2022

NARS Portfolio Risk Report

BUREAU OF THE TREASURY

EXECUTIVE SUMMARY

The National Asset Registry System (NARS) is the National Government's primary central repository for data on its strategically important and critical non-financial assets.

The NARS has become an important step in consolidating information on the government's strategically important non-financial assets and improving asset management practices. The establishment of the NARS allowed several agencies to undertake a more complete inventory activity of their current strategically important assets. The establishment of the NARS has also provided the National Government, particularly oversight agencies in the form of the DBCC TWG-AM a portfolio wide view of potential risks, asset concentrations, and valuation of key government assets.

As of Q1 2023, the NARS has data on 359,689 assets with a declared value of over PhP 2.0 Trillion from 40 agencies and instrumentalities.

These assets include strategically important assets such as schools, hospitals, transport facilities, welfare centers, and irrigation facilities in the Philippines. The submitted asset data include location information, financial information, and technical information, among others.

The DepEd's submission accounted for majority of NARS data submissions, both in value and count, representing 76% and 87%, respectively.

The data shared by the DepEd includes 314,325 school buildings across the nation. In terms of asset count, Regions VI, III, and IV-A have the most school buildings with 32,366, 29,296, and 28,992 school buildings, respectively. NCR, despite having the least number of school buildings, is among the regions with the highest aggregate replacement cost at PhP 116.6 Billion.

To enhance its usefulness, the NARS was coupled with ArcGIS, a geographic information systems (GIS) platform.

Using the platform and NARS data, the Treasury was able to generate several portfolio and risk analysis useful for government to quantify its disaster-related contingent liability exposure, development of risk transfer mechanisms, and asset management. These analyses include asset exposure concentration assessments (by value and count), hazard concentration assessments, and event risk modeling. Below are examples of the geospatial analysis conducted by the Treasury.

Using the DepEd NARS submissions and the tropical cyclone wind risk model developed, the DepEd's annual average loss is between PhP 17.98 Billion - PhP 19.70 Billion

The typhoon risk model developed shows annual average losses of around PhP 18 - 19 billion across the Philippines. By province, most of the losses were attributed to DepEd assets in Leyte, Pangasinan, Isabela, Quezon, Samar, Negros, and Metro Manila.

The high amount of losses in these areas are attributed to the high concentration of assets in these areas and the stronger average tropical cyclones in these provinces. These losses are mostly attributed to schools found in Metro Manila, Leyte, Albay, Isabela, Samar, and Camarines Sur.

On an extreme case basis, the DepEd schools have a 0.20% probability of losses exceeding PhP 210 Billion from the most devastating typhoons.

The modeling of higher magnitude typhoons using the in-house model resulted to over PhP 210 Billion worth of losses for a 1-in-500 year return period type of typhoon event. With this scenario, losses have been concentrated along the Eastern Seaboard and Luzon.

The Big One (Mag 7.2- 8.0 West Valley Fault Earthquake) is estimated to impact 20,339 National Government assets, with an estimated exposure value of nearly PhP 200 Billion.

Using a buffer assessment and the DOST's projected "Big One" parameters, 20,339 DepEd school buidings, DOH hospitals and treatment centers, DSWD welfare centers, and DPWH roads and bridges are estimated to be damaged in the event. These assets have been identified to be within a 100-km buffer zone of the simulated epicenter. These assets are estimated to be worth PhP 198 Billion and span the areas of NCR, Region III, Region IV-A, and Region IV-B.

A scenario analysis using the path of Typhoon Ondoy and the Big One simultaneously occurring would impact 21,910 National Government assets, with an estimated exposure value of over PhP 206 Billion.

Using a buffer assessment, Typhoon Ondoy's parameters, and the DOST's projected "Big One" parameters, 21,910 government assets are projeted to be within a 100-km impact zone. These assets have been identified to be within a 100-km buffer zone of the simulated epicenter and the path of Typhoon Ondoy. These assets are estimated to be worth PhP 206 Billion and span the areas of NCR, Region IV-A, and Region IV-B. Typhoon Ondoy, which occurred in 2009, crossed Central Luzon, including Metro Manila.

Table of Contents

List of Figures

List of Figures

List of Tables

Abbreviations and Acronyms

AAL	Annual Average Loss
AAMPs	Agency Asset Management Plans
ARD	Asset Registry Division
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
BLSB	Bagong Lipunan School Buildings
BTr	Bureau of the Treasury
CAAP	Civil Aviation Authority of the Philippines
CAB	Civil Aeronautics Board
CAR	Cordillera Administrative Region
CARAGA	Caraga Administrative Region (Region XIII)
CIAC	Clark International Airport Corporation
CPA	Cebu Port Authority
DBCC TWG-AM	Development Budget Coordination Committee Technical Working Group on Asset Management
DBM	Department of Budget and Management
DECS	Department of Education, Culture and Sports
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DICT	Department of Information and Communications Technology
DOE	Department of Energy
DOF	Department of Finance
DOH	Department of Health
DOST	Department of Science and Technology

Abbreviations and Acronyms

DOST-PAGASA	Department of Science and Technology Philippine Atmospheric, Geophysical and Astronomical Services Administration
DOTr	Department of Transportation
DPWH	Department of Public Works and Highways
FS	Financial statements
IAC GPI	Inter-Agency Committee on Government Property Insurance
IBTrACS	International Best Track Archive for Climate Stewardship
ICT	Information and Communication Technologies
IPCC	Intergovernmental Panel on Climate Change
JMA	Japan Meteorological Agency
JMC	Joint Memorandum Circular
LGU	Local Government Unit
LRTA	Light Rail Transit Authority
LTO	Land Transportation Office
MARINA	Maritime Industry Authority
MIAA	Manila International Airport Authority
NAIA	Ninoy Aquino International Airports
NAMP	National Asset Management Plan
NARS	National Asset Registry System
NCR	National Capital Region
NDRRMC	National Disaster Risk Reduction and Management Council
NEDA	National Economic and Development Authority

Abbreviations and Acronyms

NG	National Government
NGAs	National Government Agencies
NHC	National Hurricane Center
NIA	National Irrigation Administration
NIIP	National Indemnity Insurance Program
OTS	Office for Transportation Security
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCG	Philippine Coast Guard
PGAMP	Philippine Government Asset Management Policy
PNR	Philippine National Railways
PPA	Philippine Ports Authority
RPT	Real Property Tax
SIA	Strategically Important Assets
UNDRR	United Nations Office for Disaster Risk Reduction
WMO	World Meteorological Organization

THE NATIONAL ASSET REGISTRY SYSTEM (NARS)

Background and Legal Basis

The NARS currently housed in the Bureau of the Treasury (BTr), was initiated in 2018 with the aim of building an inventory of the strategically important assets of the National Government. It serves as the central repository of the non-financial assets of the National Government, particularly for government's strategically important assets. In 2020, the Department of Finance (DOF), Department of Budget and Management (DBM), and the National Economic and Development Authority (NEDA) issued Joint Memorandum Circular (JMC) 2020-1 which designated the NARS as the primary facility to record the inventory of assets of the National Government (NG). This was reiterated in JMC 2022-1, which was also jointly issued by the DOF, DBM, and NEDA.

Early Days

Following the initial conceptualization of the NARS in 2018, the BTr began gathering data from select National Government Agencies (NGAs) that were identified to have strategically important and/or critical assets. For its initial phase, the BTr, through its Asset Registry Division (ARD), gathered data from five (5) pilot agencies or instrumentalities that had been identified by the Inter-Agency Committee on Government Property Insurance (IAC GPI) to have strategically important assets (SIA). These agencies and their respective SIA are detailed in Table 1.

Table 1. NARS Pilot Agencies and Assets

National Government Agency	Strategically Important Assets
Department of Education	School Buildings
Department of Health	Hospitals and Treatment Centers
Department of Social Welfare and Development	Social Welfare Centers

National Government Agency	Strategically Important Assets
Department of Public Works and Highways	Roads and Bridges
National Irrigation Administration	Irrigation Facilities

After conducting the initial data gathering and coordination with agencies, the BTr-ARD provided the IAC GPI with their initial report and findings, which included the following key takeaways:

- Most government properties are not yet titled under the name of the Republic or the NGAs;
- Non-payment of local property tax and non-application of Real Property Tax (RPT) exemption;
- Lost documents evidencing ownership of Republic or NGAs;
- Missing information (location, ownership, value, etc.)
- Non-booking or incorrect booking of assets; and
- Under insurance or non-insurance of assets

The findings of the initial data gathering were then used in the revision of the NARS template. Additionally, these findings jumpstarted the formulation of the Philippine Government Asset Management Policy (PGAMP).

NARS Template

Following the findings of the initial phase of the NARS data gathering, the BTr-ARD team spearheaded the update and revisions to the NARS template and manual. These changes were meant to streamline data requirements to only information relevant to the Development Budget Coordination Committee Technical Working Group on Asset Management (DBCC TWG-AM) and the BTr. The revised template, however, does not preclude the agencies from adding information to their copies as they may need. Table 2 provides a summary of the sections of the Simplified NARS template, which was approved last July 2022. Figure 1 provides a glimpse of the information indicated therein.

Table 2. Simplified NARS Template

Section	Information Description
General Information	Agency information used to identify the asset
Location Information	Physical location of the asset including the latitude and longitude

Section	Information Description
Legal Information	Legal ownership of the asset
Financial Information	Financial and valuation information of the asset
Insurance Information	Insurance coverage of the asset, identify if assets are insured or not
Technical Information	Technical, engineering, risk description of the asset
Remarks	Other pertinent details of the asset

Figure 1. NARS Simplified Template

General Information Asset Number, Organization/Agency, Asset Name Asset Type Asset Description	**Local Information** Longitude, Latitude Address (Region, Province, Municipality, City)	**Legal/Ownership Information** Ownership, Acquisition/Conveyance details, Impediments
Financial Information Accounting value, Appraised value, Sound Market value, Assessed value, Replacement value, Improvements, Disposal information	**Insurance Information** Insurance Details Sum Insurable (uninsured assets) Policy coverage	**Technical Specifications** Asset Condition, Occupancy, Structural Information, Land information, Mitigation measures, Security

NARS Process

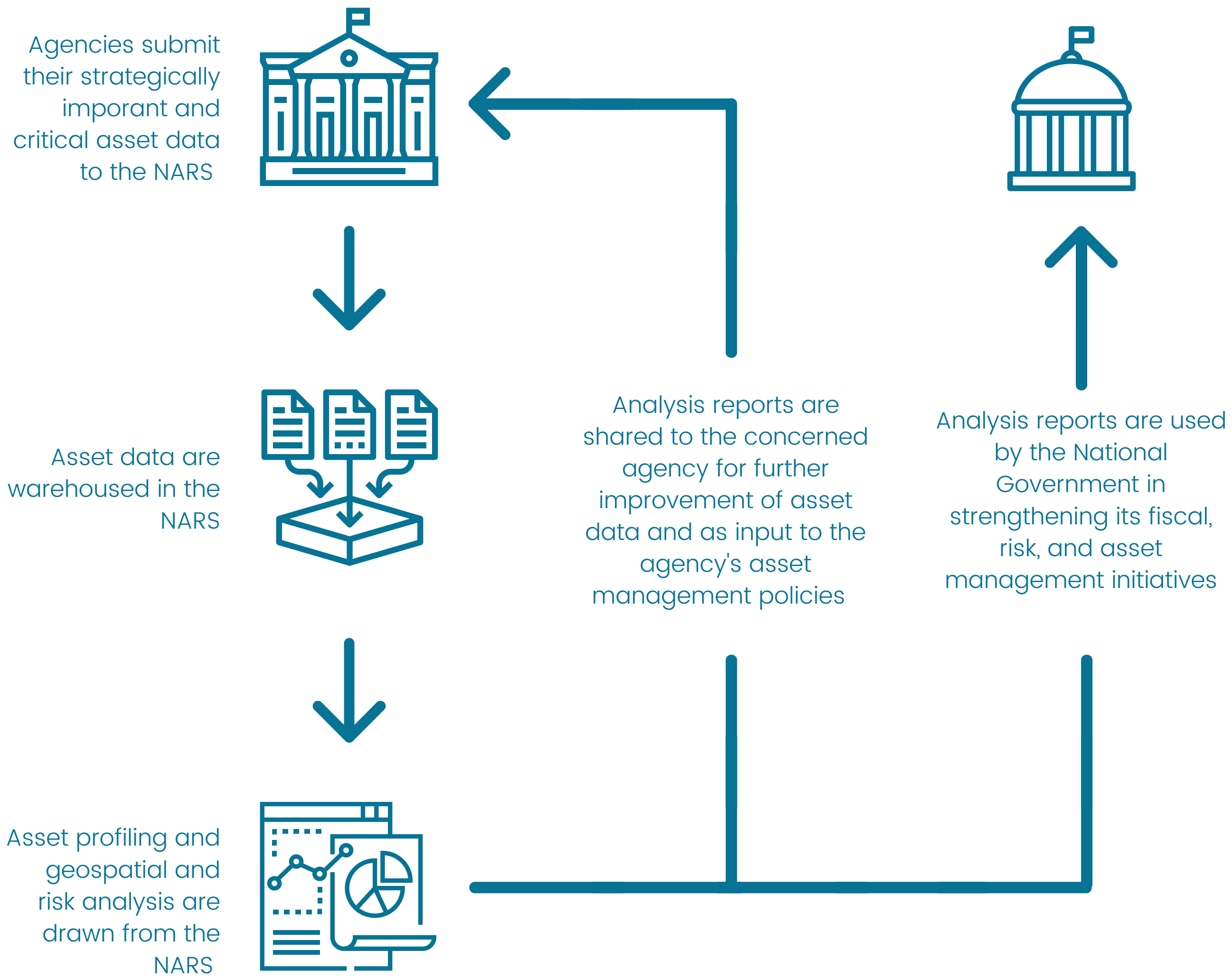
The application of the NARS is done in three (3) stages – (i) data collection, (ii) data warehousing, and (iii) data analysis and sharing.

Data Collection – The excel based NARS Simplified template is shared to the agencies. The agencies then fill up the form based on all their available data. Data do not need to be complete at the first round as continuous effort and coordination is done in the refining and updating of the data.

Data Warehousing – Submitted asset data of all agencies are then stored by the ARD to provide the National Government a consolidated repository of all government assets. To ensure that asset data are safely kept, redundancy measures are in place such as the creation of back-up copies of all agency submissions.

Data Analysis and Sharing – All submitted data are then processed by the BTr to create inventory, geospatial, and risk analysis on these assets. The analysis done by the BTr are then shared regularly to the DBCC-TWG AM for policymaking during the quarterly DBCC TWG-AM meetings.

Figure 2. NARS Process



NARS ASSET PORTFOLIO ASSESSMENT

Summary of Submissions

As of March 2023, the NARS has been rolled out to 40 NGAs and instrumentalities. To date, the NARS contains 359,689 assets with a reported value of over PhP 2.0 Trillion.

The agencies identified for the current roll-out of NARS are agencies with identified SIA such as the Department of Transportation (DOTr), Department of Information and Communications Technology (DICT), and the Department of Energy (DOE). The full list of NARS submission, including their declared values, are detailed in Table 3. Figures 3 and 4 map out the concentration of these assets (count and value) by region.

Table 3. Summary of NARS Data Submitted as of 31 March 2023

Agency	Count of Assets	Share of Total NARS Submission	Value of Asset Submission	Share of Total NARS Submission
DepEd	314,325	87.39%	PhP 1,528.26 Billion	76.22%
DOE and its attached	2,833	0.79%	PhP 72.83 Billion	3.63%
DENR	30	0.01%	PhP 451 Million	0.02%
DOH	682	0.19%	PhP 11.33 Billion	0.57%
DOST and its attached	498	0.14%	PhP 7.61 Billion	0.38%
DICT	2,291	0.64%	PhP 2.42 Billion	0.12%
DPWH	18,371	5.11%	PhP 27.60 Billion	1.38%

Agency	Count of Assets	Share of Total NARS Submission	Value of Asset Submission	Share of Total NARS Submission
DOTr and its attached	8,626	2.40%	PhP 288.53 Billion	14.39%
DSWD	547	0.15%	PhP 29.26 Billion	1.46%
NIA	11,460	3.19%	PhP 36.05 Billion	1.80%
BTr	26	0.01%	PhP 812.00 Million	0.04%
Total	**359,689**	**100.00%**	**2,005.16**	**100.00%**

Figure 3. Density Map of NARS Asset Submissions by Asset Count as of March 2023

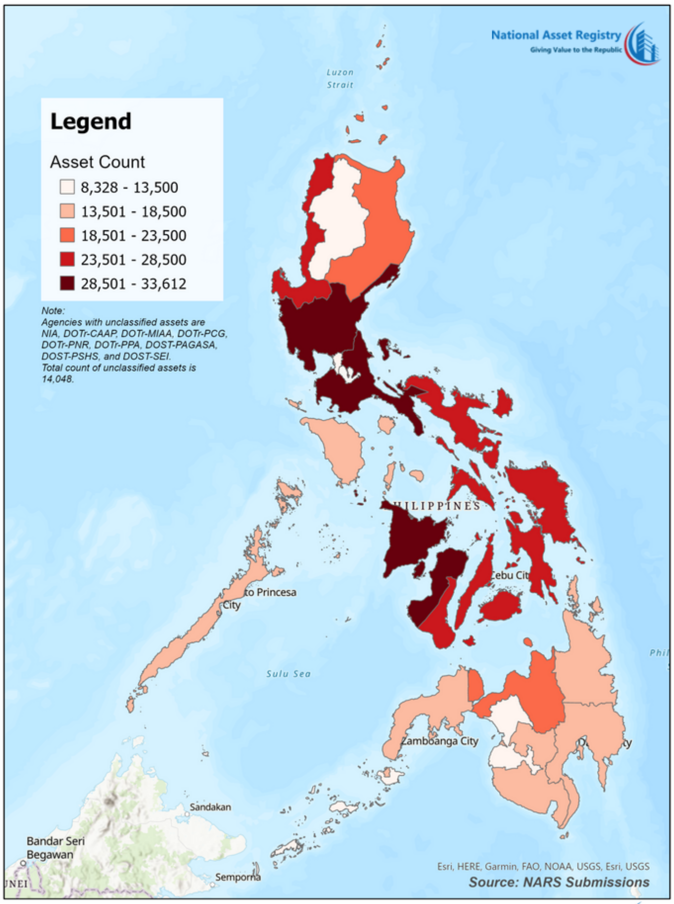
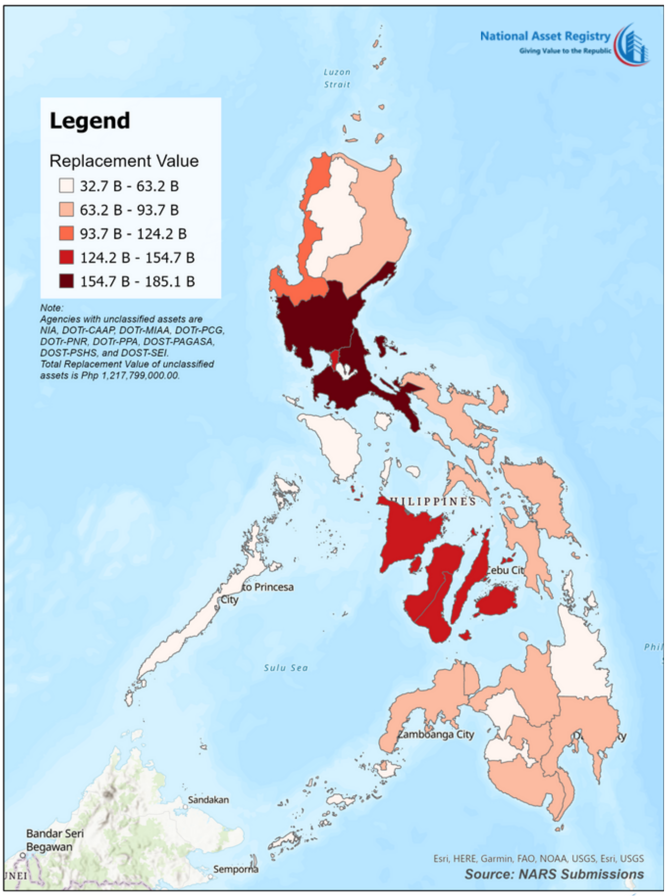


Figure 4. Density Map of NARS Asset Submissions by Replacement Value as of March 2023



Classified NARS Data Submissions

The submitted NARS asset data are classified as either Ordinary or Specialized assets. Ordinary Assets include land and buildings. On the other hand, Specialized Assets are those that are critical and/or strategic to the performance of the agency's mandate. Examples of Specialized Assets are school buildings, flood control structures, towers, and airport structures. Table 4 provides a summary of these assets by classification. As of March 2023, most of the submissions are of the agencies' specialized assets.

Table 4. NARS Asset Data by Classification as of 31 March 2023

National Asset Registry
Giving Value to the Republic

Agency	Count of Assets	Share of Total NARS Submission	Value of Asset Submission	Share of Total NARS Submission
Ordinary Assets				
Land	16,419	4.56%	PhP 154.13 Billion	7.69%
Building	4,028	1.12%	PhP 23.73 Billion	1.18%
Specialized Assets				
School Buildings	314,325	87.39%	PhP 1,528.256 Billion	76.22%
Flood Control and Drainage Structures	9,989	2.78%	-	0.00%
Towers	1,580	0.44%	-	0.00%
Airport Structures	1,256	0.35%	PhP 78.52 Billion	3.92%
ICT and Airport Equipment	1,232	0.34%	PhP 1.49 Billion	0.07%
Other Specialized Assets	10,860	3.02%	PhP 219.05 Billion	10.92%
Total	**359,689**	**100.00%**	**2,005,164,032,141.87**	**100.00%**

Portfolio Analysis on NARS Submissions

For the 2023 Report, an in-depth portfolio analysis was conducted on the submissions from the DepEd and DOTr.

Department of Education (DepEd)

Summary of Submissions

As of end-2022, the DepEd has submitted 314,325 school buildings information with general information and financial values. DepEd provided data on a per building, rather than per school to provide more granular information on each building and its characteristics. Below are summary findings from each of the sections required in the NARS template.

General Information	For the general information, all data submissions provided information on the school name, curriculum type, and school ID number. Nearly all the submissions had the number of classrooms and the number of storeys for that building.
Location Information	In terms of location, all school buildings had their regional information and the division of city school they are a part of. More granular information such as the longitude and latitude information of these schools were only present for 64,464 school buildings or approximately 20% of the provided dataset.
Financial Information	All school buildings with indicated number of classrooms had indications of its replacement value. This replacement value was a function of the number of classrooms that building had, regardless of location and structure type. For the replacement value, the DepEd had this pegged at PhP 2.5 Million per classroom for those in buildings with more than 1 storey and PhP 1.5 Million per classroom for those in buildings with 1 storey.

Technical Information	For technical information, all school buildings had information on its structure. The dataset had provided 144 structure types of DepEd school buildings ranging from the DepEd Standard School Building, Bagong Lipunan School Building, Gabaldon Type School Building, among others. Most of the school building structure types also mention their sponsor/donor in their names such as JICA, Philip Morris, McDonalds, GMA Kapuso, ABS-CBN, and Joey Lina, to name a few. Nearly 70,000 of the schools in the NARS dataset are the DepEd Standard School Building. The DepEd Standard School Building is the structure type most common in the DepEd NARS dataset. Second to the DepEd Standard School Building is the Bagong Lipunan School Building (BLSB) Type 1 with 23,773 school buildings.
Ownership and Insurance Information	For these two (2) sections, the DepEd was not able to provide the necessary information in the NARS template.

Portfolio Assessment

Using the DepEd NARS Dataset, a regional density map (see Figure 5) was generated to identify the number of school buildings per region, as one way of viewing the asset portfolio. Based on the information provided by the DepEd, the majority of school buildings are located in Region VI followed by Region III. The National Capital Region (NCR) has the fewest number of schools with only 4,070 school buildings. In terms of trend, it can be seen that most of the school buildings have been built towards the lower part of Luzon and throughout Visayas.

A density map based on the schools' aggregate replacement value (see Figure 6) was also generated. Recall that their replacement value was computed as PhP 2.5 Million (PhP 1.5 Million for 1 storey buildings) x Number of Classrooms. Intuitively, the higher the number of classrooms, the higher the replacement value. Based on the density map, among the regions with the highest replacement value concentration are Region IV-A, Region III, Region VI, and NCR. Is Notably, despite the fact that NCR has the fewest number of school buildings, it is among the regions with the greatest number of classrooms. This can be attributed to the relatively higher number of students in NCR that the DepEd must cater to compared to other regions.

Figure 5. Density Map of DepEd NARS Dataset Building Concentration by Number

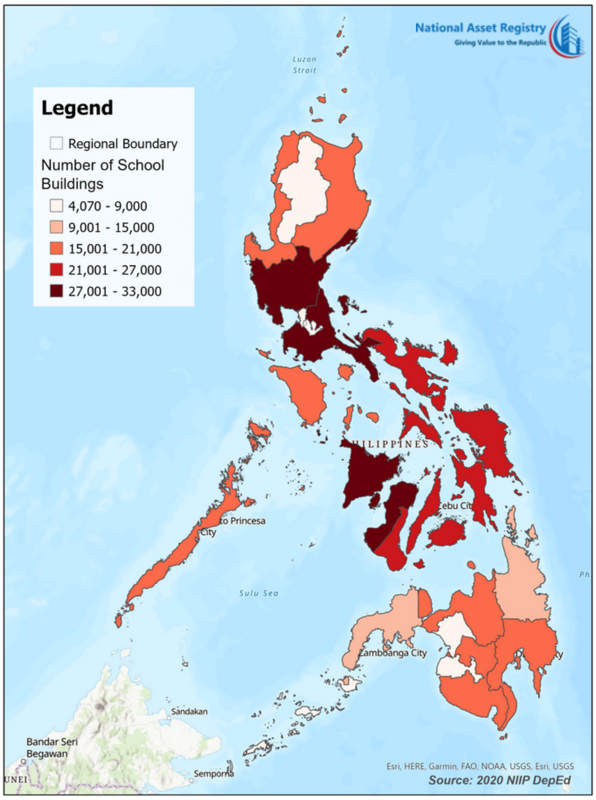
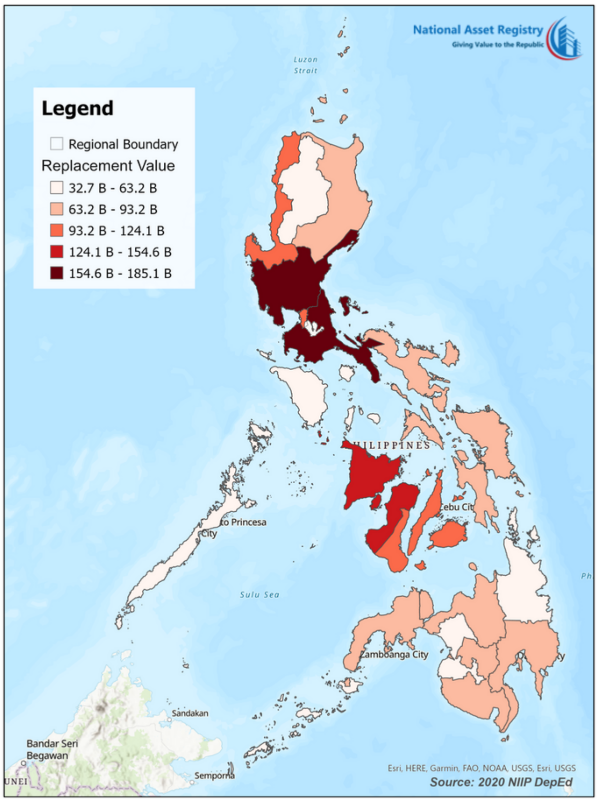


Figure 6. Density Map of DepEd NARS Dataset Building Concentration by Replacement Value



A summary of the number of school buildings per region and their corresponding aggregate replacement value can be found in Table 6.

Table 5. Regional Distribution of DepEd NARS Database

Region	Number of School Buildings	Aggregate Replacement Value
NCR	4,070	PhP 116.6 Billion
Region I	20,863	PhP 94.8 Billion
Region II	17,710	PHP 69.3 Billion
Region III	29,296	PHP 165.2 Billion
Region IV-A	28,922	PHP 185.1 Billion
Region IV-B	15,320	PHP 58.9 Billion
Region V	23,551	PHP 84.7 Billion

Region	Number of School Buildings	Aggregate Replacement Value
Region VI	32,366	PHP 133.3 Billion
Region VII	23,747	PHP 116.3 Billion
Region VIII	23,277	PHP 91.7 Billion
Region IX	14,353	PHP 63.6 Billion
Region X	17,763	PHP 75.7 Billion
Region XI	16,805	PHP 82.7 Billion
Region XII	15,745	PHP 67.7 Billion
CARAGA	13,375	PHP 53.5 Billion
CAR	8,186	PHP 36.6 Billion
BARMM	8,976	PHP 32.8 Billion

The submissions of DepEd were also compared against their submissions to COA and their financial statements (FS). Upon review, it is noted that the DepEd has submitted NARS data on approximately 97% of their schools, by count of school ID. It should be noted, however, that the DepEd's disclosed value in their FS is significantly lower than their NARS financial information. This is attributed to the disclosure of Replacement Value for NARS while the FS disclosures are based on Net Book Value.

Table 6. DepEd NARS Submission vs COA and FS Disclosure

Item	NARS	COA Disclosure/FS	NARS / COA
Count of Schools	46,114.00	47,553.00	96.97%
Count of School Buildings	314,325.00		
Average Number of Buildings/School	7		
Value of School Buildings (RV vs BV)	PhP 1,528.259 Billion	PhP 173.887 Billion	883%
Average Value of Schools	PhP 4,862,034.52		

Using the available NARS information, a simple division of the number of available rooms to the total schools included in the NARS dataset show that, on average, each school has 18 classrooms. On a building basis, the average number of classroom goes down to 3. The low figures in the average number of classrooms per school building is attributed to the many school buildings with only 1 or 2 rooms. Depending on the region, this amount can increase, such as in the case of Metro Manila where there is an average of 11 classroom per school building.

Table 7. DepEd NARS Submission Schools Information

Total Number of Rooms (a)	827,750
Count of Schools (b)	46,114.00
Total Number of School Buildings (c)	314,325
Average Number of Rooms/School (a/b)	18
Average Number of Rooms/Buildings (a/c)	3
Average Number of Buildings/School (c/b)	7

Looking at the allocations to DepEd for the maintenance of its schools, we see that 2020 had the highest allocation per school and school building of an average of PhP 620,488.59 and PhP 117,731.95, respectively. This amount significantly decreased in 2021 and 2022, and had only seen an increase again under the 2023 budget. The amounts indicated above, however, do not include potential allocations for the post-disaster repair and rehabilitation of the schools that may have been charged through their Quick Response Fund and the National Disaster Risk Reduction and Management Fund.

Table 8. DepEd Costing Analysis based on GAA and NARS Disclosure

Item/Year	2020	2021	2022	2023
Maintenance of Schools	37,006,094,000.00	13,030,496,000.00	7,557,371,000.00	25,301,862,000.00
Gabaldon Rehab/Recon/Repair	1,000,000,000.00	383,965,000.00	97,958,000	383,965,000.00
Last Mile Schools Rehab/Recon/Repair	6,500,000,000.00	1,500,000,000.00	1,510,000,000.00	1,500,000,000.00
Basic Education Facilities (rehab, reconstruction, repair)	29,506,094,000.00	11,146,531,000.00	5,949,413,000.00	23,417,897,000.00
Average Cost of Maintenance/School (COA)	620,488.59	234,402.27	125,111.20	492,458.88
Average Cost of Maintenance per School Building	117,731.95	41,455.49	24,043.18	80,495.86

Department of Transportation (DOTr)

Summary of Submissions

As of end-2022, the DOTr has submitted submitted information on 8,626 assets with an aggregate value of PhP 288 Billion. The DOTr NARS Dataset is a combination of the assets of 12 of DOTr's instrumentalities, namely Civil Aviation Authority of the Philippines (CAAP), Civil Aeronautics Board (CAB), Clark International Airport Corporation (CIAC), Cebu Port Authority (CPA), Light Rail Transit Authority (LRTA), Land Transportation Office (LTO), Maritime Industry Authority (MARINA), Manila International Airport Authority (MIAA), Office for Transportation Security (OTS), Philippine Coast Guard (PCG), Philippine National Railways (PNR), and Philippine Ports Authority (PPA).

Below are summary findings from each of the sections required in the NARS template.

General Information	Several asset types were submitted by the DOTr's instrumentalities. These asset types ranged from lands, buildings, airport systems, piers, wharfs, trains, aircrafts, and water vessels, among others. For most of these submissions, the DOTr submission included the asset name and description.

Table 9. Assets Submitted by DOTr Instrumentalities

Instrumentality	Asset Type
CAAP	Buildings, Airport Structures, Passenger Terminal Buildings, Control Tower, Radar Building, Taxiway, and Runway
CAB	2 buildings and 1 land
CIAC	Control Tower, Office Building, Warehouse, Covered Parking
CPA	Port Area, Pier, Wharf, Causeway, Buildings, Passenger Terminals, Crane Rails
LRTA	Buildings, Stations, Substations, Depot, Warehouse, land, and Light Rail Vehicles
LTO	Land, Buildings, Various equipment
MARINA	Buildings and Land

Instrumentality	Asset Type
MIAA	Airport related assets – Passenger terminal buildings, taxiways and runways, land, and other buildings. MIAA used the title numbers or lot numbers as their asset name and description for some of their assets.
OTS	Building and ICT Equipment. ICT Equipment submitted included x-rays and scanners
PNR	Office Buildings, Railways Stations, Railway Tracks, and Land.
PCG	Land, buildings, schools, aircrafts, and vessels.
PPA	Specialized assets such as breakwaters, causeways, crane rails, lighthouses, passenger terminals, roads, wharfs, and piers.

Figure 7. Airports in the Philippines and their Net Book Value

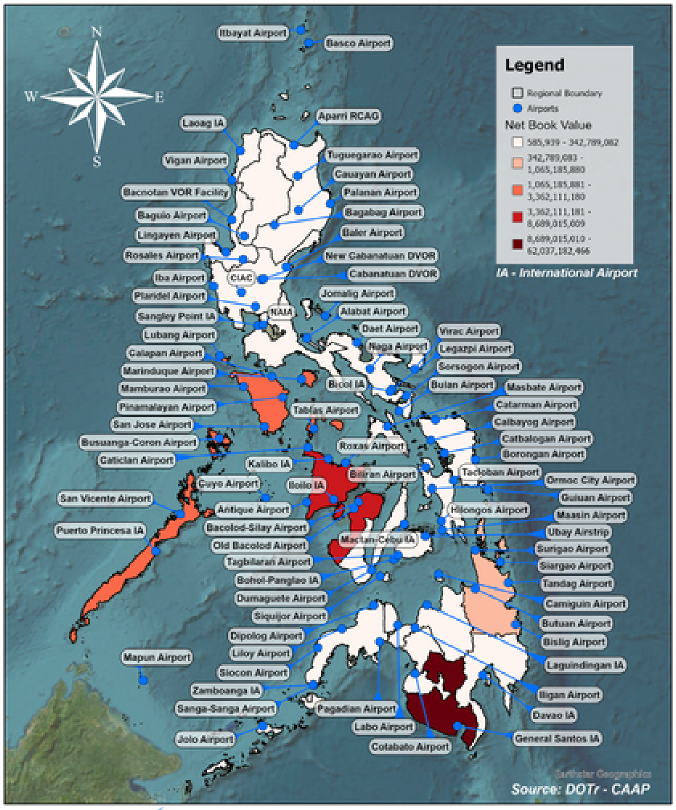
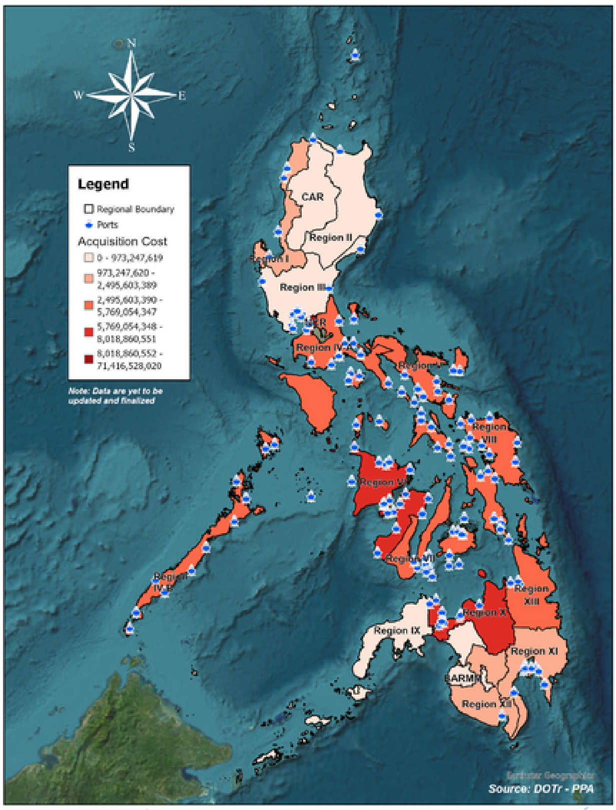


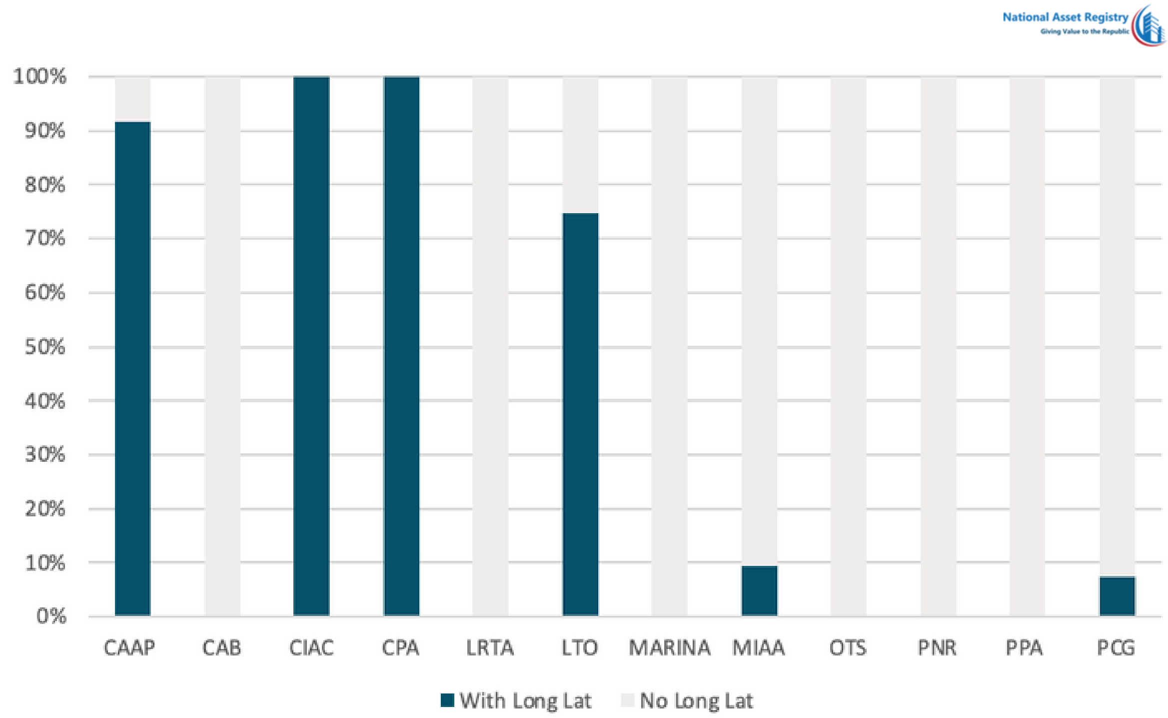
Figure 8. Ports of DOTr and its Acquisition Cost



Location Information

Only 24% of the DOTr's submission contains geolocation information (i.e., longitude and latitude). Among the different attached instrumentalities of the DOTr, only the CIAC and CPA were able to fully comply with this requirement. Figure 9 provides a graphical representation of the DOTr instrumentalities submission with and without longitude and latitude data.

Figure 9. Share of DOTr Assets with Geolocation by Attached Instrumentality



Financial Information

For financial information, a mixture of net book value, replacement value, acquisition cost, appraised value, sound market value were used by the DOTr instrumentalities. Below is a summary of what each of the 12 instrumentalities:

Table 10. Valuation of DOTr Submitted Assets

Instrumentality	Asset Type
CAAP	Net Book Value for most assets. Assets in Region V were valued using Acquisition Cost
CAB	Acquisition Cost

Instrumentality	Valuation Used
CIAC	Net Book Value
CPA	Replacement Value
LRTA	Combination of Appraised, Sound/Market Value, and Replacement Value
LTO	Acquisition Cost or Net Book Value
MARINA	Acquisition Cost
MIAA	Acquisition Cost or Net Book Value
OTS	Acquisition Cost for its ICT Equipment
PNR	Appraised Value
PCG	Acquisition Cost or Net Book Value
PPA	Net Book Value

Technical Information

Of the 12 DOTr instrumentalities, only three (3) submitted technical information – CPA (100%), CIAC (92%), and MIAA (54%). In terms of technical information, all three (3) submitted information on the condition of the asset – whether it was in good, fair, poor, or bad condition. All assets with submitted technical information were noted as in 'good' condition.

Legal/Ownership Information

Ownership information of DOTr submitted assets varied per agency. There was a mixture of assets owned by the DOTr, the instrumentality, the airport authority, other NGAs, a Local Government Unit (LGU), or a private person. There was also asset sharing among the DOTr instrumentalities with the MIAA leasing and renting out its properties to the CAB and OTS. Below is a summary of the legal/ownership of the assets submitted.

Table 11. Ownership Information of DOTr Submitted Assets

Instrumentality	Legal/Ownership Information
CAAP	Ownership information provided for 28% of their assets. Owners declared are 'CAAP', 'Airport', 'DOTr', and 'Private Person'
CAB	Rents its assets from MIAA
CIAC	Owns all its reported assets
CPA	Owns all its reported assets
LRTA	Disclosed their ownership of 49% of their reported assets
LTO	Disclosed their ownership of 42% of their reported assets
MARINA	Ownership information provided for 17% of their assets. Owners declared are 'MARINA', 'PPA', and 'Local Government Unit'
MIAA	Ownership information provided for 10% of their assets. For land titles, the title number was provided in the general information, but details of the title were not included under the Legal/Ownership Information Section.
OTS	No ownership information was provided for the ICT equipment disclosed. For the building information, however, OTS indicated that it was leased from MIAA.
PNR	No ownership information provided.
PCG	Ownership information provided for 92% of their assets. Owners declared are 'PCG, other 'NGAs', 'Local Government Unit', and 'Private Person'.
PPA	No ownership information provided.

Insurance Information

Similar to Technical Information, only three (3) of the 12 instrumentalities provided insurance information. These are CPA (100%), CIAC (100%), and MIAA (54%). These assets with declared insurance information were noted as insured by the instrumentalities.

Portfolio Assessment

Using the DOTr NARS Dataset, a regional density map (see Figure 10) was generated to show the concentration of assets. The map plots assets within the DOTr dataset that has information regarding the asset's location at the regional level. Based on the information provided by the DOTr and its attached instrumentalities, majority of the DOTr's assets are located in NCR where there are 1,250 assets out of their submission of 8,626 assets.

A density map based on the aggregate value of all assets per region (see Figure 11) was also generated. In terms of value, Region XII and NCR have the highest with an aggregate value of PhP 62B and PhP 46.9B, respectively. Most assets in these regions are of buildings and airport structures. It should be noted that upon review of the data submissions, over PhP 122B worth of assets do not have location information.

Figure 10. Density Map of DOTr NARS Dataset Asset Count

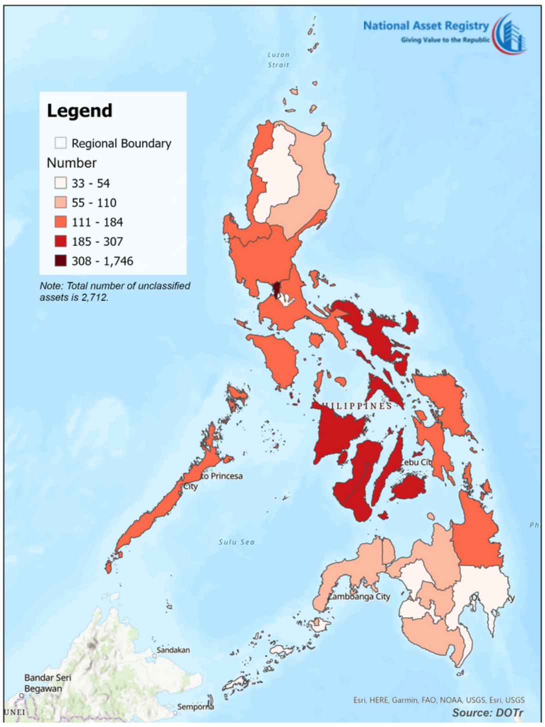
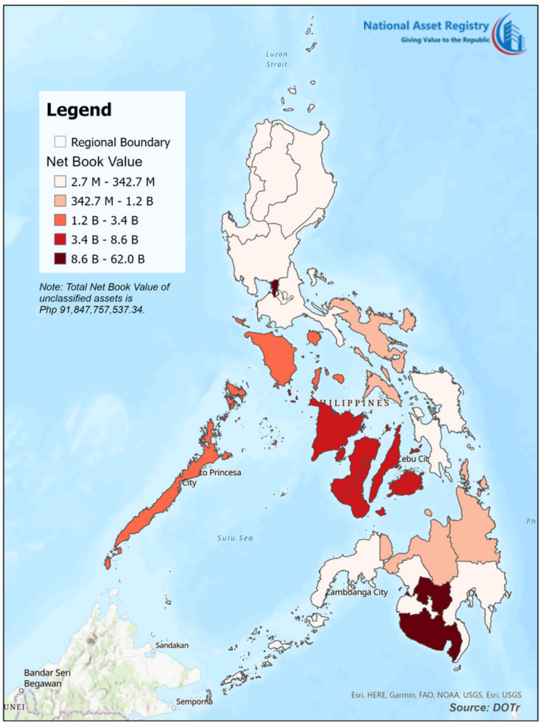


Figure 11. Density Map of DOTr NARS Dataset Aggregate Asset Value



A summary of the number of assets and their aggregate values per region can be found in Table 12.

Table 12. Regional Distribution of DOTr NARS Dataset

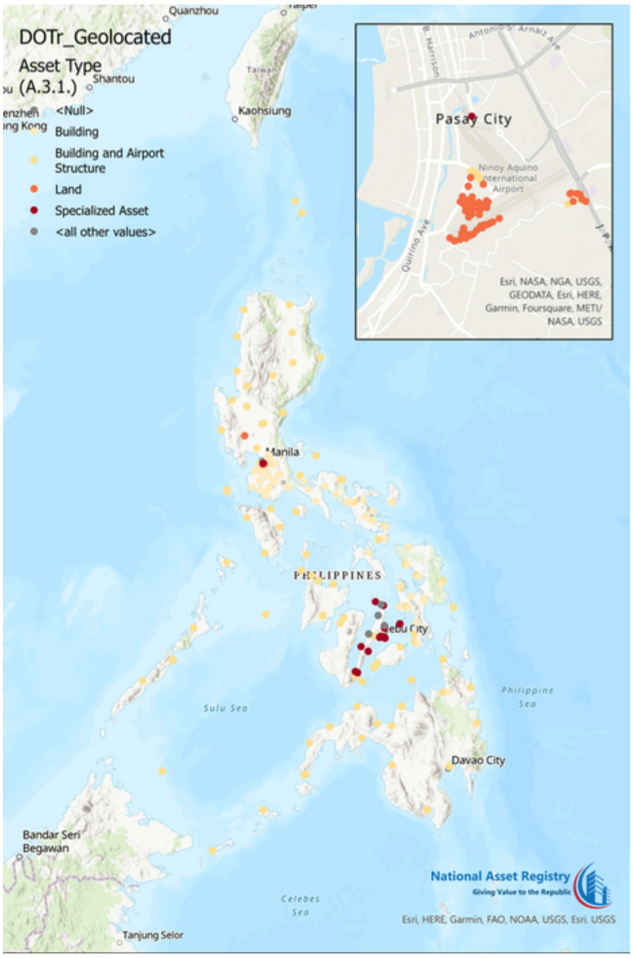
Region	Total Asset Count	Total Value
Region I	116	PhP 297 Million

Region	Total Asset Count	Total Value
Region II	95	PhP 232 Million
Region III	128	PhP 70 Million
Region IV-A	175	PhP 187 Million
Region IV-B	184	PhP 3,401 Million
Region V	250	PhP 1,342 Million
Region VI	215	PhP 8,689 Million
Region VII	307	PhP 9,513 Million
Region VIII	133	PhP 236 Million
Region IX	110	PhP 70 Million
Region X	76	PhP 825 Million
Region XI	54	PhP 342 Million
Region XII	87	PhP 62,073 Million
Region XIII	126	PhP 1,065 Million
NCR	1,250	PhP 46,957 Million
CAR	33	PhP 1,327 Million
BARMM	54	PhP 29,797 Million
No Location	5,233	PhP 122,096 Million
Total	**8,626**	**PhP 288,527 Million**

For DOTr assets with geolocation data, Figure 12 shows a map of where these are located across the country. Additionally, Figure 13 presents these assets by its type – building, airport structure, land, and other specialized assets of the DOTr. For Figure 8, a zoomed in map of Pasay City is provided as a concentration of DOTr assets are located here – e.g., airport structures of the different Ninoy Aquino International Airports (NAIA).

Figure 12. Geolocated DOTr NARS Dataset

Figure 13. Geolocated DOTr NARS Dataset by Asset Type



Challenges and Next Steps

Challenges and Opportunities

Throughout the deployment of the NARS, the BTr identified several challenges and key opportunities in its implementation. The primary challenge faced by the BTr and the pilot agencies was the limited availability of the information that were required for the NARS template. This was seen in various instances - i. the lack of a consolidated database for the agency, ii. missing information, especially regarding ownership and valuation, and iii. varying standards and descriptors of their data.

Despite the challenges presented in the conduct of this activity, several opportunities have been identified to improve the management of the NG's non-financial assets:

- First, a consolidated database of each agency's assets was created. This was useful not just for the individual agencies who now had easier access to their information, but for the NG to better understand its assets and potential risks.

- This provided government an opportunity to harmonize its data collection and data standards for recording asset information. The DBCC-TWG AM issued two (2) JMCs that have provided guidelines on how to improve asset management. Supplementing these, the BTr issued manuals on the population of the NARS template. These manuals adopt best practices in recording of key asset information.
- It has allowed government to have an updated record of its assets. Asset information needs to be updated regularly to ensure it continues to be relevant in the decision making activities of the government. Hence, collection of data for NARS is done regularly.
- It provided government another layer of information to link to other key information on hazards, budgeting, and the like for a more robust analysis of its risk.

Next Steps

While the NARS initiative has certainly made improvements to the government's asset management and asset data availability, its implementation remains a continuous process. These next steps are anchored on 3 pillars - People, Technology, and Data.

People
The BTr holds workshops, hands-on sessions, and consultations with identified agencies and instrumentalities in using the NARS template and portal. The identification of focal groups and asset management teams dedicated to the use of the NARS - from information gathering to information usage, have also been done.

Technology
BTr is also looking at technology and digitalization to improve the usefulness and user-friendliness of the NARS. The BTr has coupled NARS data with geographic information systems (GIS) programs to aid in the development of risk analysis reports. The BTr is also building a web platform for the NARS to simplify and make more accessible the NARS. The platform is expected to be launched to agencies in the coming months. The platform will provide access to agencies and the DBCC TWG-AM to easily view agency asset information, which will be useful in their respective budgeting and planning processes.

Data
Given the challenges in gathering data and the varying data standards across government, the BTr is actively working with agencies on harmonizing data standards in the recording of asset information. Additionally, the BTr has identified its next set of agencies for the further population of the NARS.

To institutionalize these next steps and the overall vision of the NARS, a Governance Framework is currently being drafted by the BTr. The Governance Framework will detail the scope of NARS, its capability and coverage, team requirements and competencies, users of NARS and their respective roles and responsibilities, and the NARS process, among others.

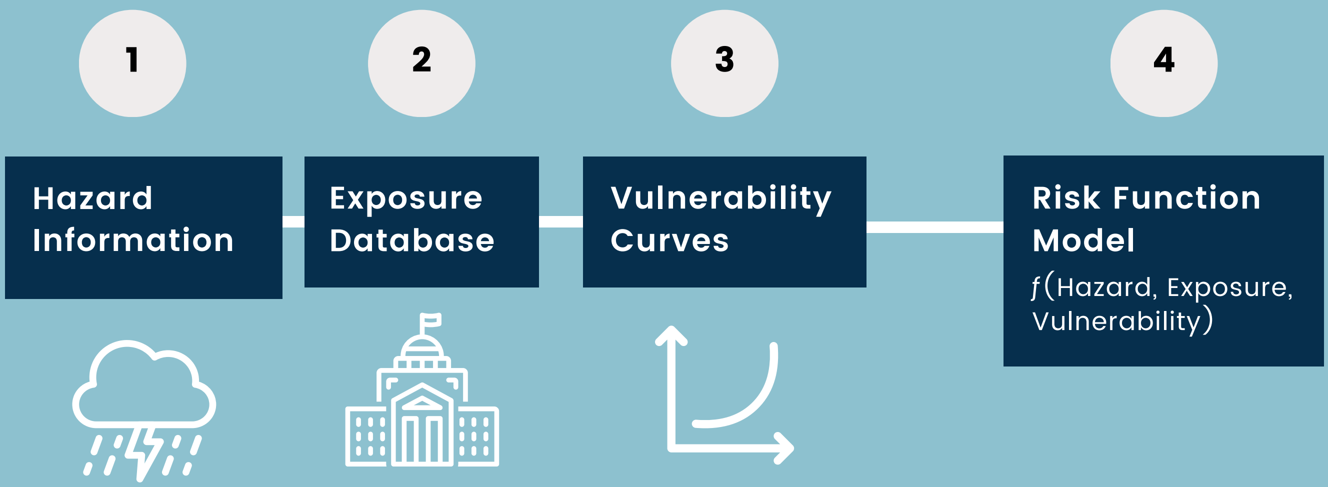
RISK ASSESSMENT

What is Risk?

Disaster risk has three components: hazard (frequency and location of natural perils), exposure (location and types of assets), vulnerability (how these assets behave in case of a certain peril)

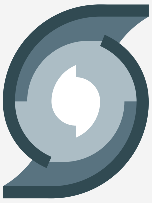
disaster risk = f(hazard, exposure, vulnerability)

Figure 14. Risk Analysis Framework



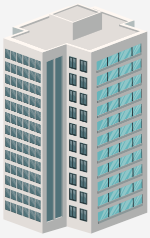
The formula and framework reference the definition of the United Nations (n.d.) that a disaster is "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, and capacity". Visually, this relationship is represented in the Intergovernmental Panel on Climate Change's (IPCC) 2012 Disaster Risk Influence and Relationship Diagram.

For clarity, the United Nations Office for Disaster Risk Reduction (UNDRR) definitions of hazard, exposure, and vulnerability will be used.



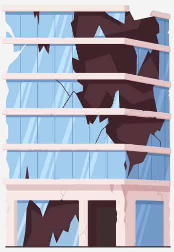
Hazard

Refers to "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation. Natural hazards are predominantly associated with natural processes and phenomena. Each hazard is characterized by its location, intensity or magnitude, frequency, and probability" (UNDRR, n.d.). Examples of these hazards are typhoons, earthquakes, volcanic eruptions, droughts, and landslides.



Exposure

Refers to "the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest" (Ibid.).



Vulnerability

Refers to "the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" (Ibid.). Examples of this could include the type of materials used to construct a building - nipa huts are more susceptible to damages due to strong winds compared to concrete and steel buildings. This vulnerability can increase or decrease depending on the coping and adapting capacity and capability.

Data Sources

Hazard Information

For hazard information on earthquake and volcanic activity data, reports from the DOST-PHIVOLCS were used. On the other hand, tropical cyclone data tracksw were gathered from the International Best Track Archive for Climate Stewardship (IBTrACS). The IBTrACS, which was developed collaboratively by the World Meteorological Organization's (WMO) Regional Specialized Meteorological Centers, is known to be the most comprehensive global collection of tropical cyclone data. Information provided by IBTrACS is sourced from reliable agencies such as the US National Hurricane Center (NHC) and Japan Meteorological Agency (JMA). Additionally, the BTr used tropical cyclone data shared by the DOST to create additional hazard concentration maps.

The Saffir-Simpson Hurricane Scale (see Figure 15) is an international standard of categorizing Tropical Cyclones, or hurricanes as it is called in the western hemisphere. The Saffir-Simpson Hurricane Scale classifies the weakest events as "tropical depression" and the strongest types of tropical cyclone events as "Category 5" hurricanes. Relating the aforementioned scale to the PAGASA Wind Scale used in the Philippines, hurricanes assigned under Category 5 and the upper bound of Category 4 are classified as Super Typhoons. Figure 15 presents a side-by-side comparison of the Saffir-Simpson Hurricane Wind Scale and the PAGASA Tropical Cyclone Wind Scale to show similarities and differences in categorization.

Figure 15. Saffir-Simpson Hurricane Scale and the PAGASA Tropical Cyclone Scale

Saffir-Simpson Hurricane Wind Scale	
Category	**Wind Speeds**
5	≥ 137 knots ≥ 252 kph
4	113 - 136 knots 209 - 251 kph
3	96 - 112 knots 178 - 208 kph
2	83 - 95 knots 154 - 177 kph
1	64 - 82 knots 119 - 153 kph
Tropical Storm	35 - 63 knots 63 - 118 kph
Tropical Depression	≤ 34 knots ≤ 62 kph

PAGASA Tropical Cyclone Wind Scale	
Category	**Wind Speeds**
Super Typhoon	≥ 119 knots ≥ 220 kph
Typhoon	64 - 119 knots 118 - 220 kph
Severe Tropical Storm	48 - 63 knots 89 - 117 kph
Tropical Storm	34 - 47 knots 62 - 88 kph
Tropical Depression	≤ 33 knots ≤ 61 kph

Exposure Database

Exposure data was sourced from the information submitted by pilot national government agencies to the BTr as part of their NARS or National Indemnity Insurance Program (NIIP) requirement, as noted in the analyses conducted. This information, which was discussed at length in Part 2: Asset Portfolio Assessment, provides the BTr with the necessary financial, geographical, temporal, and social information to map the government's exposure concentration.

Vulnerability Curves

With the assistance of the World Bank, preliminary vulnerability curves were developed based on available literature and industry data on structural integrity of schools in the Philippines. These curves represent the probability of loss at certain wind speeds taking into consideration the different materials or structure types of buildings. As of December 2022, the identified vulnerability curves created are limited to those for DepEd school building types. It is noted that these curves would still require further validation.

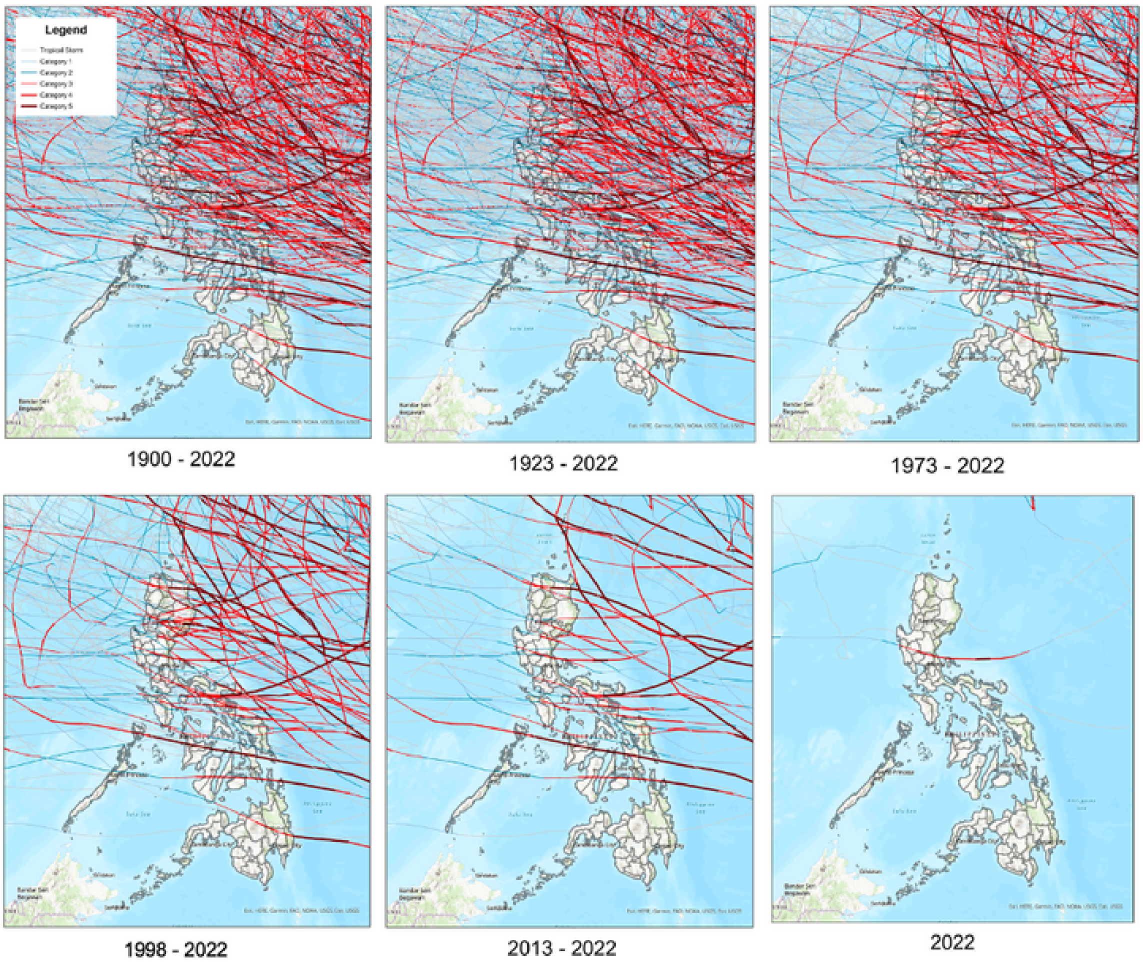
Hazards in the Philippines: A Focus on Tropical Cyclones

Historical Hazard Concentration

Visualizing past tropical cyclone activities is important to plan for potential impacts to publicly owned assets and the potential impacts on public services linked to these services. One way to look at assets at risk is to look at past cyclones and their impact.

To capture the Philippines' tropical cyclone experience, IBTRaCS data from 1900 to 2022 were superimposed on the map of the Philippines. Each tropical cyclone track is color and thickness coded based on its intensity within the Saffir-Simpson Hurricane Scale across different times and locations (i.e., multiple categories can be observed in one typhoon track as it weakens or strengthens across different areas). Multiple outputs were generated to show the country's tropical cyclone experience over a 123-, 100-, 50-, 25-, 10-, and 1-year horizon (see Figure 16). The outputs over different time periods are meant to capture the general trend of tropical cyclones over the years.

Figure 16. Tropical Cyclone Tracks Against Philippine Boundary Map



As seen in Figure 16, majority of the tropical cyclones that enter the Philippine Area of Responsibility have made landfall in the Luzon and Visayas group of islands. Notably, only two strong tropical cyclones have passed through Mindanao – Typhoon Pablo in 2012 and Typhoon Titang in 1970. For 2022, only one significant tropical cyclone event was captured – Typhoon Karding (Noru).

The visualization of all the typhoon tracks support the thinking that Eastern Seaboard provinces (e.g., Isabela, Camarines Sur, Camarines Norte, Albay, Sorsogon, Samar, Aurora) are among the most often and hardest hit provinces in the country. The track of Super Typhoon Yolanda is notably the only track that was consistently a Category 4 and 5 as it moved past the Philippines.

Aggregating the different typhoon tracks by area, Figure 17 illustrates that areas often hit by tropical cyclones, regardless of intensity, are those in Eastern Luzon and Visayas. This is consistent with the overlain tropical cyclone tracks in the previous figure.

Looking at typhoon tracks by decade (see Figure 18a and 18b), several key areas of intersect come up on where tropical cyclones have tended to pass, as emphasized by the box superimposed on the Philippine map. Common from the decades of the 70s, 80s, 90s, 2000s, and 2010s are provinces in Eastern Luzon.

Figure 17. Occurrences of Tropical Cyclones 1900-2022

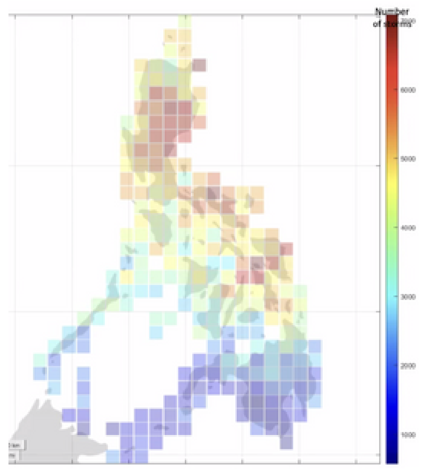
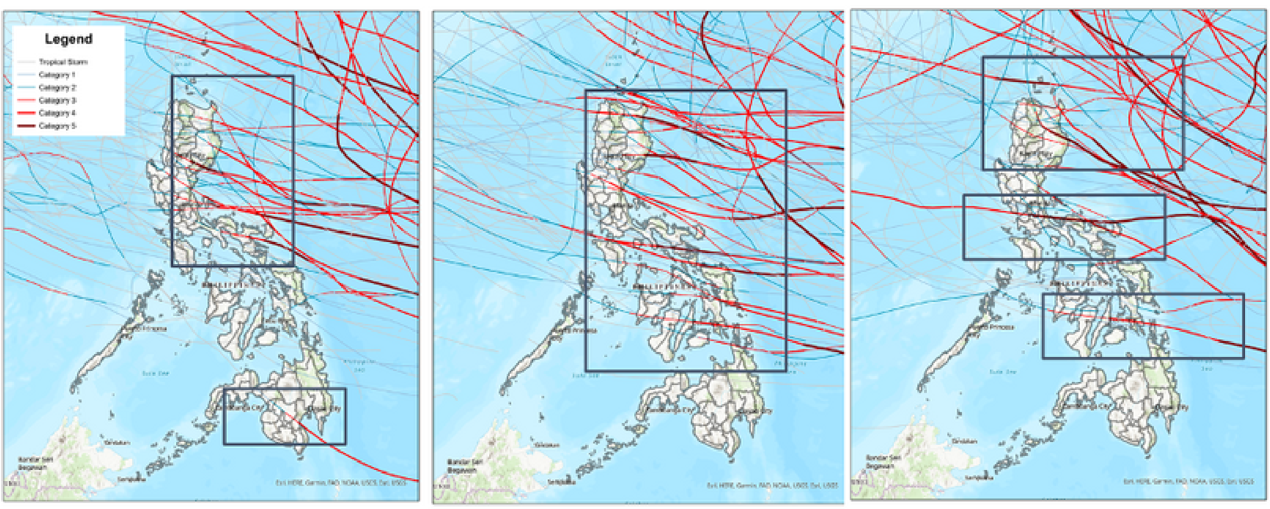
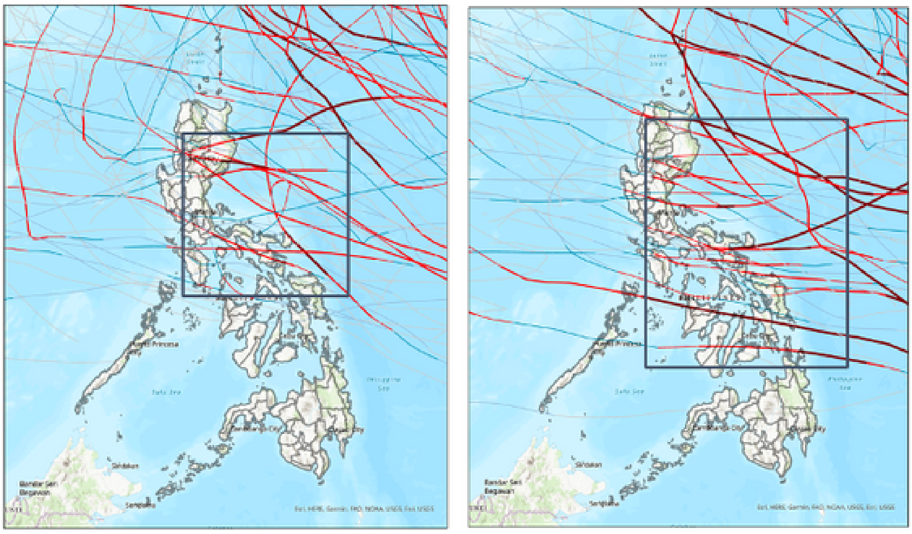


Figure 18a. Tropical Cyclone Tracks Against Philippine Boundary Map by Decade



1970-1980 | 1980-1990 | 1990-2000

Figure 18b. Tropical Cyclone Tracks Against Philippine Boundary Map by Decade



2000-2010 2010-2022

Potential Impact

Data shared by the Department of Science and Technology Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST-PAGASA) on the provincial level experience of various tropical cyclones was used to plot potential provinces most impacted by past Tropical Cyclones. The data provided spans from 1948-2017.

In computing the “impact” of these events to the respective provinces, a simple formula of assigning multipliers based on the different categories of a Tropical Cyclone was applied. Magnitude of Typhoon Exposure roughly computed as follows:

Count of Tropical Depression + (Count of Tropical Storms x 2) + (Count of Typhoons x 3) + (Count of Super Typhoons x 5)

The multipliers assigned to each category of a Tropical Cyclone is based on a leveling of the strength of each level of a tropical cyclone. A Super Typhoon was given a 5-multiplier given the potential impact it has on the province its passes through compared to only a typhoon or tropical storm. The multipliers for each category are the BTr's own assumptions for a simpler assessment.

Figure 19 presents the provinces in the Philippines most and least affected by Tropical Cyclones between 1948-2017. As seen in Figure 19, several provinces in Mindanao are among the least affected by different tropical cyclones in the Philippines. Table 11 shows a summary of the different categories of Tropical Cyclones that the Top 10 most affected provinces has experienced.

Figure 19. Impact of Tropical Cyclones on Philippine Provinces

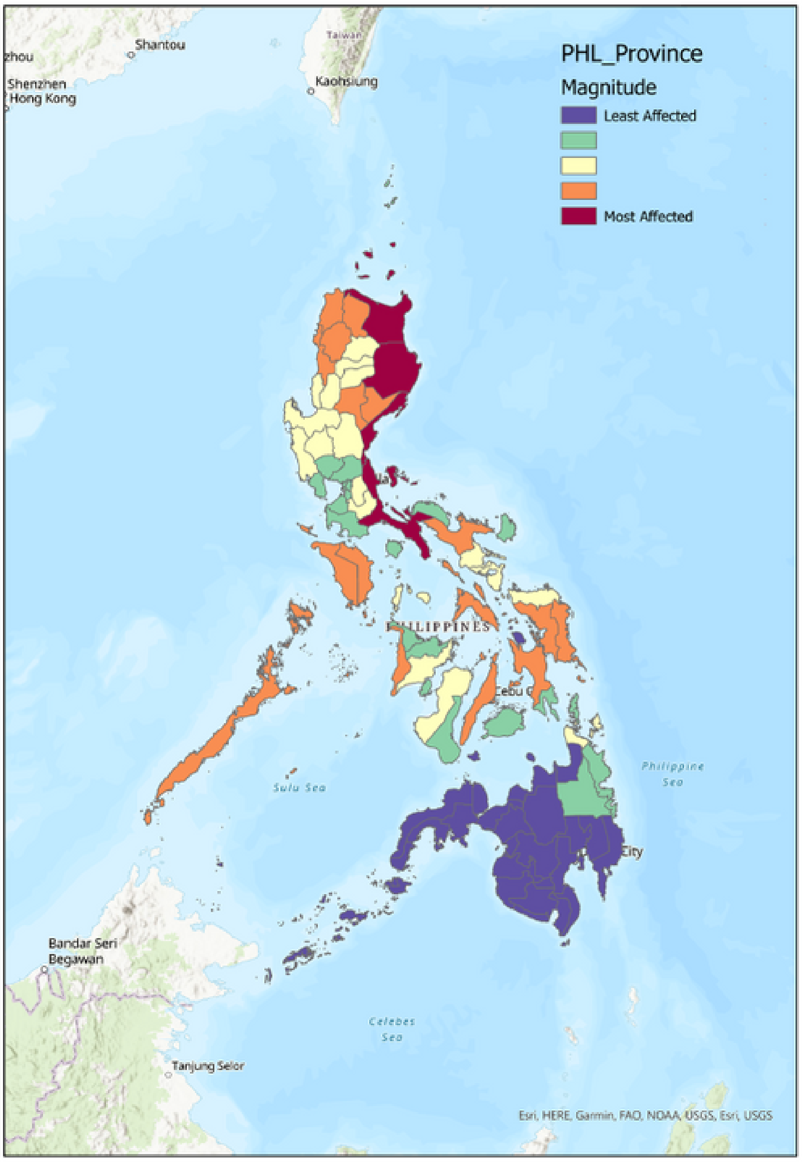


Table 13. Provincial Counts of Tropical Cyclone Events

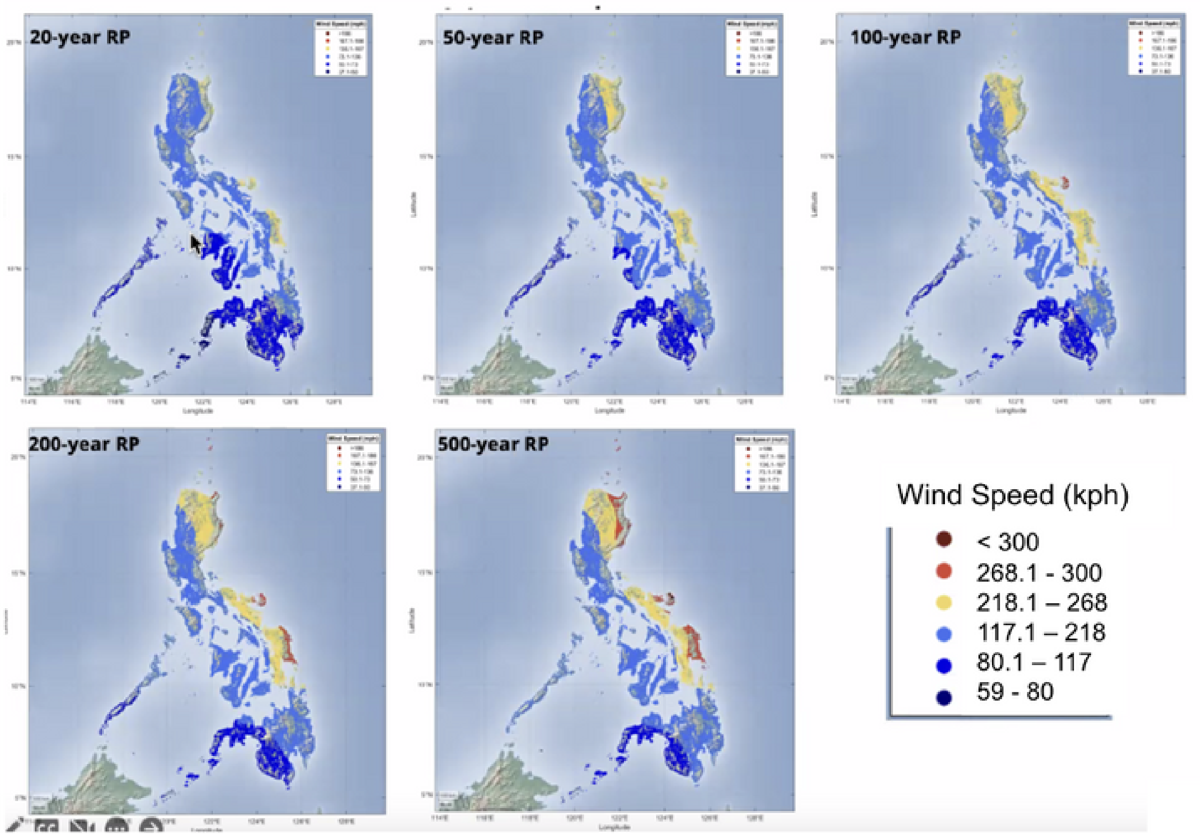
Province	Tropical Depression	Tropical Storm	Severe Tropical Storm	Typhoon	Super Typhoon	Rank
Cagayan	16	43	2	66	1	1
Aurora	19	25	1	50	0	2
Quezon	20	33	0	43	0	3
Isabela	13	37	1	40	0	4
Palawan	18	40	1	30	0	5

Province	Tropical Depression	Tropical Storm	Severe Tropical Storm	Typhoon	Super Typhoon	Rank
Eastern Samar	15	35	0	32	0	6
Masbate	9	35	0	34	0	6
Western Visayas	14	39	1	25	0	8
Cebu	10	38	0	23	0	9
Ilocos Sur	11	23	0	32	0	10

Tropical Cyclone Wind Speed by Return Period

Using the DOST-PAGASA simulations, Figure 20 presents the different return period simulations of Tropical Cyclones across the Philippines.

Figure 20. Tropical Cyclone Wind Speed for Different Return Periods (source: DOST PAGASA)



For the return period simulation, 5 different return periods were selected to show the potential wind intensities of Tropical Cyclones across the Philippines. As seen in Figure 19, "less frequent" tropical cyclones along the Eastern Seaboard area would have significantly greater windspeeds compared to tropical cyclones of the same severity in the Western and Southwestern regions of the Philippines. Based on the scenarios, within a 100-year period, windspeeds could exceed more than 268kph.

Box 1

Defining Return Periods

A return period, typically denoted as 1-in-X years, illustrates the average frequency of an event. The higher the number of years (denoted by X), the less frequent the event will occur. This means that a tropical cyclone that is categorized as a 1-in-100 year event is less likely to occur and more severe compared to a 1-in-2 year event.

To calculate annual probability, divide 1 with the return period years - i.e., 1/X. For easier understanding, a summary table of select return periods is provided below. Alternatively, return period of an event can be computed as:
T = 1/p, where p is the probability of exceedance of each particular event in any given year.

Note that the number of years (X) identified in the return period is not the exact period one has to wait for the event to occur. This is because these events could occur at any time. What should be considered is the annual probability of it occurring.

Return Period (RP)	Computation (1/X)	Annual Probability
1-in-10 Years 10-Year RP	1/10 = 0.10	10.00%
1-in-20 Years 20-Year RP	1/20 = 0.05	5.00%
1-in-50 Years 50-Year RP	1/50 = 0.02	2.00%
1-in-100 Years 100-Year RP	1/100 = 0.01	1.00%
1-in-200 Years 200-Year RP	1/200 = 0.005	0.50%
1-in-500 Years 500-Year RP	1/500 = 0.02	0.20%

Risk Analysis Using NARS Dataset: A Focus on DepEd Schools

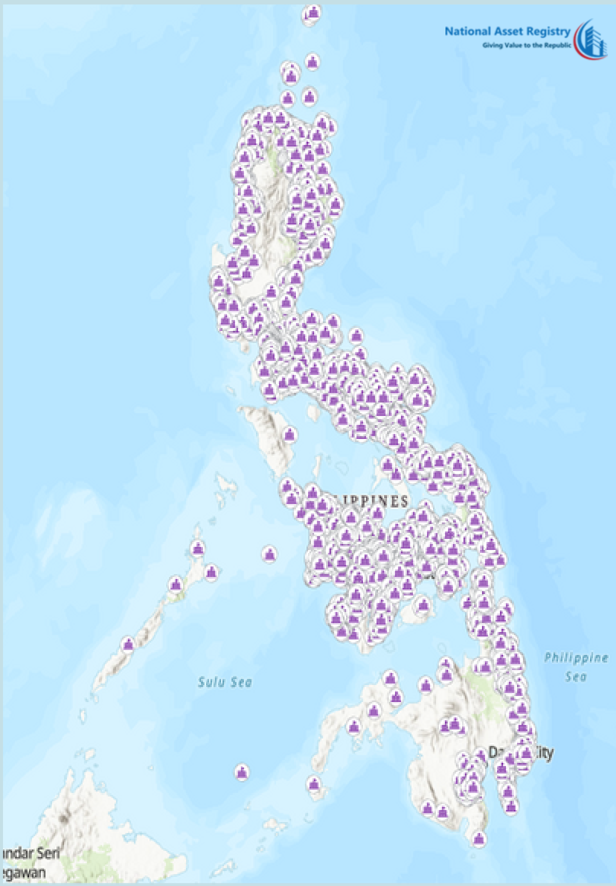
Box 2

DepEd NIIP Database

In addition to the NARS dataset of the DepEd mentioned in Section 1, the DepEd also provided to the BTr a National Indemnity Insurance Program (NIIP) dataset for the planned NIIP program. The NIIP dataset consists of the 82,998 school buildings. Similar to the NARS dataset of the DepEd, the NIIP dataset includes information on the region, division, school name, building attributes (number of classrooms, number of storeys), building structure type, and approximate costing. In addition to these information, the NIIP Dataset also provides information such as enrollment, building condition, and year completed.

Portfolio Analysis – DepEd NIIP Dataset

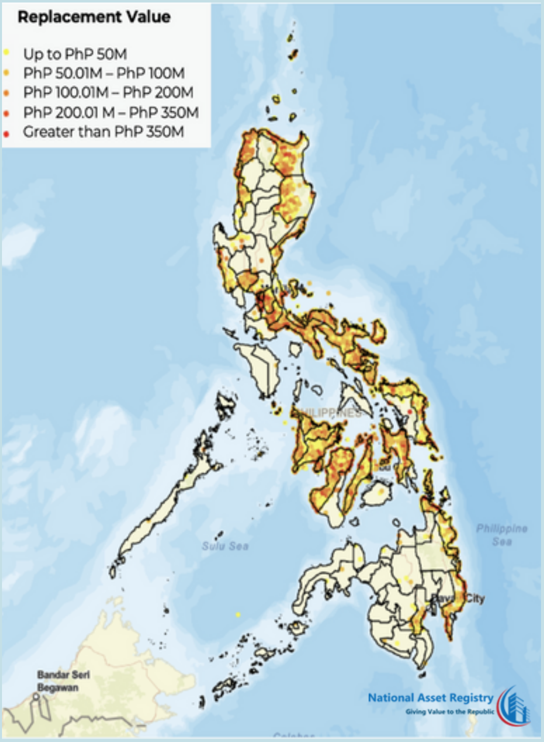
Using the DepEd NIIP Dataset, which includes the longitude and latitude data of each school building, the figure on the right maps where these school buildings are located. It should be noted that there are still errors in the geocoding conducted by the DepEd as some schools were tagged in the middle of the ocean or in a different region. In view of this, the BTr-Asset Registry Division is continuously working on data cleansing, validation, and reconciliation with the DepEd.

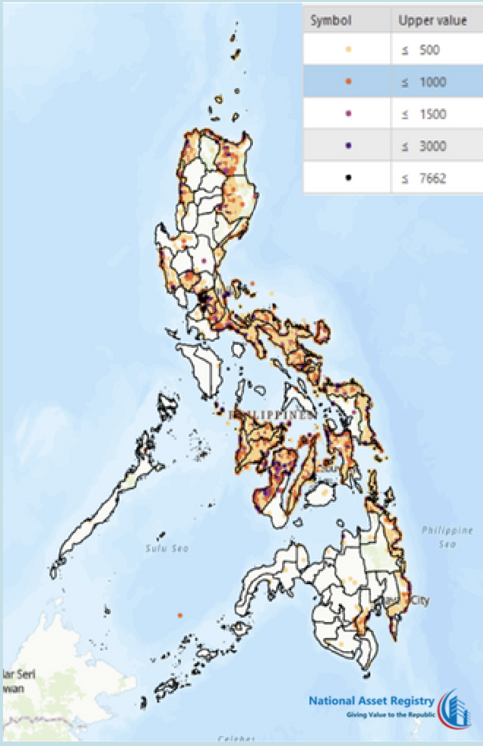


A density map (see top left figure on the next page) based on the schools' replacement value was also generated. The density map supports the DepEd NARS Dataset analysis of higher replacement value of school buildings in NCR.

Box 2, continued

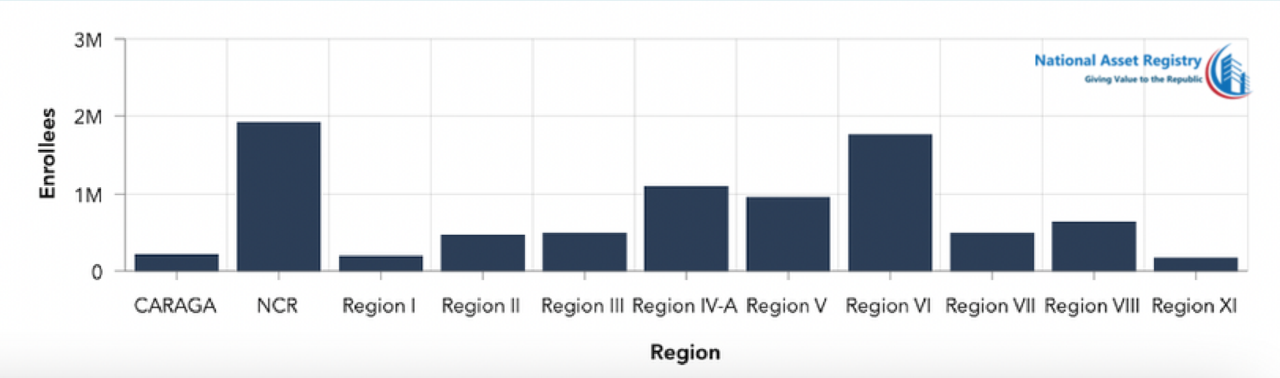
DepEd NIIP Database





The DepEd NIIP Dataset was limited to the 25 provinces in the 2017 and 2018 Parametric Insurance Program and areas identified by the DepEd as critical – i.e., Region VI and NCR.

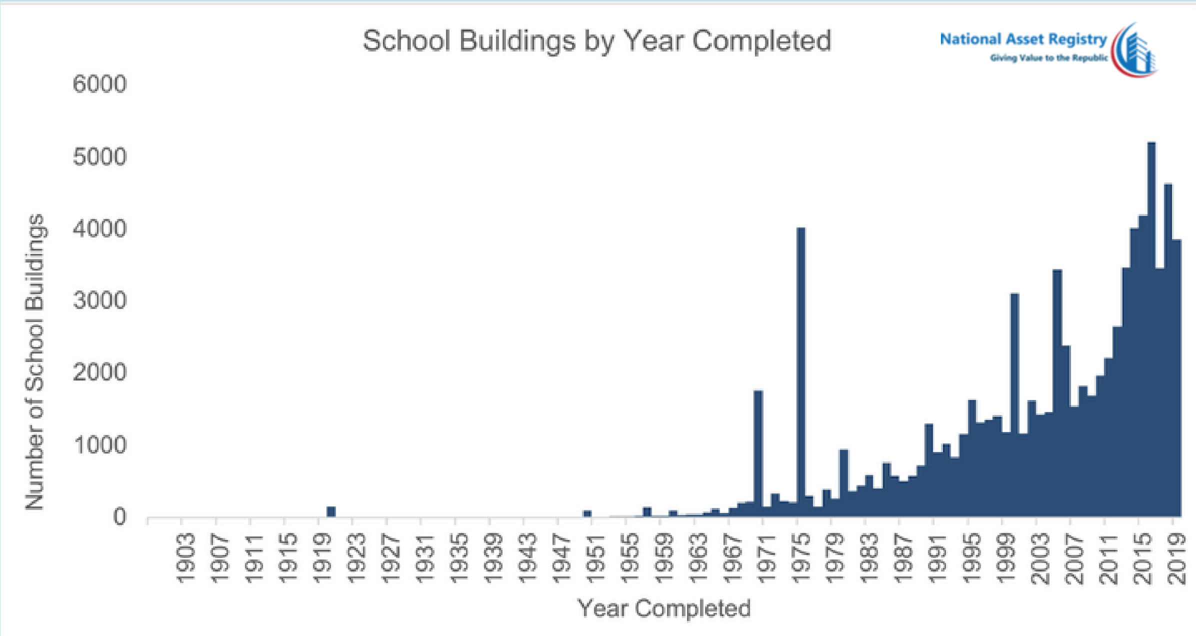
A density map on the enrollment information (see top right figure) was also generated to show which regions service the most students. In terms of enrollment, NCR has the highest number of recorded enrollees at 1.9 million students (figure below). Moreover, the ten schools in the country with the greatest number of enrollees are all within NCR. Following NCR, Region VI has the most number of enrollees at 1.7 million.



Box 2, continued

DepEd NIIP Database

The figure below shows a histogram on the DepEd school building completion dates. The majority of schools were built within or after the year 2000. This shows that DepEd schools are still within their useful life. It should be noted, however, that there are 198 schools in the DepEd's portfolio that are at least 100 years old – this information should influence maintenance regimes and replacement scheduling.



DepEd Disclosed Hazards Experience

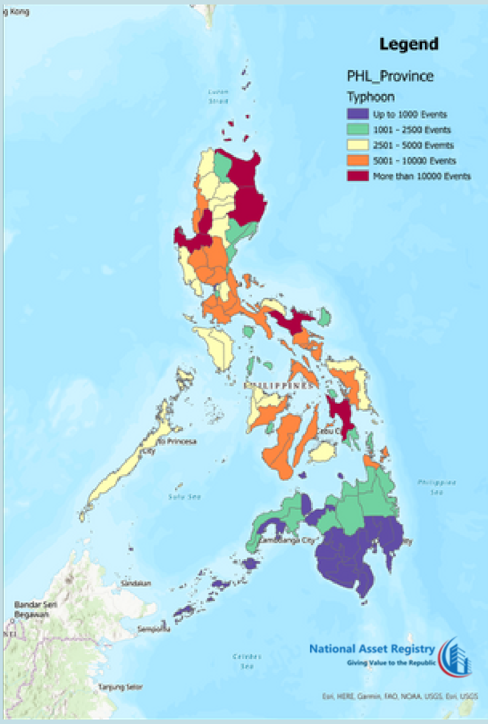
A geospatial analysis was conducted to map key regions that experience typhoons, flooding, and earthquakes based on the information provided by DepEd. The disclosure of the DepEd of its disaster and hazard experiences was part of their 2020 submission for the NIIP. In the document, the DepEd marked the number of times a particular school experienced any of the named events (e.g., typhoon, flood, earthquake). The information merely provided instances when these disasters were noted and did not consider the severity of these events. Understanding the severity and impacts of these events is critical longer term – as impacts will cascade to the services provided from the assets over time – not just an immediate impact.

Box 2, continued

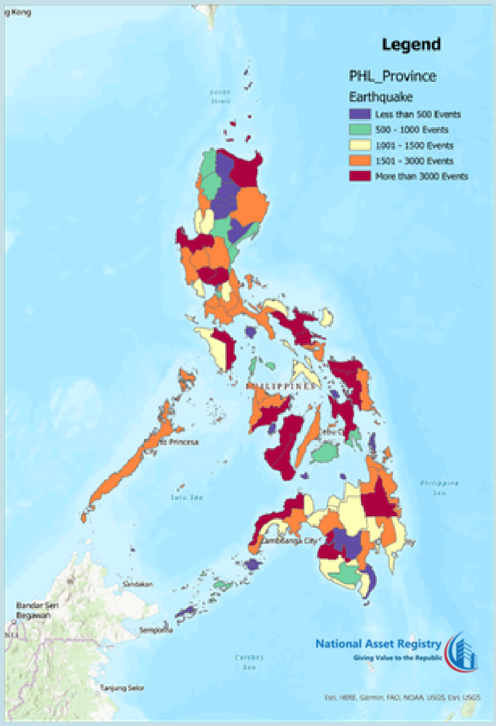
DepEd NIIP Database

The experience noted by the DepEd (see below) shows that regions along the Eastern Seaboard have the most experience when it comes to typhoons. This is supported by the earlier mapping of typhoon paths. Earthquake experiences are spread out across the country due to the many fault lines in the Philippines.

Typhoon Experience



Earthquake Experience



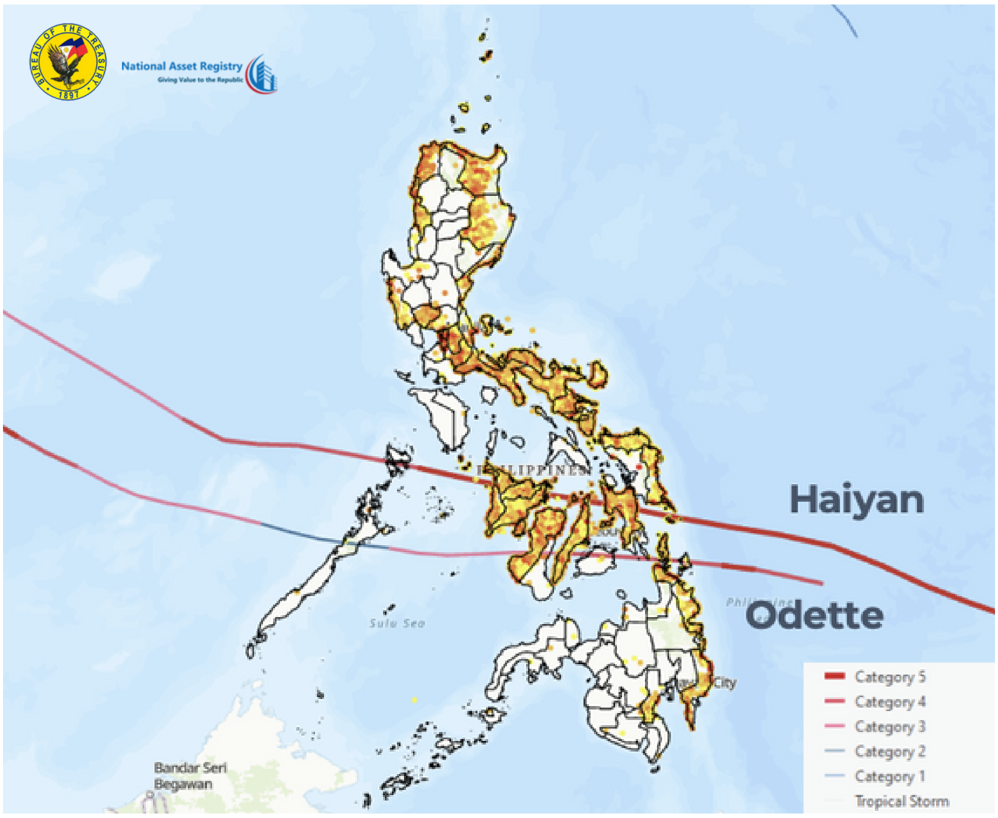
DepEd Typhoon Odette Simulation

For a more accurate assessment of potential losses arising from and the impact of Typhoon Odette, the BTr used the NIIP dataset. For this, the BTr conducted two analyses – (i) a buffer analysis to characterize the typhoon path using the buffer and intersect tools and satellite imaging, and (ii) a wind swath loss assessment analysis using the asset inventory array, vulnerability curves, and wind swath data.

Buffer Analysis

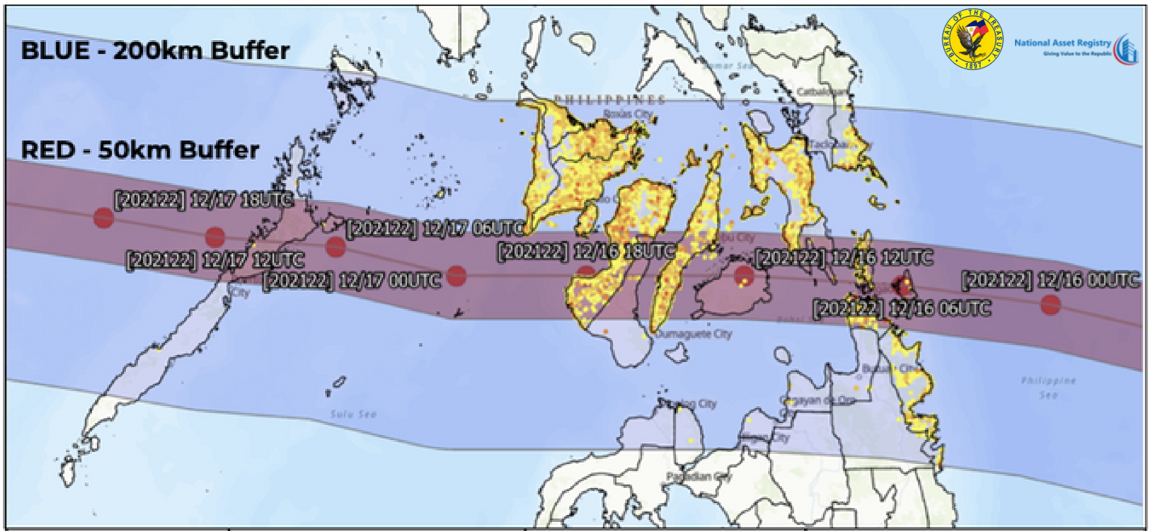
The buffer analysis was done in two parts. First, the BTr overlaid the tracks of Typhoons Odette and Haiyan against one another to see their similarities and differences in terms of strength and path. For this, it can be observed in the map (see Figure 21) below that Haiyan was consistently stronger compared to Odette. From its peak of being a Category 5 hurricane, Odette weakened as it moved towards the Visayas group of islands from right to left, and eventually became a Category 2 hurricane by the time it had reached Palawan. In terms of its path, Haiyan was geographically higher compared to Odette. However, the path of Odette directly passed Cebu City, which is one of the densest cities in the Philippines outside of those in Metro Manila.

Figure 21. Typhoon Haiyan vs Typhoon Odette against DepEd NIIP Dataset



For the second part, the BTr created a 50km buffer and 200km buffer around the path of Typhoon Odette. These buffers help estimate the potential impact of the typhoon to the affected regions. The 50km buffer represents the areas potentially hit hardest by the Typhoon. Meanwhile, the 200km buffer represents the areas with relatively lower potential impact. These buffers are represented by the red and blue zones seen in Figure 22.

Figure 22. Typhoon Odette Buffer Analysis



Province	Number of Schools	Value of Schools		Students
CARAGA	279	PhP	7.07 B	85,908
Region VI	540	PhP	17.28 B	282,423
Region VII	415	PhP	12.86 B	236,602
Region VIII	106	PhP	2.91 B	30,970
TOTAL	**1,340**	**PhP**	**40.12 B**	**635,903**

50km Buffer information

The BTr then extracted information on the schools that fall within the red buffer zone. As detailed in Figure 22, a total of 1,340 schools worth PhP 40.12B are within the identified impact zone. These 1,340 schools provide education to 635,903 students.

Using a damage rate of 50% for the schools within the 50km buffer yields a potential damage cost of PhP 20.06B. This figure is a close approximation as supported by the National Disaster Risk Reduction and Management Council's (NDRRMC) recorded infrastructure damage of PhP 30.5B.

Wind Swath Analysis

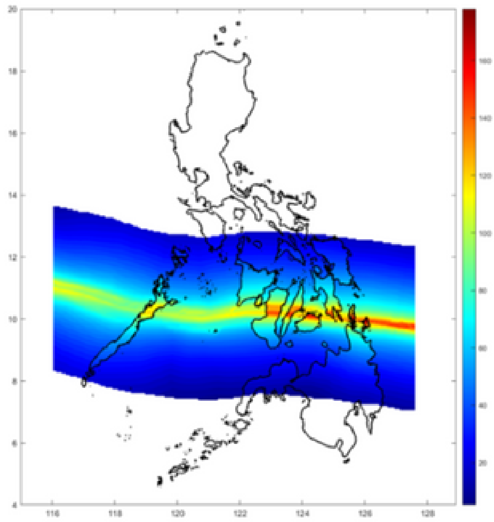
For the wind swath analysis, the BTr, with the assistance of the World Bank, used more granular information on typhoon features and structural vulnerability to model the potential impact of Typhoon Odette. To do this, the team generated Odette's wind swath by identifying the maximum wind speed at various locations of Odette's path. The wind swath (see Figure 23) shows the wind intensity of Odette as it passed through the Philippines. As can be seen, the strongest winds are those nearest the drawn path of Odette.

Figure 23. Typhoon Odette Wind Swath

General Information

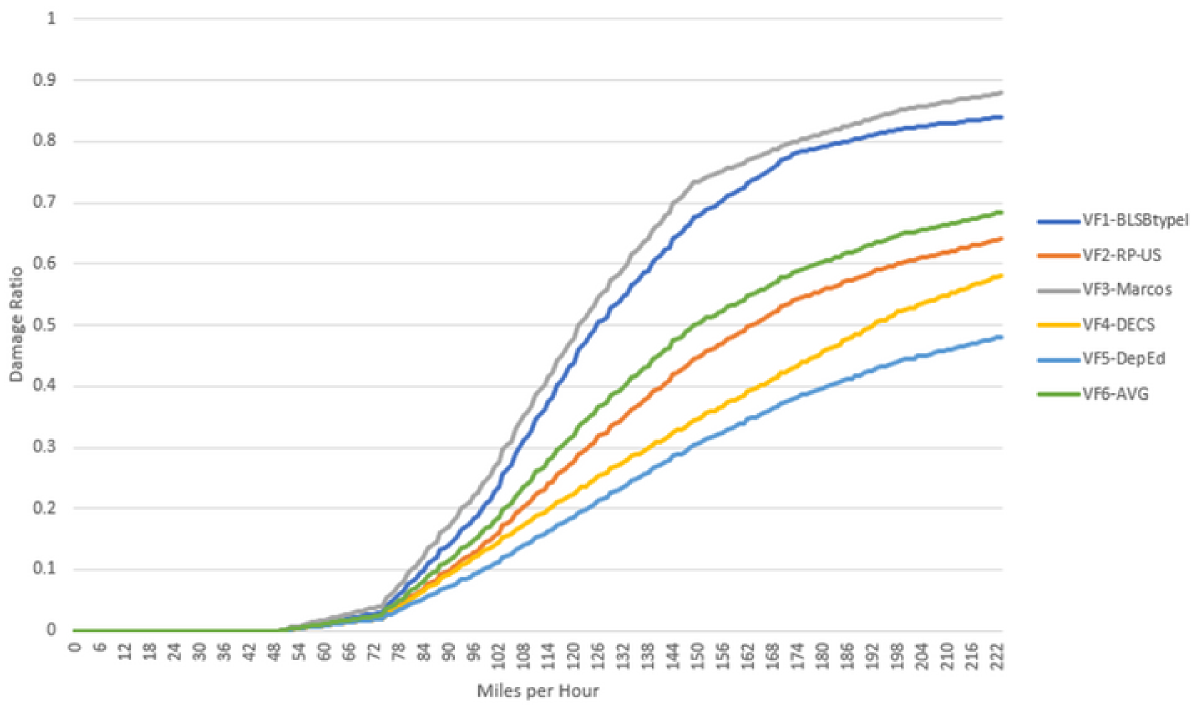
Time	Dec 16 – Dec 17, 2021
Max Wind speed	175 mph
Max Wind speed on schools	172 mph

Wind Path and Field



Vulnerability curves based on the wind speed that could be withstood by the different DepEd building structure types were also generated. The vulnerability function (VF) curves (see Figure 24) present the damage ratio of different NIIP DepEd building structure types at certain wind speeds. The ratio is based on the percentage of the structure that gets destroyed given certain wind speeds. As seen in Figure 24, the Marcos type school building (gray line), one of the oldest structures, is among the most fragile types with a damage ratio of nearly 0.9, or near complete destruction at wind speeds of 222 mph (350 kph). However, as we look at more recent structures – e.g., VF 5 (DepEd New School Building) and VF 4 (DECS) – their damage ratio significantly decreases for the same maximum windspeed. For the remaining school building types, they were aggregated and noted with VF 6. VF 6 averages the damage ratio at each given wind speed of the 5 most common building types in the inventory.

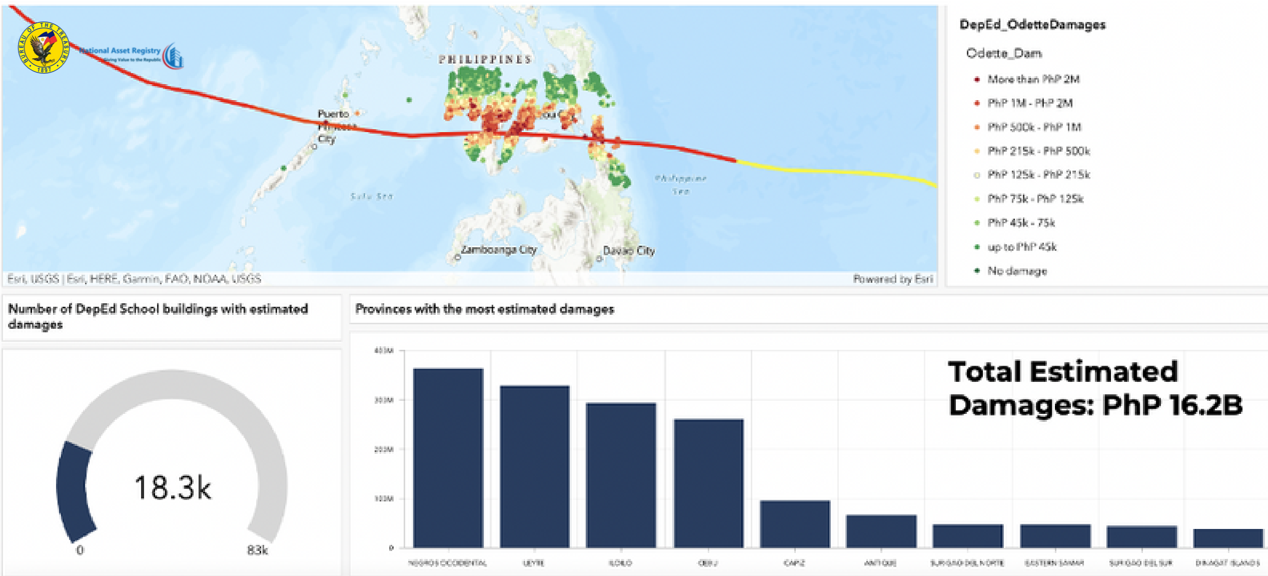
Figure 24. DepEd Vulnerability Curves



Note: Vulnerability curves are preliminary and subject to further validation, research, and refinement.

The risk model combined the wind swath typhoon data, vulnerability functions, and geolocated schools to simulate the path and potential damages Typhoon Odette would have caused. A visualization of damages and its distribution can be seen in Figure 25. The model estimated damages of PhP 16.2B spread across more than 18,000 schools. Some of these schools had minor damages, while some would reach more than a million worth of damages. The model estimate supports the buffer analysis conducted in Figure 22.

Figure 25. DepEd NIIP Dataset Event Simulation



DepEd Historical Typhoon Analysis

Paths of typhoons from 2013 - 2022 were overlaid against the DepEd NARS dataset to identify provinces in the Philippines with a high number of schools that are within the 50km buffer zones of these typhoons (see Figure 26). A 50km buffer zone was chosen to estimate potential impact area of these typhoon events.

After overlaying these information, it was seen that Regions III, IV-A, VIII, and V have the most number of school buildings that were within the typhoon buffer zone. In terms of value, however, NCR had the highest aggregate replacement value of schools within the buffer zone, followed by Region III, IV-A, and VIII.

To identify areas most impacted by strong typhoons, the typhoon tracks in Figure 27 were filtered for those equating a Category 4 and 5 hurricane, which is equivalent to a Super Typhoon. The buffers were then narrowed to a 20km buffer since the strength of the typhoon would be more focused over a smaller buffer zone compared to a weaker typhoon whose winds would cover a wider area (see Figure 27).

Figure 26. 2013-2022 Typhoons Overlaid on DepEd NARS Dataset

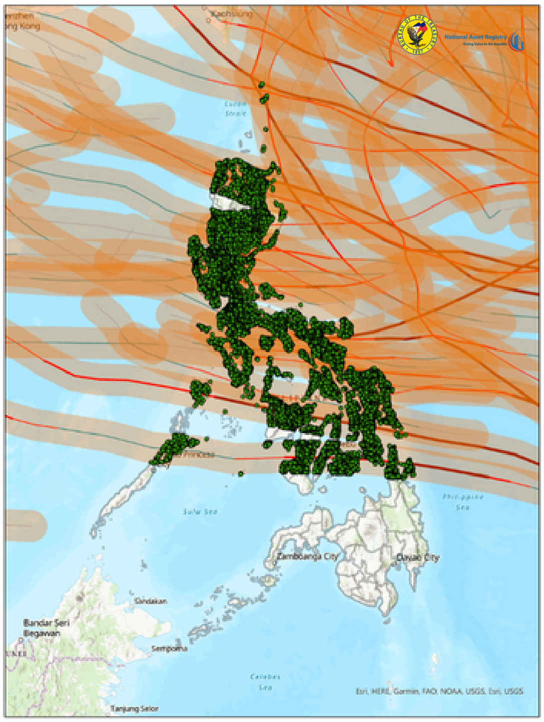
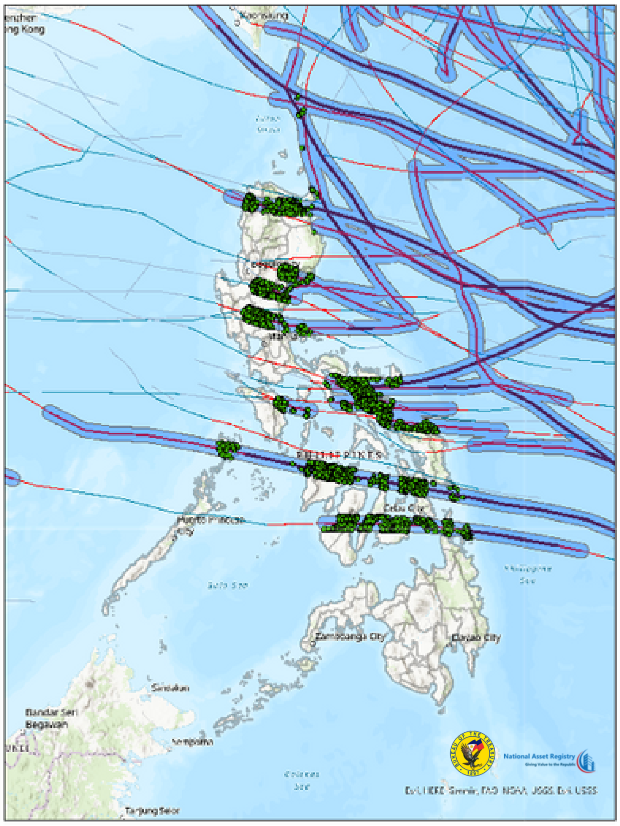


Figure 27. 2013-2022 Category 4 and 5 Tropical Cyclones Overlaid on DepEd NARS Dataset



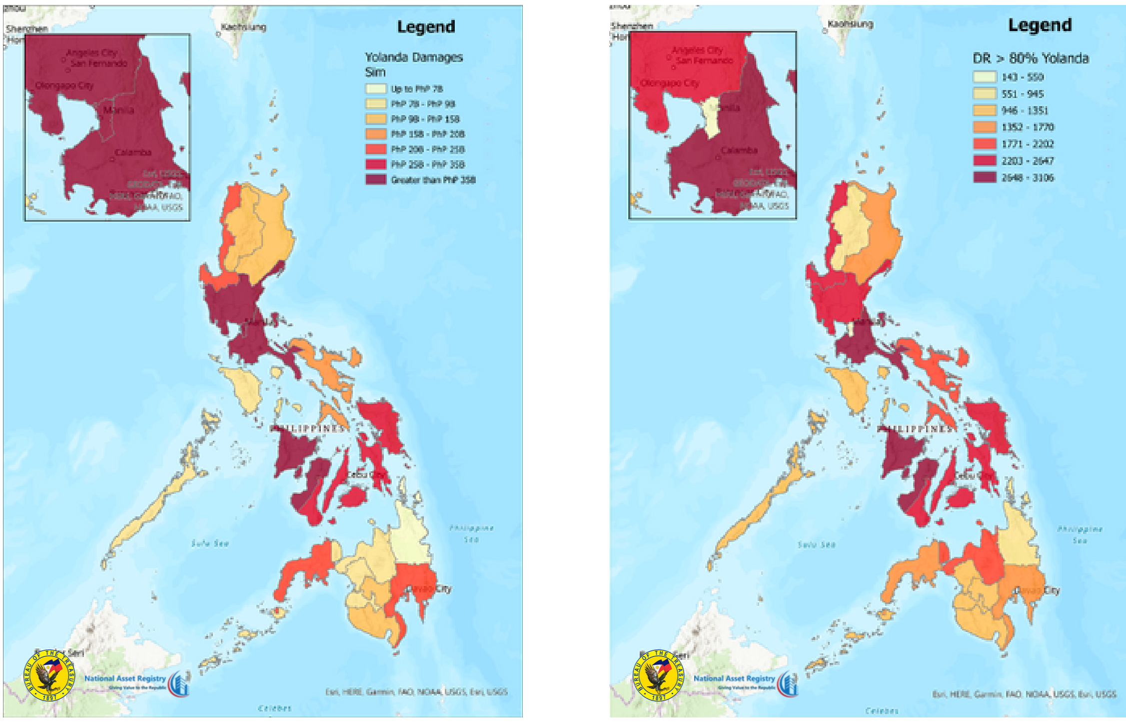
Looking at the filtered buffer for only a Category 4 and 5 typhoons, the areas hit are located mostly in Eastern Luzon and Eastern Visayas - Albay, Camarines Sur, Capiz, Cebu, Ilocos Norte, Leyte, Nueva Ecija, Samar, Sorsogon, and Tarlac.

DepEd Extreme Event Simulation

Assuming a super typhoon with a constant wind speed of 315kph across the Philippines, not accounting for topological differences, meteorological changes, and potential natural buffering interventions (e.g., mangroves, mountain ranges), 10% or or over 30,000 schools are estimated to be nearly destroyed (0.80 damage ratio). Most of the schools expected to be nearly completely damaged are located along Region III, IV-A, Region VI, and Region VII.

In terms of value, the modeled event estimates PhP 368 Bn worth of damages.
As shown in Figure 28, the region with the highest aggregate cost of damages is NCR. This is attributed to the high value of schools in the region. Next to NCR, Region III, IV-A, and VI would have the highest aggregate damage cost for its schools.

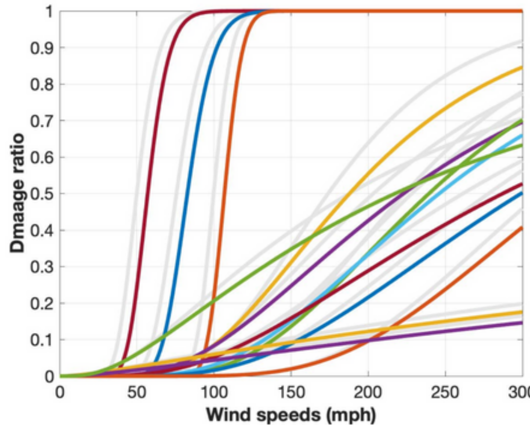
Figure 28. 315 kph Event Simulation over DepEd NARS Dataset



DepEd NARS Data Annual Average Loss and Return Period Analysis

Throughout the second half of 2022, the DepEd NARS portfolio was geotagged with its proximate location to provide an accurate annual average loss assessment. From over 100 building structure types provided in the NARS portfolio, these were categorized into 13 main structure groups. These structure groups and their assessed vulnerability functions are illustrated in Figure 25.

Figure 29. Sample DepEd NARS Vulnerability Functions from Available Literature



Note: Vulnerability curves are preliminary and subject to further validation, research, and refinement.

Annual Average Loss (AAL) was calculated to measure the potential damage cost to DepEd's school facilities. In assessing the annual average cost, three different scenarios were used to calculate the potential losses. The scenarios were based on the condition of the school buildings. Scenario 1 assumes that 27% of school buildings are in good condition and the rest in poor condition. Scenario 2 assumes that all school buildings are in good condition. Finally, Scenario 3 assumes that all school buildings are in poor condition.

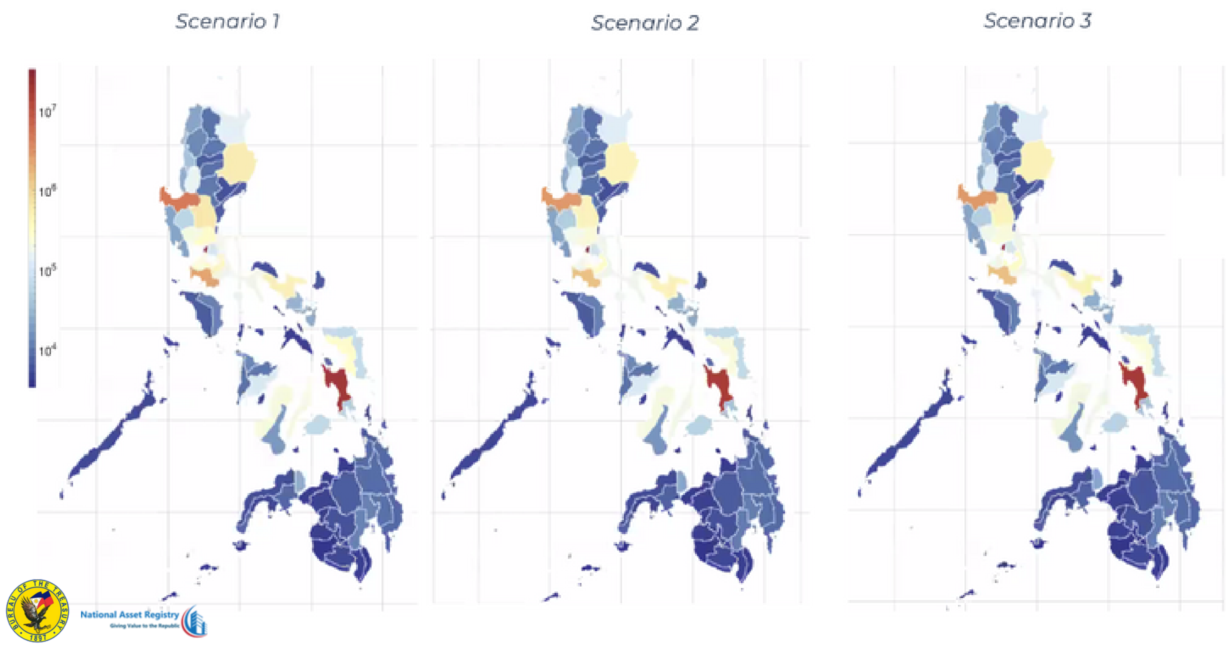
Based on the simulation, the following results were obtained for each of the three (3) scenarios:

Table 14. DepEd NARS Submission Annual Average Loss

Scenario	Scenario 1:27% good, 73% poor condition	Scenario 2:All good condition	Scenario 3:All poor condition
Annual Average Loss	**PhP 19.11 B**	**PhP 17.98 B**	**PhP 19.70 B**
Share of Annual Average Loss to total Portfolio value	**2.17%**	**2.00%**	**2.24%**

Figure 30 provides a heat map illustration of the AAL by province based on the inventory provided. As can be seen, most losses would be concentrated in Leyte, Pangasinan Isabela, Quezon, Samar, Negros, and the Greater Manila Area.

Figure 30. DepEd Annual Average Loss Heatmap



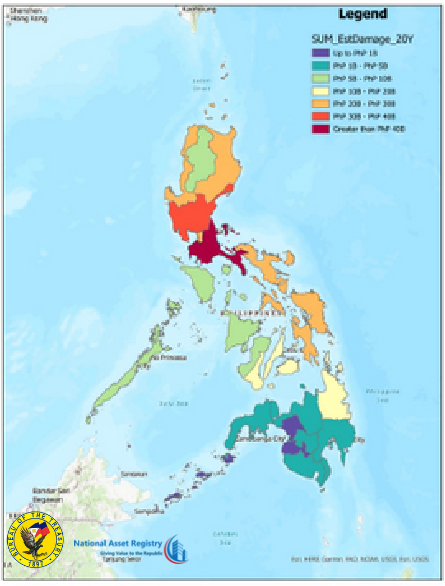
In addition to assessing DepEd's AAL, return period analysis were also done. A summary of expected losses by return period is summarized below:

Table 15. DepEd Return Period Loss Assessment

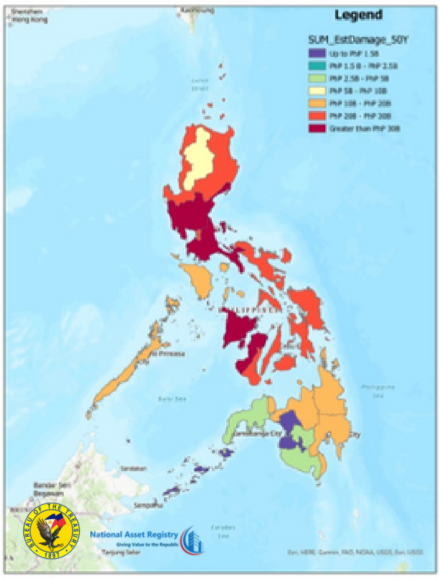
Annual Probability of Occurrence	Expected Loss
10.00%	**PHP 31 B - 35 B**
5.00%	**PHP 153 B - 166 B**
1.00%	**PHP 196 B - 213 B**
0.50%	**PHP 206 B - 224 B**
0.20%	**PHP 216 B - 235 B**

Figure 31 shows the aggregate return period losses by region. As can be seen, damages have concentrated along the Eastern Seaboard and the Island of Luzon. This concentration is attributed to the stronger typhoons experienced in these areas compared to that of Mindanao for the same return period and the higher value of asset concentration in these areas.

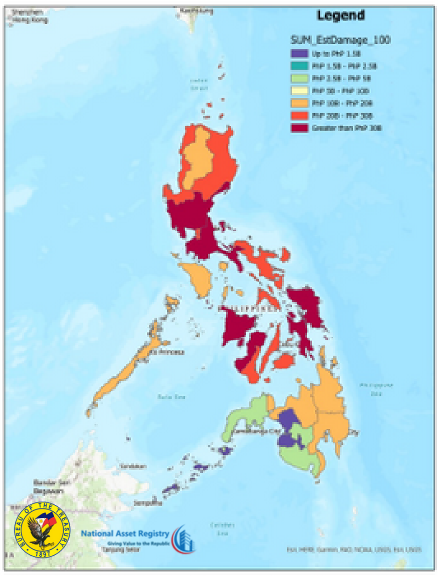
Figure 31. DepEd Return Period Loss Assessment



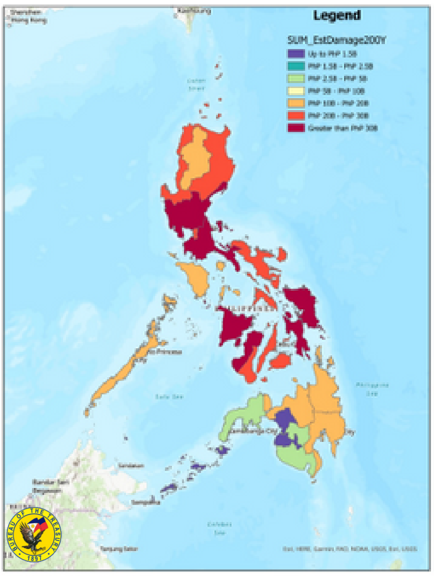
1-in-20Y Damages



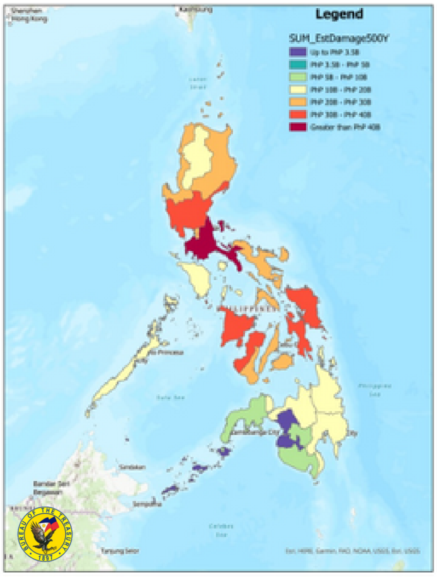
1-in-50Y Damages



1-in-100Y Damages



1-in-200Y Damages



1-in-500Y Damages

Hazards in the Philippines: The Big One

Earthquake Hazard

The Philippines is located along the Pacific Ring of Fire, it experiences a high frequency of earthquakes, both minor tremors and occasional major events that can have devastating consequences (Asian Disaster Reduction Center). Daily, the PHIVOLCS reports an average of 20 earthquakes or over 7,000 earthquake a year. Among the more notable of these events was the 7.8 magnitude earthquake that struck Luzon in July 1990 (DOST). The table below presents a list of select large earthquake events that struck the Philippines.

Table 16. Select Strong Earthquakes in the Philippines (PHIVOLCS)

Date	Magnitude	Location
22 April 2019	6.1	Castillejos, Zambales
15 Dec 2019	6.9	Matanao, Davao del Sur
18 Aug 2020	7.1	Masbate Pass near Cataingan, Masbate
11 Aug 2021	7.1	Governor Generoso, Davao Oriental
27 Jul 2022	7.0	Tayum, Abra
18 Jan 2023	7.0	Balut Island, Davao Occidental
01 Feb 2023	6.0	Compostela, Davao De Oro
11 Feb 2023	6.0	Balut Island, Davao Occidental
16 Feb 2023	6.0	Batuan, Masbate
24 Feb 2023	6.4	Sarangani Island, Davao Occidental

The Big One

The Big One refers to a major earthquake caused by one of the major fault lines in the Philippines, one of which traverses Metro Manila, the densest metropolitan in the country. It can have a magnitude of 8 or above, which can have the potential to cause widespread destruction and loss of life. In recent years, the PHIVOLCS has made projections and simulations on the type of event the "Big One" can be.

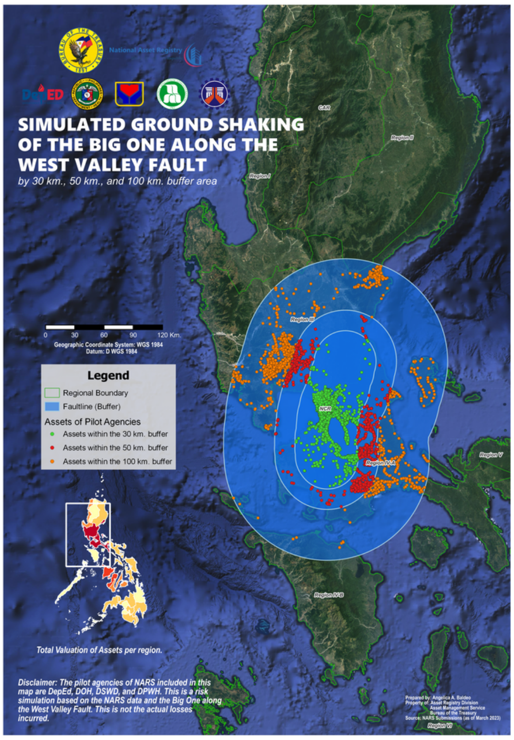
Using the DOST projected parameters of the event and the NARS data of select pilot agencies (DepEd, DOH, DSWD, and DPWH), Table 17 summarizes the assets within pre-identified buffer impact zones and the value of these identified assets.

Table 17. Earthquake Estimated Losses per Buffer Level

Buffer Area (km.)	Areas Affected	Number of Agency Assets	Value of Exposed Assets
30	NCR, Aurora, Cabuyao City, Laguna, Quezon, Rizal	8,707	PHP 143.1 Billion
50	NCR, Pampanga, Aurora, Rizal, Quezon, Laguna, Cabuyao CIty	13,569	PHP 168.6 Billion
100	NCR, Zambales, Pampanga, Aurora, Rizal, Quezon, Laguna, Cabuyao CIty	20,339	PHP 198.0 Billion

Using the available parameters and NARS dataset, DepEd has the most potential loss with over 17,000 school buildings within the buffer zone. These 17,721 schools have an estimated value of PhP 195.5 Billion. Following DepEd, DOH has 234 facilities and offices, of which 121 are hospitals and treatment centers, with a total estimated value of PhP 2.8 billion, and 52 DSWD buildings and centers with an estimated value of PhP 253.9 million. An estimated 2,332 DPWH infrastructure (road segments and bridges) will also be affected by the event.

Figure 32. Simulated Impact of the Big One Along the West Valley Fault



Extreme Case Scenario: Typhoon and Earthquakes

Parameters Used

For the extreme case scenario, Typhoon Ondoy (International Name: Ketsana) and The "Big One" data were used to assess a 100-km buffer/impact zone along Central Luzon. The choice of both events is to simulate a worst case scenario of a typhoon and earthquake hitting Metro Manila and the surrounding provinces.

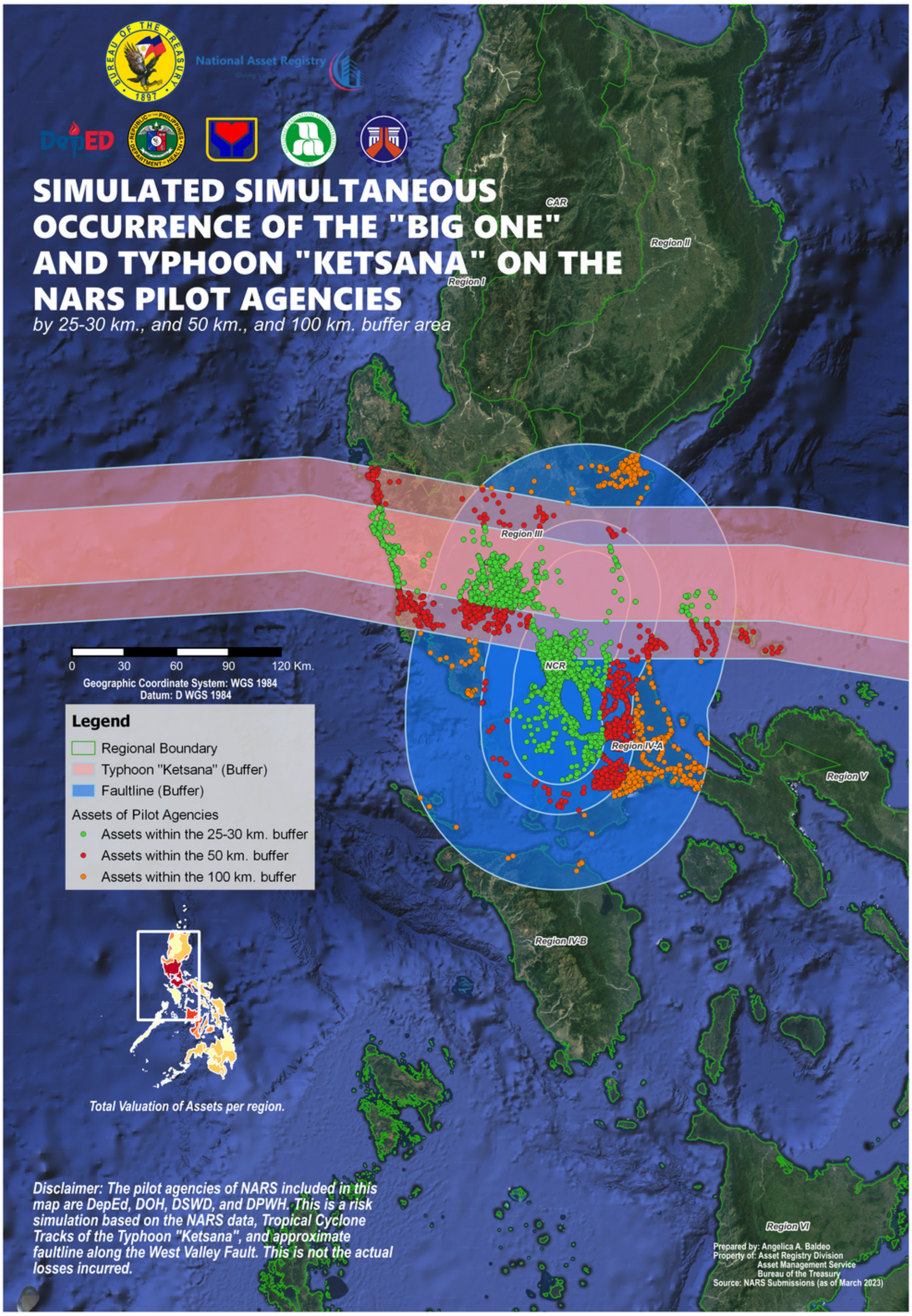
For Typhoon Ondoy, the parameter used is limited to the Typhoon's path to illustrate potential impact area of a similar trajectory event.

Table 18. Typhoon and Earthquake Simulation - Assets within Selected Buffer Zones

Buffer Area	Number of Assets	Value of Exposed Assets
25-30	12,758	PHP 163.1 Billion
50	19,251	PHP 196.6 Billion
100	21,910	PHP 206.9 Billion

Based on the simulation, NCR, Region IV-A, and Region III will be within the the 25 km (typhoon buffer) - 30 km (earthquake buffer) buffer area. Within this buffer, most of the assets are of the DepEd (10,686 school buildings worth over PhP 160B). This is followed by DPWH with 1,798 assets, DOH with 230, and DSWD with 44. The same trend can be seen when the buffer is at 50- and 100-km, respectively.

Figure 33. Simulated Impact of The Big One and Ondoy Path



Hazards in the Philippines: Past Volcanic Eruptions

Volcanic Hazard

The Philippines is home to 24 active volcanoes, with 13 located in Luzon, 3 situated in Visayas, and 8 located in Mindanao (Fiscal Risk Statement). According to PHIVOLCS, from the 24 active volcanoes, Mt. Mayon is at Alert Level 2 (Increased Unrest) as of June 5, 2023, while Mt. Taal and Kanlaon Volcano are at Alert Level 1 (Low-level unrest) as of March 15, 2023

In the risk analysis conducted, the scope of damage specifically focused on the potential impact of lava flow from the two (2) active volcanoes, rather than considering the hazards associated with ash fall.

Mayon Volcano

Mt. Mayon or Mayon Volcano is located in the province of Albay in the Bicol Region and is one of the seven (7) wonders of the world because of its perfect cone.

It is a highly active volcano with a well-documented eruption history dating back to 1616. The most recent eruptive activity began in early January 2018 and involved a series of phreatic explosions, steam-and-ash plumes, lava fountaining, and pyroclastic flows, as reported in the Bulletin of the Global Volcanism Network. Subsequent reports noted the presence of small but noticeable thermal anomalies, gas-and-steam plumes, and slight inflation.

These phenomena persisted from May to mid-October 2019, as documented by PHIVOLCS and observed through Sentinel-2 satellite imagery.

Figure 34 shows the potential damage resulting from a major eruption of Mt. Mayon with buffer areas of 25 km., 50 km., and 100 km. From 25 km. to 50 km. buffer area, the most affected areas are the province of Albay and other nearby provinces within the Bicol Region.

With a buffer area of 100 km, the extent of potential damage includes some parts of Region VIII, which are approximately located near the Bicol Region. Region V has the most number of assets damaged from a potential major volcanic eruption. In addition, there are 791 assets at PhP 74.5 million that were unclassified as to Regional location but were included in the risk simulation.

Figure 34. Simulated Risk of Mt. Mayon per Buffer Level

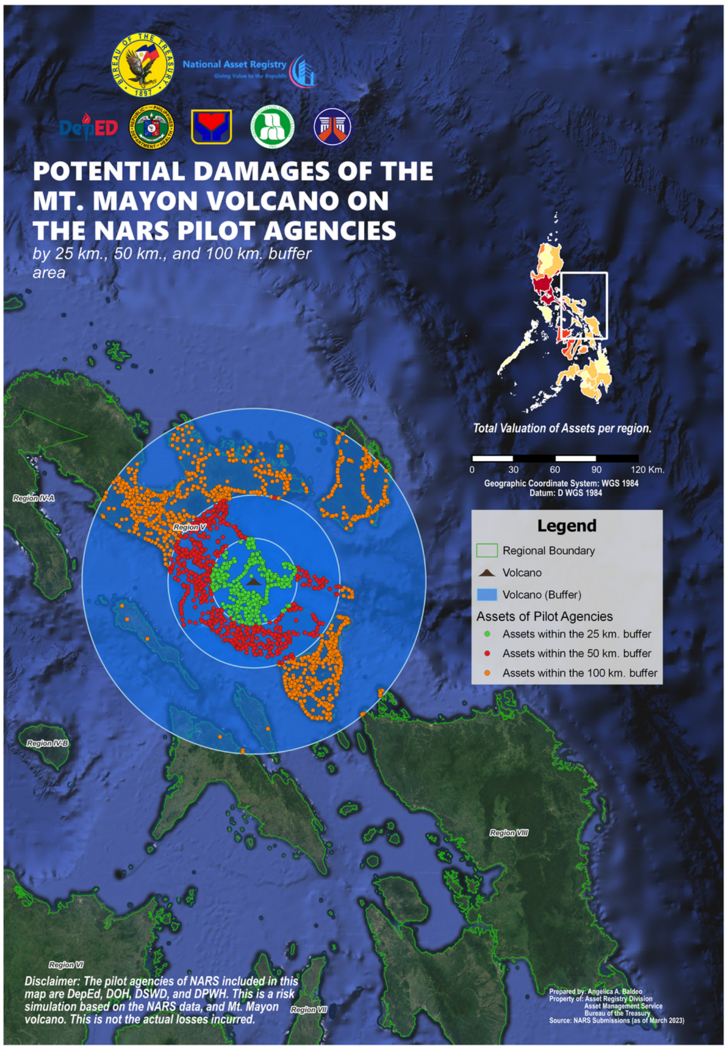


Table 19. Potential impact of Mt. Mayon per buffer level

Buffer Area (km.)	Number of Assets	Value of Exposed Assets
25	2,754	PHP 11.1 Billion
50	7,260	PHP 26.1 Billion
100	15,540	PHP 53.7 Billion

Table 20. Potential impact of Mt. Mayon per 100 km Buffer

Region	Number of Assets	Value of Exposed Assets
V	24,683	PHP 90.7 Billion
VIII	80	PHP 216 Million

The potential asset losses from DepEd have an estimated value of PhP 52.8 Billion. Meanwhile, the hospitals and treatment and rehabilitation centers (TRCs) under the DOH have an estimated value of PhP 752.1 Million.

Taal Volcano (Mt. Taal)

Mt. Taal is located in the province of Batangas about 50 km. south of Manila. The PHIVOLCS has declared Volcano Island a Permanent Danger Zone due to frequent eruptions. The volcano is situated within a large caldera, measuring 15km x 20 km, which encompasses Lake Taal. On 26th March 2022, there was a significant eruption characterized by 66 explosions that released wet ash.

Prior to this eruption, the PHIVOLCS reported "phreatomagmatic bursts" on the 15th and 22nd of November 2021, the 29th-30th of January, the 2nd and 10th of February, and the 25th of March 2022. Similar events were also observed on the 27th and 28th of March.

Figure 35. Simulated Risk of Mt. Taal per Buffer Level

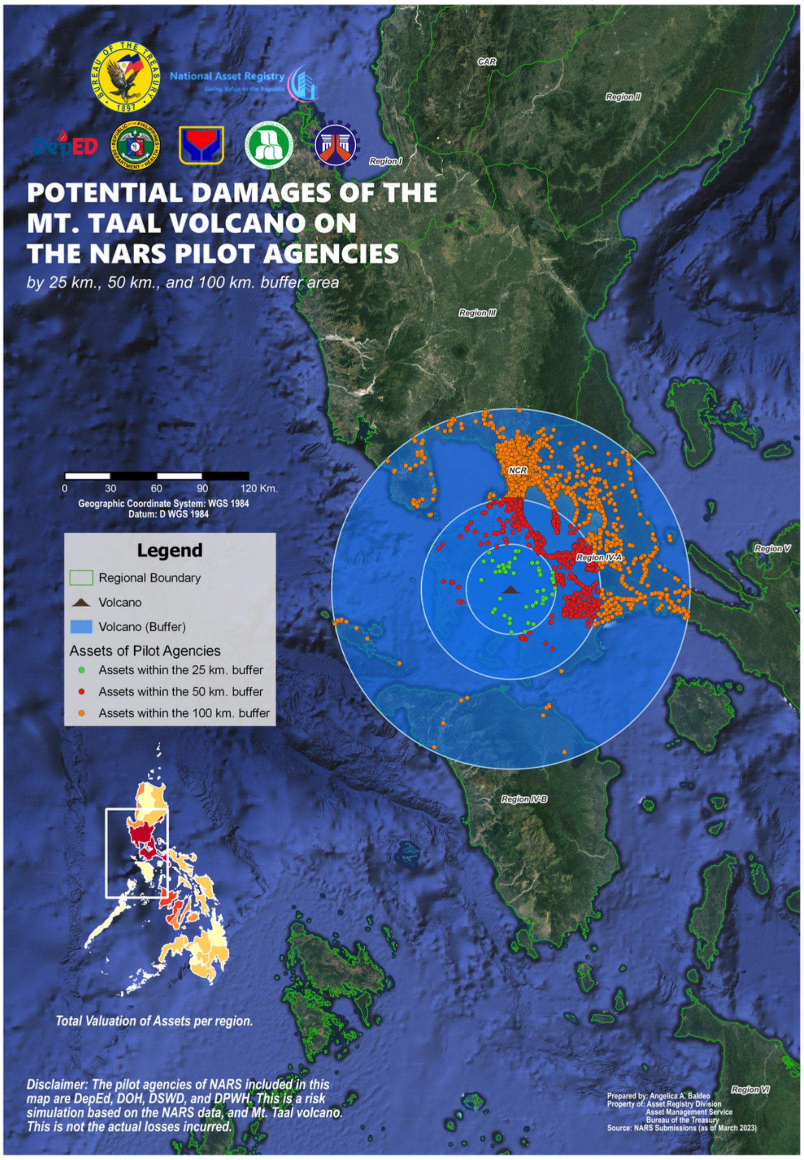


Figure 35 shows the potential damage from Mt. Taal volcanic eruption based on estimated buffer areas of 25 km., 50 km., and 100 km. For the 25 km buffer, the damages are contained within the province of Batangas with municipalities or towns near Mt. Taal. While for the 50 km. to 100 km. buffers, parts of Laguna, Quezon, Rizal, and Metro Manila can be potentially affected.

Table 21. Potential impact of Mt. Taal per buffer level

Buffer Area	Number of Assets	Value of Exposed Assets
25	138	PHP 417 Million
50	3,440	PHP 25.8 Billion
100	13,734	PHP 167.4 Billion

For the 100 km. buffer, NCR has the highest value of potentially damaged assets However, Region IV-A has the most number of assets to be affected by a major eruption of the volcano. In addition, 683 assets valued at PhP 249.7 million were mapped within the area but unclassified as to regional location due to the incomplete location information provided by agencies.

Table 22. Potential impact of Mt. Taal by region per 100 km. buffer area

Region	Number of Assets	Value of Exposed Assets
NCR	5,502	PHP 122.2 Billion
III	4	PHP 16.9 Million
IV-A	10,901	PHP 70.7 Billion
IV-B	21	No data

The analysis showed significant potential losses of DepEd with an estimated amount of PhP 164.9 Billion. This highlights the substantial value at risk for educational infrastructure and resources. Additionally, the hospitals and TRCs under the DOH are projected to experience potential losses with an estimated amount of PhP 1.73 Billion.

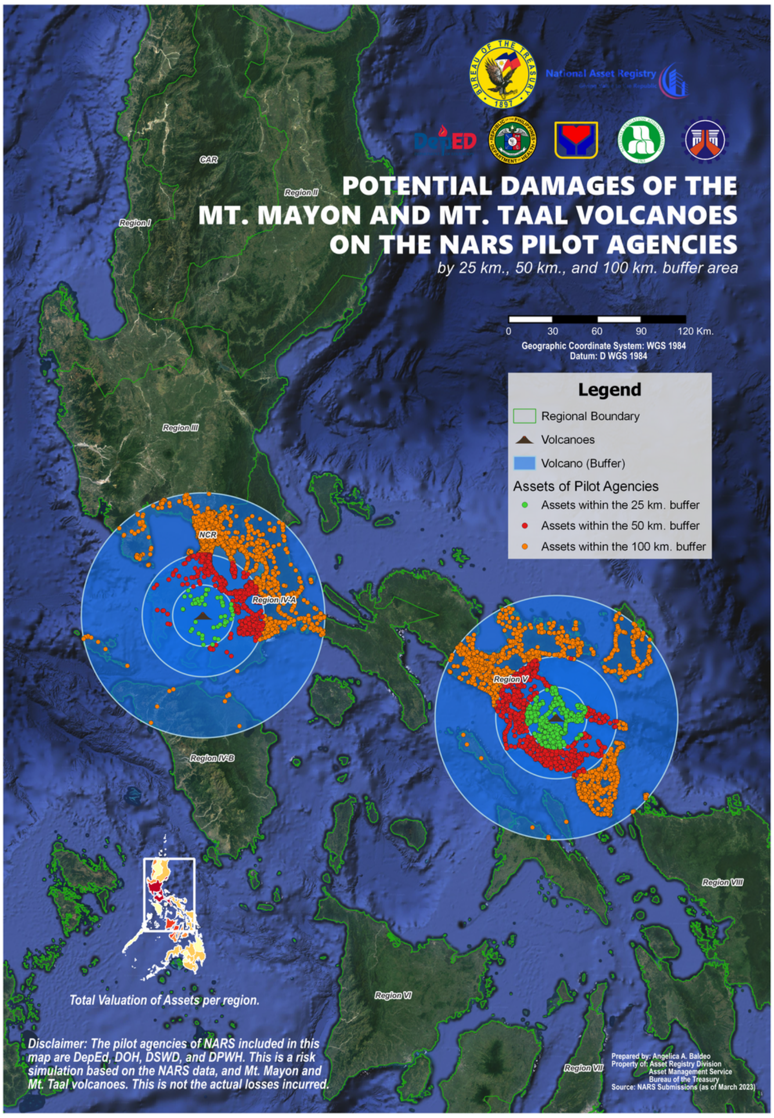
Two Volcano Simultaneous Eruption Scenario

The worst-case scenario is that the two (2) volcanoes erupted simultaneously, the potential scope and amount of damage based on the level of buffers are as follows:

Table 23. Potential impact of Mt. Taal and Mt. Mayon per buffer level

Buffer Area	Number of Assets	Value of Exposed Assets
25	2,892	PHP 11.5 Billion
50	10,700	PHP 52.0 Billion
100	29,274	PHP 221.2 Billion

Figure 36. Mt. Mayon and Mt. Taal Volcanoes Simultaneous Eruption



A simultaneous eruption of Taal and Mayon Volcano show no common assets up to the 100-km buffer simulated.

These findings underscore the critical importance of proactive risk management and preparedness strategies. It is imperative for the National Government to prioritize measures such as asset relocation, reinforcement, and comprehensive emergency preparedness planning to minimize the potential damage and financial losses associated with the larger buffer zones or hazards with large impacts.

KEY FINDINGS

Areas of Interest

In identifying areas of interest, three methods can be used – i. hazard concentration (where typhoons typically pass); ii. exposure concentration (count or value of assets); or iii. the intersection of i. and ii. These identified methods would be useful in the further design and development of the National Indemnity Insurance Program as well as for future investment, budgeting, and planning activities of the National Government.

By Assessed Risk

Areas of interest due to the intersection of exposure and hazard, among others and based on the simulations done include the following provinces:

Albay	Isabela	Metro Manila and surrounding areas
Camarines Sur	Leyte	Samar

By Exposure Concentration

Areas of interest due to the number of assets (value and quantity) include the following regions based on the DepEd and DOTr submissions:

Metro Manila	Region IV-A	Region VII
Region III	Region VI	Region XII

By Hazard Concentration

Areas of interest due to the number of Tropical Cyclones and the intensities of such events that pass through them include the following provinces along the Eastern Seaboard, Luzon, and Visayas:

Albay	Camarines Sur	Isabela	Mountain Province
Aurora	Cebu	Kalinga	Quezon

Cagayan	Ifugao	Leyte	Samar
Camarines Norte	Ilocos Sur	Masbate	Sorsogon

Sources

Online Sources:
Asian Disaster Preparedness Center.
https://www.adpc.net/igo/Default.asp?

Deped COA Report 2021. https://www.coa.gov.ph/reports/annual-audit-reports/aar-ngs/#49-5270-department-of-education-1654481445

General Appropriations Act 2018, 2019, 2020, 2021, 2022, 2023.
https://dbm.gov.ph

Intergovernmental Panel on Climate Change. (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. New York: Cambrdige University Press.

National Centers for Environmental Information (NCEI). (2022).
International Best Track Archive for Climate Stewardship (IBTrACS):
https://www.ncei.noaa.gov/products/international-best-track-archive

National Museum of Natural History, Global Volcanism Program, Smithsonian Institution. https://volcano.si.edu.

United Nations Office for Disaster Risk Reduction. (n.d.). Terminology.
Retrieved from United Nations Office for Disaster Risk Reduction:
https://www.undrr.org/terminology

Data Submissions from partner agencies:
DOST data on Tropical Cyclones in the Philippines 1948-2017
DOST PHIVOLCS data on the "Big One"
NARS Data from NARS partner agencies and instrumentalities

Ayuntamiento de Manila, Intramuros
Manila, Philippines
Website: http://www.treasury.gov.ph

The preparation of this report was led by the Bureau of the Treasury's Capital Markets Strategy and Planning Division (CMSPD). Assisting the Capital Markets Strategy and Planning Division were Asset Registry Division (ARD) and Risk Management Division (RMD). The World Bank also provided technical assistance in the generation of the more complex risk simulations.

The report and analysis included herein are based on the submissions of the named agencies and other publicly available information. The submissions of the named agencies are NOT publicly available. Any and all information provided in this document are subject to further update and analysis as soon as more information are available.