs for cleaning, repair and/or replacement) were estimated and accumulated by assumed flood inundation depth and then damage rate was calculated by ratio of total rehabilitation cost to replacement cost of the building.

In GMMA RAP, damage caused by flooding is not assumed, but by submergence and loss of electrical equipment, finishing (floor, wall surface), fittings (windows, doors, etc.), fixed equipment (such as cupboards), movables (furniture, fixtures).

Table 5-8 Methodologies applied for Recommended Vulnerability Curves for Flood

Material	Type	Sub-type	Method for recommended Vulnerability Curve		Remarks
			Build-up Method	Heuristic Method	
Wood	W1	W1-L-1		O	
		W1-L-2		O	
	W3	W3-L		O	
	N	N-L-1		O	
		N-L-2		O	
Masonry	MWS	MWS-L	O		
	CHB	CHB-L-1	O		
		CHB-L-2	O		
Concrete	CWS	CWS-L	O		
	C1	C1-L-1	O		
		C1-L-2	O		
		C1-M	O		
Steel	S1	S1-L-1	O		
		S1-L-2	O		
		S1-M	O		

a.3 Earthquake

Following table shows the status of the vulnerability curve development. In the computational method, building models were developed and then structural damage of the models by earthquake was evaluated through mathematical analysis.

Table 5-9 Methodologies applied for Recommended Vulnerability Curves for Earthquake

Material	Type	Sub-type	Method for recommended Vulnerability Curve			Remarks
			Computational Method	Empirical Method	Heuristic Method	
Wood	W1	W1-L			O	
	W3	W3-L			O	
	N	N-L			O	
Masonry	MWS	MWS-L		O		
	CHB	CHB-L		O		
	URA	URA-L		O		
	URM	URM-L			O	
Concrete	CWS	CWS-L	O			
	C1	C1-L	O			
		C1-M	O			
	C4	C4-M			O	
		C4-H			O	
	PC2	PC2-L			O	
		PC2-M			O	
Steel	S1	S1-L			O	
		S1-M	O			
	S3	S3-L			O	
	S4	S4-M			O	

b. Vulnerability Curves for Public School Buildings Incorporated in the Risk-Based Premium Rate Calculation Tool

For the vulnerability curve of public schools, the study team decided to use the one developed through said GMMA RAP project. The obtained data is "Development of Vulnerability Survey of Key Building Type in the Greater Metro Manila Area Philippines, 2014". The vulnerability curve constructed by UP is intended for earthquakes, typhoons and floods. The vulnerability curve obtained is shown below.

The study team confirmed public schools in MM have a reinforced concrete structure; so the curves in the table below the study team used were CL-1 (reinforced concrete structure: 1-2 storey) and C1-M (reinforced concrete structure: 3-7 storey).

Table 5-10 Structural Type of Buildings

Material	Type	Sub-Type	Description	Year of Construction		
				Pre-1972	1972-1992	Post-1992
Concrete	CWS	CWS-L	Half-RC Frame/Half-Wood/Metal (1-2 storeys)	✓		
	C1*	C1-L	Moment Frame (1-2 storeys)	✓		
		C1-M	Moment Frame (3-7 storeys)	✓	✓	✓
		C1-H	Moment Frame (8-15 storeys)	✓	✓	✓
	C2*	C2-L	Shear Walls (1-2 storeys)	✓		
		C2-M	Shear Walls (3-7 storeys)	✓	✓	✓
		C2-H	Shear Walls (8-15 storeys)	✓	✓	✓
		C2-V	Shear Walls (16-25 storeys)	✓		✓
		C2-E	Shear Walls (26-35 storeys)	✓		✓
		C2-S	Shear Walls (36+ storeys)	✓		✓
	C4	C4-M	Shear Walls and Frames (3-7 storeys)	✓	✓	✓
		C4-H	Shear Walls and Frames (8-15 storeys)	✓	✓	✓
	PC1*	PC1-L	Precast Tilt-up (1-2 storeys)	✓	✓	✓
	PC2*	PC2-L	Precast Frame (1-2 storeys)	✓	✓	✓
		PC2-M	Precast Frame (3-7 storeys)	✓	✓	✓

Source: Institute of Civil Engineering, University of the Philippines Diliman (2014)

b.1 Strong winds

Vulnerability curves are based on a log-normal distribution, and individual parameters are as given in the table below. As mentioned above, GMMA RAP uses three types of approach to develop vulnerability curves; however, according to a comment the study team obtained in an interview with Jaime Y. Hernandez, Jr, Associate Professor of UP, person-in-charge for curve development, the vulnerability curve applicable to public schools in MM is the one developed through computer simulation. Accordingly, the study team recommends using C1-L and C1-M listed in the report of GMMA RAP for the risk-based premium rate calculation tool.

Table 5-11 Typhoon / Wind Vulnerability Curve Parameters per building Type

Bldg Type	No Vintage		Wood (~1992)		Steel (1992~)	
	Mean	Beta	Mean	Beta	Mean	Beta
W1-L	176[†]	0.09[†]				
W3-L						
N-L	136	0.2				
MWS-L			321	0.52	398	0.16
CHB-L			456	0.59	469	0.44
CWS-L			321	0.52	398	0.16
C1-L			416	0.52	477	0.46
C1-M	221[‡]	0.33[‡]				
S1-L	379	0.61				
S1-M	180[‡]	0.24[‡]				
S3-L	387	0.37				
BB	381	0.27				
PT	369	0.15				

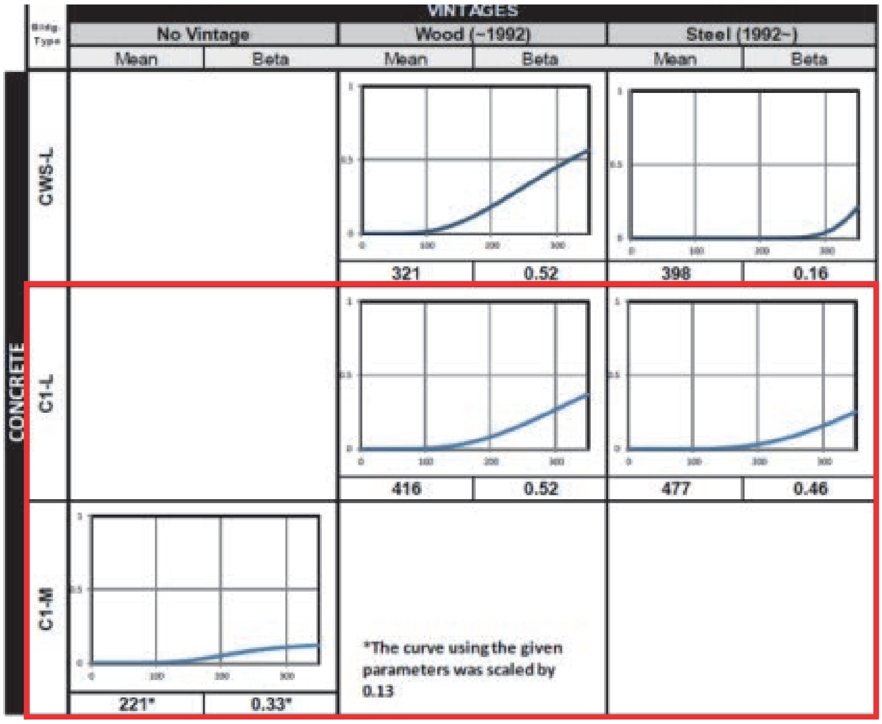


Figure 5-28 Vulnerability Curve for Typhoon / Wind

Mean, Beta: Parameters used in establishing vulnerability curves with lognormal distribution

Source: Institute of Civil Engineering, University of the Philippines Diliman (2014)

b.2 Earthquake

Vulnerability curves are based on a log-normal distribution, and individual parameters are as given in the table below. As mentioned above, GMMA RAP uses three types of approach to develop vulnerability curves; however, not all curves were prepared for low and middle concrete structures, and only curves based on computer simulation were available. Accordingly, the study team use in the Risk-based Premium Rate Calculation Tool C1-L and C1-M listed in "Computational VC Parameters in MMI."

Table 5-12 Earthquake Vulnerability Curve Parameters per building Type

Bldg Material	Bldg. Type	COMPUTATIONAL VC Parameters in MMI						HEURISTIC VC Parameters in MMI						EMPIRICAL VC Parameters	
		Pre-code (~1972)		Low-code (1972-1992)		Hi-code (1992~)		Pre-code (~1972)		Low-code (1972-1992)		Hi-code (1992~)			
		Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta
Wood	W1-L			-						8.15	0.25			6.92	0.13
	W3-L			-						8.11	0.24			-	-
	N-L			-						7.62	0.29			-	-
Masonry	MWS-L			-						7.74	0.26			7.09	0.21
	CHB-L			-						7.74	0.26			7.09	0.21
	URA-L			-						-				7.56	0.26
	URM-L			-						7.72	0.25			-	-
Concrete	CWS-L			9.18	0.16					7.75	0.25			-	-
	C1-L			8.29	0.18					8.40	0.22			-	-
	C1-M	8.67	0.16	8.67	0.16	8.77	0.16	-		-		8.33	0.23	-	-
	C4-M	9.86	0.13	9.89	0.13	9.91	0.13	8.03	0.26	8.43	0.24	8.89	0.23	-	-
	C4-H	N/A	N/A	N/A	N/A	N/A	N/A	7.88	0.25	8.36	0.23	8.64	0.21	-	-
	PC2-L	-	-	-	-	-	-	-	-	8.72	0.21	8.72	0.21	-	-
	PC2-M	-	-	-	-	-	-	-	-	8.22	0.25	8.22	0.25	-	-
Steel	S1-L	9.32	0.11	9.54	0.11	9.23	0.14	8.28	0.23	8.36	0.23	8.83	0.19	-	-
	S1-M	9.26	0.13	9.40	0.13	9.44	0.12	8.15	0.23	8.52	0.22	8.75	0.20	-	-
	S3-L	-	-	-	-	-	-	-	-	9.00	0.16	9.00	0.16	-	-
	S4-M	-		-		-		-	-	-	-	8.90	0.17	-	-

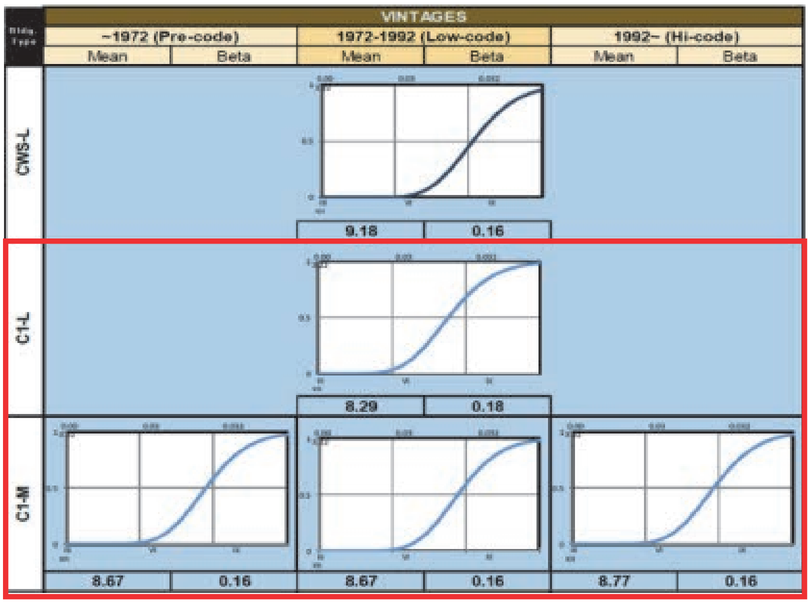


Figure 5-29 Vulnerability Curves for EQ

Source: Institute of Civil Engineering, University of the Philippines Diliman (2014)

b.3 Flood, Tsunami, and Storm Surge

"Development of Vulnerability Survey of Key Building Type in the Greater Metro Manila Area Philippines, 2014" also builds vulnerability curves against floods. In the interview with Richmark N. Macuha, Associate Professor, person-in-charge for curve development, commented that even in the aftermath of flooding caused by Typhoon Ondoy in 2009, no building frame of concrete structure suffered damage and that they assume damage in parts other than the building frame, such as finishing materials and electric facilities. Furthermore, the existing curves assume a general household; it includes such property as bed and kitchen appliances, not normally furnished in schools.

So, the study team requested UP to reconstruct vulnerability curves assuming public schools in MM. For public schools in MM, the curve should be developed assuming typical 1–4 storey buildings, with DPWH material used as a reference. The study team requested UP to carry out a field survey in schools listed in the table below to assess the real conditions of finishing materials and electric facilities. The following pictures show the conditions at the time of survey, and Table below lists facilities subject to damage based on the survey result. Assumed loss includes the cleaning of floors, walls, etc., the replacement of ceilings, blackboards and windows, and the repair of electric facilities.

Figure 5-30 Standard Type of Public School Buildings

Table 5-13 A list of the schools visited for the Field Survey

Name of School	Location
Balara Elementary School	H. Ventura St., Brgy. Pansol, Quezon City
Balara High School	H. Ventura St., Brgy. Pansol, Quezon City
Concepcion Integrated School	J.P. Rizal, Concepcion Uno, Marikina City
Ernesto Rondon High School	Road 3, Project 6, Quezon City
H. Bautista Elementary School	J.P. Rizal, Concepcion Uno, Marikina City
Mines Elementary School	Brgy. Vasra, Quezon City
Project 6 Elementary School	Road 7, Project 6, Quezon City

Photo Overview of the Public Schools Visited

Table 5-14 Building Components and Expected Damage due to Inundation

Attribute	Damage Response	Attribute	Damage Response
Floor	Clean	Electrical Outlets	Replace
Interior Wall	Clean (d=0.1) / Repaint (d≥0.5)	Electrical Switch	Replace
Exterior Wall	Clean (d=0.1) / Repaint (d≥0.5)	Other Electrical Fixtures	Replace
Door	Clean (d=0.1) / Repair (d=0.5) Replace (d≥1)	Lighting Fixtures	Replace
Window	Clean and Repair	Fire Alarm System	Repair
Blackboard	Replace	Septic Tank	Maintenance
Ceiling	Replace (Wood) / Clean& Repaint (Concrete)	Roof	Clean

UP assessed the replacement cost of each facility as of 2016 which is subject to damage, and calculated the loss amount depending on flood inundation depths (Table below).

Table 5-15 Damage Extent per Components at Flood Depth

Inundation Depth (m)	Component with Damage	Damage Response	Unit	Quantity	Unit Cost	Damage Cost
0.0	None	None	N/A	N/A		-
0.1	Floor	Clean	sq.M	565	32.83	18,550.08
	Interior Wall	Clean	sq.M	25.71	42.68	1,097.34
	Exterior Wall	Clean	sq.M	50.785	42.68	2,167.59
	Door	Clean	sets	18	79.38	1,428.84
	Subtotal				-	**23,243.85**
0.5	Floor	Clean	sq.M	565	32.83	18,550.08
	Interior Wall	Repaint	sq.M	822.72	362.88	298,548.63
	Exterior Wall	Repaint	sq.M	464.32	362.88	168,492.44
	Door	Repair	sets	18	648.00	11,664.00
	Electrical Outlet	Replace	lot	1	17,551.99	17,551.99
	Septic Tank	Maintenance	lot	1	10,800.00	10,800.00
	Subtotal				-	**525,607.14**
1.0	Floor	Clean	sq.M	565	32.83	18,550.08
	Interior Wall	Repaint	sq.M	822.72	362.88	298,548.63
	Exterior Wall	Repaint	sq.M	464.32	362.88	168,492.44
	Door	Replace	lot	1	610,829.10	610,829.10
	Electrical Outlet	Replace	lot	1	17,551.99	17,551.99
	Blackboard	Replace	sets	6	10,461.15	62,766.90

Aside from this, the study team requested UP to sort out damage rates depending on flood inundation depths by using the replacement cost for public schools (table below) calculated based on the DPWH material.

Table 5-16 Replacement Costs for Public School

PROJECT: 12-CLASSROOM TWO-STOREY BUILDING
SUBJECT: BILL OF QUANTITIES
DATE: AUGUST 13, 2016

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
A.	TWELVE CLASSROOMS				
I.	Mobilization/ Demobilization	lot	1.00	81,270.0	81,270.00
	Subtotal				**81,270.00**
II.	Temporary Facilities and Billboard	lot	1.00	103,950.0	103,950.00
				-	**103,950.00**
III.	Safety and Health			-	-
	Item SPL-1 Personal Protective Equipment	md	1920.00	22.8	43,835.90
	Item SPL-2 Safety and Health Personnel	md	16.00	2,800.0	44,800.00
	ITEM SPL-3 Signages and Barricades	sets	7.00	1,606.5	11,245.50
	Subtotal				**99,881.40**
IV.	Earthworks			-	-
	Item 803 Excavation of Column Footing, WF and SW Footing	m^3	283.98	420.0	119,271.60
	Item 804(a) Backfilling of Excavated Materials	m^3	175.37	350.0	61,379.50

As a result, the study team obtained the vulnerability curves shown below.

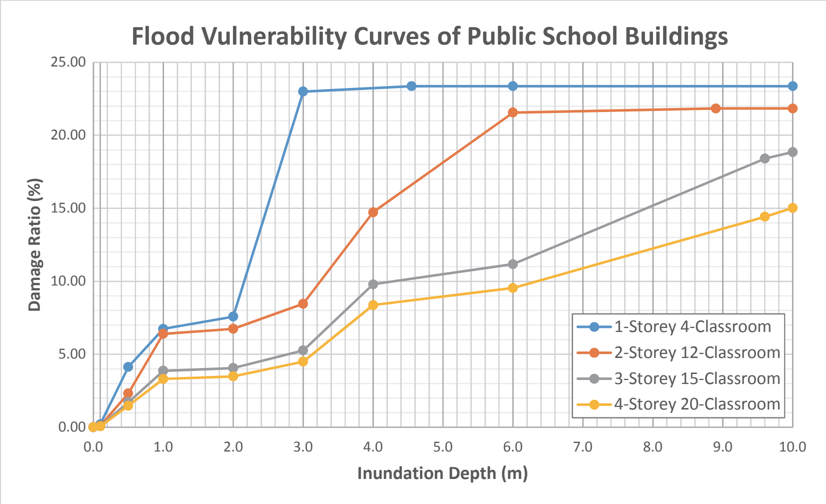


Figure 5-31 Vulnerability Curves for Flood Inundation

Table 5-17 Damage Rate per Flood Depth

MODEL: 1-Storey 4-Classroom Building		
Construction Cost (Php)		5,550,551.83
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	11,779.53	0.21
0.5	229,552.01	4.14
1.0	373,853.06	6.74
2.0	420,881.96	7.58
3.0	1,276,125.92	22.99
4.6	1,296,875.74	23.36
6.0	1,296,875.74	23.36
10.0	1,296,875.74	23.36

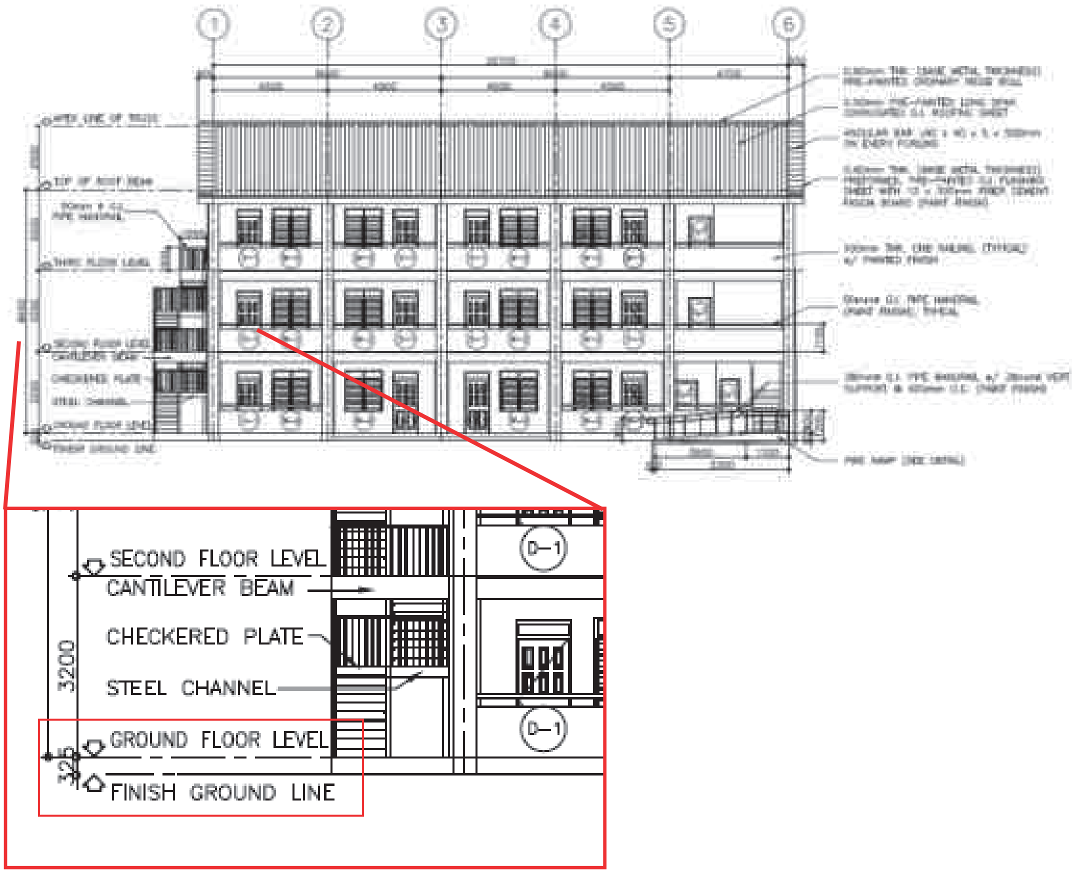
MODEL: 2-Storey 12-Classroom Building		
Construction Cost (Php)		22,608,887.36
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	23,243.85	0.10
0.5	525,607.14	2.32
1.0	1,446,840.66	6.40
2.0	1,524,562.35	6.74
3.0	1,911,518.22	8.45
4.0	3,328,702.84	14.72
6.0	4,873,260.57	21.55
8.9	4,935,769.57	21.83
10.0	4,935,769.57	21.83

MODEL: 3-Storey 15-Classroom Building		
Construction Cost (Php)		29,776,120.41
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.07
0.5	512,427.69	1.72
1.0	1,153,081.48	3.87
2.0	1,206,889.38	4.05
3.0	1,566,649.26	5.26
4.0	2,915,345.86	9.79
6.0	3,325,673.64	11.17
9.6	5,479,609.93	18.40
10.0	5,611,903.01	18.85

MODEL: 4-Storey 20-Classroom Building		
Construction Cost (Php)		34,816,448.99
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.06
0.5	512,427.69	1.47
1.0	1,153,081.48	3.31
2.0	1,213,722.48	3.49
3.0	1,564,392.06	4.49
4.0	2,913,088.66	8.37
6.0	3,321,159.24	9.54
9.6	5,020,542.83	14.42
10.0	5,229,634.29	15.02

Note that the inundation depth for use in damage rate calculation is a depth from the floor surface of the ground floor, not from the ground level. Since the inundation depth used in the flood hazard map is based on the ground level, the study team used 32.5 cm as a compensation factor for premium calculation by referring to the DPWH standard drawings in Figure below.

For tsunami, the study team decided to use the same vulnerability curves for flooding, assuming that a building frame of a concrete structure will not suffer damage, since a large-scale tsunami that hit Japan on the occasion of the Great East Japan Earthquake is not assumed in MM, according to the hazard information the study team bought from AIR. For storm surges, a phenomenon where the sea level rises gradually as a typhoon approaches, the vulnerability curves for flooding are also applicable.



Source: DPWH

Figure 5-32 Assumed Difference between Building Floor and Ground Level

b.4 Liquefaction and Landslide

UP has never assessed the vulnerability for liquefaction and landslides, so the study team could not collect relevant information about school facility-related vulnerability. On the other hand, the study team confirmed that no pile foundation has been used in school buildings, based on the school drawings obtained from DPWH and a comment from a construction consultant (of Avseneca Construction) in our interview.

Once liquefaction occurs, a concrete structure without a pile foundation inclines. The study team decided to assume a damage rate of 100% when liquefaction occurred, for it is difficult to keep using a tilted school building over an extended time period. Similarly, the damage rate in the case of a landslide is also set at 100%, for once a building is caught up in a landslide, its reuse is almost impossible.

On the other hand, in order to calculate the premium rate, it is necessary to calculate the probability of liquefaction or landslide occurrence, but useful information on the probability of occurrence could not be found in this study. Therefore, in this study, the study team decided to put the position information of the liquefaction dangerous areas and the landslide risk areas obtained from PHIVOLCS into the tool and decide to visually understand the dangerous place.

c. Vulnerability Curves for MRT3 and NAIA T3

c.1 Earthquake

The study team was unable to confirm the study results in the Philippines for railway and airport special structures. On the other hand, design standards in the Philippines use the United States standards as a base. In the United States, a risk evaluation methodology called HAZUS that was prepared by Federal Emergency Management Agency (FEMA) is used when performing risk assessments. Consequently, the study team decided to incorporate the vulnerability curves organized by HAZUS into the tool for this project. Furthermore, for railway stations and terminal buildings, the study team has used the study results of GMMA RAP by UP etc. described earlier.

Table 5-18 Vulnerability references adopted for earthquake assessments

Type	Target	Facility	Reference	Indicator	Remarks
Railway	Building	Station Building	GMMA RAP	MMI*1	S1-L (shown below)
	Track	Elevated part	HAZUS*1	Sa*2	Bridge of LRT
		Underground	HAZUS	PGD*3	Roadway of LRT
		Underground	HAZUS	PGD	Tunnel of LRT
		Tunnel	HAZUS	PGD	Tunnel of LRT
Airport	Building	Terminal Building	GMMA RAP	MMI	C1-M (shown below)
	Apron	Apron	HAZUS	PGD	Roadway of Highway

*1 The Modified Mercalli Intensity Scale

*2 Acceleration Response Spectrum

*3 Permanent Ground Displacement

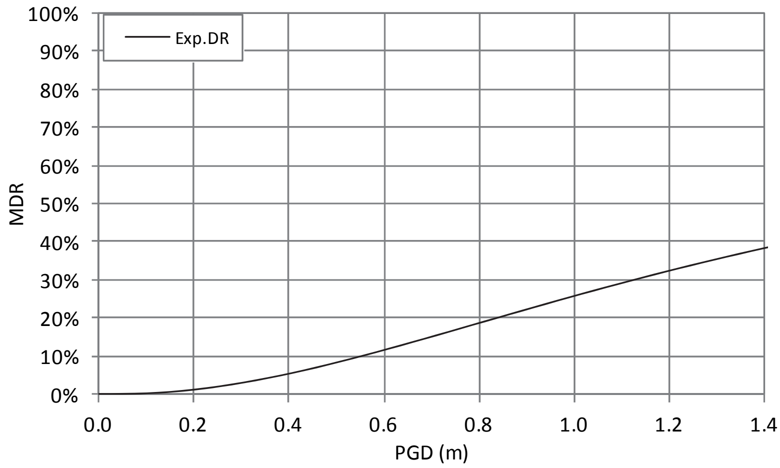
*1 HAZUS is Multi-hazard Loss Estimation Model coded by Federal Emergency Management Agency (FEMA), https://www.fema.gov/media-library-data/20130726-1820-25045-6286/hzmh2_1_eq_tm.pdf

Table 5-19 Earthquake vulnerability curve parameters

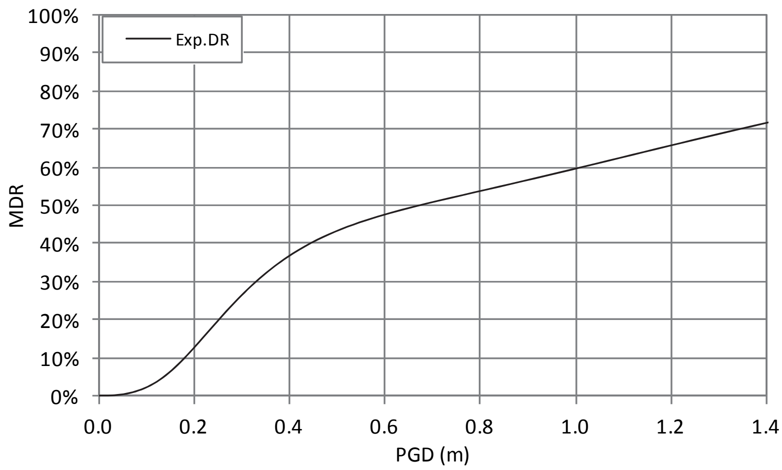
Bldg Material	Bldg. Type	COMPUTATIONAL VC Parameters in MMI						HEURISTIC VC Parameters in MMI						EMPIRICAL VC Parameters	
		Pre-code (~1972)		Low-code (1972-1992)		Hi-code (1992~)		Pre-code (~1972)		Low-code (1972-1992)		Hi-code (1992~)			
		Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta	Mean	Beta
Wood	W1-L	-								8.15	0.25			6.92	0.13
	W3-L	-								8.11	0.24			-	-
	N-L	-								7.62	0.29			-	-
Masonry	MWB-L	-								7.74	0.26			7.09	0.21
	CHB-L	-								7.74	0.26			7.09	0.21
	URA-L	-								-				7.56	0.26
	URM-L	-								7.72	0.25			-	-
Concrete	CWS-L			9.18	0.16					7.75	0.25			-	-
	C1-L			8.29	0.18					8.40	0.22			-	-
	C1-M	8.67	0.16	8.67	0.16	8.77	0.16	-		-		8.33	0.23	-	-
	C4-M	9.06	0.13	9.89	0.13	9.91	0.13	8.03	0.26	8.43	0.24	8.89	0.23	-	-
	C4-H	N/A	N/A	N/A	N/A	N/A	N/A	7.88	0.25	8.36	0.23	8.64	0.21	-	-
	PC2-L	-	-	-	-	-	-	-	-	8.72	0.21	8.72	0.21	-	-
	PC2-M	-	-	-	-	-	-	-	-	8.22	0.25	8.22	0.25	-	-
Steel	S1-L	9.32	0.11	9.54	0.11	9.23	0.14	8.28	0.23	8.36	0.23	8.83	0.19	-	-
	S1-M	9.26	0.13	9.40	0.13	9.44	0.12	8.15	0.23	8.52	0.22	8.75	0.20	-	-
	S3-L	-	-	-	-	-	-	-	-	9.00	0.16	9.00	0.16	-	-
	S4-M	-		-		-		-	-	-	-	8.90	0.17	-	-

Source: Institute of Civil Engineering, University of the Philippines Diliman (2014)

The HAZUS vulnerability curves used for the aboveground, underground, and tunnel portions of railway tracks and for airport aprons are shown below.



MRT, Roadway of MRT



Tunnel of Highway

Figure 5-33 Vulnerability curves used for aboveground, underground, and tunnel portions of railway tracks and for airport aprons

＊MDR：Mean Damage Ratio

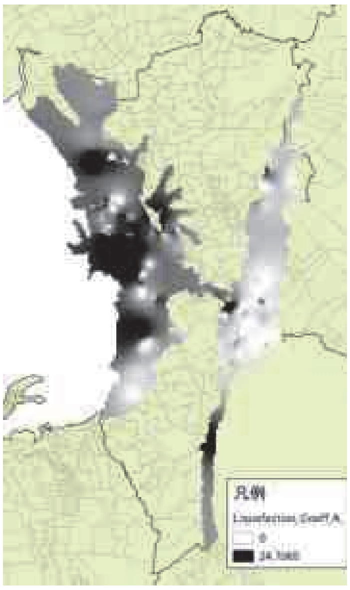
Because permanent ground displacement (PGD) is being used as the indicator to determine the damage rate, for this report the study team decided to calculate PGD based on the following assumptions, using the PGA purchased from AIRWorldwide.

Table 5-20 PGD (Permanent Ground Displacement) calculation methodology

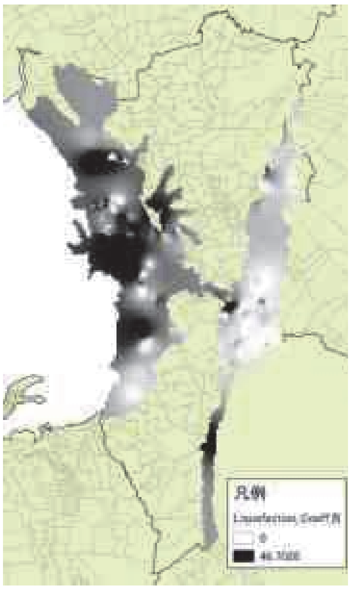
----

The study team used the MDR (Mean Damage Ratio) from liquefaction and the liquefaction layer thickness distribution to calculate PGD using the following equation.

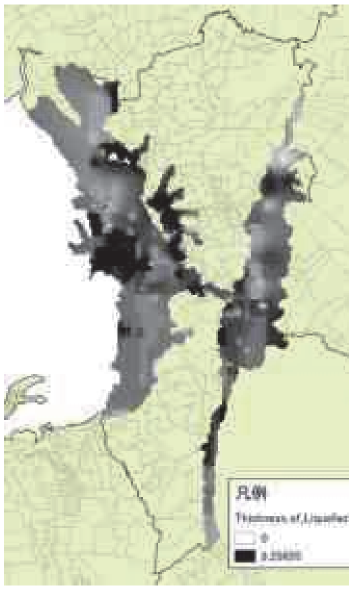
PGD = the MDR from liquefaction x he liquefaction layer thickness x 5%



PL value coefficient A



PL value coefficient B



Liquefaction layer thickness

The study team calculated the MDR from liquefaction using the PL value (Liquefaction potential) as follows.

PL value = A x In(PGA)

The MDR is calculated from the figure below.

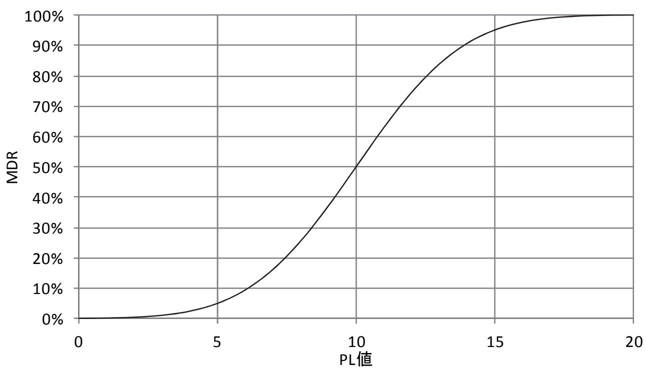


Figure 5-34 PL value – MDR relationship (μ=10, σ=3.04 normal distribution)

For the elevated portions of MRT3, the study team decided to calculate the MDR as follows in accordance with the HAZUS analysis methodology.

Table 5-21 Damage rate calculation methodology for elevated portions (1)

○Computation procedure

- Step 1: Configure the Bridge Class

Configure the Bridge Class according to the input value. Because the class highlighted within the red line in the table below will be used for the elevated portions of MRT3, the configuration within the red line has been implemented in the tool.

Table 5-22 Bridge Class

構造	橋梁長 (m)	建築年	Design	CLASS	K_{3D}	Ishape	Description
RC	<30	< 1990	Conventional	HWB5	EQ1	0	Multi-Col. Bent, Simple Support - Concrete
		>= 1990	Seismic	HWB7	EQ1	0	Multi-Col. Bent, Simple Support - Concrete
	>=30	< 1990	Conventional	HWB10	EQ2	1	Continuous Concrete
		>= 1990	Seismic	HWB11	EQ3	1	Continuous Concrete
Steel	<30	< 1990	Conventional	HWB12	EQ4	0	Multi-Col. Bent, Simple Support - Steel
		>= 1990	Seismic	HWB14	EQ1	0	Multi-Col. Bent, Simple Support - Steel
	>=30	< 1990	Conventional	HWB15	EQ5	1	Continuous Steel
		>= 1990	Seismic	HWB16	EQ3	1	Continuous Steel
PC	<30	< 1990	Conventional	HWB17	EQ1	0	Multi-Col. Bent, Simple Support - Prestressed Concrete
		>= 1990	Seismic	HWB19	EQ1	0	Multi-Col. Bent, Simple Support - Prestressed Concrete
	>=30	< 1990	Conventional	HWB22	EQ2	1	Continuous Concrete
		>= 1990	Seismic	HWB23	EQ3	1	Continuous Concrete

- Step 2: Estimate the acceleration response spectrum Sa (T=0.3 sec, 1.0 sec)[*2]

T=0.3 sec estimation

$$log_{10}\left(Sa_{T=0.3s}\right) = 1.077 \times log_{10}\left(PGA\right) + 0.19$$

T=1.0 sec estimation

$$log_{10}\left(Sa_{T=1.0s}\right) = 0.99 \times log_{10}\left(PGV\right) + 1.0$$

Where $log_{10}\left(PGV\right) = 0.89 \times log_{10}\left(PGA\right) - 0.74$

- Step 3: Compute the correction factors "K_{shape}" and "K_{3D}"

$$K_{shape} = 2.5 \times Sa_{T=1.0sec} / Sa_{T=0.3sec}$$

K_{3D} uses the equations shown in the table below, according to the Bridge Class application formula.

N = Bridge span / 30 (30m span assumed; N rounded to an integer [Roundup])

For the elevated portions of MRT3, parameters that assume a 500m bridge span have been implemented in the tool.

Table 5-23 K3D application formula according to Bridge Class

Equation	K_{3D}
EQ1	1 + 0.25 / (N – 1)
EQ2	1 + 0.33 / (N)
EQ3	1 + 0.33 / (N – 1)
EQ4	1 + 0.09 / (N – 1)
EQ5	1 + 0.05 / (N)

Table 5-24 Damage rate calculation methodology for elevated portions (2)

<u>- Step 4: Correct fragility curve median</u>

Using the following equation, correct the median for each Class shown in the table below.

$$New\_Median\ [slight] = Old\_Median\ \ [slight] \times Factor_{slight}$$

Where I_{shape}=0 $\rightarrow Factor_{slight}$=1

I_{shape}=1 $\rightarrow Factor_{slight}$=$Min(1\ ,K_{shape})$

$$New\_Median[moderate] = Old\_Median\ [moderate] \times K_{3D}$$

$$New\_Median[extensive] = Old\_Median\ [extensive] \times K_{3D}$$

$$New\_Median[complete] = Old\_Median\ [complete] \times K_{3D}$$

Table 5-25 Fragility curve median according to Bridge Class (standard value)

Sa [1.0 sec in g's] for Damage Functions due to Ground Shaking				
CLASS	Slight	Moderate	Extensive	Complete
HWB5	0.25	0.35	0.45	0.70
HWB7	0.50	0.80	1.10	1.70
HWB10	0.60	0.90	1.10	1.50
HWB11	0.90	0.90	1.10	1.50
HWB12	0.25	0.35	0.45	0.70
HWB14	0.50	0.80	1.10	1.70
HWB15	0.75	0.75	0.75	1.10
HWB16	0.90	0.90	1.10	1.50
HWB17	0.25	0.35	0.45	0.70
HWB19	0.50	0.80	1.10	1.70
HWB22	0.60	0.90	1.10	1.50
HWB23	0.90	0.90	1.10	1.50

<u>- Step 5: Use the corrected median to calculate the expected loss</u>

Calculate loss for median = (Each Class value after correction), β=0.6

For each Damage State, use the DR in the table to the right.

Table 5-26 DR for each damage state

Damage state	DR
slight	2%
moderate	10%
extensive	50%
complete	100%

*2 Ooi et al. 2002. Relationship among the various intensity indexes of the strong motion, http://www.j-map.bosai.go.jp/j-map/first_project/works/paper/JEES02_121.pdf

c.2 Strong winds

Regarding damage from strong winds, the study team was unable to confirm past payments of insurance claims by GSIS, and based on the field survey results, the study team confirmed it is difficult to envisage the occurrence of damage to the engineering works structure portions from strong winds. A certain amount of damage to the stations and terminal buildings can be expected, however.

Consequently, for damage from typhoons, the study team used the GMMA RAP study results and developed a tool for preparing station and terminal building risk assessments.

Table 5-27 Vulnerability references adopted for typhoon assessments

Type	Target	Facility	Reference	Indicator	Remarks
Railway	Building	Stations Building	GMMA RAP	km/h	S1-L (shown below)
	Track	Elevated part	No damage		
		Underground	No damage		
		Underground	No damage		
		Tunnel	No damage		
Airport	Building	Terminal Building	GMMA RAP	km/h	C1-M (shown below)
	Apron	Apron	No damage		

Table 5-28 Typhoon vulnerability curve parameters

Bldg Type	No Vintage		Wood (~1992)		Steel (1992~)	
	Mean	Beta	Mean	Beta	Mean	Beta
W1-L	176	0.09				
W3-L						
N-L	136	0.2				
MWS-L			321	0.52	398	0.16
CHB-L			456	0.59	469	0.44
CWS-L			321	0.52	398	0.16
C1-L			416	0.52	477	0.46
C1-M	221	0.33				
S1-L	379	0.61				
S1-M	180	0.24				
S3-L	387	0.37				
BB	381	0.27				
PT	369	0.15				

Source: Diliman Technology Laboratories Inc. at University of the Philippines (2014)

c.3 Flood, Tsunami, and Storm Surge

As with typhoons, the study team also could not confirm the actual payment of insurance claim by GSIS to MRT3 and the airport terminal for floods, and the study team was unable to confirm the results of payments made for Typhoon Ondoy as well. While the danger of flooding occurring at the airport terminal and at MRT3 depots and underground areas was confirmed by the field survey, the results of flooding could not be confirmed, and the study team also was not able to gather past surveys results concerning the vulnerability of the corresponding facilities. For flood, tsunami, and storm surge, the effect on premium rates is believed to be negligible; this needs to be addressed as a future task, and the study team has not implemented vulnerability curves in the tool.

c.4 Liquefaction and Landslide

Regarding liquefaction, both MRT3 and NAIA T3 have pile foundations, and even if damage occurs as the result of seismic tremors, it is believed the damage caused by liquefaction will be very minimal. For this project, the study team prepared a tool for the special structures of MRT3 and NAIA T3 that assumes there will be no liquefaction damage. Liquefaction in the airport runway is possible to occur, and the Tool cannot cope with assessing the liquefaction damage on the entire facility and function of the airport.

The study team did not perform a risk assessment for landslides, because MRT3 and NAIA T3 are not located in the landslide danger zones released by PHIVOLCS.

d. Recommended Vulnerability Curve and Impact

Since this study has focused on public schools, MRT3, and NAIA T3, the study team has extracted and organized the vulnerability curves the study team believes should be used for each type of facility. Moreover, although the study team gathered existing data for this study and used them, which the study team determined could be utilized with the tool, the study team has not incorporated into the tool the results from analyzing individual structures in detail. While the study team have shown the recommended curves that should be used for insurance purposes, it will be necessary to incorporate the latest scientific and technological results and elaborate the vulnerability curves in the future.

d.1 Public Schools

The study team recommended using the curve for concrete structures shown in the table below because the public school buildings in MM were basically with concrete structures. In all the GMMA RAP curves, the vulnerability of buildings constructed after 1992 is identical, but because of the design code transition adjustments implemented for this Study, for the design code after 2001 the thinking toward seismic capacity has been modified to a method of selecting either the ultimate strength design method or the allowable stress design method. The study team therefore prepared curves after 2001, depending on the expert judgment on structural design that is based on the modified contents of the design code. In the table below, Ranks 36 and 42 are applicable for earthquakes, and Ranks 21 and 25 are applicable for typhoons. For buildings where earthquake and windbreak countermeasures for existing buildings will be implemented, the study team recommend using Ranks 36 and 42 in case of earthquakes, and Ranks 21 and 25 for typhoons, because the countermeasures to be implemented basically meet standards corresponding to the present standards. Because a proposal to install impermeable walls at school entranceways to prevent flooding will be considered, for floods the study team decided to reflect the countermeasure’s effect by inputting the impermeable wall height to the exposure data input in the model.

d.2 MRT3、NAIAT3

Nearly all the MRT3 and NAIA T3 facilities were special structures. Therefore, as described above the study team has incorporated into the tool the assessment method used with HAZUS. From the results of the local interviews, the study team confirmed seismic retrofitting measures have been completed for the MRT3 depot and Terminal 3 building. On the other hand, such seismic retrofitting measures as those implemented in Japan (encasing in steel plates, etc.) have not been implemented for the elevated intervals of MRT3, and are considered a future task. The study team therefore has set Rank 46 as the curve that should be used when seismic retrofitting measures are undertaken on the MRT elevated intervals. However, the study team has not confirmed the specific countermeasure method at this time and expert judgments have been incorporated into the tool because the buildings are special structures. Thus, the study team recommends confirming items such as the structural calculation results when countermeasures actually have been implemented, and newly adding vulnerability curves to the tool.

Table 5-29 Earthquake vulnerability curve

	rank	Bldg. Type	Bldg. Material	Storeys	Year Build	Description	Vulnerability Source
Public School	31	C1-L	Concrete	1-2	-1972	Moment Frame	GMMA RAP
	33	C1-L	Concrete	1-2	1972-1992	Moment Frame	GMMA RAP
	35	C1-L	Concrete	1-2	1992-2001	Moment Frame	GMMA RAP
	36	C1-L	Concrete	1-2	2001-	Moment Frame	JICA Team
	37	C4-M	Concrete	3-7	-1972	Moment Frame	GMMA RAP
	39	C4-M	Concrete	3-7	1972-1992	Moment Frame	GMMA RAP
	41	C4-M	Concrete	3-7	1992-2001	Moment Frame	GMMA RAP
	42	C4-M	Concrete	3-7	2001-	Moment Frame	JICA Team
MRT	43	MRT Line Ground			Current	HAZUS Highway Road	HAZUS
	44	MRT Line Underground			Current	HAZUS Highway Tunnel	HAZUS
	45	MRT Line Overpass			Current	HAZUS Highway Bridge	HAZUS
	46	MRT Line Overpass w upgrade			Improved	Improved by JICA team based on HAZUS Highway Bridge	JICA Team
	47	MRT Station			Current	GMMA RAP S1-L Steel 1-2 1992- Moment Frame	GMMA RAP
	48	MRT Bridge			Current	HAZUS Highway Bridge	HAZUS
	49	MRT Depo			Current	No Damage	-
	50	MRT Motor			Current	No Damage	-
NAIA Terminal 3	51	NAIA apron			Current	HAZUS Highway Road	HAZUS
	52	NAIA Terminal 3			Current	GMMA RAP S1-M Steel 3-7 1992- Moment Frame	GMMA RAP
	53	NAIA Parking			Current	GMMA RAP C1-M Concrete 3-7 1992- Moment Frame	GMMA RAP

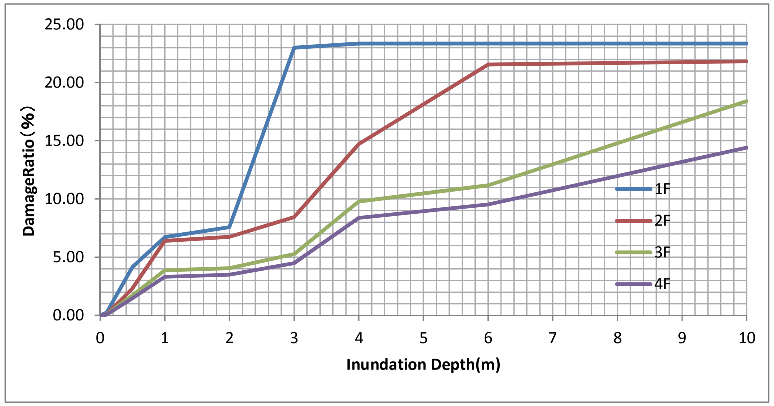
Table 5-30 Typhoon vulnerability curve

	rank	Bldg. Type	Bldg. Material	Storeys	Year Build	Description	Vulnerability Source
Public School	18	C1-L	Concrete	1-2	-1992	Moment Frame	GMMA RAP
	20	C1-L	Concrete	1-2	1992-2001	Moment Frame	GMMA RAP
	21	C1-L	Concrete	1-2	2001-	Moment Frame w Upgrade	JICA Team
	22	C1-M	Concrete	3-7	-1992	Moment Frame	GMMA RAP
	24	C1-M	Concrete	3-7	1992-2001	Moment Frame	GMMA RAP
	25	C4-M	Concrete	3-7	2001-	Moment Frame w Upgrade	JICA Team
MRT	26	MRT Line Ground			Current	No Damage	-
	27	MRT Line Underground			Current	No Damage	-
	28	MRT Line Overpass			Current	No Damage	-
	29	MRT Line Overpass w upgrade			Current	No Damage	-
	30	MRT Station			Current	GMMA RAP S1-L Steel 1-2 Moment Frame	GMMARAP
	31	MRT Bridge			Current	No Damage	-
	32	MRT Depo			Current	No Damage	-
	33	MRT Motor			Current	No Damage	-
NAIA Terminal 3	34	NAIA apron			Current	No Damage	-
	35	NAIA Terminal 3			Current	GMMA RAP S1-M Steel 3-7 - Moment Frame	GMMARAP
	36	NAIA Parking			Current	GMMA RAP C1-M Concrete 3-7	GMMARAP

Table 5-31 Public school flood vulnerability curve (when 1m impermeable wall countermeasures have been completed)

MODEL: 1-Storey 4-Classroom Building		
Construction Cost (Php)		5,550,551.83
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	11,779.53	0.00
0.5	229,552.01	0.00
1.0	373,853.06	0.00
2.0	420,881.96	7.58
3.0	1,276,125.92	22.99
4.6	1,296,875.74	23.36
6.0	1,296,875.74	23.36
10.0	1,296,875.74	23.36

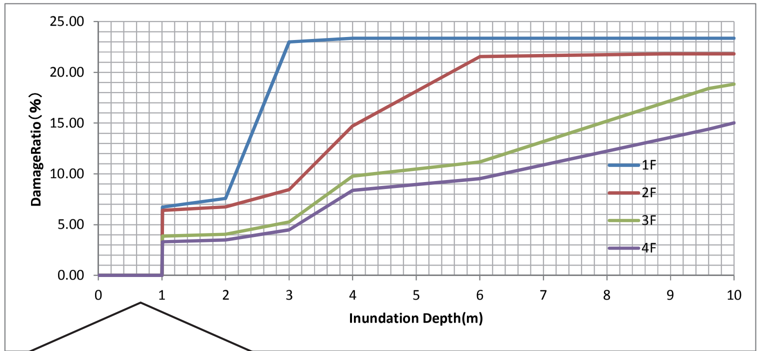
MODEL: 2-Storey 12-Classroom Building		
Construction Cost (Php)		22,608,887.36
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	23,243.85	0.00
0.5	525,607.14	0.00
1.0	1,446,840.66	0.00
2.0	1,524,562.35	6.74
3.0	1,911,518.22	8.45
4.0	3,328,702.84	14.72
6.0	4,873,260.57	21.55
8.9	4,935,769.57	21.83
10.0	4,935,769.57	21.83



After

MODEL: 3-Storey 15-Classroom Building		
Construction Cost (Php)		29,776,120.41
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.00
0.5	512,427.69	0.00
1.0	1,153,081.48	0.00
2.0	1,206,889.38	4.05
3.0	1,566,649.26	5.26
4.0	2,915,345.86	9.79
6.0	3,325,673.64	11.17
9.6	5,479,609.93	18.40
10.0	5,611,903.01	18.85

MODEL: 4-Storey 20-Classroom Building		
Construction Cost (Php)		34,816,448.99
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.00
0.5	512,427.69	0.00
1.0	1,153,081.48	0.00
2.0	1,213,722.48	3.49
3.0	1,564,392.06	4.49
4.0	2,913,088.66	8.37
6.0	3,321,159.24	9.54
9.6	5,020,542.83	14.42
10.0	5,229,634.29	15.02



No damage under 1 m

5.3 Risk-Based Premium Rate Calculation Tool

The study team created a tool for risk-based premium calculations based on GIS (Geographic Information System) that will enable GSIS to manage its portfolio visually. Furthermore, the study team conferred with GSIS and selected QGIS, free software that will not require any administrative and maintenance expense, as a platform.

With the above-mentioned hazard information and vulnerability curve information stored in the tool, property damage rates can be computed by calculating the hazard information at arbitrary locations in MM and inputting the vulnerability curves. Premium rates are calculated by calculating the damage rate for each natural disaster event and using the property replacement costs. The specific procedures for installing and using the tool are shown in Annex H (Risk-based Premium Rate Calculation Tool Manual). The study team conducted training on the contents for GSIS personnel during the fifth and sixth field surveys. During the training, the GSIS personnel used a PC to install the tool and perform the analyses to calculate premiums. For details, refer to Annex I (Training Report).

Furthermore, by obtaining information on structural elements, floor heights, and years of construction and selecting the vulnerability curves when performing analyses of properties other than the public schools, MRT3, and NAIA T3 covered by this Study, the stored vulnerability curves make it possible to calculate premium rates, as shown in the following tables.

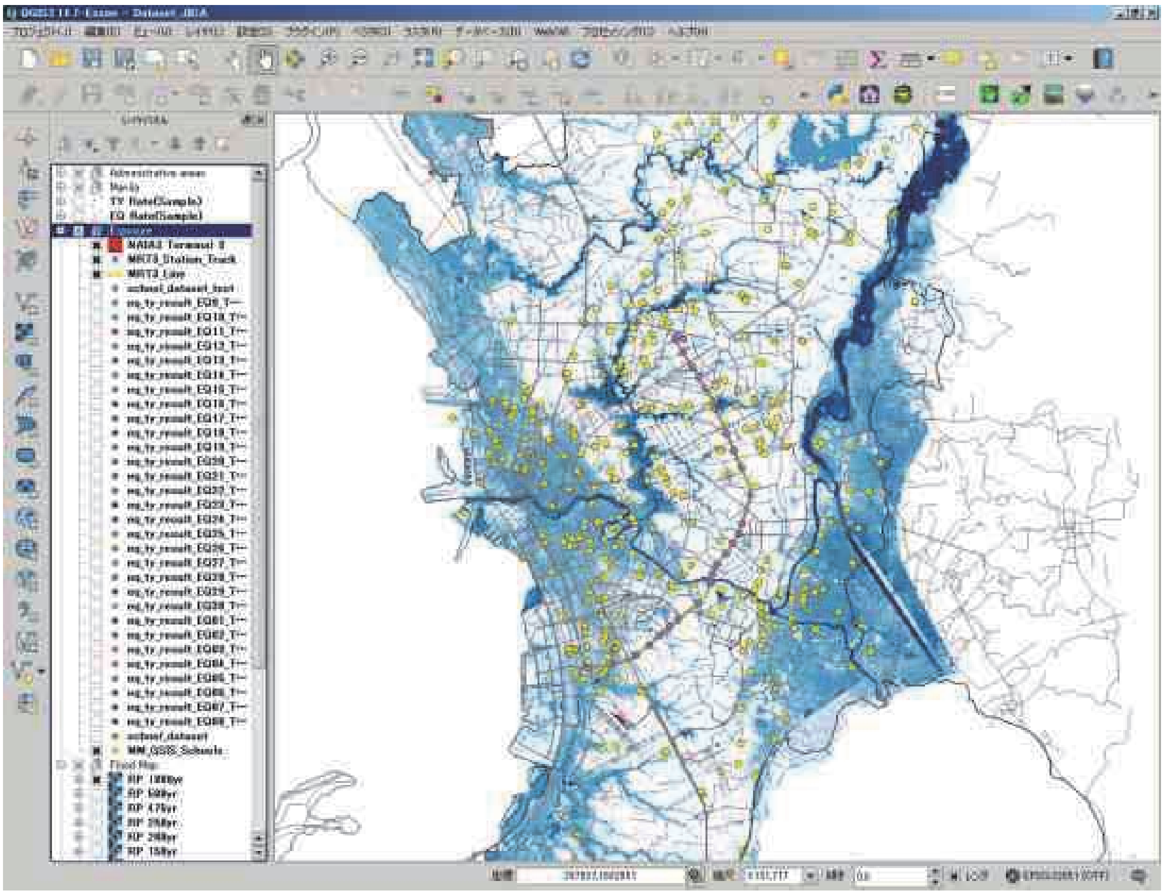


Figure 5-35 Risk-based Premium Rate Calculation Tool screen image

Note: Tool screen displaying a relationship diagram of the public schools, MRT3, and Airport Terminal 3 covered by this project and the flood hazard map

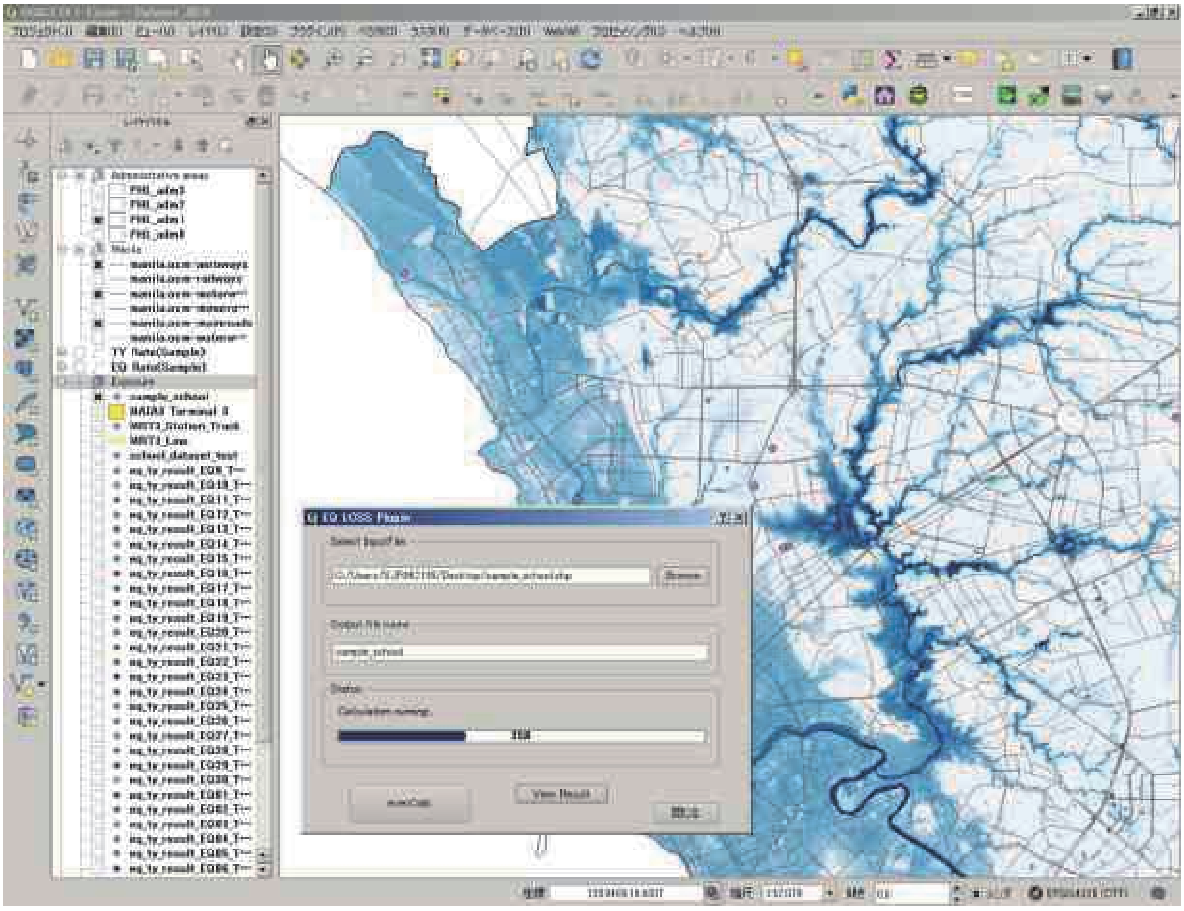


Figure 5-36 Risk-based Premium Rate Calculation Tool screen image

Note: Image during execution of analysis

Table 5-32 Earthquake vulnerability curves

rank	Bldg. Type	Bldg. Material	Storeys	Year Build	Description	Vulnerability Source
1	W1-L	Wood	1-2	-	Wood Frame with Area < 500sq.m(1-2storeys)	GMMA RAP
2	W3-L	Wood	1-2	-	Wood Frame with Area > 500sq.m(1-2storeys)	GMMA RAP
3	N-L	Wood	1-2	-	Makeshift	GMMA RAP
4	MWS-L	Masonry	1-2	-	Half-Masonry/Half-Wood/Metal	GMMA RAP
5	CHB-L	Masonry	1-2	-	Concrete Hollow Blocks	GMMA RAP
6	URA-L	Masonry	1-2	-	Adobe	GMMA RAP
7	URM-L	Masonry	1-2	-	Brick	GMMA RAP
8	CWS-L	Concrete	1-2	-	Half-RC Frame/Half-Wood/Metal	GMMA RAP
9	C1-L	Concrete	1-2	-	Moment Frame	GMMA RAP
10	C1-M	Concrete	3-7	-1972	Moment Frame	GMMA RAP
11	C1-M	Concrete	3-7	1972-1992	Moment Frame	GMMA RAP
12	C1-M	Concrete	3-7	1992-	Moment Frame	GMMA RAP
13	C4-M	Concrete	3-7	-1972	Shear Walls and Frames	GMMA RAP
14	C4-M	Concrete	3-7	1972-1992	Shear Walls and Frames	GMMA RAP
15	C4-M	Concrete	3-7	1992-	Shear Walls and Frames	GMMA RAP
16	C4-H	Concrete	8-15	-1972	Shear Walls and Frames	GMMA RAP
17	C4-H	Concrete	8-15	1972-1992	Shear Walls and Frames	GMMA RAP
18	C4-H	Concrete	8-15	1992-	Shear Walls and Frames	GMMA RAP
19	PC2-L	Concrete	1-2	1972-1992	Precast Frame	GMMA RAP
20	PC2-L	Concrete	1-2	1992-	Precast Frame	GMMA RAP
21	PC2-M	Concrete	3-7	1972-1992	Precast Frame	GMMA RAP
22	PC2-M	Concrete	3-7	1992-	Precast Frame	GMMA RAP
23	S1-L	Steel	1-2	-1972	Moment Frame	GMMA RAP
24	S1-L	Steel	1-2	1972-1992	Moment Frame	GMMA RAP
25	S1-L	Steel	1-2	1992-	Moment Frame	GMMA RAP
26	S1-M	Steel	3-7	-1972	Moment Frame	GMMA RAP
27	S1-M	Steel	3-7	1972-1992	Moment Frame	GMMA RAP
28	S1-M	Steel	3-7	1992-	Moment Frame	GMMA RAP
29	S3-L	Steel	1-2	-	Light Metal	GMMA RAP
30	S4-M	Steel	3-7	-	Frame w/ Cast-in place Shear Wall	GMMA RAP

Table 5-33 Typhoon vulnerability curves

rank	Bldg. Type	Bldg. Material	Storeys	Year Build	Description	Vulnerability Source
1	W1-L	Wood	1-2	-	Wood Frame with Area < 500sq.m(1-2storeys)	GMMA RAP
2	W3-L	Wood	1-2	-	Wood Frame with Area > 500sq.m(1-2storeys)	GMMA RAP
3	N-L	Wood	1-2	-	Makeshift	GMMA RAP
4	MWS-L	Masonry	1-2	-1992	Half-Masonry/Half-Wood/Metal	GMMA RAP
5	MWS-L	Masonry	1-2	1992-	Half-Masonry/Half-Wood/Metal	GMMA RAP
6	CHB-L	Masonry	1-2	-1992	Concrete Hollow Blocks	GMMA RAP
7	CHB-L	Masonry	1-2	1992-	Concrete Hollow Blocks	GMMA RAP
8	CWS-L	Concrete	1-2	-1992	Half-RC Frame/Half-Wood/Metal	GMMA RAP
9	CWS-L	Concrete	1-2	1992-	Half-RC Frame/Half-Wood/Metal	GMMA RAP
10	C1-L	Concrete	1-2	-1992	Moment Frame	GMMA RAP
11	C1-L	Concrete	1-2	1992-	Moment Frame	GMMA RAP
12	C1-M	Concrete	3-7	-	Moment Frame	GMMA RAP
13	S1-L	Steel	1-2	-	Moment Frame	GMMA RAP
14	S1-M	Steel	3-7	-	Moment Frame	GMMA RAP
15	S3-L	Steel	1-2	-	Light Metal	GMMA RAP
16	BB	Billboards	-	-	-	GMMA RAP
17	PT	Power transmission towers	-	-	-	GMMA RAP

Table 5-34 Public school flood vulnerability curves

MODEL: 1-Storey 4-Classroom Building		
Construction Cost (Php)		5,550,551.83
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	11,779.53	0.21
0.5	229,552.01	4.14
1.0	373,853.06	6.74
2.0	420,881.96	7.58
3.0	1,276,125.92	22.99
4.6	1,296,875.74	23.36
6.0	1,296,875.74	23.36
10.0	1,296,875.74	23.36

MODEL: 2-Storey 12-Classroom Building		
Construction Cost (Php)		22,608,887.36
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	23,243.85	0.10
0.5	525,607.14	2.32
1.0	1,446,840.66	6.40
2.0	1,524,562.35	6.74
3.0	1,911,518.22	8.45
4.0	3,328,702.84	14.72
6.0	4,873,260.57	21.55
8.9	4,935,769.57	21.83
10.0	4,935,769.57	21.83

MODEL: 3-Storey 15-Classroom Building		
Construction Cost (Php)		29,776,120.41
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.07
0.5	512,427.69	1.72
1.0	1,153,081.48	3.87
2.0	1,206,889.38	4.05
3.0	1,566,649.26	5.26
4.0	2,915,345.86	9.79
6.0	3,325,673.64	11.17
9.6	5,479,609.93	18.40
10.0	5,611,903.01	18.85

MODEL: 4-Storey 20-Classroom Building		
Construction Cost (Php)		34,816,448.99
Inundation Depth (m)	**Damage Cost (Php)**	**Damage Index (%)**
0.0	0.00	0.00
0.1	21,308.45	0.06
0.5	512,427.69	1.47
1.0	1,153,081.48	3.31
2.0	1,213,722.48	3.49
3.0	1,564,392.06	4.49
4.0	2,913,088.66	8.37
6.0	3,321,159.24	9.54
9.6	5,020,542.83	14.42
10.0	5,229,634.29	15.02

The vulnerability curves indicated above are stored in the following installed system files. The contents of these files can be confirmed by using a general text editor or Microsoft Excel.

Earthquake：C:¥dev_space¥EQ_Data¥vul_param_EQ.csv

Windstorm：C:¥dev_space¥WS_Data¥vul_param_WS.csv

Flood：C:¥dev_space¥FL_Data¥vul_param_FL.csv

This makes it possible to easily add vulnerability curves by preparing vulnerability curves based on lognormal distributions and adding then to the files indicated above, if users want to add vulnerability curves in the future in cooperation with UP or other institutions.

While there is a procedure for inputting exposure data into the tool, the tool is configured to enable data to be incorporated into the tool by preparing the data according to the following format. To manage exposure, data can be input for “No”, “City Name”, and “Location Name (example: school name)”, while property locations are input using “latitude” and “longitude”. At present, the latitude and longitude geographic coordinate system is WGS84, the general geographical coordinate system adopted for purposes such as GPS. Next, each property’s replacement cost is input in pesos. The last step is to input the vulnerability curve numbers, determined from characteristics such as the properties’ structural forms, floor heights, and years of construction, in the columns labelled “Rank”. Moreover, because installing impermeable walls is being considered as an anti-flood measure for public schools as described below, the effect of the impermeable walls can be reflected in the premiums by inputting in the FL_Wall column in meters the height from the ground level to the crown of the impermeable wall in the location where the impermeable wall is installed.

Table 5-35 Format for input of exposure data into the tool

No_	CITY	Location Name	Latitude	Longitude	Replacement Cost(Php)	Rank _EQ	Rank _TY	Rank _FL	FL_ Wall (m)
1	QUEZON	BALINGASA ELEMETARY SCHOOL	14.651944	121.067778	11040000	8	9	4	0
2	QUEZON	DEMETRIO TUAZON ELEMETARY SCHOOL	14.629167	120.999167	3680000	8	9	4	0
3	QUEZON	RAMON MAGSAYSAY ELEMETARY SCHOOL	14.628889	120.998333	31100000	8	9	4	0
4	QUEZON	SAN JOSE ELEMETARY SCHOOL	14.639722	120.993333	29600000	8	9	4	0
5	QUEZON	PAG-IBIG SA NAYON ELEMETARY SCHOOL	14.646389	120.996389	3800000	8	9	4	0
6	QUEZON	DALUPAN ELEMETARY SCHOOL	14.644444	121.013056	7000000	8	9	4	0
7	QUEZON	CONG. R.A. CALALAY ELEMETARY SCHOOL	14.638333	121.014722	8700000	8	9	4	0
8	QUEZON	MASAMBONG ELEMETARY SCHOOL	14.639444	121.007222	29000000	8	9	4	0

The results of the analysis using the tool are stored in the following folder.

C:¥dev_space¥"Project_Name"*

*Project_Name is prepared by the user when performing an analysis using the tool; analysis results can be managed easily by creating a uniform naming rule for each analysis portfolio.

The folder indicated above stores the hazard strength, damage ratio, and loss amount for each event used for the analysis, and the loss amount (VaR), annual average expected loss (pure premium), and premium rates for each probability of exceedance realized from the results have been output.

XX_hazard_table.csv：Hazard strength table

damage_ratioXX.csv：Damage ratio table

loss_table2_XX.csv：Loss table

VaR_Table_XX.csv：VaR, annual average expected loss (pure premium), and premium rate output

A sample of the VaR Table output results is shown in the table below. The output shows, in pesos, the damage rate (VaR) corresponding to return periods of 1,000- to 50- years, and in the rightmost column the VaR of the entire analysis portfolio, for each property. The AAL (Annual Average Loss) in the lower half of the table shows the annual expected loss (pure premium); STD (Standard Deviation) is the standard deviation of the AAL, Replacement Cost is the replacement cost, and Rate is the premium rate (AAL /Replacement Cost).

Table 5-36 Sample VaR Table output result

	S00001	S00002	S00003	S00004	S00005	S00006	Total
1000	5,725,254	1,473,324	12,458,528	10,424,816	1,862,809	2,061,568	32,628,079
500	5,257,148	1,183,614	10,055,693	8,218,091	1,603,018	1,914,202	28,441,013
400	5,010,696	1,122,666	9,555,196	7,738,683	1,520,036	1,831,587	26,769,369
300	4,333,507	1,012,324	8,629,363	6,955,727	1,420,844	1,740,421	23,901,484
200	3,057,511	820,380	7,038,230	5,638,023	1,213,868	1,604,251	19,079,476
150	2,678,775	709,368	6,024,169	4,571,558	1,076,976	1,479,669	16,678,966
100	1,989,768	551,041	4,749,375	3,708,040	900,379	1,276,365	13,180,929
50	1,074,396	254,129	2,223,007	1,580,963	493,764	830,384	6,461,361
AAL	86,468	20,077	174,718	129,550	38,750	61,652	511,216
STD	410,861	103,795	887,685	717,054	153,750	211,120	2,448,840
Replacement Cost	11,040,000	3,680,000	31,100,000	29,600,000	3,800,000	7,000,000	86,220,000
Rate	0.78%	0.55%	0.56%	0.44%	1.02%	0.88%	0.59%

The tool stores all the programming sources in the following folder, with an eye towards future scalability. For the programming language the study team used Python, and the specific calculation logic has been programmed in “Calc_loss_eq_ty.py”.

C:¥Users¥”UserName”*¥.qgis2¥python¥plugins¥EQ_LOSS

*UserName varies depending on the PC used; if UserName is unclear, it must be confirmed with the system administrator.

5.4 Hazard Risk Assessment based on the Field Surveys

A field survey was made at selected public schools in Metro Manila in order to develop a methodology of vulnerability check list and risk evaluation. A natural peril risk assessment was also conducted by a survey team based on field research in order to select vulnerability curves for the railway (MRT3) and airport (NAIAT3), which are special structures.[38] The recommended vulnerability curves are described in 5.2.2.d.2.

5.4.1 Risk Evaluation Results of Public Schools

a. Preliminary Assessment and Selection of Schools for Field Survey

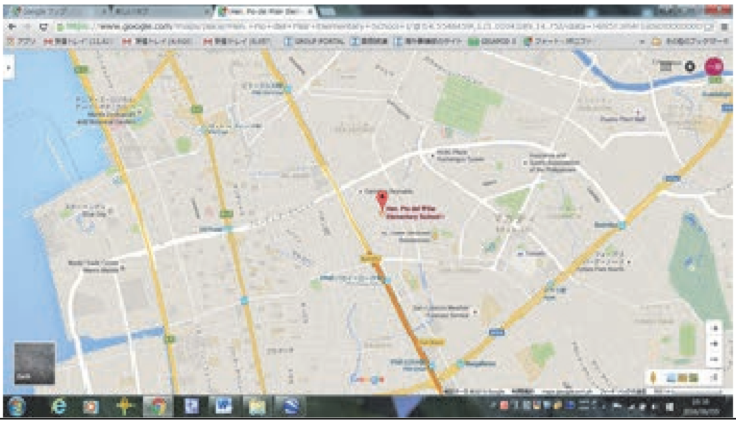
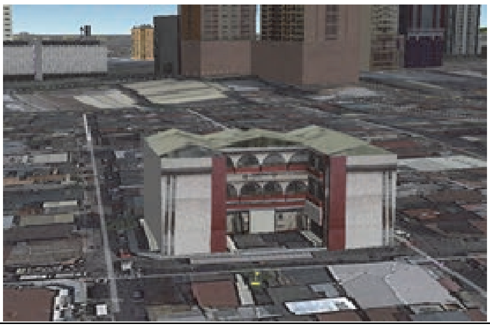
a.1 Preliminary Assessment Sheet

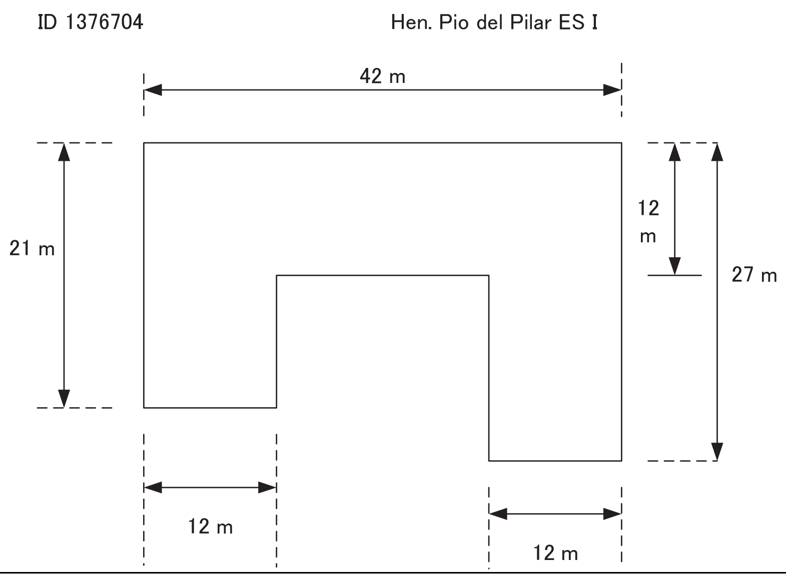
Preliminary assessment was carried out in order to understand the outline of school buildings and the surrounding environment and to select 10 schools for field investigations. The preliminary assessment sheet shown below includes the following points: 1) Location; 2) Plan (Satellite image); 3) elevation plan; 4) Layout of the buildings and floor area; 5) School ID; 6) Year of construction; 7) Type of structure; 8) Elevation; 9) Storeys; 10) Distance from the river; 11) Distance from the sea shore; 12) Existence of steep slope; and 13) Danger to various disasters, This information shall be limited to information which can be obtained from the internet. This primary evaluation sheet was prepared for 67 schools out of 770 schools in Metro Manila. By utilizing the Internet like this, it is possible to collect considerable information

a.2 Selection of Schools for Field Survey

Public schools were selected by reference to preliminary assessment sheets and DepEd school list. Selection criteria will cover the following: various construction years, closeness to west valley fault, flood prone areas and spread out areas in Metro Manila. The following 10 schools were selected for the field survey.

[38] DepEd and DPWH building engineers will need to be asked to perform these assessments (if performed in the future), as GSIS's engineering division is not presently able to conduct them itself. DPWH has the capability and actually performs them. Developing DepEd's risk assessment capabilities is also incorporated in the World Bank project/DepEd Metro Manila public school support program.

Hen Pio Del Pilar ES I
Location Map

Plan and Elevation
 
Size of Building

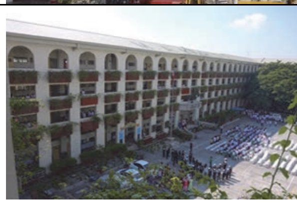
Photo

Building Outline and Location	Simplified Assessment of Nartural Hazard
School ID:136704	Earthquake：Medium Risk
Building No: 1	Tsunami：High Risk
Year of Construction：?	Liquefaction：not known
Structure：RC	Typhoon：Medium Risk
Altitude：9m	Storm Surge：High Risk
Floor: 3 Stories	Flood：High Risk
Distance to the River：200m	Landslide：Low Risk
Distance to the Sea：2,400m	
Surrounding Slope：Nil	

Figure 5-37 Sample of Preliminary Assessment Sheet

Source： The study team based on the internet-based information (Google Map, Google Earth)

Table 5-37 List of 10 Schools which conducted Field Assessment

No.	School ID	Date of Survey	Name of School		Const. Year
1	320607	2016.7.25	Simplicio Manalo NHS (High School)		2013
2	136704	2016.7.25	Hen Pio Del Pilar ES I (Elementary School)		1987
3	305412	2016.7.26	Benigno Aquino HS (High School)		2006
4	136697	2016.7.26	Tibagan ES (Elementary School)		1986

No.	School ID	Date of Survey	Name of School		Const. Year
5	136745	2016.7.27	Salapan ES (Elementary School)		1971
6	136469	2016.7.27	Antonio Maceda IS (High School)		1981
7	136482	2016.7.28	Bagong Diwa ES (Elementary School)		1966
8	136422	2016.7.28	Antonio Luna ES (Elementary School)		1945
9	305315	2016.7.29	Victoriano Mapa HS (High School)		1968
10	136800	2016.7.29	A. Deato ES (Elementary School)		2011

The following map indicates each location of the public schools. Schools 1, 3, and 4 are located near the west valley fault; schools 5, 6, 7, and 9 are located at flood prone areas; and school 10 is located along sea shore which is prone to Tsunami and Storm surge.

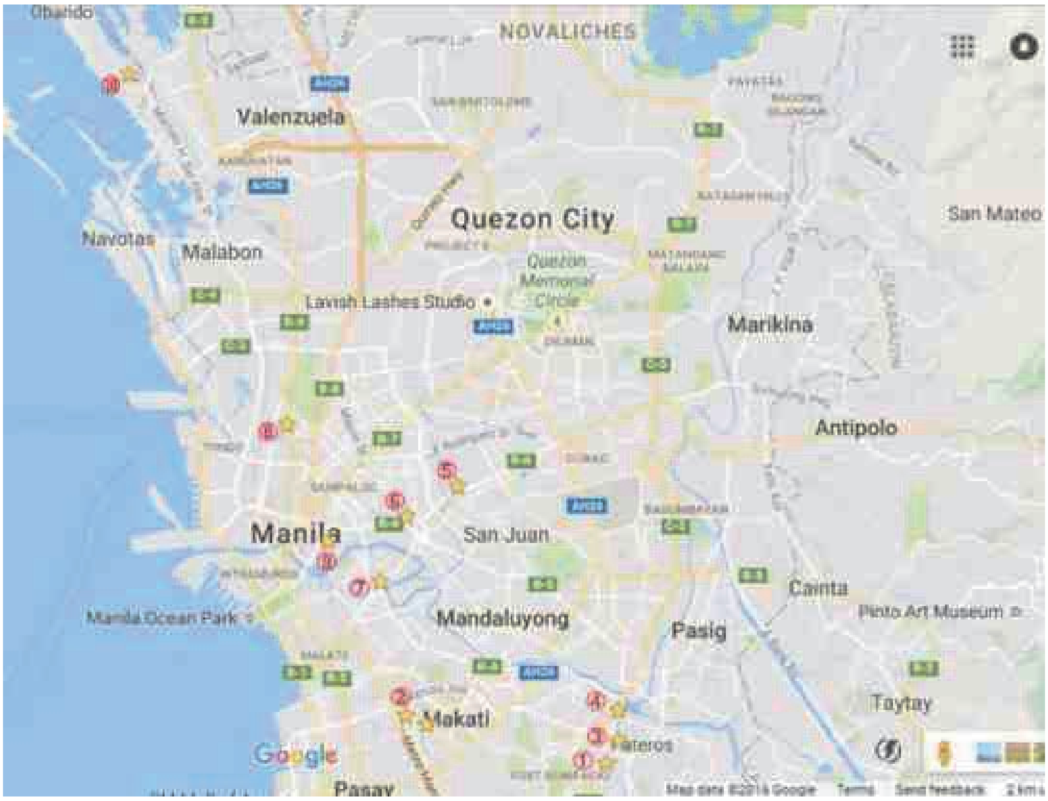


Figure 5-38 Location of 10 Schools

Source: The study team (Back ground map: Google Map)

b. Secondary Assessment: Earthquake

The purpose of the secondary assessment is to assess structural vulnerability to natural disasters. In the future GSIS staff may visit schools subject to insurance, evaluate the vulnerability of the building and reflect it in the premium rate.

For earthquakes, Rapid Visual Screening (RVS) by the Federal Emergency Management Agency (FEMA) was adopted for assessment. As for the quality of the building structures, it must be investigated and maintained during construction period because it is difficult to conduct quantitative assessment after completion of the buildings. Therefore, assessment items for building quality were not included in the secondary assessment sheet. Details for the assessment are shown in Annex J (Disaster Risk Assessment Method of Existing Schools). Furthermore, another seismic assessment was carried out by the structural design expert in order to verify the appropriateness of RVS results.

b.1 Methods of Assessment (Checklist)

Under the RVS of FEMA, a basic score will be determined according to the type of building structure, and then the score will be adjusted according to the seismic design standards, plan and vertical irregularity and ground conditions. The following is a sample of assessment sheet.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA P-154 Data Collection Form

Level 1
HIGH Seismicity

PHOTOGRAPH

Address: ____
Zip: ____
Other Identifiers: ____
Building Name: ____
Use: ____
Latitude: ____ **Longitude:** ____
S_S: ____ S_1: ____
Screener(s): ____ **Date/Time:** ____

No. Stories: Above Grade: ____ Below Grade: ____ **Year Built:** ____ ☐ EST
Total Floor Area (sq. ft.): ____ **Code Year:** ____
Additions: ☐ None ☐ Yes, Year(s) Built: ____

Occupancy: Assembly Commercial Emer. Services ☐ Historic ☐ Shelter
Industrial Office School ☐ Government
Utility Warehouse Residential, # Units: ____

Soil Type: ☐A Hard Rock ☐B Avg Rock ☐C Dense Soil ☐D Stiff Soil ☐E Soft Soil ☐F Poor Soil DNK *If DNK, assume Type D.*

Geologic Hazards: Liquefaction: Yes/No/DNK Landslide: Yes/No/DNK Surf. Rupt.: Yes/No/DNK

Adjacency: ☐ Pounding ☐ Falling Hazards from Taller Adjacent Building

Irregularities: ☐ Vertical (type/severity) ____
☐ Plan (type) ____

Exterior Falling Hazards: ☐ Unbraced Chimneys ☐ Heavy Cladding or Heavy Veneer
☐ Parapets ☐ Appendages
☐ Other: ____

COMMENTS:

SKETCH

☐ Additional sketches or comments on separate page

BASIC SCORE, MODIFIERS, AND FINAL LEVEL 1 SCORE, S_{L1}

FEMA BUILDING TYPE	Do Not Know	W1	W1A	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	MH
Basic Score		3.6	3.2	2.9	2.1	2.0	2.6	2.0	1.7	1.5	2.0	1.2	1.6	1.4	1.7	1.7	1.0	1.5
Severe Vertical Irregularity, V_{L1}		-1.2	-1.2	-1.2	-1.0	-1.0	-1.1	-1.0	-0.8	-0.9	-1.0	-0.7	-1.0	-0.9	-0.9	-0.9	-0.7	NA
Moderate Vertical Irregularity, V_{L1}		-0.7	-0.7	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.5	-0.6	-0.4	-0.6	-0.5	-0.5	-0.5	-0.4	NA
Plan Irregularity, P_{L1}		-1.1	-1.0	-1.0	-0.8	-0.7	-0.9	-0.7	-0.6	-0.6	-0.8	-0.5	-0.7	-0.6	-0.7	-0.7	-0.4	NA
Pre-Code		-1.1	-1.0	-0.9	-0.6	-0.6	-0.8	-0.6	-0.2	-0.4	-0.7	-0.1	-0.5	-0.3	-0.5	-0.5	0.0	-0.1
Post-Benchmark		1.6	1.9	2.2	1.4	1.4	1.1	1.9	NA	1.9	2.1	NA	2.0	2.4	2.1	2.1	NA	1.2
Soil Type A or B		0.1	0.3	0.5	0.4	0.6	0.1	0.6	0.5	0.4	0.5	0.3	0.6	0.4	0.5	0.5	0.3	0.3
Soil Type E (1-3 stories)		0.2	0.2	0.1	-0.2	-0.4	0.2	-0.1	-0.4	0.0	0.0	-0.2	-0.3	-0.1	-0.1	-0.1	-0.2	-0.4
Soil Type E (> 3 stories)		-0.3	-0.6	-0.9	-0.6	-0.6	NA	-0.6	-0.4	-0.5	-0.7	-0.3	NA	-0.4	-0.5	-0.6	-0.2	NA
Minimum Score, S_{MIN}		*1.1*	*0.9*	*0.7*	*0.5*	*0.5*	*0.6*	*0.5*	*0.5*	*0.3*	*0.3*	*0.3*	*0.2*	*0.2*	*0.3*	*0.3*	*0.2*	*1.0*

FINAL LEVEL 1 SCORE, $S_{L1} \geq S_{MIN}$:

EXTENT OF REVIEW
Exterior: ☐ Partial ☐ All Sides ☐ Aerial
Interior: ☐ None ☐ Visible ☐ Entered
Drawings Reviewed: ☐ Yes ☐ No
Soil Type Source: ____
Geologic Hazards Source: ____
Contact Person: ____

LEVEL 2 SCREENING PERFORMED?
☐ Yes, Final Level 2 Score, S_{L2} ____ ☐ No
Nonstructural hazards? ☐ Yes ☐ No

OTHER HAZARDS
Are There Hazards That Trigger A Detailed Structural Evaluation?
☐ Pounding potential (unless S_{L2} > cut-off, if known)
☐ Falling hazards from taller adjacent building
☐ Geologic hazards or Soil Type F
☐ Significant damage/deterioration to the structural system

ACTION REQUIRED
Detailed Structural Evaluation Required?
☐ Yes, unknown FEMA building type or other building
☐ Yes, score less than cut-off
☐ Yes, other hazards present
☐ No
Detailed Nonstructural Evaluation Recommended? *(check one)*
☐ Yes, nonstructural hazards identified that should be evaluated
☐ No, nonstructural hazards exist that may require mitigation, but a detailed evaluation is not necessary
☐ No, no nonstructural hazards identified ☐ DNK

Where information cannot be verified, screener shall note the following: EST = Estimated or unreliable data OR DNK = Do Not Know

Legend: MRF = Moment-resisting frame; BR = Braced frame; RC = Reinforced concrete; SW = Shear wall; URM INF = Unreinforced masonry infill; TU = Tilt up; MH = Manufactured Housing; LM = Light metal; FD = Flexible diaphragm; RD = Rigid diaphragm

Figure 5-39 Field Seismic Assessment Sheet (FEMA RVS)

Source : FEMA, https://www.fema.gov/media-library/assets/documents/15212

Almost all the public school buildings in Metro Manila are made of reinforced concrete, classified as FEMA building type C1. The chronology of the structural code of Philippines is summarized below with reference to the USA building code.

Table 5-38 Chronology of Seismic Design Standards in Philippines[39]

Generation	Seismic Design Methods in Philippines [ ] indicate relevant USA standard	Building Completion Year	Earthquake Area Coefficient	Seismic Design Methods
1st-Generation	—	Before 1974	—	—
2nd-Generation	**NSCB 1972**・1981・1987 [UBC 1970・1979・1985]	1975～1993	NSCB 1972・1981 : Nil NSCB 1987 : Metro Manila: Zone 4 Z＝1.0	allowable stress design method
3rd-Generation	**NSCP 1992** [UBC 1988]	1994～2002	Metro Manila: Zone 4 Z＝1.0	allowable stress design method
4th-Generation	NSCP 2001・2010 [UBC 1997・IBC 2009]	After 2003	Metro Manila: Zone 4 Z＝1.0	ultimate stress design method or allowable stress design method

According to the table above, "Pre Code", before adoption of seismic code, is set to 1972 and "Post Benchmark", after adoption of seismic code is set to 1992[40].

b.2 Assessment Results

The field survey was conducted from the 25th to 29th July 2016 with secondary assessment sheet. Staff of GSIS's marketing department also participated in the field survey. Each evaluation sheet is referred to in Annex G The result of Secondary vulnerability Assessment. In addition, the following is a summary of the seismic risk evaluation.

Table 5-39 Summary of Seismic Risk Evaluation by FEMA RVS

	ID NO	School Name	Construction Year	Floor	Type of Building	Basic	Severe VI	Modrate VI	Plan Irregularity	Pre Code (before1972)	Post Benchmark (After 1992)	Total	Final Point	% from 1.5
1	320607	Simplicio Malano NHS	2013	3	C1L	**1.5**					1.9	**3.4**	**3.4**	227%
2	136704	Hen Pio Del Pilar ES I	1987	3	C1M	**1.5**			-0.6			**0.9**	**0.9**	60%
3	305412	Benigno Aquino HS	2006	4	C1M	**1.5**	-0.9				1.9	**2.5**	**2.5**	167%
4	136697	Tibagan ES	1986	2	C1L	**1.5**						**1.5**	**1.5**	100%
5	136745	Salapan ES	1971	2	C1L	**1.5**		-0.5	-0.6	-0.4		**0.0**	**0.3**	20%
6	136469	Antonio Maceda IC	1981	3	C1L	**1.5**						**1.5**	**1.5**	100%
7	136482	Bagong Diwa ES	1966	4	C1M	**1.5**	-0.9		-0.6	-0.4		**-0.4**	**0.3**	20%
8	136422	Antonio Luna ES	1945	2	C+W	**1.5**		-0.5	-0.6	-0.4		**0.0**	**0.3**	20%
9	305315	Victoriano Mapa HS	1968	4	C1M	**1.5**			-0.6	-0.4		**0.5**	**0.5**	33%
10	136800	A.Daeto ES	2011	3	C1M	**1.5**		-0.5	-0.6		1.9	**2.3**	**2.3**	153%

[39] Chronology of coefficients and factors in seismic design is shown in Annex L and comparison of seismic design standards among Philippines, USA and Japan is shown in Annex M.

[40] According to the "Development of Vulnerability Curves of Key Building Type in the Greater Metro Manila Area, Philippines 2014" design code in 1992 is set to Hi-Code and different vulnerability curves were applied.

Note: Evaluation item for soil condition was deleted since intensity of hazards is subject to the location of the buildings

- Three schools obtained points over 2.0[41] and they were all constructed after 1992, under the new building standard.
- Two schools obtained a basic score of 1.5, one school obtained a score of 0.9 and the other four schools scored 0.3, which is the lowest score.
- The four schools that obtained 0.3 were all constructed before 1972 when seismic resistance standards were newly introduced.
- The average score of the 10 schools is 1.3.

The 10 schools will be separated into a few groups according to the points and a few vulnerability curves will be applied to each group. As a result, insurance premiums will be calculated under risk related premium calculation tools.

b.3 Verification of the RVS Assessment Results

As mentioned before, RVS assessment results were verified by the structural design expert.

Evaluation was made according to the location of the buildings (seismic and liquefaction risk). The field survey results were conducted according to the items shown in the table below. It was assumed that the buildings were constructed according to the relevant building standards at the time of construction.

Table 5-40 Seismic Evaluation Criteria

Item	Criteria	Evaluation Methods	1st～3rd-Generation	4th-Generation
Location	Seismic Risk	Distance from "West Valley Fault"	Consideration for all the cases	Consideration in cases within 5km
	Liquefaction	Liquefaction Hazard Map by PHIVOLCS	Consideration in cases with "Areas of High-Moderate Hazard"	Not required
Building	Structural Resilience	Concrete Compression Strength	Less than 18N/mm2	
	Distortion, Swing	Horizontal Plan・Vertical Rigidity	Consideration for all the cases	Consideration is not required
	Brittle fracture	Extreme short column (Opening/Column Height≦2.0)	Consideration for all the cases	

Evaluation results of public schools are shown in "List of the seismic risk evaluation results based on field survey of 10 selected public schools[42]" (Refer to Annex N).

[41] In case the score is less than 2.0, it is recommended to go for further investigation by the structural design expert.

[42] The evaluation results by FEMA P - 152 RVS are also listed in the "List of the seismic risk evaluation results based on field survey of 10 selected public schools". Regarding the evaluation results of RVS, there are slight differences in evaluation results due to the difference of "Near-Source Factor Ca, Cv" between "NSCP 2001,

It is concluded that RVS assessment results and this evaluation are almost similar, and the RVS assessment results can be utilized for grouping buildings according to the vulnerability.

However, in consideration of the distance from the West Valley fault, it was evaluated that 9 out of 10 schools need some reinforcement.

c. Secondary Assessment: Windstorm, Floods and Landslides

c.1 Assessment Sheet

As for windstorms, floods and landslides, the study team has modified assessment sheet from UNISDR "Guidance Note on Safer School Construction (2009)" by extracting items that can be visually judged (including those that may be visually judged depending on the situation) in the field investigation (refer to the figure shown below).

Evaluation Sheet for Vulunerability of School Building

LGU			Const. Year		
School ID			Structure Type		
School Name			Num of Storey		
Bldg Name			Const. Quality		Good, No good
Policy No.			O&M Quality		Good, No good

Evaluation based on Basic design guidelines					Evaluation					
No	Hazard	Area of evaluation	GL item	Item assessed	Visivility at site	Yes	No	Not Applicable	DNK	Remarks
1	Windstorms	Roof	W10	Roof's slope is between 30 to 45 degrees. (Avoid very low and very steep sloped roofs.)	○					
2			W11	Avoid wide roof overhangs.	○					
3			W12	Minimize total height of building.	○					
4		Exterior surface	W14	Minimize exterior surface irregularities.	○					
5		Transitional spaces	W17	Verandahs should be structurally separated, not have extension roofs attached to the main roof.	○					
6		Interior components	W21	Brace or secure interior non-structural elements of the building to structural elements.	○					
7	Floods	Water pressure	F11	Design and construct shear walls, columns, or fill to elevate building.	○					
8		Wet-proofing a building	F12	Create a waterproof building.	○					
9			F14	Design building such that water can quickly drain from all building components.	○					
10	Landslides, mudslides	General	Added	Designed/constructed with any special attention(s) for sediment disasters	○					

Source: The study team modified from UNISDR "Guidance Note on Safer School Construction (2009)"

Figure 5-40 Field Assessment Sheet for Windstorm, Floods and Landslide

According to the assessment sheet, the more yes boxes that are checked, the more resilient the building is to relevant hazards. Details on the effect of the measures for windstorm are shown in the table on the next page.

It is thought that by surrounding the premises of public schools in Metro Manila with concrete walls and installing a flood-proof wall at the gates, it is possible to implement flood prevention measures if the flooding depth during a flood is around 1 meter. However, during implementation of the measures, there is a need to verify the level of water pressure that the flood-proof walls and concrete walls are capable of withstanding and whether or not the drainage facilities within the school premises would flow back into the school and cause flooding.

2010" and "UBC 1997", for two schools（1.【320607】Mayor Simplicio Manalo NHS，and 3.【305412】Benigno "Ninoy" S. Aquino HS_160726）where the design standards are in the school buildings after 1992 and are very close to active faults.

Table 5-41 Effect of measures

Component	The effect of measures
W7 Connection of structural elements	Connection of all structural elements is important. The survey on the damage caused by Typhoon Haiyan found some roofs had been blown off due to their insufficient connection to the walls or pillars (Photo1, 2). The damage was caused due to the inappropriate connection of the joining part by "embracing" the horizontal beams constituting the roof with the reinforcing bars extending from the wall or the pillar (as indicated in red circle in photo 2). Currently, the reinforcing bars are individually bent and embraced in the horizontal beams but not "tied" to each other. This state leads to open easily when an external force is applied. Improvement of considerable strength is expected by connecting reinforcing bars with each other.
W10 Roof slopes W12 Building height W14 Building shape	Given the required performance of school buildings, it is difficult to make a drastic change in the roof slope, building height and building shape. Also, with some changes from current school building specifications, we cannot expect significant load reduction effect.
W11 Roof overhangs W17 The roof of the veranda separated from that of main structure	For roof overhangs and the roof of the verandas separated from that of main structure, it is better to avoid wide roof overhangs considering wind loads. On the other hand, it is difficult to make all the roofs narrower considering everyday rain and sunlight control. Avoid attaching veranda roof structurers to main roof (and that of transitional spaces such as a corridor) is effective for suppressing the expansion of roof damage, and makes it easier to repair damaged parts as they can be separated.
W18 Fixing the building envelope to the structure	Securely fasten building envelope to structure is important, in particular to reduce damage to roof coverings. Damage develops from the point where roof coverings are attached to the structural elements with a nail (or a screw etc.) and tear off roof coverings. Such damage includes pull-out (nails), pull-over, and shear-tear-out, which were also common in the damage caused by the Typhoon Haiyan (Photo 3, 4). Such damage can be reduced by using roofing coverings of appropriate thickness and appropriate nails (or appropriate screws etc.), and by decreasing fastening interval. However, material tests are required to select appropriate fasteners. Also, the necessary and sufficient fastening schedule needs to be calculated for each region, as the wind hazard differs from region to region. Although school buildings in other developing countries including the Philippines are specially designed, specification concerning the fastener is not defined, and it is effective to specify this specification to improve wind resistance in these areas.
W19 Protection against wind-borne debris **W20 Wind resistance in openings**	Protection against wind-borne debris, wind resistance in openings. Major strong wind damage mode includes such damage that strong wind, blowing into existing openings made by wind-borne debris, by damage to doors and windows, made for ventilation, and by inappropriate construction, raises internal pressure of the building and blows off roof coverings. The measure to prevent the effect of large wind pressure and the collision of scattered materials by introducing a shutter door is effective because it is difficult to reduce the damage caused by a large wind pressure or collision of scattered objects by raising the strength of the door or window glass or the jalousie window itself.
W21 Brace, support and/or attach interior components (desk/chair) to the structural elements	It seems that the effect of reducing damage caused by the attaching interior components is not large. Interior components in the classroom are limited such as desks / chairs and simple teaching materials, and the major damage factors are wetting by leaking rainwater. Even if component scattering caused by wind-acting can be prevented by the attaching components, water leakage cannot be prevented. In addition, since it seems that the school will be canceled when the typhoon strikes, there are no people in the classroom, and human casualty due to scattering of components is unlikely (please refer to photo5 and 6).

<u>Underlined and bold text</u>: highly effective, <u>Underlined text:</u> moderately effective,

No formatted text: lowly effective

Photo: Damage of roof structural elements (at school in Pastrana, Leyte Island)

Photo: Damage of roof structural elements due to poor connection (Left) (at school in Pastrana, Leyte Island)

Photo: Pull-over failure of roof panel blown-off (at school in Pastrana, Leyte Island)

Photo: A wind-blown roofing with a hole in the connection part (at school in Pastrana, Leyte Island)

Photo: Damage to interior components including desks and chairs (at school in Gujuan, Samar Island)

Photo: Water damage to textbooks (at school in Gujuan, Samar Island)

c.2 Assessment Results on Windstorm, Floods and Landslide

A summary of the evaluation is shown below.

Table 5-42 Summary of Field Evaluation for Wind storms, Floods and Landslides

No.	School ID	School Name	Construction Year	Number of Storey	Total Floor Area	Windstorm			Flood			Sediment Disaster	
						Yes	No	Yes %	Yes	No	Yes %	Yes	No
1	320607	Simplicio (Agripino) Manalo NHS	2013	3	1,596	3	2	60.0%	3	0	100.0%	0	1
2	136704	Hen Pio Del Pilar ES I	1987	3	2,081	4	2	66.7%	2	1	66.7%	0	1
3	305412	Benigno Aquino HS	2006	4	13,907	3	2	60.0%	2	1	66.7%	0	1
4	136697	Tibagan ES	1986	2	543	4	2	66.7%	2	1	66.7%	0	1
5	136745	Salapan ES	1971	2	1,288	2	4	33.3%	2	1	66.7%	0	1
6	136469	Antonio Maceda Integ. S	1981	3	2,178	2	3	40.0%	2	0	66.7%	0	1
7	136482	Bagong Diwa ES	1966	3	2,249	0	6	0.0%	2	1	66.7%	0	1
8	136422	Antonio Luna ES	1945	2	982	2	4	33.3%	2	1	66.7%	0	1
9	305315	Victoriano Mapa HS	1968	4	8,596	3	3	50.0%	2	1	66.7%	0	1
10	136800	Arcadio F. Deato ES	2011	3	1,231	3	3	50.0%	2	1	66.7%	0	1

Note: Based on the "Guidance Note on Safer School Construction (UNISDR, 2009)", the study team extracted the evaluation items which can evaluate visually and modified the sheet. In case 'Yes %' is more, the school is evaluated as resilient to the relevant hazard.

- Regarding windstorms, four schools obtained over 60 % of "yes" ratio, two schools obtained over 50 %, and three schools obtained less than 33 %. One school obtained 0 %; it has a weak structure on its top floor where there are columns and a roof without a wall.

- Regarding floods, Evaluation was divided depending on whether there was drainage facility, but it is structured to withstand immersion in all cases, water proof paint is applied to all the schools and there are not many different factors except existence of drainage systems.

- Regarding landslides, there are no buildings which can structurally resist strong forces like landslides. However, most of the surveyed schools were built in a flat area, and also considering its surrounding environment, there is a low probability of landslide occurrence for the 10 schools.

For floods, different vulnerability curves will be applied according to the number of storeys. As a result, insurance premiums will be calculated by risk-based premium rate calculation tool.

For landslides, whether buildings collapse or not depend on the occurrence of landslides. Therefore, structural vulnerability will not be considered and location of the building will govern the possibility of the occurrence of loss.

5.4.2 Results of Risk Assessment on MRT-3

a. Facilities Subject to Assessment

The risk assessment on MRT 3 was conducted based on the local survey results and the standards for seismic retrofitting that were probably applied to the design, since it was not possible to obtain detailed construction drawings and structural calculation sheets. The facilities subjected to assessment were only those with structural objects. The following table shows the facilities subject to assessment.

Table 5-43 Facilities Subject to Assessment

№	Facility Name	Structure Type	Frame Structure	Structural Features
1	Stations	Railway part: reinforced concrete structure, precast structure Station building part: steel structure	Ramen framework Ramen framework with steel pipes	A station building constructed with steel will be built over the railways constructed with reinforced concrete.
2	Railway Viaduct	Pillars/Stringers: reinforced concrete structure Beams: Precast structure	Gate-style ramen framework Monopole structure	General elevated bridge structure
3	Depot	Reinforced concrete structure	Ramen framework	The depot will be in the basement and first floors, and a shopping mall will be constructed above.

b. Design Specification

Considering that MRT-3 construction was begun in October 1996 and operations commenced in 1999, the following design standards and material standards are assumed to have been adopted for each facility's structural design.

Design standards

- Portions made of reinforced concrete: ACI-318-89 (ACI: American Concrete Institute) or NSCP 1992 (4th Edition)
- Portions made with steel frame: NSCP 1992, because there was no AISC (AISC：American Institute of Steel Construction) standard at the time of the design
- Seismic retrofitting standard: Refer to 1994 NEHRP or 1994 Edition FEMA 222A/223A

Material standards

- Portions made of reinforced concrete: Concrete ASTM A-318-89; steel ASTM A-615
- Portions made with steel frame: ASTM A-36 or ASEP Handbook（ASEP: Association of Structural Engineers of the Philippines）

c. Consideration of Seismic Retrofitting based on Field Survey Results and Design Criteria

The consideration of design criteria and seismic performance is described below based on the results of on-site survey.

c.1 Station Buildings

(Overview on Design Criteria)

(1) The structure is surmised to have been designed using ultimate strength design because precast components have been used
(2) Because NSCP 1992 was an allowable stress design, ultimate strength design based on Load & Resistance Factor Design (LRFD) is surmised to have been used, with 1994 NEHRP as a reference.
(3) "Near-Source Factors" in NSCP 2010, the current seismic regulation in the Philippines, were adopted in 1994 Edition FEMA 222A/223A.

(Overview on Seismic Resistance)

(1) The Seismic Zone Factor of 0.4 for MM in NSCP 1992 is equivalent to the "very rare seismic ground motion" in Japan's seismic regulations, but because of the difference in the base shear coefficient calculation procedure and other factors, for two-level buildings made of reinforced concrete, the proof strength is surmised to be about 75%.
(2) The steel-frame stations rest on elevated bridges made of reinforced concrete, and because of the difference in rigidity, there is a possibility that parts of the stations will be buffeted vigorously by local seismic intensity.
(3) The sway bracing for equipment and ducts installed in station ceilings is inadequate, and the equipment and ducts are projected to drop if parts of the stations sway vigorously as mentioned above.

c.2 Railway Viaducts, Railway track, Elevated (railway)

(Overview on Design Criteria)

It is same as Station Buildings.

(Overview on Seismic Resistance)

It is same as (1) of Station Buildings.

In addition, the details of the support sections for precast girder stringers could not be confirmed.

c.3 Depot (Railyard)

(Overview on Design Criteria)

(1) For the structure, the ultimate strength design is surmised to have been carried out to meet the design criteria of other facilities.
(2) Identical to Station Buildings.
(3) Identical to Station Buildings
(4) Because a depot is built in the basement of the shopping mall built on the ground, it is designed taking this weight into account.

Full view of the station building

Inside the station building

Railway Part of the Station

Railway Viaduct

Photo Field survey of MRT 3

The study team conducted a seismic safety evaluation for Station Building Part and Railway Part respectively, and the reinforcement procedures described below will be considered when reinforcing the various components.

■ Station Building Part

- Strengthen with enclosed reinforced concrete

  To prevent them from shaking significantly due to a lack of rigidity of the station building

- Strengthen steel beams and pillars

  if joints are not strong enough.

- Prevent the buckling of steel beams

  Prevent the lateral buckling of steel beams

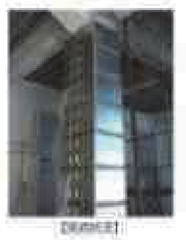
- Reinforce seismic isolated duct

  Increase the deformation following performance of duct

■ Railway Part

- Strengthen reinforced concrete pillars using panels

  Increase the strength of pillars



- Strengthen reinforced concrete pillars using panels

5.4.3 NAIA T3

Since the study team was unable to obtain drawings and a structural accounting statement, the study team performed the NAIA T3 risk assessment based on the field survey results and the seismic standards envisaged to be adopted for design.

The structures evaluated were Terminal 3 and Car Park.

Considering the fact NAIA T3 construction began in 1997 and operations commenced in 2008, the following design standards and material standards are surmised to have been adopted for the structural design of each facility.

a. Design Standards

- Portions made of reinforced concrete: ACI-318-89
  (ACI: American Concrete Institute) or NSCP 1992 (4th Edition)
- Portions made with steel frame: NSCP 1992, because there was no AISC (AISC ： American Institute of Steel Construction) standard at the time of the design
- Seismic retrofitting standard: Refer to 1994 NEHRP or 1994 Edition FEMA 222A/223A

b. Material Standards

- Portions made of reinforced concrete: Concrete ASTM A-318-89; steel ASTM A-615
- Portions made with steel frame: ASTM A-36 or ASEP Handbook (ASEP: Association of Structural Engineers of the Philippines)

c. Evaluation of Seismic Retrofitting based on Field Survey Results and Design Criteria

The study team will describe the discussion regarding seismic retrofitting based on the field survey results and these design standards.

c.1 Terminal 3

(1) Judging from the roof shape and other considerations, by structural type the building is surmised to be steel frame construction, with reverse-V type brace structure construction work in the longer side direction and rigid frame construction in the short side direction.

(2) Because NSCP 1992 was an allowable stress design, ultimate strength design based on Load & Resistance Factor Design (LRFD) is surmised to have been used, with NEHRP as a reference.

(3) "Near-Source Factors" in NSCP 2010, the current seismic regulation in the Philippines, were adopted in 1994 Edition FEMA 222A/223A.

(4) The study team were unable to confirm the ceiling material subframe, hangers, and sway bracing in the ceiling, and the sway bracing for the equipment and ducts installed in the ceiling.

There is a possibility the ceiling, equipment, and ducts will drop if they sway vigorously during an earthquake.

c.2 Car Park

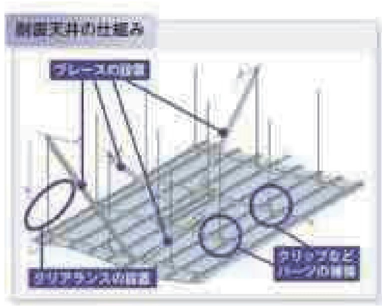
(1) Judging from its use, by structural type the building is surmised to be reinforced concrete structure, with rigid frame construction work in the long side and short side directions, and a floor of precast concrete construction.

All others were identical to Terminal 3.

Terminal 3 External view

Terminal 3 Interior

c.3 Seismic Reinforcement Method for Ceiling of Terminal 3



Strengthen the ceiling material subframe material, and install additional braces.

Brace using earthquake resistant clips, earthquake resistant suspenders, etc.

5.5 Trial Calculation of Insurance Premiums based on Public School Risk Assessment Results

Once the risk assessment results for public schools have been obtained, it will be possible to use the vulnerability curves discussed above as a function of the evaluation result points. The relationship between the years in which seismic regulations were revised and the points obtained from the field surveys is laid out below. In this study, we recommend selecting the vulnerability curve based on the risk assessment points as follows, with consideration given to the field survey results and effects of the vulnerability curve on determination of the premium rates.

Table 5-44 Selection of vulnerability curves based on risk assessment points

Risk assessment points	Vulnerability curves Earthquake	Vulnerability curves Typhoon	Vulnerability curves Flood, Storm surge, Tsunami
～0.6	Rank 31,37	Select a curve according to age, structure type	Regardless of points, create input data according to floor height, impervious wall measures
0.7～1.7	Rank 33,39		
1.8～2.5	Rank 35,41		
2.6～	Rank 36,42		

Table 5-45 Chronology of Seismic Design Standards in Philippines

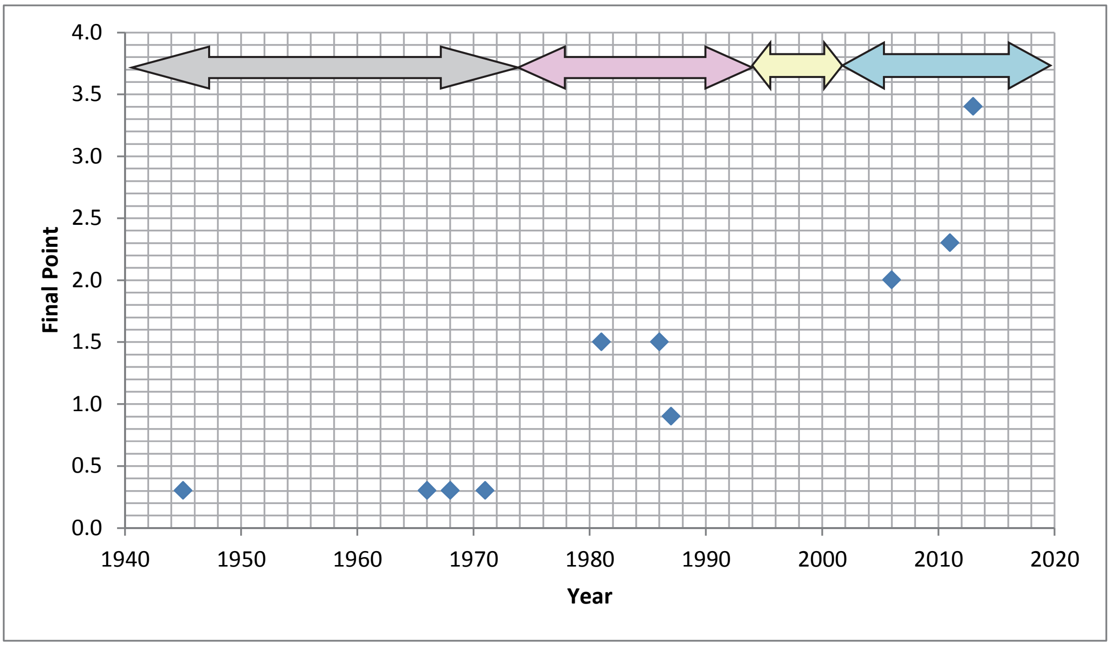
Generation	Seismic Design Methods in Philippines [ ] indicate relevant USA standard	Building Completion Year	Earthquake Area Coefficient	Seismic Design Methods
1st-Generation	―	Before 1974	―	―
2nd-Generation	**NSCB 1972**・1981・1987 [UBC 1970・1979・1985]	1975～1993	NSCB 1972・1981 : Nil NSCB 1987 : Metro Manila: Zone 4 Z＝1.0	allowable stress design method
3rd-Generation	**NSCP 1992** [UBC 1988]	1994～2002	Metro Manila: Zone 4 Z＝1.0	allowable stress design method
4th-Generation	NSCP 2001・2010 [UBC 1997・IBC 2009]	After 2003	Metro Manila: Zone 4 Z＝1.0	ultimate stress design method or allowable stress design method

*NSCB: National Structural Code of Buildings

*UBC: Uniform Building Code

*IBC: International Building Code

Table 5-46 Relationship between earthquake resistant design standards and risk assessment result points



The premium rates analyzed using the recommended curves, and the premium rates assuming the countermeasures are implemented, are shown on the following page. The study team performed an analysis by assuming replacement cost for all schools. Exposure data used for analysis and analysis results are shown on the following pages.

Although the study team were able to confirm an effect of 10,000 pesos or more per school if the seismic countermeasures are implemented, for typhoons the study team could only confirm an effect of several thousand pesos. The reason is that because the level of damage from typhoons is small to begin with, the effect from countermeasures is small as well. The value of the tariff rate GSIS currently is using for typhoons is set one digit smaller than the rate for earthquakes.

By understanding the change in the pure premium rate calculated using the tool, it will be possible to prepare a system in the future that can calculate the cost-effectiveness of resiliency enhancement measures for public infrastructure. As this trial calculation makes clear, however, the insurance premium reduction effect alone will not become a strong incentive to strengthen public infrastructure. In the following chapters, the study team proposes a scheme to move forward with resiliency enhancements by using not only the insurance premium reduction but other incentives as well as a set.

Table 5-47 Input of exposure data

No_	CITY	Location N	Latitude	Longitude	Replacement	Rank_EQ	Rank_TY	Rank_FL	FL_Wall(m)
1	Current	Simplicio Malano NHS	14.5443917	121.0620778	25855200	42	25	3	0
2	Current	Hen Pio Del Pilar ES I	14.5555556	121.0116667	33708960	33	22	3	0
3	Current	Benigno Aquino HS	14.5497361	121.0651361	233640960	35	24	4	0
4	Current	Tibagan ES	14.5570861	121.0642972	7757750	39	18	2	0
5	Current	Salapan ES	14.6111111	121.0244444	18418400	37	18	2	0
6	Current	Antonio Maceda IC	14.6032	121.0118111	35283600	33	18	3	0
7	Current	Bagong Diwa ES	14.5881111	121.0053472	36439308	31	18	3	0
8	Current	Antonio Luna ES	14.6267611	120.9816889	14048320	37	22	2	0
9	Current	Victoriano Mapa HS	14.5979333	120.9922778	144412800	31	22	4	0
10	Current	A.Daeto ES	14.7113889	120.9422222	19937664	35	24	3	0
11	Improved	Simplicio Malano NHS	14.5443917	121.0620778	25855200	42	25	3	1
12	Improved	Hen Pio Del Pilar ES I	14.5555556	121.0116667	33708960	42	25	3	1
13	Improved	Benigno Aquino HS	14.5497361	121.0651361	233640960	42	25	4	1
14	Improved	Tibagan ES	14.5570861	121.0642972	7757750	36	21	2	1
15	Improved	Salapan ES	14.6111111	121.0244444	18418400	36	21	2	1
16	Improved	Antonio Maceda IC	14.6032	121.0118111	35283600	42	25	3	1
17	Improved	Bagong Diwa ES	14.5881111	121.0053472	36439308	42	25	3	1
18	Improved	Antonio Luna ES	14.6267611	120.9816889	14048320	36	21	2	1
19	Improved	Victoriano Mapa HS	14.5979333	120.9922778	144412800	42	25	4	1
20	Improved	A.Daeto ES	14.7113889	120.9422222	19937664	42	25	3	1

Table 5-48 Earthquake premium rate calculation results (present facilities)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	10,733,823	18,035,570	110,940,825	3,557,022	8,080,662	19,235,205	19,234,655	5,506,388	71,659,837	6,113,139
500	9,925,299	15,714,743	103,644,498	3,308,680	6,556,966	16,689,176	16,962,940	4,662,053	62,998,737	5,691,269
400	9,425,914	14,726,779	98,128,596	3,162,844	6,132,054	16,164,722	16,351,524	4,521,489	61,540,225	5,406,673
300	7,517,535	13,924,300	81,431,015	2,606,236	5,297,869	14,638,048	15,317,539	4,184,657	57,502,208	5,213,978
200	5,811,881	12,172,496	62,681,726	1,932,823	4,018,179	12,712,038	13,427,031	3,550,367	52,138,200	4,758,496
150	4,612,631	10,977,305	50,686,254	1,554,076	3,414,798	11,429,758	12,228,999	3,110,157	47,737,030	4,419,906
100	3,270,451	9,077,645	36,543,419	1,102,725	2,697,337	9,794,587	10,539,303	2,587,234	41,227,599	3,709,864
50	1,426,546	5,213,628	16,754,284	475,587	1,089,203	5,611,086	6,440,704	1,391,585	26,395,243	2,352,230
AAL	129,392	437,184	1,470,151	42,652	94,581	470,868	554,869	107,773	2,311,222	173,864
STD	733,772	1,548,420	7,817,513	245,804	537,799	1,652,437	1,779,020	451,005	6,997,982	616,264
Replacement Cost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.50%	1.30%	0.63%	0.55%	0.51%	1.33%	1.52%	0.77%	1.60%	0.87%

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

Table 5-49 Earthquake premium rate calculation results (facilities after implementation of countermeasures: assuming measures are taken to score 2.6 points or more in risk evaluation)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	10,733,823	12,565,569	97,711,224	2,718,144	6,115,469	13,537,400	13,304,050	4,069,467	47,958,497	5,148,417
500	9,925,299	10,176,918	90,594,702	2,488,833	4,753,356	10,890,512	10,976,899	3,334,142	39,411,546	4,761,735
400	9,425,914	9,219,958	85,267,992	2,356,593	4,388,132	10,373,370	10,380,416	3,214,947	38,035,845	4,502,815
300	7,517,535	8,469,310	69,424,332	1,868,257	3,689,929	8,923,274	9,400,807	2,933,108	34,323,917	4,328,406
200	5,811,881	6,914,961	52,153,117	1,312,687	2,668,928	7,213,174	7,705,672	2,417,156	29,615,828	3,919,119
150	4,612,631	5,922,283	41,411,592	1,018,082	2,209,835	6,150,308	6,696,993	2,070,803	25,946,304	3,617,648
100	3,270,451	4,461,867	29,093,217	685,566	1,684,276	4,885,748	5,363,503	1,672,542	20,847,840	2,993,547
50	1,426,546	1,973,234	12,635,094	264,335	602,732	2,151,013	2,592,751	822,533	10,792,662	1,834,396
AAL	129,392	165,513	1,152,263	26,356	57,708	179,695	211,408	64,624	868,144	133,644
STD	733,772	872,135	6,631,508	176,284	378,825	931,671	981,716	307,832	3,712,514	499,262
Replace ment Cost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.50%	0.49%	0.49%	0.34%	0.31%	0.51%	0.58%	0.46%	0.60%	0.67%
Premium reduction	0	-271,672	-317,887	-16,296	-36,872	-291,173	-343,461	-43,149	-1,443,078	-40,220

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

Table 5-50 Typhoon premium rate calculation results (present facilities)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	90,164	140,222	2,009,764	116,327	183,791	321,364	313,205	58,771	594,559	1,294,313
500	63,371	97,566	1,502,032	90,547	123,626	229,519	231,617	37,829	392,389	1,105,042
400	52,236	87,811	1,256,072	81,444	115,989	211,174	200,706	34,687	334,122	1,069,513
300	46,300	73,604	1,141,222	74,446	108,309	192,766	190,158	31,745	308,947	1,022,042
200	35,561	55,113	899,669	61,801	86,422	158,291	163,864	23,718	246,627	950,558
150	26,915	44,666	749,806	54,323	74,679	138,136	133,373	19,790	196,047	847,850
100	19,766	32,343	549,372	42,634	57,970	108,323	106,474	13,781	136,959	729,123
50	10,718	17,385	323,053	28,776	37,895	69,288	67,423	6,915	69,943	543,612
AAL	858	1,416	24,098	2,467	3,195	5,868	5,866	587	5,956	48,804
STD	6,538	10,326	148,532	10,053	14,361	25,860	25,570	3,995	41,465	154,914
Replace ment Cost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.003%	0.004%	0.010%	0.032%	0.017%	0.017%	0.016%	0.004%	0.004%	0.245%

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

Table 5-51 Typhoon premium rate calculation results (facilities after implementation of countermeasures)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	90,164	50,329	820,376	8,923	11,568	59,712	56,509	6,861	213,034	870,963
500	63,371	33,009	581,239	6,147	6,438	35,754	35,629	4,191	131,432	704,442
400	52,236	29,218	470,977	5,253	5,861	31,431	28,525	3,812	109,143	674,605
300	46,300	23,830	420,893	4,598	5,299	27,272	26,217	3,461	99,712	635,426
200	35,561	17,082	318,793	3,492	3,802	20,012	20,745	2,531	76,937	577,896
150	26,915	13,425	257,904	2,886	3,069	16,122	14,954	2,091	59,130	498,300
100	19,766	9,285	179,905	2,020	2,119	10,915	10,406	1,435	39,253	410,785
50	10,718	4,588	97,697	1,135	1,140	5,259	4,922	716	18,306	283,871
AAL	858	419	7,847	95	101	477	461	65	1,743	22,863
STD	6,538	3,819	59,806	686	826	4,242	4,078	472	14,869	85,274
Replace ment Cost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.003%	0.001%	0.003%	0.001%	0.001%	0.001%	0.001%	0.000%	0.001%	0.115%
Premium reduction	0	-997	-16,251	-2,372	-3,094	-5,392	-5,405	-522	-4,213	-25,941

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

Table 5-52 Flood premium rate calculation results (present facilities)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	421,497	188,139	1,329,456	0	2,415,028	0	1,411,114	462,829	4,841,144	0
500	302,091	142,270	538,481	0	2,354,994	0	1,320,168	399,862	4,824,543	0
475	292,496	139,490	472,567	0	2,335,367	0	1,309,191	392,993	4,822,782	0
250	178,421	97,791	67,207	0	2,085,991	0	1,169,636	318,009	4,802,408	0
200	138,974	82,501	18,589	0	2,104,464	0	1,139,844	301,621	4,796,371	0
150	83,536	63,042	0	0	2,047,893	0	1,088,099	278,990	4,788,071	0
100	23,833	35,243	0	0	1,887,415	0	973,632	237,630	4,564,888	0
75	12,027	22,434	0	0	1,796,209	0	921,887	213,438	4,389,505	0
50	2,405	17,127	0	0	1,657,667	0	798,013	169,737	4,054,682	0
25	0	7,237	0	0	1,515,613	0	628,665	102,625	3,565,734	0
20	0	0	0	0	1,344,756	0	1,017,537	90,139	3,454,127	0
10	0	0	0	0	1,261,219	0	798,013	13,287	2,853,571	0
5	0	0	0	0	1,225,337	0	539,949	9,243	2,157,352	0
4	0	0	0	0	1,217,043	0	446,791	8,810	1,911,571	0
3	0	0	0	0	1,203,556	0	314,566	8,088	1,565,267	0
2	0	0	0	0	1,121,636	0	98,199	6,933	959,236	0
1.33	0	0	0	0	27,121	0	0	3,611	31,818	0
1.25	0	0	0	0	189	0	0	2,166	0	0
1.11	0	0	0	0	0	0	0	0	0	0
AAL	1,506	1,169	2,064	0	622,098	0	201,241	12,735	947,103	0
STD	19,212	9,826	45,663	0	587,831	0	273,119	38,558	1,094,585	0
Replacement Cost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.006%	0.003%	0.001%	0.000%	3.378%	0.000%	0.552%	0.091%	0.656%	0.000%

Table 5-53 Flood premium rate calculation results (Facilities that have installed 1m-impervious walls)

	Simplicio Malano NHS	Hen Pio Del Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	0	0	0	0	2,415,028	0	0	0	4,841,144	0
500	0	0	0	0	2,354,994	0	0	0	4,824,543	0
475	0	0	0	0	2,335,367	0	0	0	4,822,782	0
250	0	0	0	0	2,085,991	0	0	0	4,802,408	0
200	0	0	0	0	2,104,464	0	0	0	4,796,371	0
150	0	0	0	0	2,047,893	0	0	0	4,788,071	0
100	0	0	0	0	1,887,415	0	0	0	0	0
75	0	0	0	0	1,796,209	0	0	0	0	0
50	0	0	0	0	1,657,667	0	0	0	0	0
25	0	0	0	0	1,515,613	0	0	0	0	0
20	0	0	0	0	1,344,756	0	0	0	0	0
10	0	0	0	0	1,261,219	0	0	0	0	0
5	0	0	0	0	1,225,337	0	0	0	0	0
4	0	0	0	0	1,217,043	0	0	0	0	0
3	0	0	0	0	1,203,556	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
1.33	0	0	0	0	0	0	0	0	0	0
1.25	0	0	0	0	0	0	0	0	0	0
1.11	0	0	0	0	0	0	0	0	0	0
AAL	0	0	0	0	428,319	0	0	0	32,049	0
STD	0	0	0	0	599,502	0	0	0	391,082	0
ReplacementCost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.000%	0.000%	0.000%	0.000%	2.325%	0.000%	0.000%	0.000%	0.022%	0.000%
Premium reduction	-1,506	-1,169	-2,064	0	-193,780	0	-201,241	-12,735	-915,053	0

Table 5-54 Storm Surge premium rate calculation results (present facilities)

	Simplicio Malano NHS	Hen Del Pio Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	0	49,213,431	0	0	8,905,876	0	61,162,111	20,079,485	524,444,043	36,738,737
500	0	20,355,759	0	0	0	0	58,274,335	19,072,881	515,449,366	36,087,579
400	0	0	0	0	0	0	57,333,811	18,753,503	512,734,293	35,906,692
300	0	0	0	0	0	0	57,037,182	18,653,791	511,901,718	35,852,691
200	0	0	0	0	0	0	54,957,940	17,970,355	506,402,402	35,513,313
150	0	0	0	0	0	0	52,897,836	17,324,583	501,566,205	35,239,551
100	0	0	0	0	0	0	49,170,346	16,257,787	494,470,307	34,876,905
50	0	0	0	0	0	0	0	0	469,158,869	33,949,974
AAL	0	87,599	0	0	17,119	0	725,119	297,403	18,627,226	6,975,709
STD	0	2,019,987	0	0	591,781	0	6,093,506	2,168,340	89,914,132	11,176,542
ReplacementCost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.000%	0.260%	0.000%	0.000%	0.093%	0.000%	1.990%	2.117%	12.899%	34.988%

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

Table 5-55 Tsunami premium rate calculation results (present facilities)

	Simplicio Malano NHS	Hen Del Pio Pilar ES I	Benigno Aquino HS	Tibagan ES	Salapan ES	Antonio Maceda IC	Bagong Diwa ES	Antonio Luna ES	Victoriano Mapa HS	A.Daeto ES
1000	0	0	0	0	0	0	0	0	0	32,948,728
500	0	0	0	0	0	0	0	0	0	31,038,755
400	0	0	0	0	0	0	0	0	0	29,845,308
300	0	0	0	0	0	0	0	0	0	29,426,364
200	0	0	0	0	0	0	0	0	0	28,281,270
150	0	0	0	0	0	0	0	0	0	26,479,187
100	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
AAL	0	0	0	0	0	0	10,881	3,561	371,308	266,171
STD	0	0	0	0	0	0	769,641	251,865	13,138,500	2,710,132
ReplacementCost	25,855,200	33,708,960	233,640,960	7,757,750	18,418,400	35,283,600	36,439,308	14,048,320	144,412,800	19,937,664
Rate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.03%	0.26%	1.34%

*AAL:Annual Average Loss = Pure Premium

*STD:Standard Deviation

*Rate: = AAL / Replacement Cost

6 Utilization of the Risk-Based Premium Rate Calculation Tool

In this study, the study team has created a tool for calculating risk-based premium rates for Metro Manila (MM). By using the tool, it has become possible to know the pure premium of natural disaster insurance for facilities requiring insurance coverage. It has become possible to calculate a premium rate properly by finding out the pure premium, and it has also become possible to quantitatively assess the effect of strengthening public infrastructure in terms of premiums. By quantitatively demonstrating the effect of the measures in terms of premiums, it will become possible for relevant organizations to share numerical grounds for promoting the initiative of strengthening public infrastructure.

6.1 Insured Property by Using Risk-Based Premium Rate Calculation Tool

Natural disaster hazard data in MM is incorporated in the risk-based premium rate calculation tool in advance together with its occurrence probability. In addition, vulnerability curves of the facility subject to this study are incorporated according to the type of facility and the construction year. The tool user can calculate the premium rate (pure premium) for each building by selecting the vulnerability curve to be applied based on the facility information. The result shows the pure premium reflecting the natural disaster hazard corresponding to the location of the building and the degree of damage based on the strength of the facility. Underwriting insurance based on the risk-based premium rate enables to reflect the vulnerability and resilience of the building that is not reflected at the current premium rate.

The introduction of the risk-based premium rate has the following effect from the viewpoint of improving the rationality of risk transfer fulfilled by the insurance system and incorporating risk control into the insurance system (improvement of disaster prevention level) compared with the current premium rate.

- GSIS can collect premium commensurate with the amount of risk since this is a method of assuming insurance with a reasonable premium rate according to the risk of damage to facility.
- The occurrence of unfairness among the insured is suppressed compared to the current nearly uniform premium rate
- The quantitative evaluation of natural disaster risk on the target facility in the form of premium rate enables to improve the awareness of the insureds on natural disaster risk.
- Since the reduction of the premium rate as a result of retrofitting can be confirmed with the tool, it becomes the base of a mechanism to promote prior investment in DRR.

6.2 Other Expected Effects and Possible Use of the Tool

6.2.1 Improvement of the GSIS' Underwriting Capability Using the GIS platform through Visualizing Underwriting Risks

System of the risk-based premium rate calculation tool (the Tool) is built using a GIS base map and it allows visually managing portfolios of insured facilities. The Tool can visualize on the GIS accumulation and dispersion of insured facilities and hazard maps as well as risks by insured facility. In addition, it can calculate premium rates and insurance losses by exceedance probability on the screen. Concerning facilities such as public school which has many of its buildings scattered in a wide area, hazards of the location, information on the facilities and adequate premium rates in particular can be confirmed visually on the GIS. With these features, the Tool is considered that GSIS' visibility of and awareness for underwriting risks will improve.

As flood hazard is largely influenced by even a small altitude difference, hazard maps showing the elevation from the ground surface are made using data obtained from accurate aerial survey. The Tool develops surface altitudes for hazard maps using complex aerial survey data. Regarding inundation, assessment was conducted at every 10 meters, and its hazard models include the status of riverbanks. It is more sophisticated than publicly-available maps developed for assessment of insurance underwriting risks. In terms of the aforementioned points, GSIS' underwriting capability (ability to evaluate the risk and determine whether to accept it) is expected to improve by continuing to use the Tool.

6.2.2 Negotiations for Property Insurance with Concerned Authorities and Reinsures based on Natural Disaster Risks

The Tool indicates levels of natural disaster risks of the insured facilities in a form of premium rate and loss amount; therefore, it allows the GSIS for insurance negotiations with the insured parties as it clearly displays risks with the Tool. As shown in Chapter 7, many public organizations are still uninsured, and the natural disaster risks are uncovered by insurance. By displaying natural disaster risks quantitatively and visually using the Tool, it will become an effective measure to encourage such organizations to take out insurance.

For large-scale public infrastructure that are generally reinsured, the GSIS currently sets the budget for public procurement by interviewing reinsures and brokers to understand levels of insurance premium. The GSIS will be able to refer risk-based premium rates calculated by the Tool as a benchmark when it negotiates with reinsures.

6.2.3 Utilization of Natural Disaster Insurance Premium Rate as a Benchmark for Large-scale Facilities that Procure Reinsurance such as Transportation Infrastructure

Large public infrastructure facilities such as MRT 3 and NAIA T3 purchase reinsurance by bidding procedure from the viewpoint of holding risk management. The reinsurance premium rate is not constant as it is affected by the reinsurance market. GSIS decides the public bidding budget amount (upper limit of reinsurance fee) based on market research including interviews with reinsurers and brokers, and past trends in rates. The tool enables GSIS to grasp the level of appropriate premiums for natural disaster risk, can be used as a benchmark of premium rate in large public infrastructure facilities, and can be used for consultation with reinsurers and brokers.

In addition, the insurance policy of large public infrastructure facilities often uses "all risk policy" in which premium rate is not specified for each type of disaster such as fire, natural disaster, mechanical accident etc. For this reason, premium rate for natural disaster insurance calculated by the Tool cannot be simply compared with premium rate of the all risk policy, but GSIS can refer to the premium rate for natural disaster insurance calculated by this tool as data supporting the natural disaster insurance part of the all risk policy.

6.2.4 Setting Limits of Liability based on Maximum Loss Evaluation

For MRT3 and NAIA T3 whose sum insured is large, a sub-limit of liability is set for insured loss caused by natural perils[43]. This is because a 16-km long facility has no chance of undergoing a total loss due to fire; however, earthquakes, typhoons, or flooding may cause an enormous loss all along the line. Accordingly, without setting a sub-limit of liability, it is likely that it will become impossible to obtain insurance in the insurance market; otherwise, the premium would become huge. That is why a sub-limit is normally set in property insurance for such facilities against natural disasters; however, how to determine such sub-limit is a vital risk assessment process in designing insurance.

The Tool developed in the Study is able to assess loss at each occurrence frequency in MRT3 and NAIA3 due to assumed natural disaster hazards including earthquakes, typhoons, and flooding. It enables GSIS to assume a sub-limit for liability for natural disaster cases on solid foundations and have discussions with insured parties and reinsurers. The figure below shows the relationship between underinsurance and sub-limit for natural disaster losses.

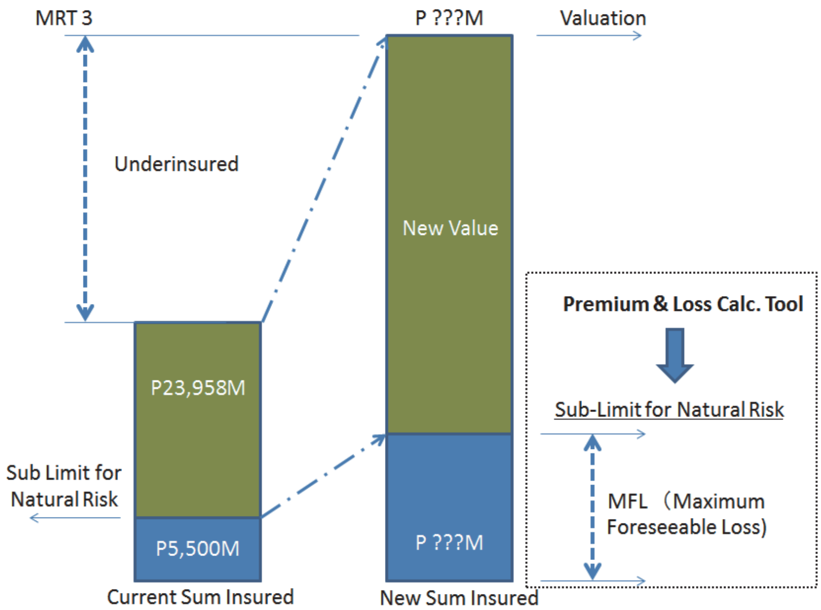


Figure 6-1 Underinsurance, Replacement Costs and Setting Sub-Limit for Coverage against Natural Disaster – An Image for MRT3 case

[43] In NAIA T3, sub-limits for liability are set for all insurance accidents regardless of natural disasters.

Table 6-3 shows the evaluation results of the maximum loss amount in the seismic risk using the risk-based premium rate calculation tool for MRT 3 and NAIAT 3.

Table 6-1 MRT3 and NAIAT3 The maximum loss amount in the seismic risk

Php in thousand

Facility	Current policy			Risk Tool			
	Sum insured Note 1)	Limit of liability		Return period (year)	Replacement cost	Estimated loss	
		Amount	%			Amount	%
MRT3	23,958,144	5,500,000	23.0%	500	44,510,825	8,563,183	19.2%
				200		3,337,689	7.5%
NAIA T3	7,880,530	1,500,000	19.0%	500	31,958,371	4,236,073	13.3%
				200		2,602,315	8.1%

Note 1): Reinsurance bid infromation for 2016 renewal

Under the current contracts, the sub-limit for liability for the loss caused by natural disasters in the Metro Rail Transit Line 3 (MRT-3), and the payment limit for all insured loss for Ninoy Aquino International Airport Terminal 3 (NAIAT3) are stipulated as above. If the Tool is used, it allows assessing the probable maximum loss for each return period. Since the Tool can be used for determining necessary insurance coverage and negotiating premium rates based on the coverage, it will lead to select most appropriate insurance.

6.2.5 Making Use of the Tool as a Reference to Prioritize Investment in DRR

The risk-based premium calculation tool can be used as a reference to prioritize prior investment in DRR such as seismic retrofitting since the premium rate for each building at school which is not a linear structure is an indicator of natural disaster risks. As for linear structures including MRT3, the tool can be used as a reference to prioritize retrofitting by the comparison of natural disaster risks per railroad section because the expected loss can be calculated in a certain section between railroad stations (refer to the figure shown below).

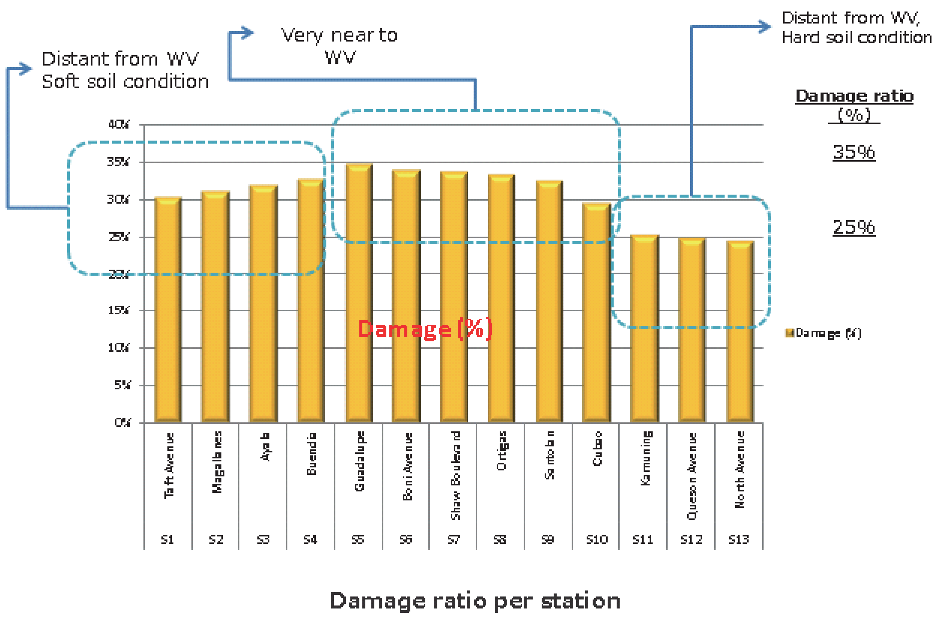


Figure 6-2 Damage ratio for each railroad section of MRT3 according to the scenario of West Valley Fault earthquake

6.2.6 Use the Risk-Based Premiums as Reference for Revision of the Tariff rates of PIRA Ltd.

PIRA tariff rates in 1998 version are currently effective. Detailed premium rates based on facility-use classification are set for fire risk, the basic terms of contract. Different rates are applied based on building structure although there are only two kinds. The applicable rates also differ for different locations taking into account the credibility of local fire department. Concerning natural disasters on the other hand, as discussed in 3.2.3, hazards arising from location are classified by state. However, vulnerability and toughness of building against the hazards are taking into account only to premium rates for seismic risk classified by the number of stories of building.

In terms of a public nature of property insurance, it is another issue how clearly-defined classifications should be established. To understand risk-based premium rates is necessary for risk management as insurer. Toughness and vulnerability of facilities are hardly reflected to the current tariff rates. The latest version of the tariff rates is as of 1998. Since then, Philippines have experienced fault investigations on MM by government agencies, and repeated large-scale typhoons and flooding. Research studies for natural disaster hazards and vulnerability of facilities by concerned organizations including PHIVOLCS, PAGASA and UP have been making progress. Currently, IC is reviewing how to collect information on insurance events caused by natural disasters; a revision of the tariff rates of PIRA Ltd. are expected to take place in the near future[44]. It is considered to have significance that the GSIS as the largest insurance organization in the Philippines proactively adopt the concept of risk-based premium rates using the actual tool and to use the rates as a reference for revision of the tariff rates.

[44] According to IC, currently there is no plan to revising the tariff rate.

7 Incentive for Investment in DRR

7.1 Necessity for Risk Control through Investment in DRR (Damage to Schools Caused by the Kumamoto Earthquake)

In the Kumamoto district of Kumamoto Prefecture, a foreshock with a magnitude of 6.5 occurred at 9:26 pm on April 14, 2016, and then a main shock with a magnitude of 7.3 struck at 1:25 am on April 16, 2016 (hereinafter called "The Kumamoto Earthquake"[45]). This was a strike-slip fault epicenter earthquake. According to the report by the Cabinet Office, over 163,000 buildings comprising mainly dwellings were damaged in Kumamoto Prefecture. There were 49 deaths at the time of the earthquake, and 15 deaths due to disease caused by the earthquake[46].

The government has been working on seismic retrofitting of public buildings in Japan after the Great Hanshin Earthquake in 1995. In the meantime, the seismic retrofitting rate for Japanese elementary and junior high schools was 44.5% in 2002, which increased to 98.1% in 2016, partly due to the immense damage to schools caused by the 2008 Sichuan Earthquake in China.

The seismic retrofitting rate for public elementary and junior high schools in Kumamoto Prefecture reached 98.5% in April 2015, and no large structural damage, such as collapse of public elementary and junior high school buildings, occurred during the Kumamoto Earthquake. On the other hand, the seismic retrofitting rate among private schools is 74.1%, and some severe structural damage resulted, such as shear failures of pillars and walls in those schools in which seismic retrofitting had not yet been completed. According to the report of the government’s post-Kumamoto Earthquake review committee for maintenance of school facilities, the degree of damage differs substantially between schools whose structures are earthquake-resistant and those that are not earthquake-resistant. It was reported that seismic retrofitting was effective. On the other hand, damage to non-structural elements and large facilities such as gymnasia are issues to be addressed in the future. It is also an issue that 73 schools out of 223 could not be used as places of refuge after the earthquake because of damage to non-structural elements, such as fallen ceiling materials, fractured roof braces and broken windows, etc.

Since both the foreshock and main shock occurred during the night when there were no students in schools during the Kumamoto Earthquake, there were no casualties among students and teachers. However, if it were to occur during the day, there is potential for casualties.

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[45] http://dl.ndl.go.jp/view/download/digidepo_9979249_po_0910.pdf?contentNo=1

[46] http://www.bousai.go.jp/updates/h280414jishin/h28kumamoto/pdf/h280729sanko01.pdf

Table 7-1 School damage caused by the Kumamoto earthquake

School Type	School Division	Number	Affected	Affected Rate	Retrfit work comelted
Public	Elementary School	364	222	61%	98.5%
	Junior High school	161	112	70%	
Private	Junior High school	9	9	100%	74.1%
	High school	21	20	95%	

Damage Type	Seismic Retrofitting	Damage Situation
Structural Member	Seismic Retrofitted/ New quake-resistance standards	No serious damages including building collapse
	Not Supported	Some buildings with serious structural damages including pillar shear-failure and axis collapse
Non-Structural Member	Seismic Retrofitted/ New quake-resistance standards	Damages to ceiling, glass window, pipe, brace and exterior wall
	Not Supported	Great number of damages to ceiling, light, glass window, external material, and equipment

Human Lives	Damage	Reason
Students	No	Both earthquakes occurred at night. First shock was at 09:26PM and main shock was at 01:25AM.

Source: The study team based on "The study meeting material (July 2016) on the improvement of school facilities based on the damage of the Kumamoto earthquake, the Ministry of Education, Culture, Sports, Science and Technology"

Many students and teachers are in a school during the day, so there is a risk that a collapsing building could cause considerable loss of human life all at once. Most schools in Metro Manila are multi-story, reinforced concrete structures. Destroyed pillars and walls on a lower floor have a risk leading to the collapse of the building and the loss of many lives. As the results of the Kumamoto Earthquake show, it is possible to prevent structural destruction of a building by seismic retrofitting. In the event of a natural disaster, the role of the school as a shelter of the area is also important, and from this point also, toughness against natural disasters is required.

There are currently over 4,000 school buildings among the over 600 public elementary and junior high schools in Metro Manila. Among them, for 372 schools insured by GSIS and whose location data was confirmed, the loss amount by the West Valley earthquake scenario was estimated using the premium rate calculation tool. The result was 5.1 B Php for the expected loss amount for sum insured of 16.6 B Php (30.7%). In addition to the enormous damage to buildings, if it is a daytime earthquake, many lives will be lost.

Although a risk transfer of natural perils through insurance mechanism is important measures to secure the funds for recovery. Risks also need to be simultaneously controlled through prior investment in DRR to prevent and mitigate damage in order to provide the necessary coverage at competitive premiums.

In this respect, incentives for investments in DRR as the risk control mechanism must be aggressively incorporated into public property insurance as disaster risk financing.

7.2 Analysis of Current State of GSIS Public Property Insurance

7.2.1 System and Incentive to Facilitate Disaster-Prevention Measures in Domestic and International Natural Disaster Insurance Schemes

As natural disasters can cause repeated damage to specific areas, and many losses and damage will accumulate in the event of a disaster, it is difficult for nonlife insurance companies to manage such risks, being one of the disaster risks difficult to insure. In Table 7-2 Domestic and foreign insurance system, institutions and incentives to promote disaster prevention, in relation to "A Comparative Study of the World's Natural Disaster Insurance Systems: Implications for the Earthquake Insurance System of Japan" (2007), a report by the Economic and Social Research Institute, Cabinet Office, Government of Japan, the research group sets out a summary of disaster prevention systems and assesses the effectiveness of systems for making investments in disaster prevention[47].

Table 7-2 Domestic and foreign insurance system, institutions and incentives to promote disaster prevention

Cmparison of natual disaster insurance programs in view of incentive scheme for promoting DRR

	Natural Disaster Insurance	US Federal Flood Insurance		US / CA Earthquke Insurance (NFIP)		France PPP		Japan EQ insurance for household	
	viewpoint↓ / Perils →	Flood		EQ and Tsunami		EQ, Flood, Avalanche (excludes wind)		Fire + EQ/Tsunami	
1	Linckage with other regulations	◎	Flood insurance can be purchased where the communities participate in the NFIP, thus, it promotes to reduce flood risk of the entire community	○	Seismic retrofit work	○	Linckages between Natural hazard assessment and level of building regulations	×	No linkage with other regulation schemes
2	Regulation and penalty	◎	Regulations in the development by the commuity	○	Fire insurance policy must be sold together with EQ coverage	◎	Urban planning and building regulation based on the hazard map developed by the government. Additional DRR measures are requested based on the hazard maps. Non compliance may be subject to penalty. Natural disaster insurance is combined to fire policy	×	Voluntary enrollment - not mandatory. (In case of a typical mortgage loan, fire coverage is required, but natural disaster endorcement is not mandatory
3	Incentives for DRR	○	Insurance rate differe based on the DRR activities acheved by the communities and individuals Premium is adjusted based on design flood elevation and level of DRR at a community	△	Preferred interest loan, dscount insurance premiums	△	At ceartain areas with natural disaster risks, construction of a building becoes possible and insurance is available.	△	Premium reduction based on a class of building capacity against EQ
4	Additional services to promote the program	○	NFIP is sold through private insurers with their own name in the policy. Utilize know-how and net work of private insurers for selling the NFIP.	○	SAFER Program Introduction of housing inspectors. Discount of insurance premiums for seismic retrofit work (5%). Free seismic review of the residencial house, Introduction of loan for seismic retrofit work.	△	A back up guarantee by the Government for the insurace program against natural disaster.	△	Insurance policies are issued by a prvate insurer, hwever, most of the risks are transferred to the government, thus, a stable capacity is maintained.

Note: The above informaton is derived from [A Comparative Study of the World's Natural Disaster Insurance Schemes] ESRI, Cabinet office of Japan. Evaluation for each items was done by the Study team.

Evaluation	◎	Very effective shcemes are incorporated	○	Effective schemes are incorporated	△	Limited shceme is available	×	No effective scheme is incorporated

Source: Cabinet Office Economic and Social Research Institute, Cabinet Office (2007)

Even in developed countries, the natural disaster insurance system is established by public agency efforts and public-private partnerships. Systems that provide incentives to help increase the level of disaster prevention under these insurance systems include a broad range of systems. These include financial incentives, such as discounts on insurance premiums in respect to investment in DRR, grants for the cost of carrying out earthquake resistance assessments, and capital financing for disaster-prevention refurbishments; as well as insurance system measures, such as compulsory

[47] US Federal Flood Insurance, California Earthquake Insurance, PPR in France and Japanese Earthquake Insurance Scheme for households

insurance coverage, linkage with construction standards and development regulations, and guarantee systems under government insurance schemes.

The following can be considered effectively functioning as an incentive to increase the level of disaster prevention among these measures. The following can be considered effectively functioning as an incentive to increase the level of disaster prevention among these measures. Effective ways of enhancing disaster preparedness include strengthening building regulations, requiring mandatory purchase of natural disaster insurance, compulsorily bundling natural disaster insurance with fire insurance, and discounting premiums according to the level of DRR retrofitting and earthquake resistance of buildings. Particularly effective are mechanisms that foster linkages between an insurance scheme and other arrangements, such as DRR administration by local governments and building regulations, rather than relying on an insurance scheme alone. (The relevant sections are shown in bold below.)

(◎: Mechanisms considered particularly effective)

- **Linkage of insurance scheme with DRR administration by local governments, building regulations, and seismic retrofitting** (U.S. National Flood Insurance Program (NFIP), Californian CEA earthquake insurance, France's PPR system)
- Promotion of disaster preparedness in an entire region by **having the purchase of insurance administered at the local government level and requiring residents to implement DRR measures themselves** (NFIP)
- **Criminal penalties for infringement of regulations and mandatory purchase of natural disaster insurance** (PPR)

(○: Mechanisms considered effective)

- **Reflection of DRR efforts made by local governments and individuals in discounts to insurance premium discounts**（NFIP）
- Sale through private-sector insurers despite being a federal insurance program (NFIP)
- **Linkage of insurance scheme with seismic retrofitting** (CEA earthquake insurance)
- **Compulsory bundling of earthquake insurance with fire insurance** (CEA earthquake insurance)
- **Integration into the insurance scheme of various services to encourage DRR** (system of discounting premiums when seismic retrofitting work is performed, facilitation of loans to finance retrofitting work, etc.) (CEA earthquake insurance)

(△: Mechanisms considered to have limited effect)

- **Facilitation of low-interest loans for DRR retrofitting work, insurance premium discounts** (CEA earthquake insurance)
- **Possibility of building construction and arrangement of insurance through DRR countermeasures** even in regions exposed to natural disaster hazards (PPR)
- **Insurance premium discounts based on earthquake-resistance grade** of building (Japanese household earthquake insurance)
- Existence of government reinsurance and public guarantees as security for coverage against natural disaster hazards (Japanese household earthquake insurance, PPR)

This study will examine policies for the utilization of property insurance in order to enhance public infrastructure resiliency, in reference to these examples.

7.2.2 GSIS Public Property Insurance from the Viewpoint of Disaster Incentive Initiative

As explained in 3.2.3, the GSIS public property insurance system uses almost a flat rate for insurance premiums, and does not incorporate a system for providing incentives to encourage investment in DRR based on difference in premium rates. The features of the public property insurance are classified from the standpoint of whether the incentive system to encourage DRR works effectively or not.

Table 7-3 Features of public property insurance (classified from the standpoint of whether the incentive system for DRR works effectively or not)

	Viewpoint	Features		Review point / Issues
1	Obtaining insurance (Enrollment)	Mandatory per laws	A	This is a mandatory insurance program, and adjsutment of premium is possible.
2			B	No penalty for no insurance contract which may negates mandatory principle.
3	Insurer	GSIS is only insurer, no comeptition	A	No competition. Adjustment of premium is possible.
4	Policy type	(School) Per peril	A	Insurance premium is identified per peril.
5		(MRT/NAIA) Industrial All Risk	B	No premium per peril is idendified.
6	Procurement	Reinsurance must be through a public bid	B	Premium varies in accordance with market condition.
7	Insured	Government, Agency, Project Entity (BOT)	B	Managament of a facility such as school may not have authority of insurance budget.
8	Premium payment	Government, Agency	B	Premmium saving remains to public agnecies (i.e. within common budget).
9	Indeminication base	Replacement cost	A	Properly designed insurance can contribute faster recovery after a disaster.
10	Validity of insured value	Many accounts are under insurance	B	Correcting replacement value may lead to increase of premium which negates premium savings to the insured.

A: Advantage to inttroduce an incentive scheme
B: Issue to be addressed

a. The features of an incentive system considered to work effectively (evaluated as A in the table shown above)

Assuming there is no discount competition for premium rates not related to investment in DRR among insurance companies to incorporate a system to promote investment in DRR with an incentive including premium discount, into public property insurance, but this is not likely in the private insurance market without legal restrictions. Public property insurance is a compulsory coverage undertaken by the government according to the laws and regulations (fallen under the first viewpoint of the table above). GSIS, a sole government insurance agency can use its discretion in setting the premium rate (fallen under the viewpoint #3). As GSIS's insurance policies are named-perils policies (except those for infrastructure such as transportation and electric power facilities, which are all-risk policies), it is possible to confirm the reduction in premium rates achieved by raising disaster preparedness (fallen under the viewpoint #4). These are advantages to introduce risk-based insurance premium rates, and to implement a scheme to promote DRR investment (an incentive system) based on the premium rates. In addition, the indemnity method of public property insurance is based on replacement costs that an insured can restore a facility without bearing any additional expense when insured loss is occurred if an appropriate insurance amount is carried in the policy (fallen under the viewpoint #9).

Meanwhile, many institutions do not comply with their legal obligation to carry insurance, without penalty for disobedience to the rules. As they are likely to remain uninsured when premium rate is high, the compulsory coverage should be maintained or strengthened (fallen under the viewpoint #2 of the table above).

b. The features of an incentive system considered difficult to work (evaluated as B in the table shown above)

In the meantime, an incentive system based on adjusting insurance premium has some features considered difficult to work.

Table 7-4 Features of an incentive system considered difficult to work

View-point	Features considered difficult to work	Measures
5	The all-risk policies used for large infrastructure facilities do not give premium rates for coverage for natural perils alone.	Calculating premium rates for natural peril coverage and indicating them to the insured would incentivize DRR investment by providing a source of information for determining budgets for tenders when procuring reinsurance. They would also provide reference data by serving as base rates that are independent of market trends.
6	Premium rates for insurance contracts covering large facilities procured by public tender are influenced by market trends, and risk mitigation does not translate directly into lower rates.	
7	As facility administrators are not the ones who bear the cost of premiums, they do not enjoy the benefits of lower premiums resulting from DRR investment.	The benefits arising from DRR investment lead not only to lower premiums but also reduced vulnerability of facilities to disasters. This too should help incentivize DRR investment.
8	The insured are all government agencies. Premiums are funded out of the government budget, and so the ultimate source of funding remains the same even if premiums are adjusted for each agency.	As government budgets are calculated for each government agency and lower premium rates lead to lower costs for local governments, the benefits of reduced premiums should be apparent.
10	As eliminating the current underinsurance situation would push up sums insured and premiums, this would make it harder to recognize the benefits of premium discounts.	Eliminating underinsurance means restoring the situation to what it should be. Regardless of any reduction in premiums arising from DRR insurance, any increase in premiums (in the case of underinsurance) would be explained through channels such as GSIS's national insurance caravan for heightening public awareness.

As shown above, reduction in insurance premium can give an incentive to each facility to invest in DRR, meanwhile combining a DRR certification scheme that gives an indication of safety level to public facility users with a risk-based insurance system would strengthen the incentive for facility owners and administrators to conduct prior investment in DRR.

7.2.3 Current Insurance Premium Scheme of the GSIS

As mentioned in Chapter 3, the GSIS is an insurance organization belonging to the Executive Office of the President and is not under the command of the Philippine Insurance Commission

(IC); GSIS has no obligation to use the tariff rates approved by the IC and can establish risk-based premium pricing. Under the current operation, the GSIS employs market rates up to a ceiling of the forecast bidding price when it takes out reinsurance through public procurement. In most other insurance contracts, GSIS uses IC approved tariff rates The IC-approved tariff rates are as shown in 3.2.3. Here the study team show the premium rate applied in the insurance program on Pasay City Public School.

Table 7-5 Premium rates for elementary schools in Pasay City, Manila

Insured perils	Sum Insured (Php)	Premium rate (%)	Premium (Php)
Fire, Lightning	22,535,223	0.1150	25,916
Earthquake（including fire induced by earthquake）	22,535,223	0.1440	32,451
Typhoon	22,535,223	0.0400	9,014
Flood	22,535,223	0.0200	4,507
Total insurance premium	22,535,223	0.3190	71,887

Source: GSIS Insurance policy

Currently, GSIS's premium rates applied to buildings in Metro Manila are almost equal and are not adjusted in accordance with vulnerability of the building. Implementing risk-based premium rates targeting Metro Manila can quantify vulnerability of the insured facilities in a form of insurance premium, which can a potential incentive for investment in DRR.

7.3 Consideration of measures to be an incentive to promote investment in DRR

7.3.1 Incentive to Promote DRR Investment Based on Risk-Based Premium Rates

a. Introduction of a Risk-Based Insurance Premium Scheme

Insurance for public infrastructure is property insurance for government assets. One of the roles of property insurance is to transfer to the insurer risks of financial burden that the insured would have to incur when a disaster occurs. There are various methods to establish premium rates such as risk-based or flat rates if systems for natural disaster insurance in Japan and overseas are referred. Each system has pros and cons. The GSIS' current premium rates follow premium rates for private sectors. However, vulnerability of the insured facilities has little influence on determining the premium rates. Private property insurance needs to address social needs such as avoiding cases where expensive insurance premiums are not tolerated in areas with high disaster risks. However, insurance for public infrastructure targets government agencies, and it is believed that the scheme for premium rates should be in accordance with risks to be covered. With such scheme, each government agency can visualize the risk level of its own facilities in a form of insurance premium. In addition, it leads to that the GSIS can collect premiums that are appropriate for the risks it takes and prepare the amount of claims for the underwriting risks.

b. Concept of Risk-Based Premium Rates

Reduced insurance premiums rates are applied to facilities that are resistant to natural disasters. Vulnerability and toughness of buildings against natural disasters differ depending on levels of natural hazards, and structures and disaster prevention measures of the buildings. Risk-based premium rates are determined by considering both elements statistically. The premium rates are calculated by entering information on facilities (location, building structure, year of construction completion, insurance value and selecting a vulnerability curve) to the Tool. The premium rates for disaster-resistant facilities are lower than the others even if they are both located in a same area.

On the other hand, the expected loss for disaster-vulnerable buildings is larger, so are the premium rates. Even with the same building, disaster prevention measures against expected natural perils (for example, seismic retrofit for seismic risk and roof structure retrofit against typhoon) are taken, the amount of expected loss would be reduced. Accordingly, the premium rates are lowered. The risk-based premium rates calculation tool has pre-installed assessment curves that represent damage levels in accordance with vulnerability and toughness of building. The Tool is capable of calculating risk-based premium rates at underwriting as well as reduced premium rates for the insured facility to which DRR retrofitting has been applied. By changing the selection of vulnerability curves, the premium rates are reduced. By establishing risk-based premium rates as a clearer system of premium rates than the current one, vulnerability and toughness of specified buildings against natural disasters can be visualized through the premium rates. Calculation of premium rates and premium reduction by strengthening building are as follows.

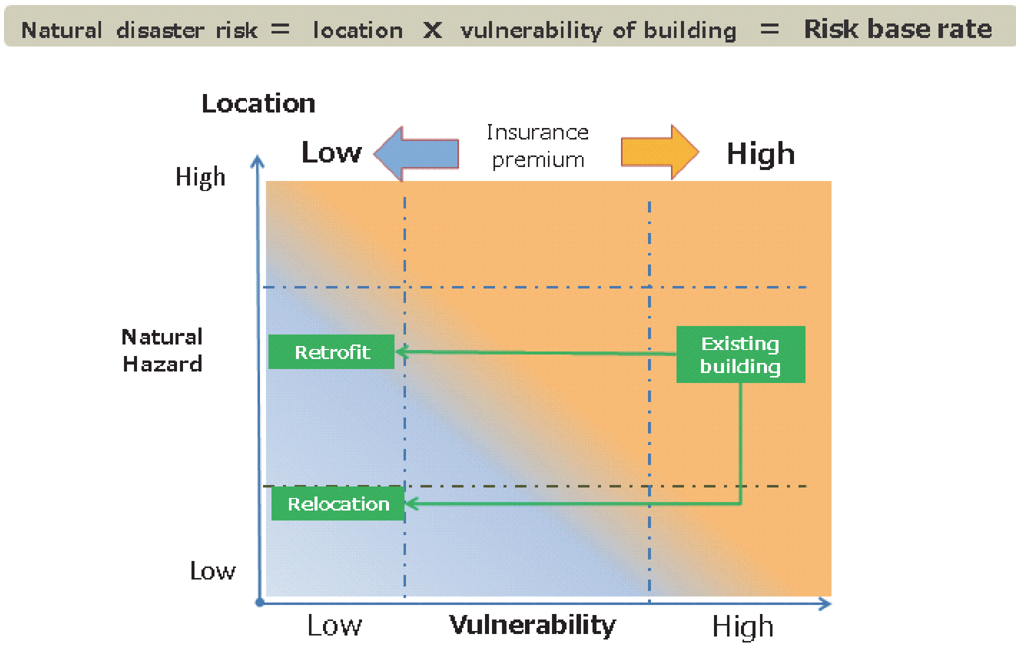

Figure 7-1 Relationship between risk reduction of natural disasters due to retrofitting, rebuilding and relocation of building; and insurance premium

c. Review of Application of the Risk-Based Insurance Premiums

As discussed in Chapter 1 (1.2 Purpose a.), one of the purposes of this study is to figure out whether it is feasible in the future to set the GSIS' premium pricing based on the toughness of public infrastructure against natural disasters. Using the Tool developed based on field research on selected ten schools out of the public schools in Metro Manila, premium rates for the following two patterns were calculated and compared: premium rates based on risks of earthquake and typhoon for the as-is buildings and those for the buildings after seismic and typhoon retrofitting.

Table 7-6 Seismic- and typhoon-risk-based premium rates for public schools in MM (as-is buildings vs. post-retrofit buildings)

Comparison of Insurance Premium			Earthquake Premium Rate				Typhoon Premium Rate		
School Name			Existing	Renovate	Reduction Rate	Payback Period for Disaster Prevention Renovation (year)	Existing	Renovate	Reduction Rate
School ID	Name	Area	(A)	(B)	(A-B)/A		(A)	(B)	(A-B)/A
320607	Simplicio NHS	Taguig	0.500%	0.500%	0%	–	0.003%	0.003%	0%
136704	Hen Pio Del Pillar ESI	Makati	1.300%	0.490%	62%	31	0.004%	0.001%	75%
305412	Beniguno Aquino HS	Makati	0.630%	0.490%	22%	179	0.010%	0.003%	70%
136697	Tibagan ES	Makati	0.550%	0.340%	38%	119	0.032%	0.001%	97%
136745	Salapan ES	SanJuan	0.510%	0.310%	39%	125	0.017%	0.001%	94%
136469	Antonio Maceda IC	Manila	1.330%	0.510%	62%	30	0.017%	0.001%	94%
136482	Bagong Diwa ES	Manila	1.520%	0.580%	62%	27	0.016%	0.001%	94%
136422	Antonio Luna ES	Manila	0.770%	0.460%	40%	81	0.004%	0.000%	100%
305315	Victoriano Mapa HS	Manila	1.600%	0.600%	63%	25	0.004%	0.001%	75%
136800	A Daeto ES	Vallenzuela	0.870%	0.670%	23%	125	0.245%	0.115%	53%

Regarding typhoon, the public schools in Metro Manila are all reinforced concrete buildings that are resistant to windstorm and even existing buildings as they have a low risk of damage. Potential damage is limited to steel-made roof and windows. In terms of asset value in property insurance, construction costs for these portions of a building account for a small percentage of those for the total building; accordingly, the premium rates is low. Further, the damage rate will significantly decrease by retrofitting to be compliant with the latest construction standards; the premium rates will be largely reduced. Although roof of a building has a small impact to premium, if anchoring of a roof or roof-panels to the building structure are effectively reinforced (without renewing the entire roof), investment in DRR by reduced premium is expected.

The tool calculates the seismic risk-based premium rates within a range of 0.50% to 1.60%. If DRR retrofitting is applied to a building in order to comply with the currently effective construction standards, the premium rate will be reduced to within the range of 0.31% to 0.67%. If the cost required for DRR retrofitting is assumed to be uniformly equal to 25% of the building price, with reference to cases in Japan, the period required for collecting funds with reduced premiums (difference between existing insurance premiums and premiums after DRR retrofitting) will be in a range of 25 years to 179 years. For this reason, it may not be easy to promote DRR retrofitting solely by reducing premium rate, but can be possible by combining the idea of safety of occupants including students and school personnel, as an additional incentive by DRR retrofitting, as shown in the following pages.

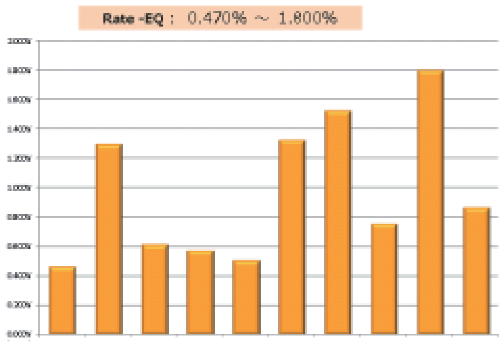

Figure 7-3 Seismic risk-based premium rate

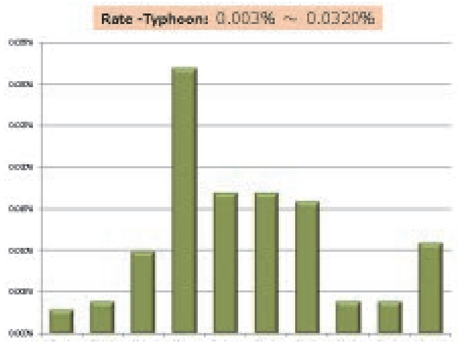

Figure 7-2 Typhoon risk-based premium rate

d. Issues on the Introduction of a Risk-Based Insurance Premium Rate Scheme

d.1 Alleviation of Regressivity

A. Issue

Given that the facility owned by the financially weak government agency is also considered vulnerable, introduction of a risk-based premium rate will increase the premium payment burden and is likely to prevent increasing subscription rate. Current policy may increase insurance premium at the time of insurance renewal.

B. Measure

The NDRRM Fund has funds for vulnerable local governments. By applying risk-based insurance premium rates, it is necessary to make it possible to utilize it to cope with increasing disaster insurance premiums and to invest in DRR retrofitting for reducing vulnerability of facilities. When providing an insurance subsidy, such an easing measure as facilitating to reduce vulnerability of facilities should be implemented assuming DRR retrofitting plan is established.

The following measures are suggested,

- Implementing natural disaster risk assessment of the insured facilities
- Premium subsidy is subject to development of an action plan for DRR based on the risk assessment
- Progress monitoring for planning and implementation of the action plan with set a target period such as three years

d.2 Data Collected upon Insurance Underwriting and Renewal

A. Issue

Information that GSIS currently obtains upon underwriting the insurance comprises, in the case of a school, the building name, address (latitude and longitude), building structure, and insurance amount only. It is difficult in practice to determine the premium rate after conducting a detailed investigation, when underwriting the insurance for a large number of facilities that are small in size, such as schools.

B. Measure

In addition to the information that GSIS obtains upon underwriting the insurance at present, in the case of a school, if data of the year built and type, roof structure, number of stories, size of the building, and whether or not DRR retrofitting has been conducted are obtained, the premium rate can be calculated. Since such information except for that on DRR retrofitting is collected through the National School Inventory Survey and compiled into a database by DepEd[48], it is possible to apply a risk-based premium rate by using the information. In case that DRR retrofitting has been conducted, such information given to the GSIS by the insured enables to update the premium rate. It is also possible to calculate the reduction of the premium rate that can be expected through the implementation of DRR retrofitting.

d.3 Expansion to Buildings of Public Institutions

A. Issue

The tool developed in this study focuses on public schools and facilities such as MRT3 and NAIA T3 located in MM. Risk assessment on a general building of the central government, local government, and related agencies insured by GSIS is possible with a small additional work (entry of building information and replacement cost).

With respect to large special structures such as those for transport infrastructure, the risk assessment method for each facility varies due to differences in the insurance underwriting method and particularity of the structure and type. Thus, the data entry method and a selection of vulnerability curves need to be expanded in order to assess the different types of facilities from MRT3 and NAIAT3.

B. Measure

The locational information given by GSIS on 1,100 public properties in Metro Manila was entered into the tool. Since most are RC structures, the same as schools, GSIS can calculate the premium rate as it does for schools, if entering facility information and selecting the curve of vulnerability assessment to be used. Since an appropriate replacement cost is uncertain, the insured amount has not been entered, but GSIS itself can enter it. Therefore, use of the risk-based premium rate as a benchmark tool for government assets mainly comprising buildings in Metro Manila is generally possible with the current tool.

d.4 Expansion to Areas other than Metro Manila

A. Issue

The tool developed in this investigation is for natural disaster hazard and vulnerability of buildings in Metro Manila. Since the buildings and facilities underwritten by GSIS are located throughout the Philippines, it is necessary to extend the tool to introduce the risk-based insurance premium rate outside Metro Manila. The study team believes that it is not practical in terms of overall consistency to use the rate only for the Metro Manila and keep the current premium rate in other areas.

B. Measure

This tool has been developed to be expandable to regions other than Metro Manila. In addition to the school buildings targeted by this study, vulnerability curves suitable for various building structures are incorporated in this tool. Regarding natural disaster hazards, it is necessary to create

[48] DepEd National School Building Inventory http://www.deped.gov.ph/

hazard information throughout the Philippines for each disaster type and incorporate it into this tool since only hazards in Metro Manila are incorporated. Since the basic information necessary for creating hazard information is owned by government agencies including PHIVOLC, PAGASA, UP, NAMRIA, etc., it is possible to expand the system as a premium rate calculation tool after acquiring the information. Expansion method and the works required are described in section 9.1.3.

7.3.2 DRR Certification System Complementing Incentives for DRR Investment

a. The need for a system complementing incentives for DRR investment

Due to the length of time required (in a range of 22 years to 192 years as shown in Table 7-2) for the cost of DRR investment in facilities to be recouped from the resulting discounts to insurance premiums, return on investment alone provides insufficient incentive to invest, assuming earthquake insurance and seismic retrofitting. As described in section 7.2.1, both Japanese Earthquake Insurance Scheme for households and Californian CEA earthquake insurance have some good but limited effects. Incorporating some system that would work in the same way as reducing insurance premium to the current insurance system is effective.

b. DRR Certification and its concept

There is public interest in not only getting a return on DRR investment in schools, transport infrastructure, and other public facilities, but also in ensuring the safety of building users. Public facilities are also used as an emergency shelter when a disaster occurs. Although property insurance does not cover people's safety, there is a correlation with reducing the vulnerability of facilities because safety increases when damage to facilities is reduced. People's safety is important to as well as the responsibility of facility administrators, regardless of natural disasters. Linking it to risk assessment for property insurance and demonstrating the results in the form of "DRR certification" by insurers should act as an incentive for facility administrators to invest in DRR. Therefore, the study team considers the incentive system based on DRR certification of the building against natural disasters as a mechanism to supplement the incentive by reducing the insurance premiums based on the long period of time required to collect DRR investment.

The criteria for DRR certification is the safety of occupants when a disaster occurs. In the case of public schools it is the safety of students and school personnel, while in the case of transportation infrastructures, that of passengers and staff members is ensured. As property insurance covers loss of buildings and equipment, safety of occupants itself has no direct relation to premium rate. However, large damage to the building threatens the safety of occupants and also leads to payment of insurance claims. GSIS undertakes property insurance of facilities and buildings as a property insurance agent. Reduction of the insured loss has a profitable effect of reducing the payment of insurance claim even for GSIS, an insurer who underwrites the accident risk. Therefore, seeking security of buildings and facilities is effective for both insurers and the insured. The insurer assumes the risk of the building being damaged by the disaster and obtains a premium corresponding to the risk from the insured. An insurer and the insured are independent. The former adjusts the insurance premium by its own risk assessment. In addition, for properties with low risk of damage, it is not contrary to underwriting insurance that an insurer performs DRR certification for insured persons such as facility owners and administrative authorities, and which is feasible as a supplemental service with underwriting insurance.

Indeed, some overseas insurance companies use business models to take insurance for only insured persons and facilities that adhere to their standards, specifying certain criteria of their company regarding DRR. In addition, the global property insurance program of a major automobile manufacturer in Europe covering more than 60 production facilities has introduced a system to receive DRR certification from its insurers when the DRR level of a facility reaches a certain standard, providing an incentive to promote DRR activities by the facility administrator. Since discounts on insurance premiums are also made for such facilities, this is a system that adds incentives for "premiums" and "DRR certification". As described in section 3.2.3, the premium rate of GSIS's current natural disaster insurance is around 0.2% of the insurance amount. The premium discount itself does not necessarily leads to a significant reduction, meanwhile as a measure to incorporate a mechanism to promote prior investment in DRR in public property insurance, it is not only desirable to introduce GSIS's DRR certification system as risk-based premiums are introduced, but also feasible based on the structure of GSIS.

As described in section 7.2.1, natural disaster insurance system in developed countries also incorporates several measures including not only premium discount but also subsidizing the cost for the seismic resistance checks, architectural regulations and DRR activities by local governments. "DRR certification" is a system which GSIS (the insurer) can work with the insured (schools, etc.) within the framework of public property insurance system, to complement the incentive for DRR investment by reducing the premium rate.

Figure 7-4 An image of DRR certification

c. Example of disaster prevention accreditation system in Japan

In Japan, local governments have accredited private sector apartment complexes that satisfy prescribed accreditation criteria and apply for accreditation as "Apartments with enhanced disaster prevention measures". The system has been introduced in Osaka City (2009) and Sendai City (2013). The accreditation systems and criteria are independently operated by the local governments. Osaka City, which was the first city to introduce the system, gives accreditation to apartment complexes which satisfy the following accreditation criteria, on the basis that this will lead to enhanced disaster prevention capabilities for the building in terms of both hard and soft aspects: (1) Building safety; (2) Building interior safety; (3) Safety during evacuation; and (4) Readiness for disasters. Applicants must then, (5) Stipulate a written disaster prevention action plan in the management rules of the apartment complex. An "accreditation plate" is given to accredited complexes. There are also incidental benefits in the sense that gaining accreditation during the planning stage has the advantage to a seller of positive appeal to a potential buyer, and lower mortgage interest rates for a buyer. In the case of Osaka City, as of January 2018, 48 complexes had undertaken accreditation during the planning stage, and of these 45 had completed accreditation.

Sendai City suffered devastating damage in the Great East Japan Earthquake, and in 2013 it introduced an accreditation system with similar goals to that of Osaka City. Sendai City assesses apartment complexes using prescribed criteria for the hard aspects of "disaster prevention performance" and the soft aspects of "disaster prevention activities". It gives accreditation for "disaster prevention capabilities" in six categories. As of September 2017, 41 complexes had received accreditation.

d. Perspective of DRR Certification

The viewpoints of assessment of DRR certification against earthquake, flood, typhoon danger, judgment tools, and checkers are organized in Table 7-7.

Table 7-7 The viewpoints of assessment of DRR certification, tool, and checker[49]

Type	Assessment Item	Assessment Tool	Confirmed by		
			GSIS	DepEd	DPWH
Earthquake	No building collapse caused by hazards in the area	RVS/Seismic diagnosis	○	●	●
	non-structural members, drop and fall of fixtures and fittings, With fall prevention measures	MEXT Check List	●	△	△
Flood	No Flood Risk(1/200year rain fall)	Risk Tool	●		
	Flood risk but with inundation prevention measure	Site Visit	●	△	△
Typhoon	RC construction building	Facility Information	●		
	No damage on the roof	Site Visit		●	△
	No failure in fixing roof plate			●	△
	Institution on the roof including water tank are fixed with structural member			●	△
	No damage to roof plate			●	△

●: Main、 ○: Future Plan、 △: Technical Support

e. Utilization of Risk Research Function of GSIS

As a property insurance institution, GSIS has risk surveyors in the underwriting department that regularly checks the status of insured facilities. The main purpose of the risk survey is to confirm the risk situation of large-scale public infrastructure projects that require reinsurance to be reinsured, but they visit more than 100 facilities annually and conduct surveys. Currently, two engineers (both engineers in civil engineering) work at the GSIS headquarters. While the main subject of the current risk survey is the assessment of fire and explosion hazards, focusing on the risk assessment of natural disasters is possible with the exception of workload problems.

f. Subject to DRR Certification

In Metro Manila, the earthquake is the most concerned natural hazard risk recent years, but typhoons and floods are also more frequent natural disasters. In Metor Manila, DPWH is using the FEMA seismic risk assessment method to undertake the evaluation of public buildings close to the West Valley fault. For large-scale public infrastructure such as railroads, airports, harbors, etc.,

[49] The reviewers share the assessment items, but GSIS as the insurance underwriter makes the final confirmation to issue the DRR certification.

uniform evaluation is not suitable since the facility contents are diverse. Subject buildings shall be general buildings such as public schools, office buildings of central government and local governments, hospital buildings, etc.

g. Assessment Method

Risk surveys conducted by GSIS for DRR certification purposes shall employ the seismic risk assessment methodology and the checklist for flood and typhoon hazards developed by FEMA. Assessment method of seismic hazards is shown as follows.

Evaluation procedure 1

GSIS evaluates existing buildings for potential seismic hazards utilizing Rapid Visual Screening (RVS) method issued by FEMA (Details of RVS is described in Chapter 5). DepEd and DPWH will initially conduct evaluation since GSIS currently has no experience of implementation. RVS consists of Level 1 Screening and Level 2 Screening that complements the former. Level 2 Screening is carried out for additional assessment such as plans and elevations of the building, structural connection between wall and ceiling/ roofing, and seismic retrofitting work, if any. When the result exceeds the threshold, the building is rated 'less likely to collapse during earthquakes.' On the other hand, when the result does not reach the threshold, a detailed seismic review needs to be performed. Moreover, Level 2 Screening also requires confirmation of existence of non-structural elements both inside and outside the building (for instance, plain parapet walls, canopies, signposts, plain block walls, building components (ceilings, etc.) that are exposed to risk of falling).

Evaluation procedure 2

Although it would be hard to set premium rates to reflect damage to non-structural elements of the school facilities, natural disasters such as earthquake and cyclone have significant impacts to life safety of students and people in the schools. For this reason, key mitigation measures of facility vulnerabilities are identified using checklists with the aim of ensuring the safety of building users (students and school staff) from natural disasters. Specifically, factors that contribute to ensuring student safety include toppling of hanging equipment and shelves, breakage of glass windows, falling of suspended ceilings, prevention of electric shocks caused by flooding, falling to lower floors of plant pots, and collapse of trees and shrubs are to be verified according to a predetermined checklist. These are verified on site by GSIS engineers having received a certain amount of training, and school personnel. It is assumed that risk assessment will be carried out using the inspection checklist of non-structural elements by the Ministry of Education, Culture, Sports, Science and Technology.

Based on the assessment result mentioned above, a DRR certificate shall be given when the following conditions are met.

Table 7-8 DRR certification tool and conditions for granting certification

Procedure	Risk assessment tool	Conditions of DRR certification for existing buildings
1)	FEMA RVS Level 1 and 2	Result > Threshold, and no critical deficiencies
2)	Non-structural elements checklist	No critical deficiencies, or measures having been completed

h. Feasibility under the GSIS

DPWH conducts risk assessment of public facilities located along the West Valley fault using RVS of FEMA. Risk assessment by RVS is possible by a self-training with the guide published by FEMA; seminar-style training is also conducted[50]. In addition, mobile-oriented free software (Rover Ready Alliance) is available to conduct RVS[51]. Engineers of the GSIS will be able to carry out risk assessment on their own with these assistance tools.

i. Differences from the Field Survey on the Ten Public Schools Conducted under this Study

In this study, an assessment using FEMA RVS Level 2 in addition to field surveys by structural consultants were conducted to understand vulnerability of public school buildings. In DRR certification, if the assessment result using FEMA RVS Level 1 for a facility does not meet certain thresholds, the Level 2 will be used to examine the details. In addition, checklists focusing on non-structural elements of the facility considering safety of students and faculty members who are in the building are used as criteria for DRR certification. Unless the structure of a building itself is judged safe, the assessment result of non-structural elements of the building would not make any difference to the building's vulnerability to large-scale earthquakes. However, placing improvement measures based on such checklists for non-structural elements are effective for small-scale earthquakes.

j. Relationship between the Existing DRR Certification and Insurance Underwriting Process and the Flowcharts

Below are the relationship between the risk-based insurance underwriting process and DRR certification, and the flowchart of the DRR certification for earthquake, inundation and typhoon risks.

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50 FEMA – Earthquake training, https://www.fema.gov/earthquake-training

51 ROVER Ready Alliance, http://www.roverready.org/about

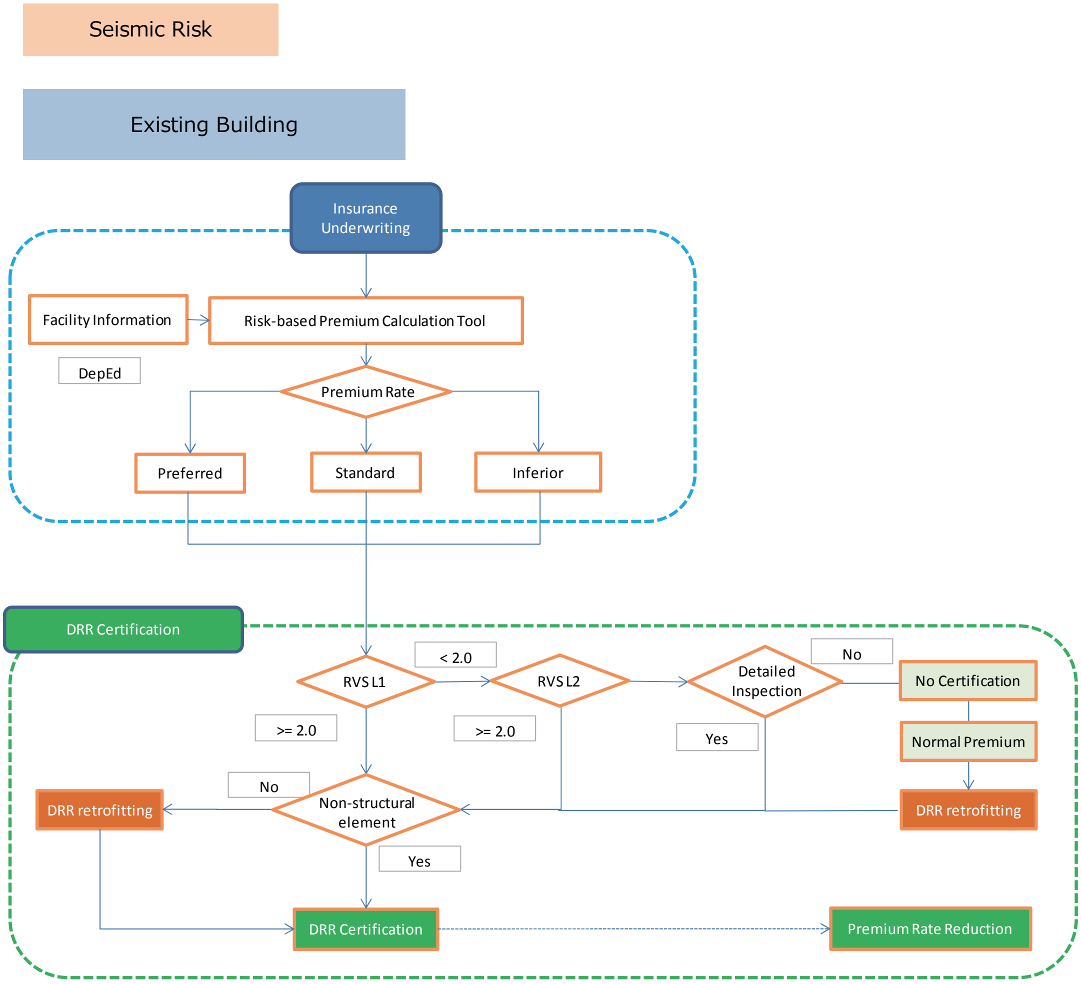

Figure 7-5 A process flowchart of seismic risk-based underwriting and DRR certification

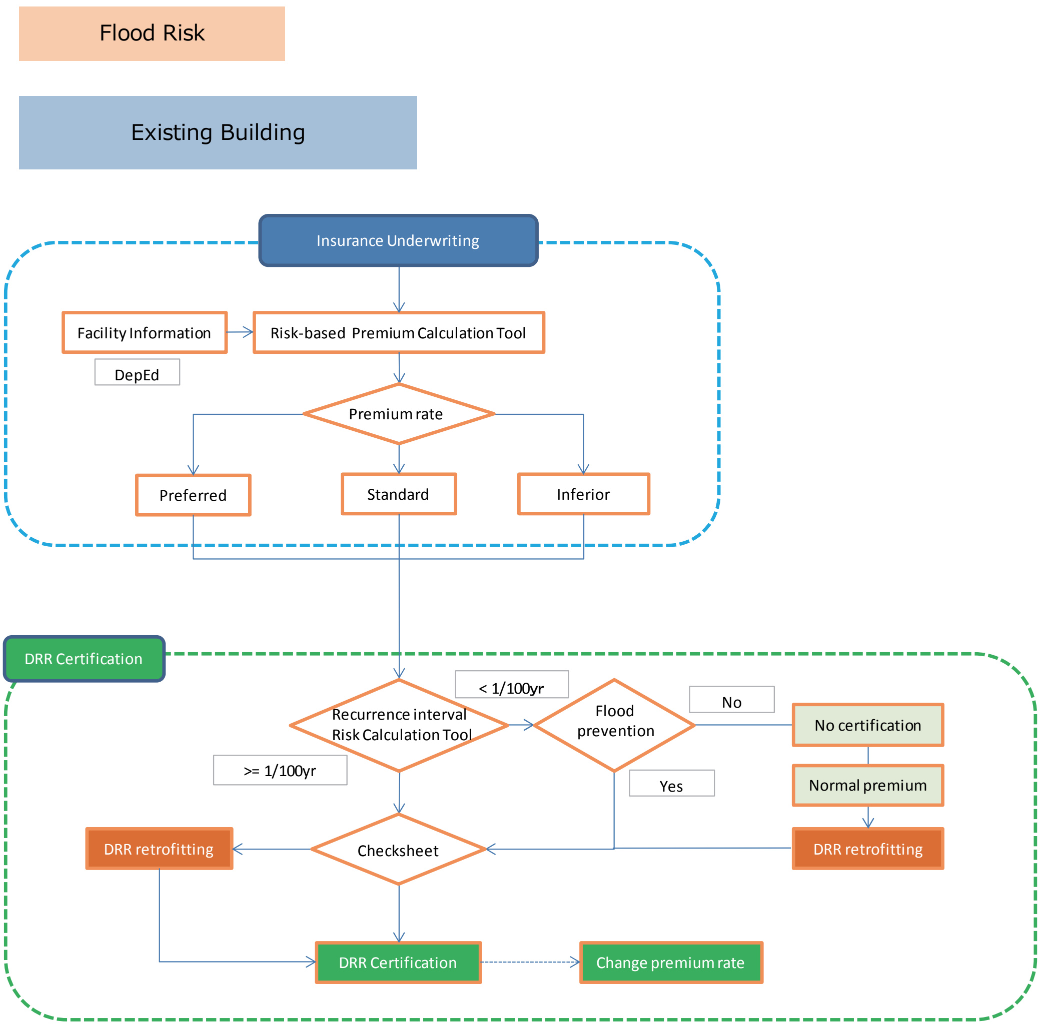

Figure 7-6 A process flowchart of flood-risk-based underwriting and DRR certification

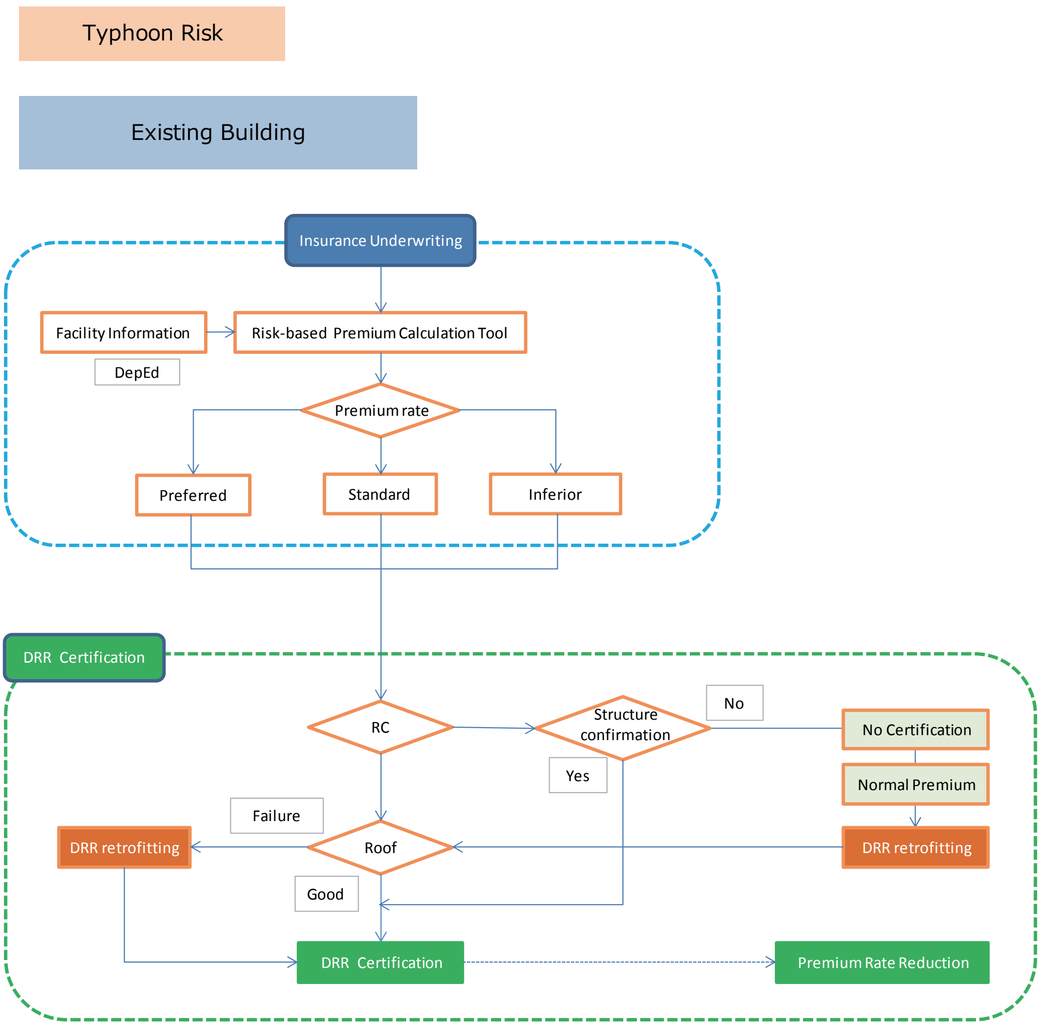

Figure 7-7 A process flowchart of typhoon-risk-based underwriting and DRR certification

k. DRR Certification at underwriting newly constructed buildings

To increase the number of natural-disaster-resistant buildings, it is important that buildings to be newly constructed are designed and constructed under well-considered disaster prevention standards in addition to applying DRR retrofitting to existing vulnerable buildings. If the Tool is applied to construction of new buildings, it will allow quantitative risk review of natural disaster hazards at each point in Manila. For example, regarding risks, it allows to check the probability of flood by frequency of occurrence and the inundation depth. If the construction site is in a flood-risk area, the Tool also allows checking that the building's design specification such as whether any prevention measures against flood inundation are incorporated into the design. As to seismic risk, in addition to the assessment method in the preceding paragraph, checking the following at insurance underwriting is possible as a part of the GSIS' extended insurance underwriting process: whether records of construction inspection and drawing plans were appropriately developed, whether an official Occupancy Certificate, the notice of construction completion and the warranty certificate by the construction company are submitted to the facility owner.

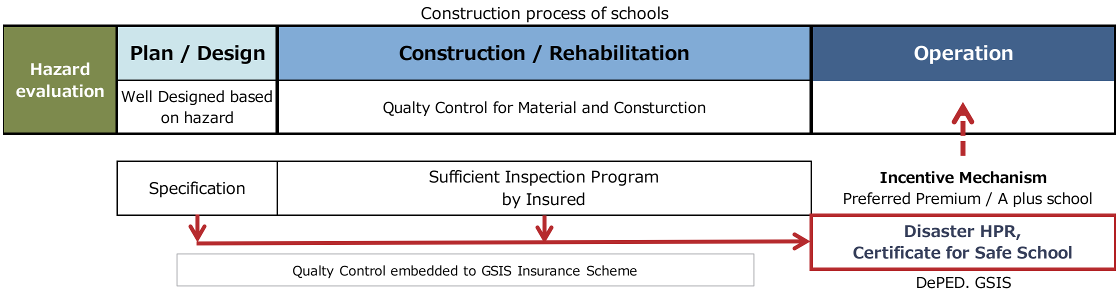

Figure 7-8 DRR certification for construction of schools

Process flows for underwriting of newly constructed buildings and DRR certification are shown below. A seismic risk is used as an example where the design and construction quality of a building largely influence the level of resistance to the disaster.

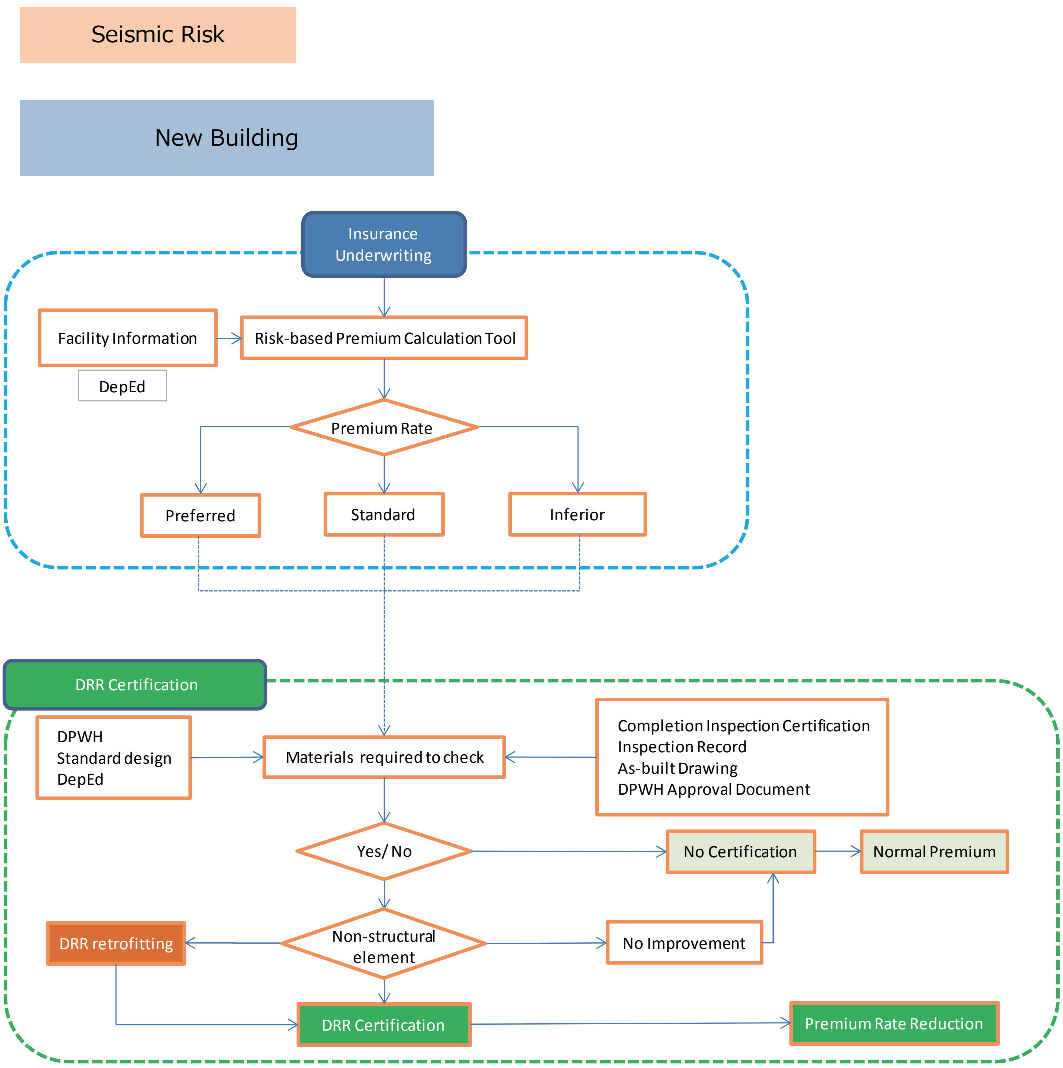

Figure 7-9 A process flowchart for underwriting of newly constructed buildings and DRR certification (seismic risk)

I. Implementation of a DRR Certification System

Current premium rates for coverage of natural perils are around 0.2% of the sum insured, and reduction of premium itself would not be a large amount. Looking at insurance programs for natural disasters in Japan and overseas, there are insurance systems that have set reduced premiums for facilities strengthened by seismic retrofit and flood countermeasures. However, reduced insurance premium alone may not promote investment in DRR. Insurance targeting public infrastructure are provided to public services where there are many students and faculty members. Safety of people in the buildings is important, and to ensure the safety of them is responsibility of the building owners. It is proposed that the GSIS, a property insurer, implements a system to certify disaster safety of facilities based on its risk assessment results. In the above “disaster prevention accreditation” systems, countermeasures are assessed based on the facility’s hard aspects. However, this system could be considered more appropriate from the perspective of the personal safety of students, teachers and staff because it would be a disaster prevention accreditation system carried out in collaboration with the comprehensive disaster risk reduction management measures being promoted by the Dep Ed ((1) Safe educational facilities; (2) School disaster risk management; and (3) Reducing disaster risks and promoting resilience in education) (led by the Dep Ed/DRRM Division (Disaster Risk Reduction and Management Service). In addition, by implementing both DRR certification and a premium reduction scheme that is linked with it together, the property insurance can contribute to reinforcement of public infrastructure.

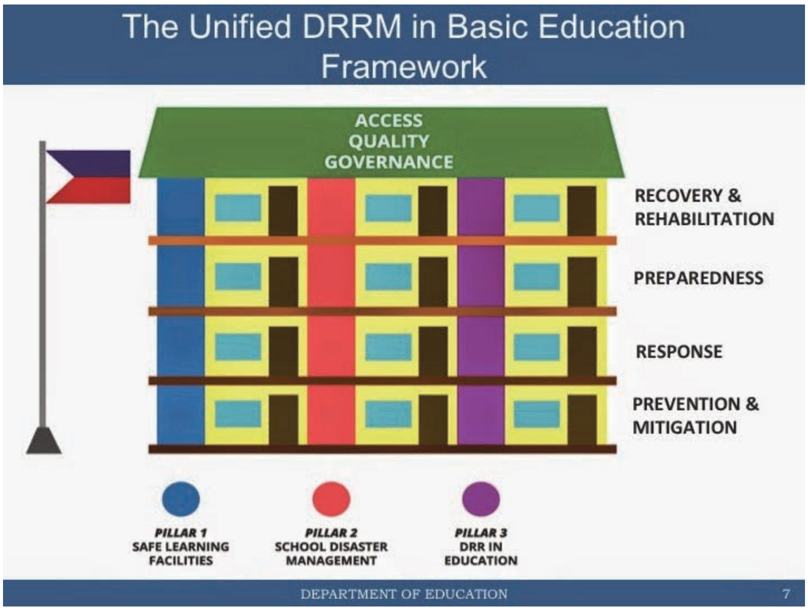

Figure 7-10 DRRM effrots taken by DepEd

7.3.3 Ensure the Government Budget for DRR retrofitting and its mechanism for public schools

a. Ensure the Government's budget for DRR retrofitting

The tool developed by this study will be used as a loss risk quantification indicator to show building vulnerability to natural disaster risk in the form of premium rates. Reducing the vulnerability of existing buildings to natural disasters will require DRR investment that corresponds to the disaster perils envisaged. Simultaneously with transferring to the insurance the financial risk when a disaster occurs, sequential reduction of building vulnerability through disaster prevention improvements will be linked to a reduction of social vulnerability. As seen in the example of the seismic retrofit of public schools in Japan, to encourage disaster prevention improvements the government must ensure a budget that will promote implementation.

Currently, Php15.775B have been earmarked in the 2017 government budget to use (post-event) for the cost of disaster risk reduction in NDRRMF or costs for recovery from damages (natural disasters and man-made disasters such as fires) incurred to facilities over the past two years, but this is not intended for DRR retrofitting of existing buildings. Now that use of this budget for investment in DRR for existing buildings as well has been clarified, a commensurate budget must be appropriated..

b. Necessity of DRR retrofitting budget for public schools

A large budget is allocated for construction of school buildings under the promotion of the K to 12 Program in the Philippines suffering from the shortage of such buildings. On the other hand, according to DepEd and DPWH[52], hardly any budget is allocated for the DRR retrofitting of existing facilities. NDRRM and LDRRM Funds provide a budget for DRR retrofitting, and they are used to budget a variety of disaster prevention measures. Therefore, it is desirable to set up an independent fund as the budget to cover ongoing and specific purposes[53], such as DRR retrofitting of schools. The budget for this will need to be provided by earmarking spending for specific uses in the budgets of the NDRMM (which leads government DRR activities) and DepEd (which is responsible for school facilities).

Government budgeting for existing public facilities that are particularly vulnerable to disasters will therefore take the form of DRR funding (DRRF) allocated to promote the development and implementation of DRR retrofitting work. This budget will be provided either within the budget of the NDRMM, which leads the Philippine government's DRR planning, or by earmarking funds specifically for retrofitting of existing facilities in the budgets of the facility administrators (DepEd in the case of public schools). Contributions to the cost of retrofitting work after the development and approval of DRR retrofitting plans will be made from the DRRF. Consideration will also be given to having insured parties bear a portion of the cost of retrofitting by using the tool to assess the reduction in contingent liability posed by disasters and the lowering of insurance premiums after retrofitting. Prior investment in DRR will be promoted by linking it to public infrastructure insurance through a system of DRR certification. Under this system, retrofitted facilities will be certified by the GSIS to be "safe schools."

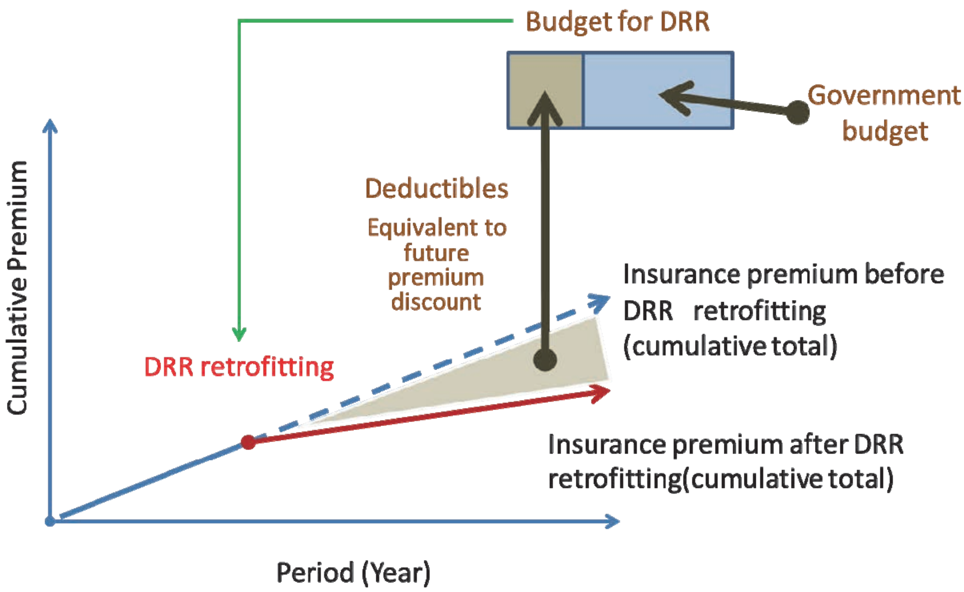

Figure 7-11 Deductibles equivalent to premium discount from DRR retrofitting

52 Hearing in March 2017 (DepEd - DRRM Services, DPWH - Bureau of Maintenance) Updated status is described in 8.2.1.

53 In the case of seismic retrofitting at public elementary and junior high schools in Japan, 73, 166 buildings of public elementary and junior high schools that needed earthquake resistance in 2002 have been reduced to 2,228 in number as of 2016 due to seismic retrofitting etc., whcih takes 15 years, and the plan in the Philippines is considered to take long time.
http://www.mext.go.jp/component/b_menu/houdou/__icsFiles/afieldfile/2016/07/26/1374618_3.pdf

c. DRR retrofitting mechanism with public school as an example

A proposed scheme and procedure for implementing this scheme are described below and is intended to apply to the public schools. Public schools are selected for this study because they are considered to be most vulnerable against natural disasters and have serious life safety concerns.

d. Implementation procedure

STEP 1: Collect information on all schools that need to undergo vulnerability assessment (coverage with public property insurance by GSIS is provided at this phase).

STEP 2: Develop a DRR retrofitting plan for each school in accordance with the risk assessment in order of DRR investment priorities (in charge by DPWH.)

STEP 3: Establish a 'DRR promotion fund' to cover the cost of DRR retrofitting and provide financing for approved retrofitting plans.

STEP 4: Discount premium rate after completion of DRR retrofitting.

e. Agency responsible for the scheme

Establish a DRR promotion fund management team consisting of DPWH (responsible for retrofit planning and construction management), DepEd (facility owner and operator), NDRRMC, and GSIS (a property insurer).

f. Implementation guidelines

- Disaster prevention loans are deposited in a specified account and used for implementing approved retrofitting plans.
- Suitability of DRR retrofitting plans and quality of construction work are guaranteed by the DRR promotion fund management team.
- The role of the management team is assumed as shown in the attached sheet.

g. Characteristics

- Planned DRR fund is to be used exclusively for DRR retrofitting to existing buildings covered by specific facility classifications (for example, schools, hospitals, etc.).
- Manages the planned DRR fund as a dedicated fund, since the NDRRM fund is used as a disaster risk reduction and mitigation fund for a broad range of objectives.
- GSIS, which manages the pension trust and insurance fund, manages the DRR fund under the direction of the DRRF management team.

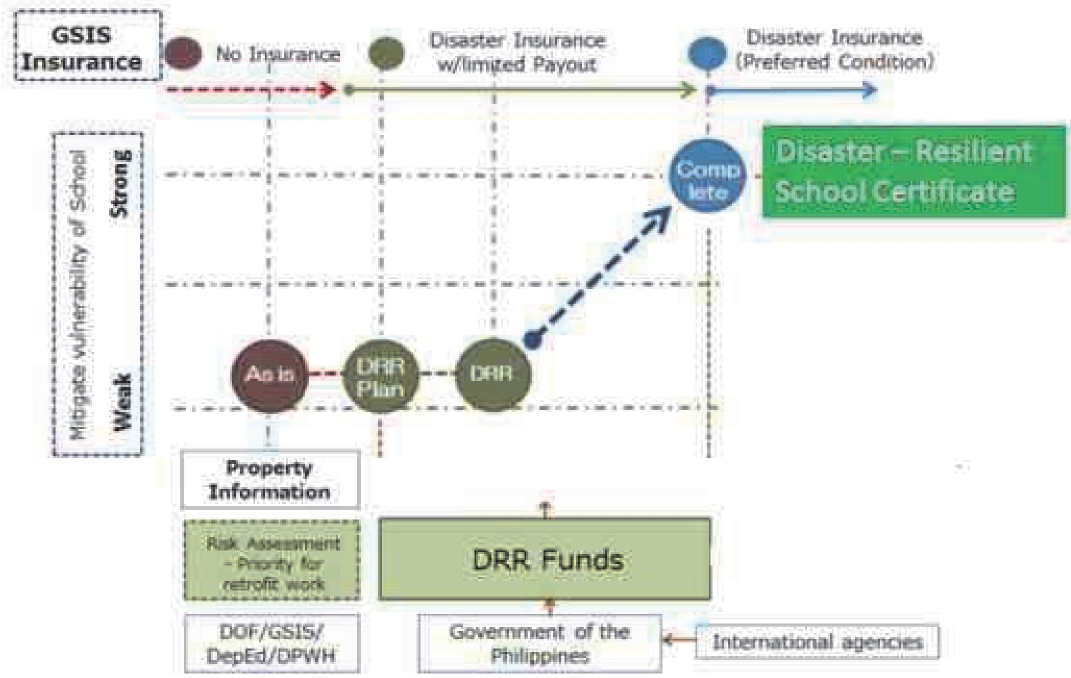

Figure 7-12 Financing structure from DRR promotion fund for DRR retrofitting

h. Potential for coordination with other agencies on DRR retrofitting of public schools

Allocating government funding to encourage DRR retrofitting work to be carried out on existing public schools will require coordination between DOF, DepEd, DPWH, NDRRM, and GSIS. Coordination with the World Bank, which works with DPWH on public school safety, will also be needed. The World Bank has extensive experience of projects to make schools safer, and it has in recent years published survey reports that have focused on the development of building regulations and the results of projects to earthquake-resistant public schools in Japan.[54]

In 2017, the World Bank commenced technical assistance (TA) to facilitate seismic retrofitting of public schools near the West Valley fault in Metro Manila. This TA consists of a building structure-based seismic risk assessment of 60 public schools near the fault that are considered most vulnerable in light of past surveys. It will suggest methods of seismic retrofitting and retrofitting costs based on the risk assessment findings, and educate DepEd in risk assessment methods. It will also assist DepEd with DRR planning by developing evaluation criteria and procedures regarding, among other things, seismic retrofitting, rebuilding on the same site, and rebuilding in another location. According to World Bank sources, TA only began in February 2017 and the schedule going forward has yet to be determined.

Per the World Bank, in the TA, Italian consultant and an engineering team from UP jointly engaged in collecting, review and assessment of structural and building drawings. While initially DepEd requested the World Bank for seismic retrofit work, scope of TA cannot go beyond detail design work. The TA is considered as part of support for comprehensive disaster risk management for Metro Manila by the World Bank, and cooperation with other agencies such as JICA may be necessary.

[54] The World Bank has published case studies of seismic retrofitting work on public elementary and junior high schools in Japan to serve as a reference for implementing large-scale government projects to make schools more disaster and earthquake resistant.

Almost all Metro Manila's public schools are low-rise reinforced concrete structures. Except for their steel roofs and wall materials (concrete blocks), they are the same in structure as conventional school buildings in Japan. Given the excellent results achieved in Japan by seismically retrofitting similar buildings (especially public schools), it should also be possible to promote the Philippine government's DRR retrofitting activities in collaboration with the World Bank.

8 Suggestion and recommendation for Promoting Resilience of Public Infrastructure through Public Property Insurance

8.1 Suggestions to resolve the current issues - Development of a standard property insurance program for public schools against natural disasters.

Insurance is a mechanism for contractually shifting burdens of risks that exhibit a possibility of unacceptable financial loss by pooling them in return of insurance premium affordable to each entity. A financial burden remains an entity who suffered property damage when the property is not protected by a specific insurance coverage, i.e. fire insurance coverage alone does not correspond to damage caused by a natural disaster. Underinsurance also reduces insurance payout according to the insurance policy, and financial burden partially remains within the insured. As one of general principals, premium should be corresponding to insured risks. Therefore, it promotes reduction of vulnerability of the facility by the insured. The current tariff rate applied in the public property insurance does not adequately reflect condition of the property. It is suggested to develop a standard insurance program that actively connects between risk transfer and risk reduction mechanisms. The standard program may provide incentives with the insureds to purchase coverage for natural perils, mechanism to prevent underinsurance, risk base premium, adjustable deductibles, early payment mechanism, premium discount for DRR investment and others. These features may positively encourage resiliency of the insured facilities against natural hazards, and leading to faster recovery after the damage. By integrating the proposed DRR certificate system and a retrofit program for DRR with the public property insurance program, the standard property insurance program aims to play more active role to mitigate natural hazard risks.

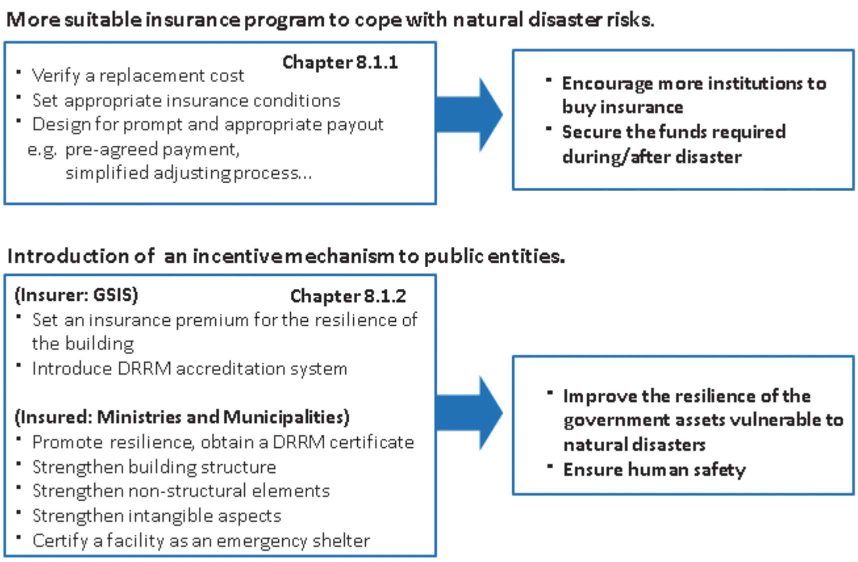

Figure 8-1 Concept of the standard insurance program and expected results

It is suggested that the standard property insurance program should target public schools based on the following reasons;

- The study showed that many of public schools are vulnerable to natural disaster risks such as earthquake, typhoon, and flood. School facilities must be safe against natural disaster to protect students, teachers and school staffs. In addition the facility is critically important as a shelter of the local community when a disaster occurs. Therefore, high-risk building should be upgraded to withstand anticipated natural hazards.

- Currently DepEd schools are not covered by the public property insurance. Therefore, funding budget must be obtained to repair the damage caused by natural hazards. Funding process may take some time, and delay the facility to bring back to pre-disaster condition.

- Public schools are located over the Philippines, and they exposed to a variety of natural hazard risks. With consideration of risk diversification benefit in insurance and DRR investment, the standard property insurance program targeting DepEd schools should be an effective property insurance program.

While discussion at IAC for addressing the outstanding issues on the public property insurance is ongoing, review of introduction of the standard insurance program as described initiated by GSIS may substantially enhance roles of public insurance program.

The proposed program should have the following features,

- Increase the role of the property insurance by eliminationg uninsurance and underinsurance (8.1.1)
- A mechanism to promote DRR investment (8.1.2)
- Capacility building of GSIS for underwriting natural disaster risks (8.1.3)

8.1.1 Increase the Role of the Property Insurance by Eliminating uninsurance and Underinsurance of Public Assets

The Philippine government has been working to develop methods of pre-disaster financing, including the use of disaster reserves, property insurance, and the creation of credit facilities, in order to meet demand for disaster funding throughout government and society in the event of a disaster. The public infrastructure insurance that is the subject of this study is a form of property insurance covering government assets, and its function is to transfer the risk of damage to government assets to insurance by having damage recovery costs covered by insurance payouts.

Public infrastructure insurance is a system of compulsory insurance coverage required under the RA656 property insurance act. However, some facilities that should be covered are uninsured, and many facilities have fire insurance but are not insured against natural disaster risks. Contravening the spirit of their insurance policies, a significant number of facilities are also underinsured. Institutions that are uninsured or underinsured would not receive payouts on the scale needed to repair damage in the event of a disaster, and would have to fall back on their own funds to repair their facilities. Having to bear unplanned-for costs impairs the role of public infrastructure insurance and ultimately places a financial burden on the government.

In countries such as the Philippines where natural disasters are extremely frequent, the facilities covered need to be dispersed geographically in order for a system of natural disaster insurance to function properly. In this respect, the compulsory coverage of facilities throughout the Philippines should increase geographical dispersion. When many facilities are uninsured, however, adverse selection is encouraged and this dilutes the effect of dispersal. If public infrastructure insurance is to function as an effective means of shifting government assets' exposure to natural disaster risk, the problem of non-insurance and underinsurance needs to be rectified. While the steps taken to date by government agencies and future measures to rectify the problem are described in Chapter 4, some additional solutions are proposed below.

Table 8-1 Additional measures to rectify problems: Public property insurance

No.			Item	Summary of proposal	Section
1)	Improvement of public infrastructure insurance				
	①	Elimination of non-insurance against natural disasters			
		a)	Provide information on natural disaster risk and loss evaluation to the Insured using the premium calculation tool	The Tool developed in this study enables to visually review natural hazard level visually on a map and conduct loss evaluation of target facilities. It is recommended to use the Tool to enhance for the awareness of the facility owners about natural disaster risks during the insurance promotion caravans by GSIS.	4.4.2 a
		b)	Consideration of rules on deductibles for natural disasters	Lowering the deductible for claims due to typhoons and flooding will facilitate appropriate recovery using payouts to repair small-scale damage. Insured parties' awareness of the usefulness of insurance will be improved by providing more opportunities for them to receive payouts.	4.4.2 b
		c)	Clarification regarding compulsory purchase of natural disaster coverage	The Implementation Rules and Regulations (IRR) drawn up after the amendment of RA656 will clarify that coverage against natural disasters as well as fire is compulsory.	4.4.2 c
		d)	Monitoring of natural disaster insurance participation rates by GSIS	Action by government agencies should raise the participation rate. Participation in insurance against natural disasters will be monitored by GSIS to encourage non-participants to buy insurance and eliminate non-coverage.	4.4.2 d
	②	Elimination of underinsurance			
			Introduction of policy-related incentives to help rectify problem of coinsurance	In order to promote appropriate appraisal of replacement costs by insured parties, provision should be made in the terms of policies for mechanisms to encourage insured parties to appraise replacement costs. These may include allowances regarding coinsurance rates and exemptions from coinsurance clauses where appraisals have been performed by a prescribed method.	4.5.1 e
			Introduction of mechanism to allow GSIS to check replacement costs	One effective way of reducing the significant level of coinsurance is to give GSIS the capacity and means to check the validity of the sum insured relative to the replacement cost as part of the insurance underwriting process.	4.5.1.d
		a)	Valuation of replacement cost by insured parties (for major infrastructure, public schools, and offices and other ordinary buildings owned by public agencies)	Insured parties will need to indicate an appropriate replacement cost as the sum insured in accordance with the terms of their insurance policies. It is proposed that professional appraisers be appointed and a system of desktop appraisal based on standard unit construction costs according to facility type be developed.	4.5.1 a-c

8.1.2 Introduce a Mechanism to Promote DRR investment

Insurance is a mechanism for shifting the financial risk posed by a disaster. By setting premium rates according to disaster risk, premiums can be used as an incentive to harden facilities and so encourage prior investment in DRR. This study considered and proposed replacing the insurance premium scheme used for public infrastructure insurance with an premium rate scheme that more accurately reflects natural disaster hazards and facilities' vulnerabilities, and identified obstacles to the scheme's introduction and possible solutions.

The study proposed the introduction of a DRR certification scheme to strengthen the incentive to engage in prior investment in DRR, and the introduction of a DRR retrofitting mechanism that embraces risk-based insurance premium rates and a DRR certification scheme. Government funding will need to be secured to promote prior investment in DRR. Although PHP 15.775 billion was allocated in the 2017 government budget to the NDRRM Fund to help cover the cost of DRR and restoration of damage suffered in the past two years (due to natural disasters and man-made disasters such as fires), this does not cover DRR retrofitting of existing buildings. A reasonable budget also needs to be allocated for the NDRRM Fund to assist prior investment in DRR in existing buildings.

Table 8-2 Additional measures to rectify problems: improve investment in DRR

No.		Item	Summary of proposal	Section
2)	Introduction of mechanisms to encourage pre-event DRR investment			
	①	Introduction of risk-based insurance rate scheme	Current insurance rates do not sufficiently reflect the natural disaster hazards posed by facilities' locations and their structural resilience to disasters. Introducing a risk-based insurance scheme and discounting the premiums charged for highly disaster-resilient facilities could form the basis for incentivizing pre-event DDR investment.	7.3.1
	②	Introduction of DRR certification scheme	Natural disaster insurance premiums are low compared to the cost of DRR investment. Introducing a DRR certification system indicating user safety alongside premium discounts will have an incentivizing effect on pre-event DRR investment.	7.3.2
	③	Securing of government funding for DRR retrofitting	Although the government's NDRRM budget includes provision for repair of facilities damaged by past disasters, it allocates no funds for carrying out DRR retrofitting work on existing facilities. DRR retrofitting work needs to be pursued at the same time as transferring financial risk using insurance, and government funding needs to be secured for this.	7.3.3

8.1.3 Capacity building of GSIS for Underwriting Natural Disaster Risks

a. Enhance Risk Accumulation Management for Natural Disaster Risks

Along with initiatives by the institutions concerned and action towards the amendment of RA10121 (NDRRM Act) and RA656 (Property Insurance Law), it is believed that the subscription rate by public property insurance will increase in the future. Although specific coverage facilities and use of applications have not yet been determined, a budget for 1 Billion PHP is allocated to the NDRRM Fund as the insurance purchase cost for government assets in the national budget for 2017. GSIS's present insurance return is extremely high, but the role of managing underwriting risk pooling will become more important due to increase in the underwriting risk volume as natural disaster insurance from now on. With respect to earthquake in particular, the GSIS' underwriting risk is deemed to be accumulated in Metro Manila where many government assets are concentrated and the seismic risk is high. It is recommended that the GSIS, as the only insurer of the government assets, continue managing to be solvent (including reinsurance) for the risks it undertakes.

Table 8-3 Enhansement for risk assumulation management

No.		Item	Summary of proposal	Section
3)	Development of GSIS's ability in accumulation management to underwrite natural disasters			
	①	Integrated management of natural disaster insurance underwriting risks	Initiatives undertaken by GSIS and related government agencies coupled with provision in the 2017 government budget for spending on premiums to insure government assets against natural disasters should increase the insurance participation rate. GSIS is the sole insurer of government assets, and is responsible for underwriting insurance regardless of facilities' vulnerability. Integrated management of risks is important to underwriting of natural disaster insurance, and integrated risk management will grow in importance as underwriting risk increases. As an insurer, GSIS will need to enhance integrated management and optimized management of reinsurance purchases using the risk insurance rate tool.	4.6.1 b

8.2 Suggestions to enhance resiliency of public schools

8.2.1 Necessity of DRR Retrofitting Works for Existing Public School Buildings

In the Philippines, 74% of the population is at risk of natural disasters, with an annual average of about 1,000 victims[55]. The annual expected value of loss amount due to natural disaster reaches 0.8% of the GDP[56]. According to DepEd, there are about 50,000 public elementary and junior high schools across the Philippines, even within MM, more than 600 hundreds public schools with 4,000 school buildings are exposed to natural hazard such as typhoon, floods, and earthquakes. In particular, Study for Earthquake Impact Reduction for Metropolitan Manila (MMEIRS) study by JICA in 2004 revealed a Magnitude 7.2 West Valley fault earthquake as one of the severest damage scenario to Metro Manila that may result in the loss of 33,500 lives.

The World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR) study, following to MMEIRS, estimated 24,000 fatalities in 3,821 school buildings would occur at the public school, and 2,100,000 students are exposed to severe damage considering rapidly increasing population and number of schools in MM as of 2013. However, the report says that the number of deaths can be reduced by 25%number of estimated fatality can be decreased by 25% if seismic retrofitting is carried out for the top 5% (186 schools) school buildings in descending order of vulnerability[57].. The report also indicates that the cost of retrofit is much cheaper than construction of new buildings, i.e. 20% of new building cost.

In Metro Manila, due to the studies such as MMEIRS and initiative with NDRRM, seismic inspection and retrofit works for road bridges are partially ongoing. However, no actual progress so far to retrofit the existing school buildings. According to DPWH, the public buildings located within 100m from the West Valley fault were identified and inspected for initial screening in 2016. There were 223 buildings were identified and, of that, 113 building were considered vulnerable against earthquakes. Seismic retrofit was determined necessary at 85 buildings. The inspection result was shared to the agency that is responsible of the particular building. However, no action for retrofit has been made so far[58].

Acooridng to DPWH[59], they have completed an initial seismic review for 5,962 public buildings as an immediate action for earthquake risks at Metro Manila was addressed at SONA in 2017. The inspection outcome shows that 2,438 buildings are needed for detail structural review. The inspected buildings include schools, hospitals and other government buildings. Sseismic retrofit cost for 2,438 building is estimated at 44B PHP by DPWH ahile 500B PHP only is currently budgeted by the government. As the state budget is based on cash disbursement basis, and year by year approval process, it is quite difficult for DPWH to effectively implement seismic retrofit projects within ceartain time frame.

8.2.2 A standard property insurance program with an incentive for DRR investment.

The standard property insurance program should have a risk base premium pricing, DRR certification system and corresponding premium discount system to promote DRR investment. The program should also have a funding mechanism for DRR projects. With these approaches and addressing the issues as stated in 7.3.3, the program should be recognized as better risk transferring mechanism and considered as a comprehensive program for promoting

55 ADB Country operation business plan, Philippines 2013-2015 https://www.adb.org/sites/default/files/linked-documents/cobp-phi-2013-2015-oth-06.pdf

56 ASEAN – Advancing disaster risk financing and insurance in ASEAN member states https://www.gfdrr.org/sites/gfdrr/files/publication/DRFI_ASEAN_REPORT_June12.pdf

57 Forum on Safe and Resilient Infrastructure – P10, Earthquake disaster risk in Manila https://www.gfdrr.org/sites/gfdrr/files/Philippines-Forum-on-Safe-and-Resilient-Infrastructure.pdf

58 Seismic risk assessment on public facilities along the West Valley fault DPWH internal document May 27, 2016

59 DPWH hearing on May 9, 2018

DRR investment.

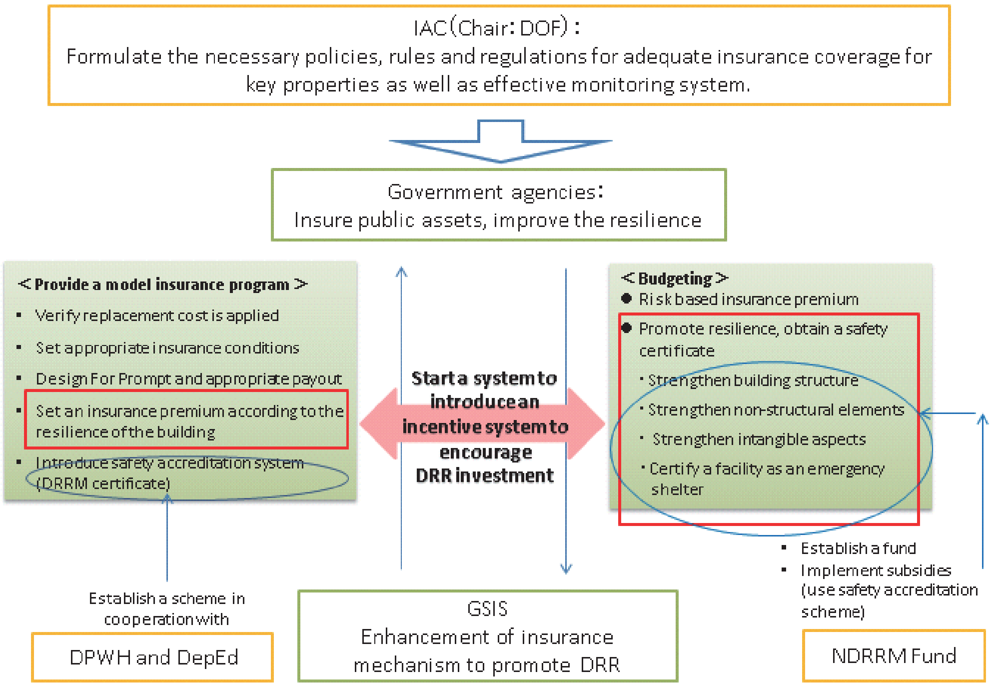

Figure 8-2 A standard insurance program and enhancement of DRR investment

The comprehensive retrofitting mechanism will function as follows: (1) government spending on DRR retrofitting will be secured and (2) a risk-based insurance premium rate tool used to (3) prioritize existing buildings for DRR retrofitting. Then (4) DRR retrofitting plans will be drawn up by order of priority and these plans put into effect taking into consideration building life and the effects of investment. Retrofitting plans should (5) draw on Japan's experience of DRR retrofitting of public schools and the retrofitting methods used. The effects of DRR retrofitting will be to (6) reducing existing buildings' vulnerability and (7) improve building safety by means of a DRR certification scheme. The aim of the comprehensive DRR retrofitting mechanism will be to reduce existing buildings' vulnerability to disasters through DRR activities interlinked with public property insurance, the result of which will be to (8) reduce the contingent liability posed by disasters. It will thus lead to lower premium rates.

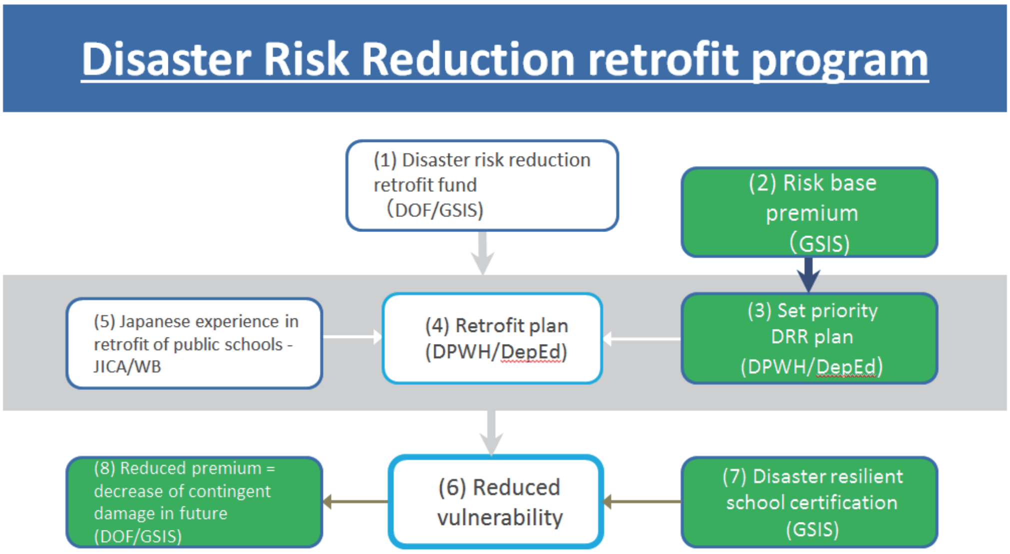

Figure 8-3 Integrated DRR retrofit mechanism with public schools as an example (Green figures show coordination with insurance)

9 Future Cooperation and Support and Support

This section describes the areas that would need future cooperation and support from the viewpoints of optimizing public infrastructure insurance, promoting prior investment in DRR, and strengthening insurance organizations' risk management against natural disasters. The relationship between recommended items shown in chapter 8 and areas of future support and cooperation described in chapter 9, with section numbers corresponding to each item are described in the table below.

Table 9-1 Corresponding between Suggestion and Proposal in chapter 8 and Future cooperation and support in chapter 9

Chapter 8	Suggestion and proposal	Chapter 9	Future cooperation and support
8.1 Suggestion to resolve the current issues and increase the role of the public property insurance		**9.1 Cooperation to resolve the current issues and increase the role of the public property insurance**	
8.1.1	Increase the role of the property insurance by eliminationg uninsurance and underinsurance	9.1.1	Development of s reference database of the replacement cost of public institutions' buildings
8.1.2	Introduce a mechanism to promote DRR investment	9.1.2	Supporting utilization of the risk-based premium rate calculation tool for Metro Manila
		9.1.3	Supporting extention of the risk-based premium rate calculation tool beyond Metro Manila
		9.1.4	Assistance with design of DRR certification scheme
8.1.3	Capacity building of GSIS for underwriting natural disaster risks	9.1.5	Expanding the role of the GSIS underwriting division's risk engnieering team and capacity building
		9.1.6	Strengthen GSIS's risk accumulation management on natural disasters and review for reinsurance procurement schemes
		9.1.7	Strengthen GSIS's adjusting capability at a large-scale natural disaster
8.2 Suggestions to enhance resiliency of public schools		**9.2 Supporting to enhance resiliency of public schools - building a oomprehensive DRR retrofitting mechanism**	
8.2.1	Necessity of DRR retrofitting works for existing public school buildings	9.2.1	Sharing Japanese experiences of DRR retrofitting
8.2.2	A standrad property insurance program integrating resiliency mechanism with DRR funds	9.2.2	Necessity of funds for DRR retrofittin work
		9.3	**A standard property insurance program utilizing Green Climate Fund as an integrated disaster risk management initiative promoting for resiliency of the public schools against natural disasters**

9.1 Cooperation to resolve the current issues and increase the role of the public property insurance

9.1.1 Development of a Reference Database of the Replacement Cost of Public Institutions' Buildings

In property insurance, it is the insured's responsibility to declare the insured value for the insured facility. In the case of an insurance contract that compensates on the basis of the replacement cost, as with public property insurance, the insured is required to declare the appropriate replacement cost as sum insured.

With respect to transport infrastructure and bridges such as MRT3 and NAIA T3 that were covered by this study, construction costs differ largely depending on types and specifications. Therefore, it is realistic to determine replacement cost by individual appraisal. Meanwhile, with respect to buildings used for offices, including schools, which account for the majority of public facilities, it is possible to assess replacement cost on the basis of a building unit price according to a building type. Some consulting companies in the U.S. provide a web-based building assessment system. They when assuming insurance can determine by using such a system whether or not replacement cost is reasonable, and such a system is widely used. Although no company provides a similar system in the Philippines, a company that accumulates building cost data and announces every year a list of unit prices by typical use does exist. According to the said company, it is easy to develop a cost database specializing in a public institution's office-use buildings, which will achieve the same objective as the system in the U.S.

If such a database is used, it is possible to determine whether or not the insurance amount declared by the government agency, i.e., the insured, is reasonable as replacement cost when GSIS underwrites the insurance. If not reasonable, GSIS can press a government agency to remedy it, which leads to an improvement in underinsurance.

Grasping the information on existing government facilities is cited as one of the future measures in the Philippine DRFI forum sponsored by APEC[60]. Collecting and building database of information on facilities and on the sum insured required for appropriate insurance underwriting can be referred to as a way of cooperation and support.

In addition, there are such institutions, being outside the scope of the Study though, that GSIS expects valuation of replacement costs as ports, transmission facilities, and The Philippine National Railways, and technical support for these facilities as simplified evaluation is difficult. Support of evaluating sum insured for each facility and of creating standard value GSIS can refer to is also considered possible.

Necessity of a registering system for public asset has been discussed in the Inter Agency Committes in order for emsure complehensive and adequate insurance for key public assets. BTr, a chair of IAC has requested the Wrold Bank for a technical assistance for development of a framework of registering system. A joint support by JICA may be feasible..

9.1.2 Supporting Utilization of the Risk-Based Premium Rate Calculation Tool for Metro Manila

Use of the risk-based premium rate calculation tool for facilities in Metro Manila now makes it possible to set premium rates for the covered facilities. Conducting on-the-job training (OJT) on methods to use the tool based on actual cases will be necessary for insurance group to practically utilize it, set the premium rate reflecting insurance contract conditions such as deductible amount, select an appropriate vulnerability curve, and collect and manage risk information, which GSIS has requested as well. Such on-site training will also be necessary at DepEd, which has authority over the public schools for which it is feasible to prioritize facility disaster prevention improvements through use of this tool.

[60] National policy forum on disaster risk financing and insurance, February 2017, Qezon city, the Philippines

9.1.3 Supporting Extension of the Risk-Based Premium Rate Calculation Tool byond Metro Manila

a. Tool Extensibility

In response to a request by GSIS, an extensible tool that is adaptable to regions outside MM has been developed. Expanding the coverage of this tool throughout the Philippines enables risk-based underwriting for all facilities covered by GSIS. In particular, in the east coast areas often suffering from typhoon, insurance underwriting which uses evaluation of vulnerability of buildings to wind storms, and resilience by DRR can be possible. It also enables development of quantitative damage evaluation model in the entire Philippines on natural disaster risk.

b. Actions Required for Extending the Use

The tool is broadly comprised of a hazard module, a vulnerability module and a financial module. This study has found that, as for the hazard module, PHIVOLCS, PAGASA and UP have an extensive knowledge about earthquake, wind and flood disasters respectively. Similarly, the study has also found that UP has an extensive knowledge about vulnerability. Meanwhile, PHIVOLCS and PAGASA do not seem to have the human resources required for performing additional tasks on top of their day-to-day tasks. UP seems to have research departments that can perform the tasks required for extending the tool usage, as long as they have the fund necessary for the development, although this depends on the balance with their other projects. Financial modules are created to reflect insurance conditions such as setting of deductibles and payment limits.

Extending the usage of the models is recommended by launching a consortium comprising mainly of GSIS, UP, PHIVOLCS and PAGASA so as to extend the usage of the tool to all the regions across the Philippines. The following table shows the proposed roles of each organization.

Table 9-2 Proposed Roles of Consortium Organization

Organization	Role
GSIS	Coordinate the process of creating the tool
University of the Philippines	Create a flood hazard map
	Create a vulnerability curve for earthquake, wind and flood disaster risks
PHIVOLCS	Extend the usage of the earthquake hazard model to all the regions
PAGASA	Extend the usage of the windstorm hazard model to all the regions

However, as mentioned above, since all of these organizations certainly do not have the necessary human resources, it would be more realistic to ask a tool development vendor, who will actually work on the task of extending the tool usage, to join the consortium led by UP, PHIVOLCS and PAGASA. In this way, the study team can promote extending the usage. The required items for and the policy on extending the tool usage are as follows:

b.1 Extending the Usage of Hazard Model to All Regions

It is necessary to prepare a system that can evaluate these natural disasters throughout the Philippines since it is thought that earthquakes, windstorms, floods have a dominant influence on premiums through this survey. In this work, the study team purchased earthquake and windstorm hazard information limited to Metro Manila. As it would be expensive to purchase a model that can be used for all the regions, it would be better to ask a tool developer to develop a unique hazard model for this tool, under the supervision of PAGASA and PHIVOLCS.

The "Disaster Risk and Exposure Assessment for Mitigation (DREAM) Program" led by Professor Paringit at UP has already created flood hazard maps at around 800 local governments. By working with this project, it will be possible to analyze the impact of natural disaster risks on public infrastructure by using a high-quality hazard map.

b.2 Development of Additional Vulnerability Curves

In this project, the study team has managed to establish a framework of appraising general buildings that are built of wood, steel or concrete, by using the vulnerability curves acquired from the University of the Philippines. On the other hand, many of the large public infrastructure facilities insured by GSIS are special structures (e.g. port facilities). This means that the risk of many facilities cannot be valuated accurately using only the vulnerability curves that have been collected.

In developing the tool nationwide, it will be necessary to evaluate special structures that are not subject to this study. Therefore, it would be advisable to review the underwriting portfolio of GSIS, and create a vulnerability curve in order from important special structures.

UP has simulation know-how for creating curves, and therefore it is desirable to add curves under the under the guidance in descending order of important structures.

c. Development of the Loss Evaluation Model by the Philippine Government's Technology Institutions

This tool was developed with such information from the Philippine government as natural disaster hazard information which is part of the positive effect of natural disaster risk management promoted by NDRRMP and information on the vulnerability of facilities. In the Philippines, various risk assessment tools and hazard maps have been developed so far, and data has been accumulated in the framework of Project NOAH, which DOST promotes[61]. This will enable them to develop a natural disaster hazard model, too. For development of the premium rate calculation tool, it was essential to have not only a natural disaster hazard model but also a valuation model concerning facility vulnerability. Onsite valuations of building or facility vulnerability require knowledge of the shortcomings of local building standards and construction methods and execution, the characteristics of building specifications, and the extent of damage from past disasters. The study has found that the technical institutions and universities (UP) in the Philippines have such knowledge sufficiently. The study team believes that having the capability to quantitatively assess in-country losses from natural disasters, and establishing and improving disaster risk financing based on it, will help improve the Philippines' disaster prevention management capabilities. Furthermore, through the enhancement process it will be possible to also refine the tool developed this time.

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[61] According to NDRRMC, Project NOAH has invested 6.4 B Php so far since its launch in 2011.

Although there is also an idea that the risk assessment model offered by a major US model company, which is a standard in the insurance market, is required for use in loss evaluation in the overseas insurance market, it is believed that development of a domestic model through cooperation with relevant technology institutions is suitable, in light of future development, technology accumulation and expansion. Since using such an open platform as the OASYS platform[62] is also underway against the market monopoly of major model companies in the insurance industry. Supporting the development of a domestic loss evaluation model as one of the measures for the Philippines to more securely assure disaster risk financing is considered to contribute to improving the capability of disaster prevention and of DRR finance in the Philippines.

9.1.4 Assistance with design of DRR certification scheme

The present study proposed the introduction of a DRR certification scheme to complement the incentivizing effect of lower premium rates in order to encourage prior investment in DRR. While it has outlined the concept of DRR certification and described the items and methods of inspection required for certification of public school buildings, actual creation of such a scheme will require DepEd (as the building administrator), DPWH (as the agency responsible for buildings), and GSIS (as the insurance underwriter) to draw up concrete plans. As there have not to date existed any schemes for certifying schools or other public facilities in the Philippines, Japan can play a useful role by offering its experience as a world leader in DRR to assist with the design of a DRR certification scheme that will effectively mitigate vulnerability.

9.1.5 Expanding the Role of the GSIS Underwriting Division's Risk Engineering Team and Strengthening the Team's Capacity

Two engineers are affiliated with the Underwriting Division at GSIS's head office, and perform a regular risk survey of large-scale insurance program facilities that obtain reinsurance. The purpose of the risk surveys is the provision of information to reinsurers (details on coverage facilities, operating status, assessments concerning the insurance underwriting risk, past accidents) and disaster prevention improvement suggestions to the insured entities, and a survey report is prepared. The main risks covered are fire and explosion hazards, and the perspective on natural disaster risk and the status of disaster prevention for facilities subject to such risk is narrow. Because of the types of insurance contracts handled and the coverage facilities, the engineer team is considered to be small-scale as an insurance organization, but given that the amount of public property insurance handled is expected to grow in the future, and that insurance coverage concerning natural disaster perils in particular is expected to increase, it is believed that expanding the role and organization of the risk engineering team and strengthening its capacity is necessary. Specifically, by using the risk survey on reduction of disaster risk as an opportunity to make effective improvement proposals to insured entities, GSIS and public property insurance will contribute to the reduction of building and facility vulnerability.

9.1.6 Strengthen GSIS's Risk Accumulation Management on Natural Disasters and Review for Reinsurance Procurement Schemes

The subscription rate for public property insurance is considered to increase in the future along with initiatives by the institutions concerned and action towards the amendment of RA10121 (NDRRM Act) and RA656 (Property Insurance Law). Although the decision regarding specific

[62] https://www.climatefinancelab.org/project/climate-risk-assessment/

coverage facilities and use of applications will be made in the future, in the national budget for 2017 a budget for 1 Billion PHP has been allocated to the NDRRM Fund as the insurance purchase cost for government assets. As stated in Section 3.1, GSIS's present insurance return is extremely high, but the role of managing underwriting risk pooling will become more important in the future because of the increase in underwriting risk volume as natural disaster insurance. In addition, such steps as reviewing how deductibles are set, which currently are nearly uniform or comparatively large (2% of the cash value of coverage facilities), and studying the effect of this on insurance premiums, also will be necessary to create an even more attractive insurance program. GSIS underwriting risk management is considered to be more important than ever as the sole insurance institution to underwrite government assets against the natural disaster risk that is expected to increase in the future.

Extension of the tool is the prerequisite, but using this tool will make it possible to manage the accumulation of natural disaster risk for public infrastructure throughout the Philippines by GSIS in house. Accumulation control is one form of risk self-management that insurance companies perform. Insurance companies verify the status of the accumulated natural disaster risk by region and portfolio, and confirm risk is not accumulated in a specific region such that payouts from one natural disaster would exceed their own guidelines.

Such management can also be used to provide capital against natural disasters in the future and to optimize the reinsurance scheme GSIS has arranged. At present, GSIS has transferred the risk to re-insurance arranged in the Philippines and overseas for much of the insurance payouts when a disaster occurs, but by using accumulation control, it is also possible to confirm whether more reinsurance than necessary has been purchased and reinsurance premiums are flowing out of the country, or whether the reinsurance purchased is insufficient.

By improving its risk management capabilities as the leader in the disaster risk financing sector for Philippine government assets, GSIS can improve the Philippines' disaster risk financing capabilities, and help alleviate the financial vulnerability of the government to natural disasters.

9.1.7 Strengthen GSIS's Adjusting Capability at a Large-Scale Natural Disaster

According to IC, for loss adjusting after Super Typhoon Yolanda it expedited the insurance claim payment process by such measures as easing the document requirements necessary for insurance payout, but preparations including a prior decision on specific details of the easing were not feasible, making it a post-disaster response. Japan as well has experienced insurance payout adjustments following large-scale disasters, such as the Hyogo-Nanbu Earthquake, the Great East Japan Earthquake, and the Kinu River Flood. In the effort to make early insurance payouts for earthquake, flood, and typhoon disasters, the study team believe they can assist GSIS in strengthening its capabilities as an insurance organization based on our experience and early payment efforts as Japan's property insurance industry (simple appraisals for residential earthquake insurance, desk-top appraisals based on aerial photographs, advanced technology such as understanding roof damage by using drones and remote sensing, etc.).

9.2 Supporting to enhance resiliency of public schools - building a oomprehensive DRR retrofitting mechanism

9.2.1 Sharing Japanese experience of DRR retrofitting

Public schools in the Philippines are, like in Japan, generally made from reinforced concrete. Japan is expected to be able to provide support and cooperation by sharing its experience of earthquake-resistant public schools, particularly in areas such as the use of seismic retrofitting methods that allow work to be completed more quickly, performance of retrofitting work while buildings remain in use, and diagnoses of remaining building life.

With respect to disaster coaused by a typhoon, Japan has common features with the Philippines. An abundant expertise of Japan based on the experience to mitigate damage from Typhoons in the areas of installation of roofing system and protection method of windows, doors and other open areas with structural upgrading can be applied to the Philippines.

9.2.2 Necessity of funds for DRR retrofitting work

According to DepEd and World Bank, a technical assistance project to conduct seismic inspection, prioritizing vulnerable 60 school buildings, development of seismic retrofit method, decision criteria for relocation and retrofit has just started. According to DepEd, they are preparing plans to conduct pilot DRR retrofitting for public schools in the Metro Manila, based on the results of the survey by the World Bank.

The disaster resilient approaches are in progress in the Philippines along with NDRRMP2011-2018. Outcome No.3 addresses the increasing resiliency of public infrastructures and schools. Developing of disaster resilient school guidelines is also discussed. On the other hand, the progress made so far is still limited within upgrading building code, development of resilient and safer school design. Actual progress to physically reinforcing existing school building structure is yet to come[63].

It is suggested that a program focusing on existing school buildings be established. The program should include to create a DRR fund, and then, implementing a risk assessment for prioritizing building for retrofitting, development of a retrofit plan, where Japanese experience can substantially contribute, insurance premium pricing connected to DRR achievement. JICA may support to establish an integrated DRR management program.

9.3 A standard property insurance program utilizing Green Climate Fund as an integrated disaster risk management initiatives promoting for resiliency of the public schools against natural disasters.

When insured properties are increased and properties with underinsurance are reduced, contingent liability retained by the government will be reduced in future. With progress of DRR projects, the insurance premium, as price of risks, will be reduced, and then more insurance coverage can be provided. In order to achieve such a chain effect, a funding mechanism for DRR projects and premium payment by the insured should be established first. Such projects should be part of an integrated disaster risk management.

According to DPWH and DepEd, the budget for new construction of classrooms -- classrooms will be in shortage due to the K to 12 program[64] and expenses for past disaster-damage reconstruction are included in the 2017 national budget. However, the budget does not include allowance for DRR projects dedicated to existing school buildings.

The standard property insurance program for public schools proposed at in chapter 8 is an

[63] Overview of the National DRRM Plan 2011-2028 and status of activities, OCD Administrator, February 2017

[64] Since the school system which was 6-4 system was changed to 6-4-2 system in the Philippines, school buildings are short and the budget for building new schools is allocated to the government budget for 2017. http://www.deped.gov.ph/k-to-12

initiative to make good connection between insurance as a risk transfer tool and DRR projects as a risk control measures in a disaster risk management. With focusing on public schoold diversified all over the Philippines, part of the funding needs for the program may be eligible for applying Green Climate Fund (GCF).

While DRR activities for public schools have been implemented by the government and DepEd, retrofit activities for the existing school building are limited ao far. It is possible that GCF may support such activities through the program and may achieve substantial reduction in vulnerability of school buildings. While the program focuses on the public schools, the same concept can apply to other public asset as well. Since DPWH is responsible for construction of the school buildings and DepEd has their own engineering sections, they are capable of managing the DRR projects. JICA has implemented many projects in the Philippines concerning rehabilitation and construction of resilient buildings that withstand strong typhoon risks in Visayas and other areas. A few of many examples are construction of out-patient building of eastern visayas regional medical center and the projects with TESDA, Technical Education and Skills Development Authority. The Philippines and Japan have common characteristics of natural hazards such as typhoon, earthquake and flood on all over the country. Similar to the Philippines, majority of the public school buildings in Japan are made of reinforced concrete structure and its construction industry retains abundant experience and expertise in DRR retrofitting work on the existing buildings[65]. JICA can avail of such expertise in its cooperation projects for DRR. Beside the public schools, such concept may be applicable to other facilities such as hospitals. In the Philppines, movement of retrofit projects with funding mechanism for DRR seems to be increased such as the legislative action for the electric copoperatives emergency and resiliency fund act [66] as part of NDRRMF.

In line with these facts, the proposed project may be eligible for accessing to GCF through JICA as one of accredited entities.

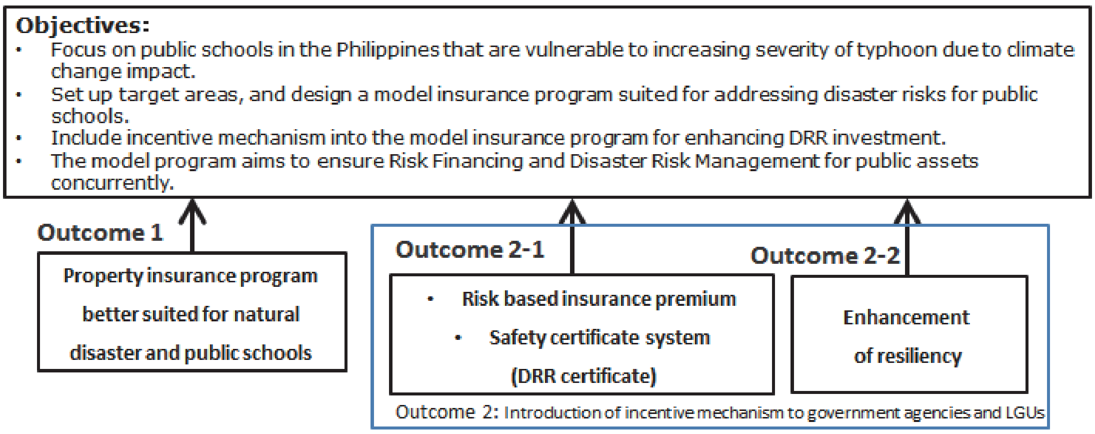

Figure 9-1 Conceptual scheme of a standard property insurance for public school promoting DRR activities for resiliency as an integrated disaster risk management.

(End of the report)

65 Building structural code in the Philippines are developed in reference with the US building code system.
66 Senate bill No. 1461, The Electric Cooperatives Emergency and Resiliency Fund Act