Executive Summary

ES 1. Project Fact Sheet

The City Government of Manila (the proponent) proposes to develop a reclamation project located along the coast of Manila Bay within the political jurisdiction of the City. The project will have a land area of approximately 407.42 hectares that is envisioned to be the new central business district of the city.

This Executive Summary provides a general overview of the proposed New Manila Reclamation Project of the Manila City Government. Also, it briefly describes the project's documentation of the process undertaken in the conduct of EIA – EIA Team, EIA Study Area, description of key EIA Methodologies, summary of baseline condition, major impacts, proposed mitigation and preventive measure, monitoring plans, and public participation.

ES 1.1 Basic Project Information

Project Information

Project Name	**New Manila Reclamation Project**
Project Type	Reclamation Project
Project Location	Along Coast of Manila Bay in the territorial jurisdiction of the City of Manila
Project Size	407.42 hectares
Major Components	• Reclamation of 407.42 hectare land • 200-meter buffer zone for adequate water circulation • Design platform level of +4.40 m CD or higher • Reclamation Equipment: Trailing Suction Hopper Dredger (TSHD), Backhoe Dredger (BHD), Hopper Barge and Tugboat • Proper drainage system • Internal and access road networks • A sand source located within a 30 km radius from the site such as the San Nicholas Shoal (SNS) has been planned for as the borrow area for the fill material • Sandkey dredging for sloping revetment and gravity wall foundation
Project Cost	PhP43.7 billion

Proponent Profile

Project Proponent	**City Government of Manila**
Authorized Representative	Hon. Joseph Estrada
Designation	Mayor
Proponent Address	Padre Burgos Ave, Ermita, Manila
Proponent Contact Details	T (02) 527 0907
EIA Preparer	**RHR Consult Services, Inc.**
Contact Person/	Ryan Filiberto P. Botengan
Designation	Managing Director
Address	9999-A Mt. Pulog St., Umali Subd., Los Banos, Laguna
Contact Details	T (02) 411 5763

The Sworn Statement of Accountability of the Proponent is provided in **Annex B**.

ES 1.2 Project Location

The Project is situated along the coast of Manila Bay, Manila City, Metro Manila, the National Capital of the Philippines. The project site will have a total are of approximately 407.42 hectares and is adjacent to the Manila South Harbor Port.

The Project site can only be accessed by boat via the 2nd Street, which is a partially paved 1-lane road and connected to Bonifacio Drive which in turn leads to Roxas Boulevard, a dual-3major arterial road in Metro Manila. Both roads form part of the R1 radial road which convey traffic in and out of the city center to Cavite in the south and other provinces.

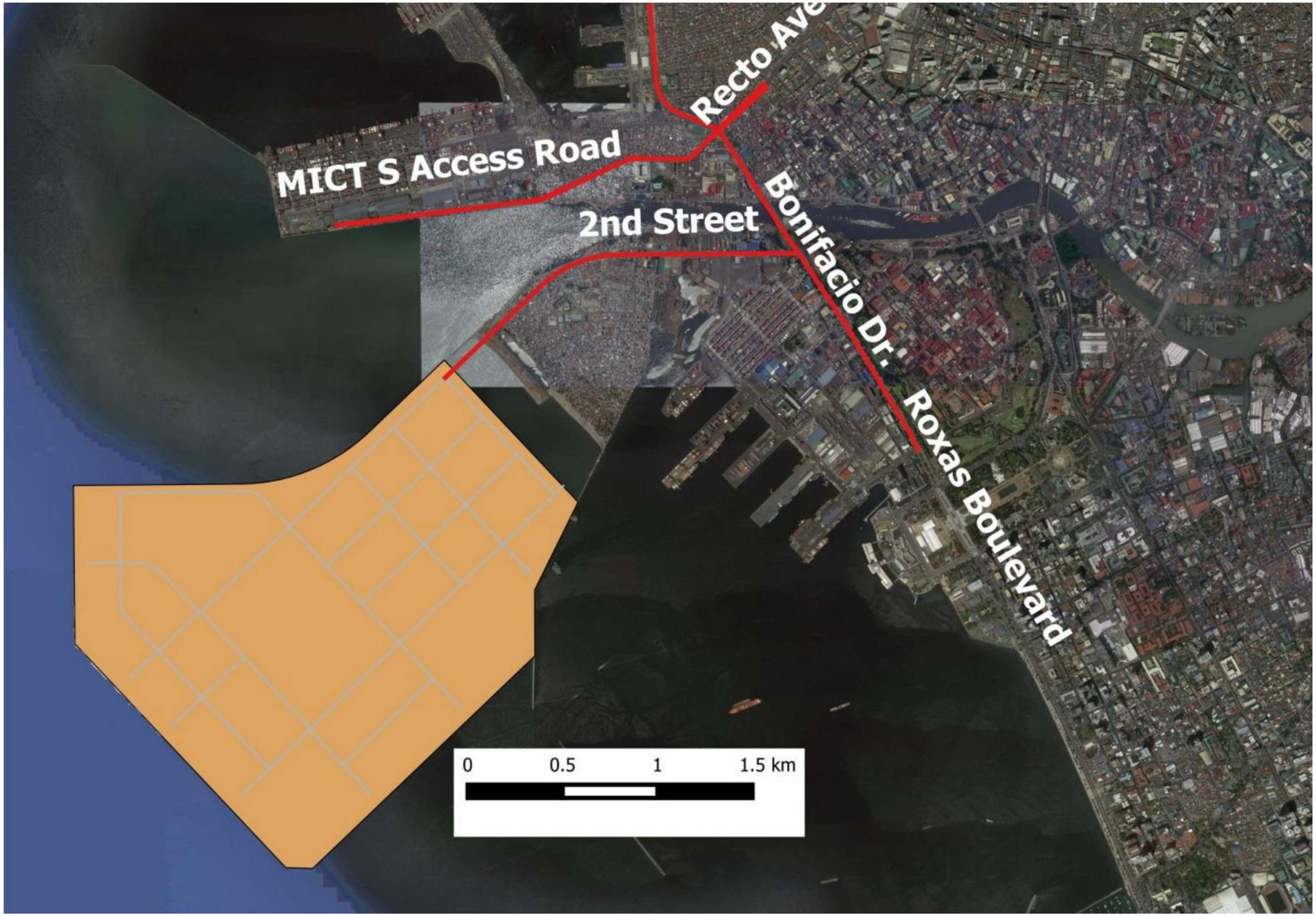


Figure ES-1. Existing roads around the Project Sit

ES 2. Process Documentation of the conduct of EIA

The process documentation of the conduct of the environmental impact assessment and the subsequent preparation of the Environmental Impact Statement (EIS) report were conducted in pursuant to Presidential Decree (PD) 1586 or the Philippine Environmental Impact Statement System, where projects declared as environmentally critical projects (ECPs), such as this project, are required to secure an Environmental Compliance Certificate (ECC) prior to commencement of construction.

The City Government of Manila has commissioned RHR Consult Services, Inc. to conduct an Environmental Impact Assessment and prepare an EIS report for the proposed New Manila Reclamation Project. This EIS evaluates the existing environmental and socio-economic conditions of the proposed project site as well as assess the potential impacts of the project.

This EIS will guide the proponent to implement environmental management strategies for all the stressors that will be generated in the operation of New Manila Reclamation Project. These strategies would determine the kind of development that will be allowed within the project site.

This study follows essentially the revised procedural guidelines of MC 2014-005.

The New Manila Reclamation Project EIS contains the following:

- Project Description;
- Analysis of Key Environmental Impacts;
- Impacts Management Plan;
- Social Development Plan and IEC Implementation;
- Environmental Compliance Monitoring;
- Emergency Response Policy and Generic Guidelines;
- Environmental Risk Assessment;
- Abandonment/Decommissioning/ Rehabilitation Policies and Generic Guidelines; and
- Institutional Plan for EMP Implementation.

In terms of process, a participative process was adopted thru public consultation and IEC. Implicit in the approach was allowing the proponent and the various project stakeholders to provide their inputs and ideas from which the Impact Management Plan (IMP) was crafted so that appropriate measures can be developed to ensure greater acceptance, commitment and support for the project.

ES 2.1 Limitations of the Study

The scoping process essentially determined the coverage of the study. Sensitive issues as well as other applicable parameters were included in the scoping activity.

The study was limited to the primary and secondary data gathered on-site, other related literatures and fieldwork conducted. The provision of precise data determines the effectiveness of the report in supplying all the appropriate conclusion and recommendations. The study team put forth its thoroughness in completing the entire EIS. Details on the scoping checklist were carefully considered to generate a reliable and accurate report.

ES 2.2 Project Team

The members of the team who professionally conducted the Environmental Impact Assessment (EIA) are depicted on **Table ES-1**.

Table ES-1.EIA Study Team

Name	Field of Expertise	Registration Number
For. Ryan Filiberto Botengan	Project Management	IPCO-108
For. Jose Paulo Devanadera	Project Management	IPCO-052
Mr. Jess Addawe	EIA Process, GIS Mapping, Water Quality	IPCO-056
Mr. Arnel Mendoza	Geology and Geomorphology	
Engr. IsabeloAbellon	Hydrology	
Engr. Ronald Pahunang	Hydrodynamic Modelling, Air and Noise	IPCO-173
Mr. Benjamin Francisco	Marine Ecology	IPCO-038
Mr. Henry James Botengan	Socio-economic/People Module	IPCO-063
Engr. Louie June D. Sioson	EIS Integration	IPCO-095

The Accountability Statement of the Preparers is provided in **Annex B**.

ES 2.3 EIA Study Schedule

The schedule of activities performed as part of the preparation of the EIS is detailed in the table below:

Table ES-2.EIA Study Schedule

Activity	Date
Pre-Public Scoping Activities	May 9-11, 2018
Public scoping	July 2, 2018
Submission of Project Description for Scoping (PDS) to EMB	July 6, 2018
Technical scoping	July 16, 2018
Conduct of field sampling and surveys	May-August, 2018
Conduct of perception survey, key informant interviews and focus group discussions	May-August, 2018
Public consultation	-

ES 2.4 EIA Study Area

The EIA study was undertaken within the vicinity of the proposed project footprint and its potential impact areas, particularly in Barangay 649, Manila City. The coverage of the EIA study is based on the agreed scope of the EIA Review Committee (EIARC) during the technical scoping activity conducted on 16 July 2016.

The primary and secondary impact zones of the project are delineated and discussed in **Section 1.1.3**.

ES 2.5 EIA Methodology

The approach and methodology adopted to complete this EIS is in accordance with the prescribed methods of EMB and the procedural manual for DAO 2003-30. **Table ES-3** provides the methodology used for each module.

Table ES-3.EIA Study Methodology

Module	Methodology	Data sources and references
Land		
Land use and classification	• Review of secondary data • Spatial analysis of reference maps	• Comprehensive Land Use Plan of Manila City (2005-2020) • NAMRIA
Geology and geomorphology	• Review of secondary data • Spatial analysis of reference maps through GIS • Analysis of historic occurrences of geologic hazards	• MGB • PHIVOLCS • NAMRIA
Pedology	• Review of secondary data • Soil sampling and analysis (July 1, 2018)	• Primary data gathering • NAMRIA
Water		
Hydrology	• Review of secondary data • Collection of rainfall data and geo-hazard maps and historical annual peak flow data of gaged river/s near the proposed project • Delineation of watersheds of rivers draining the project site using GIS software as a requisite in the flood frequency analysis and other hydrological analysis. • Conduct of Point flood frequency analysis to determine flood peaks with different return periods (5, 10, 25, 50, 100 and 200- year) of Pasig River draining to the proposed project.	• PAGASA • MGB • NAMRIA
Oceanography	• Review of secondary data • Measurements of current patterns using drogue and bathymetric sounding at the project area and vicinities using a Garmin Echosounder on June 29, 2018 • Hydrodynamic modelling was conducted using the EFDC-Explorer Version 8.3 Hydrodynamic Model.	• Primary data gathering • NAMRIA
Water quality	• Characterization of water quality by water sample collection and analysis (June 28, 2018)	• Primary data gathering

Module	Methodology	Data sources and references
Freshwater Ecology	• River Parameters (3 sampling stations; 23 July 2018): ○ Use of HONDEX Portable Handheld Depth Sounder (Ps-7 A423 067); ○ Salinity with a standard Atago refractometer, and width with the use of GPS tracking; ○ Substrate composition collected through scuba diving; ○ Turbidity measured with a standard sechhi disc attached to a fiberglass meter tape. • Plankton (3 sampling stations; 23 July 2018): ○ Phytoplankton - filtered through a 20 µm mesh sieve and fixed using Lugol's solution; samples sent to a laboratory for counting and identification ○ Zooplankton samples were filtered through a 33 µm mesh sieve and fixed with 10% buffered formalin; samples sent to a laboratory for counting and identification • Macrobenthos/ macro-invertebrates (3 sampling stations; 23-24 July 2018) ○ Use of standard kick net ○ Opportunistic survey of macro-invertebrates of significant importance for food or trade undertaken randomly to reinforce data on aquatic animal diversity specifically for bivalves, crustaceans and gastropods in the river. • Fish Biota (3 sampling stations; 23-24 July 2018) ○ Conduct of test fishing in the river employing a cast net and hook and line ○ Fish, crustacean species, and macro-invertebrates of significant value as food were identified *in-situ* through opportunistic observations in the macrobenthos stations.	• Primary data gathering
Marine ecology	• Validation of presence or absence of benthic life forms (23-25 July 2018) ○ Broad area manta tows with tuck dives aided by underwater torch (25 contiguous tows) ○ Spot Dives (6 validation dives) • Fisheries and fishing practices (July 23-25, 2018) ○ Catch rate and catch composition through observation of actual catch landing of two fishers using bottom set gill net and an actual fishing operation using simple handlines • Plankton (3 sampling stations; 24 July 2018) ○ Plankton samples were collected using a-20 µm plankton net with a mouth diameter of 0.3m • Macrobenthos (3 sampling stations, July 24, 2018) ○ Grab sampling and identification of animals was undertaken through coarse sorting *in-situ* • Mangroves (2 mangrove refo areas; July 24, 2018) ○ The mangrove areas were too small to require detailed assessment. Both sites are nearly 1 km away from the boundary of the proposed reclamation site.	• Primary data gathering
Air		
Climate and	• Climate at the proposed Project site was described using the Climate Map of the Philippines while the	• PAGASA (Port Area Station data)

Module	Methodology	Data sources and references
meteorology	meteorological condition at the Project site was described using the meteorological data from Port Area (MCO)	
GHG Emission	• The CO_2 were calculated using emission factor-based estimation method	
Air quality and noise	• Measurement of 1-hour ambient concentrations of Total Suspended Particulates (TSP), Particulate Matter less than 10 µm (PM_{10}), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2) at five (5) pre-established sampling stations on August 2, 2018 • Noise level monitoring measure the noise levels during daytime at five (5) sampling stations established for ambient air quality monitoring (August 2, 2018) • Noise modeling using CUSTIC v3.2.	• Primary data gathering
People		
Socio-economic conditions and perception of stakeholders	• Review of secondary data • Perception survey • Characterization of socio-economic condition • Focus Group Discussion	• Primary data gathering • Comprehensive Land Use Plan of Manila City (2005-2020) • Other related references

ES 2.6 Public Participation

Stakeholder participation for the project was ensured to determine the current situation of the affected residents, including the issues and concerns they are experiencing in their community.

Table ES-4. Public Participation Activities Conducted

Activity	Date	Venue	Participants
Initial Focus Group Discussion*	May 9-11, 2018	City of Manila: Barangays 286 and 649	Informal Settlers Sector: 23
Information and Education Campaign*	May 9-11, June 1, 4, & 6, 2018	City of Manila: Brgy 20 Brgy 275 Brgy 286 Brgy 653 Brgy 649 Government Agencies Business Establishments Religious Institutions Educational Institutions	1. Barangay 20, 275, 286, 653, 649 LGUs; 2. Intramuros Administration 3. National Parks Development Committee (NPDC) – Luneta Admin 4. Philippine Coast Guard HQ 5. Philippine Coast Guard NCR 6. Philippine Coast Guard Marine Environmental Protection Unit 7. Pasig River Rehabilitation Commission – Baseco Field Office 8. SamahangMagkakapitbahayng

Activity	Date	Venue	Participants
			Valderama– Brgy 286 9. Manila Ocean Park 10. Hotel H20 11. Pres. Corazon C. Aquino High School 12. Herminigildo J. Atienza Elementary School
Initial Perception Survey*	May 10-11, 2018	City of Manila: Barangay 286 Barangay 653 Barangay 649	Barangay 286 – 33pax Barangay 653 - 12pax Barangay 649 - 55pax
Public Scoping	July 2, 2018	Tamayo Restaurant, General Luna cor. Anda St., Intramuros, Manila	80 participants 27 stakeholder groups / sectors
Perception Survey	--	Barangay 649, namely: 1. Seawall, 2. Block 1 Aplaya, 3. Block 1 Gasangan, 4. Block 1 Dubai, 5. Block 15, 6. Gawad Kalinga Site, 7. Habitat/Site.	119 Total Number of Persons (Pax)

** Requirements Prior to the Public Scoping in compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System.*

The issues and concerns based on the results of the perception survey and public scoping are summarized in **Table ES-5**.

Table ES-5.Issues and concerns raised during Public Scoping and Perception Survey

Aspect	Issues and Concerns
Project Description	1. Timeline of ECC application 2. Impact on power supply 3. Source of filling materials
Land	1. Impact on earthquake hazard 2. Future land classification of the project 3. Manila Mandamus to be part of EIA study

Aspect	Issues and Concerns
Water	1. Impact on flooding 2. Impact of waste disposal on Manila Bay (aquatic life) 3. Impact on drainage thereby causing flooding in Las Piñas 4. Impact on upstream of affected rivers 5. Impact on navigable waters 6. Impact of hazardous equipment on water quality 7. Impact of project size on water displacement near Pasig River 8. Flow analysis of bay / study on impact of drainage to the community to be included in the EIA 9. Existing breakwater to be part of the project 10. Systemic problems from the proposed project and other reclamation projects in Manila Bay 11. Water pollution
People	1. Impact of access road to the residents 2. Consideration on international ports 3. Involvement of necessary stakeholders during public participation 4. Impact on traffic 5. Impact of waste disposal on the community 6. Impact of hazardous equipment on historic and aesthetic value of the area 7. Generation of jobs 8. Displacement of barangay residents/demolition of properties 9. Threat of hazards in the community 10. Improvement of the Baseco Community 11. Cleared and open Manila bay to preserve historical value of the area 12. Social preparation for the community; 13. Include in the development of the community 14. Fishing grounds affected by the equipment, ex. Compactor 15. Aid for the fisherfolk 16. Plan for aplaya residents 17. Change in lifestyle of affected residents 18. Increase in crime 19. Livelihood opportunities

ES 3. EIA Summary

ES 3.1 Summary of Baseline Characterization

The summary of baseline characterization and its corresponding environmental impacts and mitigation plan is presented below. Chapter 2 of this EIS provides a more detailed discussion of the baseline conditions, environmental impacts and mitigation measures.

Table ES-6. Summary of Baseline Characterization

Module	Summary of Baseline Condition / Key Findings
Land Use	No CARP or CADC/CADT areas were identified within or near the area of the project. The proposed project site is also situated at Manila Bay and may be vulnerable or susceptible to natural hazards.
Geology/Geomorphology	• The subsoil is generally weak (very soft to soft) with thick sequence of Quaternary alluvium made up principally of unconsolidated strata of plastic silty clay and clay. Very stiff to hard clay layers are generally deeper. • The project area may experience ground shaking of Intensity VI as felt during the July 1990 Luzon Earthquake. • The seismic hazards to which the project will be exposed to are ground shaking, liquefaction and surface rupturing. • In terms of ground shaking, five major earthquake generators, namely, the West Valley Fault, the Philippine Fault Zone, the Lubang Fault, the Casiguran Fault and Manila Trench have been identified as the most likely sources of future earthquakes that could affect the project. Of these sources, the WVF and the PFZ are most likely to generate the strongest levels of ground shaking. The worst-case scenario is a large magnitude event on the West Valley Fault. • Three zones of average, below and above average levels of ground shaking have been identified in Metro Manila. Areas within the above average are those underlain by thick piles of water-saturated sediments. These include the reclaimed areas in Manila, Navotas, Malabon, eastern Pateros, the valley side of Marikina and eastern section of Pasig. • Identified liquefaction-prone areas in Metro Manila are essentially within the zone of average to above average zone of ground shaking. Several areas in Manila (particularly those close to the Pasig River), Navotas and Malabon have high potential to liquefaction. • In addition to ground-shaking related hazards, surface rupturing may also occur from West Valley Fault. The surface rupture is expected to essentially follow the pre-existing fault trace and restricted to a narrow zone. For a magnitude 7.5 earthquake, the empirical data suggest an associated 70 km long surface rupture and maximum displacement of 2 to 3 meters along the fault trace. Damages as a result of this hazard is expected to be substantial for structures directly straddling and located within few meters from the rupture zone. • Tsunamis may occur but are not expected to significantly impact the

Module	Summary of Baseline Condition / Key Findings
	project area. • The project area is 70 km away from Taal Volcano and 85 km from Mount Pinatubo and therefore not susceptible to major volcanic hazard even if violent eruption will happen. Based on the recorded hazards associated with the eruption of Taal Volcano, the project area being 70 km away from the said volcano could only experience ashfall. • Only a minor quantity of ash has affected Metro Manila based on the review of the extent of impacted areas from the largest eruptions of Mount Pinatubo. It is thus conceivable that should Mt. Pinatubo erupt with the same magnitude in the future, the same level of ashfall impact is expected to likely affect the project area. • Manila being situated in low grounds is very much prone to flooding. • As seen during Typhoon Pedring and other previously reported storm surges that affected Manila Bay, Manila Bay coastline is considered highly vulnerable to storm surges and coastal floods.
Terrestrial Ecology	Terrestrial ecology is deemed not significant or relevant to the project as there is no terrestrial flora or fauna on the site.
Hydrology	The proposed project site, the whole Pasig River-Laguna de Bay basin and surrounding areas belong to Type 1 climate under the Corona's modified climate type classification. This type of climate has two (2) pronounced seasons; generally dry from November to April and wet during the rest of the year. The most recent catastrophic flood occurred in Metro Manila when Typhoon "Ondoy" hit the country on September 26, 2009. The various flood peaks and return period at the Sto. Nino gaging station was transposed at the mouth of Pasig River using the basin factor approach to have an idea on the response of the catchment on the intense rainfall for a period of 8 hours caused by typhoon "Ondoy". The extent of inundation of the flood equivalent to about 5,320 cms (200 year flood) at the Sto. Nino gaging station as a result of typhoon "Ondoy". In the case of the areas near the project site, inundation occurred due to rise of the sea level and bankful capacity of Pasig River has already been reached by flood waters where drainage cannot anymore drain its waters to the river or to the sea. As a result, flooding on level areas occurred. In the case of the areas near the project where access roads are within the flood prone areas, flooding is not mainly caused by the overbanking of flood waters from Pasig River due to the drainage system that are not totally function properly since it cannot discharge its waters to the sea or to Pasig River
Oceanography	***Bathymetry***. The proposed project site has a maximum depth of about 6.0 m below mean lower low water (MLLW). ***Tidal Heights/Patterns***. Tidal patterns in Manila show are generally semi-diurnal or exhibiting two highs and two lows within the 24-hour period,

Module	Summary of Baseline Condition / Key Findings
	though there are instances that diurnal tides occur depending on the moon phase. The modelled tidal heights followed the same patterns with the predicted tidal heights, specifically the tidal periods. There are, however, slight differences on the tidal heights, though comparison plots show good correlation or agreement with the predicted tidal heights.The results suggest model stability for periods of during extended periods of simulations. ***Current Patterns***. Current patterns were generally parallel with the coastline and along contours or depths with same levels. Results of simulation (**without project scenario**) showed that during low tide and slack water, NE-SW current flows at coastal areas of Manila City while S-N current flows at coastal areas of Cavite. After low tide and during high tide period, parallel current flows from south to north-northeast at or immediate vicinity of the coastline. At areas fronting the river, there appears a dominant south-westerly current flow. The prevailing or dominant currents flow away from the mouth of the river due likely to increase of river inflows during the wet season. Simulations (**with project scenario**) for both low tide and slack water periods show dominant NE-SW currents or currents flowing parallel with the proposed Project NW and SE boundaries of the project area. SE-NW current flows parallel with the SW boundary of the proposed Project while NW-SE current flows parallel with the NE boundary of the project area. The NW-SE current flow at the NE boundary and the NE-SW current at the NW boundary of the proposed Project remained unchanged even after low tide and during high tide periods. This is likely due to the influenced of river inflow. Meanwhile, the current at the SE boundary of the Project flows from southwest to northeast after the low tide and during high tide periods. Generated current roses suggest that with the project, the prevailing current directions are generally parallel with the project boundaries, and that there is substantial reduction of other current flows perpendicular (or intersects) with the project boundaries.
Water Quality	The guidelines stipulated in DENR Administrative Order No. 2016-08 – Water Quality Guidelines and General Effluent Standards of 2016 were used in the assessment of the current status of surface water quality in the study area. Philippine fresh, coastal and marine waters are classified based on their beneficial use. Based on DENR Memorandum Circular No. 2010-08, Manila Bay is classified as Class SB.
Freshwater Ecology	*River Characteristics*. In all stations, substrate was comprised intense silt mixed with garbage, mostly plastic.

Module	Summary of Baseline Condition / Key Findings
	*Phytoplankton.*The overall impression from the results obtained in the sampling along the survey area is poor, with a low number of genera and cell densities; but should be taken into account - as reflected by the relatively low diversity values, as well as the inclusion of potentially harmful genera as recorded during the sampling period. *Zooplankton*. The zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance for some groups during the time of survey. There are however no rare or endangered genera or groups in the sampled zooplankton community, and all are cosmopolitan in distribution worldwide. *Macrobenthos and macro-invertebrates collected for food and trade*. A total 727 individuals belonging to six (6) families/classes was identified across all survey stations. However, there were no edible nor economically important macrobenthos fauna sampled in the three stations during the river survey. *Commercially important macro-invertebrates in the Pasig River*. Opportunistic survey for macro-invertebrates of commercial importance for food or trade was undertaken to supplement data on macrobenthos survey but no edible macro-invertebrates were encountered. *Fish Biota*. Three test fishing operations in the Pasig River yielded six species of brackishwater species dominated by the Tilapia.
Marine Ecology	*Benthic resources and substrate characterization*. Corals and seagrass communities, including macro-algae and similar habitats were completely absent in the 6.5 kilometers of benthic observation pathways, spot dives, sediment collection and systematic snorkeling across the proposed reclamation area. *Fish Communities and Species Richness*. In the absence of coral reefs, fish visual census was no longer undertaken as no significant stocks of demersal fish species were encountered in the manta tows and spot dives. However, observations of actual fishing catch landings indicate the presence of resilient target species of at least twelve species of fish. Anecdotal accounts of fishers interviewed during the survey claiming declining catch rates are supported by fish production statistics reported by the Bureau of Agricultural Statistics on municipal fisheries production of top species caught in Manila Bay. *Phytoplankton Diversity*. The overall impression from the results obtained in the phytoplankton sampling along the survey area is poor, with a low number of genera and cell densities; but should be taken into account - as reflected by the relatively low diversity values, as well as the inclusion of potentially harmful genera as recorded during the sampling period. *Zooplankton Diversity*. The zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance during the time of survey.

Module	Summary of Baseline Condition / Key Findings
	Macrobenthos Diversity. The macrobenthos recorded in this survey was represented by five major phyla i.e Annelida, Mollusca, Nematoda, Nemertea and Sipunculida. *Macro-invertebrates significant to livelihoods*. In the proposed reclamation area itself, no macroinvertebrates collected for food were encountered. Collection of oysters and mussels is being undertaken in the "North Breakwater" about 100 meters north of the project site and in the rocky rip-rap in the Gasangan breakwater where barges are docked. Gleaning for edible bivalves of the Asian green mussel (Mytillus),and various species of the zigzag venus (Manila Clam or *Halaan; Venerupisphilippinarum*) is being undertaken regularly and is about 500 meters away from the boundary of the proposed reclamation site. *Seagrass and Associated Macrobenthic Algae*. Manta tows and spot dives revealed absence of seagrass meadows in the muddy shelf in coastal waters inside the proposed reclamation site. *Mangroves*. Two (2) mangrove reforestation areas are located in the coastline of Barangay 649, or what is more popularly known as "Gasangan". The mangrove areas, littered with trash from nearby communities, were too small to require detailed assessment. Both sites are nearly 1 km away from the boundary of the proposed reclamation site.
Meteorology	The proposed Project site falls under Type 1 climate classification characterized by two (2) pronounced seasons, which are dry from November to April and wet during the rest of the year. August has the highest monthly average rainfall at 432.4 mm. High temperatures are expected in dry season in April and May. The highest monthly mean temperature recorded at PAGASA Port Area is 30.1 °C during the month of April. The prevailing wind at the Project site is from southwest and east directions, each comprise 15% of the events. The average annual wind speed is 2.9 meters per second. The proposed project site is located in a zone wherein about five (5) tropical cyclones pass over the area in 3 years.
Contribution in Terms of Greenhouse Gas Emissions	The construction of the Project is expected to contribute an approximately 0.14 % of the total CO_2 emission based on the 2000 GHG emission data of the Philippines, which is a small contribution to the total anthropogenic CO_2 load. Moreover, this will only be temporary since the construction project will only be 3.5 years.

Module	Summary of Baseline Condition / Key Findings
Ambient Air Quality	The results of sampling for ambient air quality showed that ambient concentration levels of TSP, PM_{10}, SO_2, and NO_2, except for the ambient concentration level of TSP measured at 1,274.6 µg/Nm^3 in Station AQ3 (Brgy. Hall, Brgy. 20, Tondo, Manila), were within the ambient standards of 300, 200, 340, and 260 µg/Nm^3, respectively.
Ambient Noise Quality	The result of ambient noise level monitoring showed that noise level in Station N1 was lower than the NPCC maximum allowable noise level of 75 dBA set for heavy industrial areas during daytime period. Similarly, the noise level at Station N2 was lower than the NPCC maximum allowable noise level of 70 dBA set for light industrial areas during daytime period. However, noise level at Station N3, an area classified as light industrial, exceeded the NPCC maximum allowable noise level by 12 dBA. The noted sources of noise in this station were the continuous passing of light and heavy vehicles at the nearby access road and the pedestrians passing nearby. The noise levels at Station N4 and Station N5 exceeded the NPCC maximum allowable noise level of 55 dBA and 50 dBA, respectively, during daytime period. Station was located in a residential area (Class A) while Station N5 was located in an area which requires quietness (Class AA). The noted sources of noise in these stations were the vehicles passing nearby. The predicted noise level from equipment was added to the background noise levels to determine the cumulative noise level at the two (2) closest receptors or noise stations (MICT Access Road, Brgy. 20, Tondo, Manila and Brgy. Hall, Brgy. 20, Tondo, Manila). The results showed a <5 dBA increase in the baseline noise levels. According to the impact categories by Wilson (1986), an increase of <5 dBA in the noise level data have none to minor effects.
Socio-Demographic/ Economic Conditions	Manila City has a total population of 1,652,171 persons as of 2010. As of 2013, the total population of Barangay 649 is 56,380. A total of 8,983 families in Barangay 649 reside in the shanties. Selling, salary, and contractual jobs (i.e laundry, garlic peeling) are some of the sources of livelihood of the respondents in Barangay 649 based on the Perception Survey.

ES 3.2 Environmental Management and Monitoring Plan

Chapter 6 of this EIS presents the environmental management and monitoring plan (EMP) for the proposed Project. Table ES-7 provides the Impact Management Plan, while Table ES-8 provides the proposed EMP, which includes the proposed mitigating measures, information on environmental parameters to be monitored (i.e. EQPL values), frequency and procedure of monitoring, and its estimated costs.

Based on the impact assessment, the potential adverse impacts during construction include ground subsidence or differential settling, inducement of higher flood levels, soil erosion, degradation of water quality and marine environment due to reclamation works, degradation of air quality due to dust and fugitive emissions from heavy equipment, increased noise, traffic congestion, loss of livelihood for fishermen, and occupation health and safety risks. During operations phase, potential impacts are related to degradation of water quality and marine environment due to domestic wastes, and traffic congestion.

Majority of these impacts can be addressed by the mitigating measures proposed in this study and would result to no residual impacts. For some impacts, such as those influenced by extreme weather events (i.e. flooding), there may potentially be residual impacts due to uncertainties in the changing conditions of the environment. However, the project ensures that such risks are as low as reasonably possible by incorporating results of the study (i.e. modeling and assessment) into the project design and construction methodology. In this case, safety warning systems and emergency response procedures would need to be in place to further reduce the magnitude of such risks.

Table ES-7. Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
I. Pre-construction Phase							
Geotechnical investigation	Land Water	*Contamination of soil, groundwater, and surface water.* (-) Drilling fluid may potentially leak into receiving environment if not managed properly	▫ Use appropriate drilling fluid ▫ Implement proper bunding to avoid spillage into receiving environment. ▫ Prepare emergency spill kits in case of potential leaks.	No residual effect	Proponent / Contractor	Php200,000.00	Part of the project cost
Increased movement of heavy equipment on site and delivery of materials	Air	*Generation of dust* (-) Increased particulate matter due to movement of vehicles (-) Health effects due to inhalation of dust by residents living in areas adjacent to project site	▫ Implement dust suppression techniques. ▫ Cover trucks with tarpaulin loaded with spoils/filling materials when in transit. ▫ Pre-wetting of road surface to minimise dust.	No residual effect	Proponent / Contractor	Php50,000.00 / quarter.	Part of the project cost
	People	*Threat to public safety* (-) Possible injury or fatality as a result of heavy equipment and delivery trucks movement in the project site	▫ Implement speed limits and safety devices /signs. ▫ Ensure competency of drivers to drive safely. ▫ Engage local communities and inform them of site activities through IECs, posting construction “off limits” and safety signage	No residual effect	Proponent / Contractor	Php50,000/year on safety signage and Php50,000.00 on trainings/seminars	Part of the project cost
		Traffic congestion (-) Rapid deterioration of existing national/ municipal/ barangay road condition as a result of heavy equipment movement	▫ Coordinate with DPWH and Municipal Engineering Department in road maintenance and necessary improvements to accommodate increased vehicle movement.	No residual effect. A traffic management plan will be implemented.	Proponent / Contractor		Part of the regular coordination of the Proponent with the LGU
Geotechnical investigation	People	Occupational Health and Safety	▫ Posting of safety warning and danger signs ▫ Provision and wearing of personal protective equipment at all times	No residual effect.	CRO, Envi Department	Php 1M-2M per year (may vary	OSH and Emergency

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)			depending on the SDP program)	response program
Geotechnical investigation	Socio-Economics	Employment opportunities and economic benefits	▫ Prioritize hiring of local workers ▫ Prompt payment of taxes ▫ Implementation of social development programs for host community ▫ Continuous skills training and development and capacity building program for the impact areas ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	No residual effect.	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	Local hiring report DOLE Report Social Dev't and Mgmt Plan Corporate Social Responsibility Program
Completion of requisite MOAs, endorsements, and clearances	People	Social Acceptance and Support for the project	▫ IEC on Project to inform, respective institutions, agencies, offices, bodies and organizations for providing their respective endorsements and/or clearances ▫ MOAs with respective bodies	No residual effect.	CRO, Envi Department	Php 50,000	No commencement of construction until full compliance and completion of required endorsements and clearances
II. Construction Phase (Reclamation Works)							
Site preparation, ground levelling, and drainage improvements	Land	*Change in geomorphology* (-) The Project site's elevation will be altered. The elevation change will result in subsequent change in the hydrology surrounding the Project site	▫ Implement flood control measures which such as construction of proper and adequate drainage systems.	No residual effect.	Proponent / Contractor	Php100,000.00/ year – maintenance of the drainage facility	Part of project cost
Site preparation, excavation, and filling	Land	*Inducement of subsidence or collapse* (-) Minor subsidence may occur within the project site when the subsurface is disturbed during excavation activities for preparation of foundation	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of subsidence or differential settling.	No residual effect. Land will be stabilized prior to vertical	Proponent / Contractor	Php10M – implementation of site preparation adhering to best engineering	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		(-) Minor settling may also occur as a result of additional loads from heavy machinery and structures		development. Instrumentation to confirm absence of subsidence prior to vertical development.		practices.	
Site preparation, ground levelling and drainage improvements	Land People	*Inducement of higher flood levels* (-) Occurrence, frequency and magnitude of flooding may be affected due to the change in drainage morphology and changes in ground elevation in the project site (-) Flooding may cause damage to property, assets, and may pose threat to public safety	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of subsidence or differential settling. ▫ Probable modification of drainage systems shall maintain natural outlets or consider similar transport regimes/streamflow as the pre-existing natural drainage ▫ Maximize the capacity of two exit river channels on both sides of the reclamation area through regular desilting and clearing operations	Nil to minimal residual impact as project design considers potential effects of climate change.	Proponent / Contractor	Php10M – implementation of site preparation adhering to best engineering practices and maintenance	Part of project cost
Site preparation, excavation, and filling	Land	*Soil erosion from onsite activities* (-) Improper storage of construction materials and indiscriminate disposal of fill materials and excavated soils may affect erosion patterns.	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of subsidence or differential settling. ▫ Progressive ground preparation and clearing to minimize total area of land that will be disturbed at any one time, where practical.	No residual effect	Proponent / Contractor	Php100,000.00/ year –ground stabilization and maintenance	Part of project cost
		Contamination of soil / disposal site (-) Excavated soil materials may contain contaminants that may potentially affect soil and ground and surface water quality	▫ Implement best engineering practices such as proper stockpiling and handling of excavated materials. ▫ Implement proper filling and disposal to avoid contamination of soil, groundwater, and surface	No residual effect	Proponent / Contractor	Php 2,000,000.00 – Provision of proper waste disposal.	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			water				
Reclamation works	River water quality Marine water quality	(-) Degradation of water quality due to siltation brought about by reclamation activities	▫ Maintain water quality levels prescribed in DAO 2016-08, particularly TSS at 80 g/l. ▫ Sand bunds or other types of bund walls or silt curtains or other appropriate mitigation measures should be provided to prevent dispersion of silt or sediments away from the project site during reclamation works. ▫ Implement best environmental management practices such as, but shall not be limited to, removal of debris along the waterways, proper disposal of construction wastes, installation of silt traps at strategic locations, and spoils to be properly contoured to prevent erosion ▫ Regular dredging works should be conducted adjacent the proposed project site, specifically in vicinities of the mouth of Pasig River where sediment deposition from these highly-silted river inflows would constrict waterways and current flows. ▫ Dredging works shall regularly be conducted adjacent and at immediate vicinities along the eastern part of project boundaries wherein accretion of sediments is likely due to the presence of the reclaimed project site.	Nil to minimal effect considering that the project will be designed and implemented with modelling results factored in the reclamation and construction methodology	Proponent / Contractor	Php10M – implementation of site preparation adhering to best engineering practices and maintenance	Part of project cost.
		(-) Enhanced turbidity (temporary)	▫ The use of steel sheet piles reinforced with silt curtains will effectively reduce sediment stream reaching the river estuary				
Generation of wastes		(-) Degradation of water quality due to runoff from sanitary sewage, waste water, solid wastes, and other construction	▫ Removal of debris along the waterways will be conducted, all construction wastes will be properly disposed, silt traps at strategic locations	No residual effect	Proponent / Contractor	Php50,000 / Year – provision for proper solid	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		materials that can harm aquatic flora/fauna	and spoils will be properly contoured to prevent erosion. ▫ Construction of sediment/ settling ponds and related structures to mitigate siltation or sedimentation of water body ▫ Portalets will be provided for use of the workers and its corresponding wastewater will be properly disposed. ▫ Implementation of Solid waste management program and Hazardous waste management program. ▫ Use of DENR accredited haulers/TSD companies.			waste disposal	
Oil and lubricants	River water quality	(-) River water contamination	▫ Implement oil and grease recovery plan for all marine vessels operating in the reclamation area; ▫ Implement prohibition on releasing ship bilge into the bay.	No residual effect			
Reclamation, soil filling and compacting	Coastal water quality; Benthic communities of marine organisms; Fish resources	(-) Increase in siltation/sedimentation loading in coastal waters; increase in turbidity and suspended solids; (-) Reduction in photosynthesis and primary productivity (-) Suffocation of bivalve veliger in soft bottom benthos; (-) Disruption of fish feeding and benthos larval growth; (-) Impairment in fish and shellfish	▫ Use of steel sheet piles and sloping revetment technologies during reclamation; ▫ Provision of silt curtains where sediment streams are likely to occur and escape. ▫ Collection and trans-location of macro-invertebrates found within the reclamation area, if any; ▫ Monitoring of sediment fluxes and application of more stringent control measures when necessary; or temporary cessation of activities. ▫ Sediment canals in reclaimed areas will be installed to divert sludge into filters and weirs that capture sediments and fugitive reclamation filling materials at source.	Nil to minimal effect considering that the project will be designed and implemented with modelling results factored in the reclamation and	Proponent / Contractor		Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		reproductive process.		construction methodology			
Reclamation, soil filling and compacting	Wastewaters emanating due to influx of reclamation workers can add to marine pollution and negatively affect benthic communities of macro-invertebrates; plankton community fish	(-) Inadvertent spill of domestic wastewaters can cause coastal water pollution, loss of macro-invertebrate population, impairment in fish and shellfish reproductive physiology.	▫ Install liquid waste management system ensuring modern waste retrieval and treatment system. Treatment and disposal of liquid waste at point source will involve collecting liquids of point source origin; directing waste into integrated multiple waste streams facilities or collecting vessels, and application of treatments. Any fluid effluent to be discharged at sea will be monitored and tested before discharging. ▫ Installation of modern latrines and waste receptacles; collection facilities; ▫ Adoption of clean practices by all project operating units and personnel; ▫ Efficient waste retrieval system; ▫ Greening of reclamation area	No residual effect	Proponent / Contractor		Part of project cost
Reclamation, soil filling and compacting	Coastal waters	Oil and grease contamination	▫ Adoption of an oil and grease recovery and treatment system; ▫ Implementation of rigid policies against indiscriminate disposal of oily waste and marine vessel bilge water.	No residual effect	Proponent / Contractor		Part of project cost
Reclamation, soil filling and compacting	Fisheries and mariculture livelihoods	(-) Dislocation of gill net and hook and line fishers	▫ Provision of alternative livelihoods to affected fishers.	Irreversible impact. Alternative livelihood options to be provided.	Proponent / Contractor		Part of project cost
Delivery of construction materials and equipment, construction works	Air People	*Contribution in Terms of Greenhouse Gas Emissions*	▫ Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR	No residual effect	Proponent / Contractor		

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		(-) The sources of carbon dioxide emission in the project are the fuels used in the operation of heavy machinery and equipment such as dredgers, pile drivers and the barges during its construction.	standards on vehicular emissions; and ▫ Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible.				
	Air People	*Generation of air pollutants* (-) Generation of air pollutants such particulate matter, nitrogen dioxide and carbon monoxide due to heavy equipment used for filling of the reclamation site, soil improvement and civil works. (-) Vehicles extensively used at construction site will also generate air pollutants, primarily nitrogen dioxide.	▫ The use of electrically-powered equipment will be maximized to reduce the volume of the air pollutant that will be generated ▫ Regular preventive maintenance of heavy equipment, machineries and service vehicles shall be undertaken to keep these equipment, machineries and service vehicles in good working condition for lower emission rate of air pollutants.	No residual effect	Proponent / Contractor	Php2,000,000 / year –cost of maintenance of heavy equipment	Part of the construction cost
	Air People	*Generation of dust (temporary)* (-) Air pollution from fugitive dust resulting from ground clearing operations, site preparation, structure erection, and vehicle movement. (-) Health effects due to inhalation of dust by residents living in areas adjacent to project site	▫ Frequent water spraying at dry and unpaved reclaimed sites near ASRs, especially during dry periods where fugitive dusts are potentially dispersed by winds; ▫ Reduction of wind speeds by installing temporary wind barriers at the area, if necessary. These wind barriers could be strategically located at areas close to the ASRs; ▫ Provide wheel washing facilities for vehicles leaving the project site. This wheel washing facility is intended to remove muds from the tires of the heavy equipment and other vehicles, which are potential sources of dust if detached from vehicles traveling outside the project site (e.g., paved or unpaved roads); ▫ Impose speed limits within the project site and	No residual effect	Proponent / Contractor	Php50,000/ year –operational expenses	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			along access roads. Reduction of vehicular speed will significantly reduce generation of fugitive emissions; ▫ If possible, re-route vehicles at considerable distances from the ASRs. This measure (re-routing) is effective means of decreasing release of fugitive emissions to nearby ASRs, especially during very dry conditions where wetting of dry surfaces would be effective for short duration; and ▫ Conduct regular visual inspection at the project site (including monthly sampling of TSP, PM10, SO2, and NO2) to determine areas with high fugitive emissions, and to implement mitigation measures as necessary.				
Construction works	Air (noise)	(-) Generation of noise from construction activities	▫ All machinery will be maintained in accordance with the original manufacturer's specifications and manuals to avoid excessive noise, vibration and vehicle exhaust pollution. Regular maintenance of equipment and engines as per manufacturers requirements will be carried out ▫ Conduct reclamation works during night time at the project area relatively far from the Barangay Baseco. ▫ Reduce the number of equipment to be operated at night time and inform the residents and barangay officials prior to the conduct of reclamation works, especially if equipment need to be operated near residential areas. ▫ Monitor noise levels especially at night time periods (10:00 P.M. to 5:00 P.M) at residences closest reclamation works	Possible temporary and short-term residual impacts. Needs to be monitored.	Proponent / Contractor	Php100,000.00	Part of project cost
Site preparation activities	People	*Community protests or complaints*	▫ Conduct of IECs to host and neighboring	No residual	Proponent	Php150,000.00 /	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		(-) Potential adverse community response resulting from access restrictions in working areas.	communities. ▫ Properly implement programs stipulated in the SDP	effects		year	
Increased manpower requirements	People	*Opportunities for local employment* (+) Employment opportunities and benefits of employees and its multiplier effect or potential livelihood/business opportunities (-) Bringing in of outside workers may antagonise local communities	▫ Implement priority local hiring policy for qualified local workers. ▫ Provide skills training for local residents ▫ Coordinate with barangay or/and municipal LGU as to relevant ordinance on providing opportunities for local employment.	Positive effects in terms of livelihood and employment	Proponent / Contractor	Php20,000 / year	Employment generated together with the origins of workers will be validated by the MMT.
Increased manpower requirements	People	*In-migration* (+) Workers will be required during construction (-) In-migrants may compete with locals for employment, project benefits, natural resources (i.e. water competition), local health, welfare services and infrastructure In-migration may also lead to proliferation of informal settlers in the project impact barangay	▫ Livelihood opportunities will be provided to local communities especially to host barangay ▫ Provide skills training for local residents ▫ Conduct consultation with barangay LGUs on requirements and process of hiring to maximize employment of local residents. ▫ Coordination meetings shall be undertaken regularly with the LGUs to identify threats and vulnerabilities in the society as well as to develop programs to prevent foreseen social problems. ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	No residual effect	Proponent / Contractor	Php1M / year – SDP budget will be utilized for the implementation of activities such as, livelihood programs, education assistance, medical assistance, IEC, among others.	Part of project cost
Increased manpower requirements	People	*Cultural and lifestyle change* (-) Potential social tensions due to income and wealth disparity between those who will be benefited economically from the project and those who will not be benefited.	▫ The proponent will implement a code of conduct for employees, contractors, and subcontractors to prevent potential impacts on lifestyle and behaviour. ▫ IEC activities, open dialogue and communication with the stakeholders will be undertaken	No residual effect	Proponent / Contractor	Php1M / year – SDP budget that will be utilized for the implementation of activities such	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		(-) Workers and other in-migrants may introduce different lifestyles and patterns of behaviour leading to social tensions.	regularly by the proponent to address concerns of the people on the proposed project and promote transparency			as, cultural activities, IEC, among others	
		Threat to delivery of basic services and resource competition (-) Unplanned population increase due to in-migration or increase in informal settlers/structures puts pressure on basic services (education, health and social welfare) and utilities (water, electricity and waste management).	▫ Develop and implement SDP, which shall involve improvement of basic services such as health and welfare, livelihood, infrastructure, education, among others	No residual effect	Proponent / Contractor	Php1M / year – SDP budget that will be utilized for the implementation of activities such as, cultural activities, IEC, among others	Part of project cost
Increased movement of heavy equipment on site and delivery of materials, Increased manpower requirements	People	*Traffic congestion* (-) Possible increase in traffic given the number of workers to be employed and delivery of some construction materials.	▫ Implement speed limits, vehicle load limits, vehicle maintenance requirements, and limiting driving hours. ▫ Signs for ongoing construction activities (i.e. speed limit, safety signage) shall be installed at strategic places to notify and warn the general public as necessary.	No residual effect – A traffic management plan will be implemented	Proponent / Contractor	Php100,000/ year – Safety and health program will cover this activities.	Part of project cost
Dredging and reclamation works	Hazards and disaster risks	*(-) Impacts of storm surges, flooding, and other disaster risks*	▫ Residents and workers to evacuate the area in the event of incoming typhoon. Provision of early warning systems and effective dissemination procedures could effectively avoid casualties in the event of extreme weather events. ▫ Reclamation site should be designed considering the projected sea level rise in Manila Bay, including the heights of the highest astronomical tide and wave effects during southwest monsoon (not storm surges).	Potential residual impact considering extreme weather events. Early warning systems need to be in place and	Proponent / Contractor	Php 1M-2M per year (may vary depending on the SDP program)	OSH and Emergency response program

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Residual Impacts	Responsible Entity	Cost	Guarantee/ Financial Arrangement
				maintained.			
	People	(-)*Occupational Health and Safety*	▫ Posting of safety warning and danger signs ▫ Provision and wearing of personal protective equipment at all times ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	No residual effect.	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	OSH and Emergency response program
	Socio-Economics	*Loss of livelihood* (-) Loss of livelihood and income source for fisher folks previously mooring in the coastal area within the vicinity	▫ Just Compensation and relocation package ▫ Provision and development of alternative livelihood	Irreversible impact. Compensation or development of alternative livelihood to be provided.	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	▫ Plan for Compensation ▫ Livelihood programs ▫ Fund for compensation
IV. Decommissioning Phase							
Clearing and removal of structures	Land Water People	*Ground and water contamination* (-) Clearing and removal of structures and facilities that may result to improper disposal of contaminated materials or release of toxic and hazardous wastes / compounds	▫ Proper implementation of the approved Abandonment/ Decommissioning Plan that details the decommissioning, rehabilitation, and social activities which shall include the methodology, timing, and techniques. ▫ Use of DENR accredited haulers/TSD companies for wastes classified under RA No. 6969.	No residual effect.	Proponent / Contractor	Php2M – for the handling, transport, and disposal of all hazardous waste and chemicals.	Part of project cost
	People	Loss of employment / livelihood	▫ Abandonment for SDP (see Chapter 5 in Section 5.1) ▫ Abandonment for IEC (see Chapter 5 in Section 5.2)	Irreversible impact. Alternative source of livelihood to be included in SDP.		Part of SDP / IEC Cost	Contractor's contract/ Abandonment Plan

Table ES-8. Self-Monitoring Plan

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
			Methods	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
Land													
Geology and Geomorphology	Geohazards	Liquefaction and ground subsidence monitoring	Periodic monitoring of ground stability	5 years or immediately after a major geologic event has taken place	Project area	Engineering Department	No additional cost; in-house	Noticeable ground subsidence and surface creep	Continuous occurrence of ground subsidence and creep	Significant ground subsidence and surface creep; Formation of cracks in columns, beams, pavement; Misalignment of structures; Impoundment of water due to liquefaction	Increase in monitoring frequency and measurement of magnitude of movement for cracks and surface creep	Check impact of ground subsidence to integrity of infrastructures. Implement necessary engineering measures.	Temporary cessation of construction; Retrofitting of damaged structures; Implement necessary engineering measures. Consider abandonment or relocation if necessary
Water													
Water Quality	Ambient Water Quality (marine water)	▫ pH ▫ Temperature ▫ Total Dissolved Solids ▫ Conductivity ▫ Total Suspended Solids ▫ Biochemical Oxygen Demand (BOD); ▫ Chloride (Cl-); ▫ Color (Apparent); ▫ Dissolve Oxygen (DO); ▫ Fecal Coliform; ▫ Nitrate as Nitrogen (N03--N); ▫ Phosphate as	In-situ measurement and laboratory analyses	Monthly sampling, Quarterly Reporting through the SMR	Baseline water quality monitoring stations (may be adjusted accordingly)	PCO	Php 50,000 per sampling station	▫ pH below 6.8 and above 8.3 ▫ Temp: 2.6°C rise in the receiving water body ▫ DO: 7 mg/L ▫ TSS: 40 mg/L ▫ As:0.003 ▫ Cd: 0.001 ▫ Cr+6: 0.03 ▫ Cu:0.009 ▫ Pb:0.008 ▫ Hg:0.001	▫ pH below 6.9 and above 8.4 ▫ Temp: 2.8°C rise in the receiving water body ▫ DO: 7 mg/L ▫ TSS: 45 mg/L ▫ As:0.005 ▫ Cd: 0.002 ▫ Cr+6: 0.04 ▫ Cu: 0.01 ▫ Pb:0.009 ▫ Hg:0.001	▫ pH below 7.0 and above 8.5 ▫ Temp: 3°C rise in the receiving water body ▫ DO: 6 mg/L ▫ TSS: 50 mg/L ▫ As:0.01 ▫ Cd: 0.003 ▫ Cr+6: 0.05 ▫ Cu:0.02 ▫ Pb:0.01 ▫ Hg:0.001	▫ Re-conduct testing to verify ▫ Investigate the source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source.	▫ Re-conduct testing to verify ▫ Investigate the source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source. ▫ If source is not project construction, inform MMT regarding possible source for the	▫ Re-conduct testing to verify ▫ Temporarily stop construction works: investigate source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source. ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement: Methods	Sampling and Measurement: Frequency	Sampling and Measurement: Location	Lead Person / Office	Annual Estimated Cost	EQPL Range: Alert	EQPL Range: Action	EQPL Range: Limit	Management Measure: Alert	Management Measure: Action	Management Measure: Limit
		Phosphorous (P043--P); ▫ Ammonia as Nitrogen (NH3-N); ▫ Total Suspended Solids (TSS); ▫ Sulfate (S042-); ▫ Arsenic (As); ▫ Cadmium (Cd); ▫ Hexavalent Chromium (Cr6+); ▫ Lead (Pb); ▫ Mercury (Hg); ▫ Oil and Grease; ▫ Sulfactants (MBAS)										group's investigation and coordination with LGU	coordination with LGU
Air													
Air Quality	Ambient Air Quality	TSP SO2 NO2	TSP Hi-volume/ Gravimetric 1-hour averaging period SO2 and NO2 24-hr gas bubbler	Monthly sampling, Quarterly Reporting through the SMR	Baseline air quality monitoring stations (may be adjusted accordingly)	PCO	Php 50,000 per sampling station	TSP: 161 ug/ncm SO2: 126 ug/ncm NO2: 105 ug/ncm	TSP: 184 ug/ncm SO2: 144 ug/ncm NO2: 120 ug/ncm Complaint lodged by community	TSP: 230 ug/ncm SO2: 180 ug/ncm NO2: 150 ug/ncm Complaint lodged by community	▫ Check weather condition during sampling and if location is downwind of construction site ▫ Check possible source ▫ If source is project construction, inform contractor for their corrective action (i.e. dust suppression) ▫ If source is not project	▫ Check weather condition during sampling and if location is downwind of construction site ▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project	▫ Check weather condition during sampling and if location is downwind of construction site ▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project construction, immediately stop all works involving soil excavation and movement,

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											construction, inform MMT regarding possible source for the group's investigation and coordination with LGU	construction, inform contractor for their corrective action, and conduct retesting to confirm results of the mitigation measures ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU	increase the frequency of the contractor's dust mitigation, resume work only upon visual clearing of the sampling station, and conduct retesting at the said sampling station ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU
Noise	Ambient noise levels	Noise levels	24hr sound measurements using sound meter	Monthly sampling, Quarterly Reporting through the SMR	Baseline noise level monitoring stations (may be adjusted accordingly)	PCO	Php 10,000 per sampling station	71dB (daytime) 66dB (morning/ evening) 61dB (night time)	73dB (daytime) 68dB (morning/ evening) 63dB (night time)	75dB (daytime) 70dB (morning/ evening) 65dB (night time)	Identify possible noise source	▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project, do corrective action, and conduct retesting to confirm results	▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project, reduce use of noisy equipment, conduct retesting at the said sampling station and resume operation only upon clearance of the sampling

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
												of the mitigation measures ▫ If source is not project inform MMT regarding possible source for the group's investigation and coordination with LGU	station, ▫ If source is not project, inform MMT regarding possible source for the group's investigation and coordination with LGU
People													
People	Acceptability of the project to the community	Perception of the Community regarding the site development and construction process of the project	Coordination with the Community	Quarterly	Community	CRO / Envi Department	Part of the Cost for the IEC	Negative verbal feedbackon the ongoing activities	Formal complaint lodged against the ongoing activity	Multiple complaints by the community lodged in various forms or/and	▫ Investigate/ Inspect and Address the subject of negative feedback. ▫ Coordinate with the Brgy LGU and MMT.	▫ Determine and address the root cause. ▫ Conduct consultation with the Municipal LGU, MMT and EMB Regional	▫ Conduct consultation with concerned and relevant stakeholders in the community. ▫ Release an official statement for general consumption and employees.
	Workers	Health and safety of workers	Review of health and safety records of company Incident reports	Annual	Project site	Community Relations Officer / PCO	Part of the construction cost	Negative verbal feedback of worker	Formal complaint lodged by worker	Multiple complaints lodged by workers	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with Contractor and MMT.	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate with contractor and MMT.	▫ Release official statement for general consumption and employees. ▫ Coordinate with contractor and MMT.

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	Labor and Wage issues	Wage Rate, Benefits, and Schedule of Payment Other worker's rights related issues	HR Management	Monthly	Project Area/Office	CRO / Envi Department	Part of the construction cost	Negative Verbal Feedback	Complaints lodged by employees	Multiple complaints by the workers lodged in various forms and agencies, or/and captured by media	▫ Investigate/ inspect and Address the subject of negative feedback.	▫ Facilitate dialogue with concerned parties. ▫ Formulate program and timetable to address the issues raised in agreement with the concerned parties	▫ Dialogue with concerned parties and with 3rd party agency/ institution involvement, ie DOLE, BLR, churches that are neutral yet competent and conducive with conflict resolution. ▫ Formulate program and timetable to address the issues raised in agreement with the concerned parties
	Social Development and Management Plan	Projects initiated by the Proponent under the approved SDP	Community Coordination, social engagements	Quarterly	Host barangay	Community Relations Officer	Part of the SDP Cost	Negative verbal feedback of community	Formal complaint lodged by the community	Multiple complaints by the community	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with barangay LGU and MMT.	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate with barangay LGU and MMT.	▫ Conduct consultation with concerned members of the community. Release official statement. ▫ Coordinate with barangay LGU and MMT.
	Information, Education, and Communication	Implementation of IEC activities	Community Coordination, social engagements	Quarterly	Host barangay	Community Relations Officer	Part of the IEC Cost	Negative verbal feed back to the Proponent	Formal complaint lodged by the community	Multiple complaints by the community captured by local media organizations	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with barangay LGU and MMT.	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate with barangay LGU and MMT.	▫ Conduct consultation with concerned members of the community. ▫ Release official statement. ▫ Coordinate with barangay LGU and MMT.
	Unauthorized Prohibition (may either be	Security Prohibition Practices	Community Grievance / Complaints	Monthly	Project Area and	CRO / Envi Department	Part of the construction cost	Negative Verbal feedbacks on Security	Formal Complaint lodged	Incidence of confrontation between project	▫ Investigate/inspect and Address the	▫ Determine and address the root cause.	▫ Conduct consultation with concerned and

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	setting up of physical barriers or prohibition of security personnel) of Access to Public Areas		Registry		Adjacent Vicinity			prohibition		security personnel	subject of negative feedback. ▫ Coordinate with the Brgy LGU and MMT to validate feedback. ▫ Conduct IEC on Protocols, Rules, Regulations and other dynamics re-access and prohibition issues and security measures ▫ Investigate/ inspect and Address the subject of negative feedback.	▫ Coordinate with the Municipal LGU, MMT and EMB Regional Office to validate complaints and determine causes, and formulate corrective actions.	relevant stakeholders in the community. ▫ Release an official statement for general consumption and employees. ▫ Coordinate with MMT and EMB Central Office to discuss and implement corrective actions.
	Emission and Water Contamination Health Issues	Respiratory And Digestive System Ailments of Worker s and People in the Community	Health records	Quarterly	Project Area	CRO/ Envi Department	Minimal Cost	Reported/ recorded incidences of minor ailments/ illness	Formal Complaints lodged. Rapid Increase in reported/ recorded Incidences of minor ailments/ illnesses	Rapid Increase in Reported/ recorded incidences of grave ailments/ illnesses necessitating intensive treatments , or resulting in death	▫ Investigate the possible source of the subject of complaints attributed to the project. ▫ Address the root cause if investigation confirms source is from the project ▫ Provide for compensation if confirmed source of ailment is from	▫ Conduct intensive Project-wide inspection and address root cause if upon inspection the source is confirmed to be from the project. ▫ Provide for compensation of affected individuals if confirmed source of	▫ Decrease the level of operation/ aspects of operation commensurate to addressing the problem (fixing the equipment, materials, etc). ▫ Release Statement on the Issue. ▫ Assist/facilitate medical care/ response to those affected. ▫ Provide for compensation of

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											the project	ailment is from the project ▫ Provision of personal protective equipment (PPE) to at-risk personnel and individuals	affected individuals if confirmed source of ailment is from the project

ES 3.3 Environmental Monitoring Fund and Environmental Guarantee Fund

An Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF) for the Project will be established in accordance with the Revised Procedural Manual of DAO 2003-30.

An EMF amounting to Six Hundred Thousand Pesos (Php 600,000) will be established to support the compliance monitoring activities and the annual work and financial plan (AWFP) of the MMT. The AWFP will be proposed by the MMT and concurred by the project proponent for the approval of the EMB Regional Director.

As part of the EGF, a Trust Fund amounting to Five Million Pesos (Php 5,000,000) will be established to compensate aggrieved parties for any damages to life or property, undertake community-based environmental programs, conduct environmental research aimed at strengthening measures to prevent environmental damage, and to finance restoration and rehabilitation of environmental quality of the project-affected area. In addition, an Environmental Guarantee Cash Fund amounting to One Million Pesos (Php 1,000,000) will be reserved for immediate rehabilitation and compensation of affected communities in case of damage or accidents. This may also be utilized for community-based environmental programs and information campaign.

1 Project Description

1.1 Project Location and Area

The Project is situated in Metro Manila, the National Capital of the Philippines. The site is adjacent to Manila South Harbor Port with a total site area of approximately 407.42 ha.

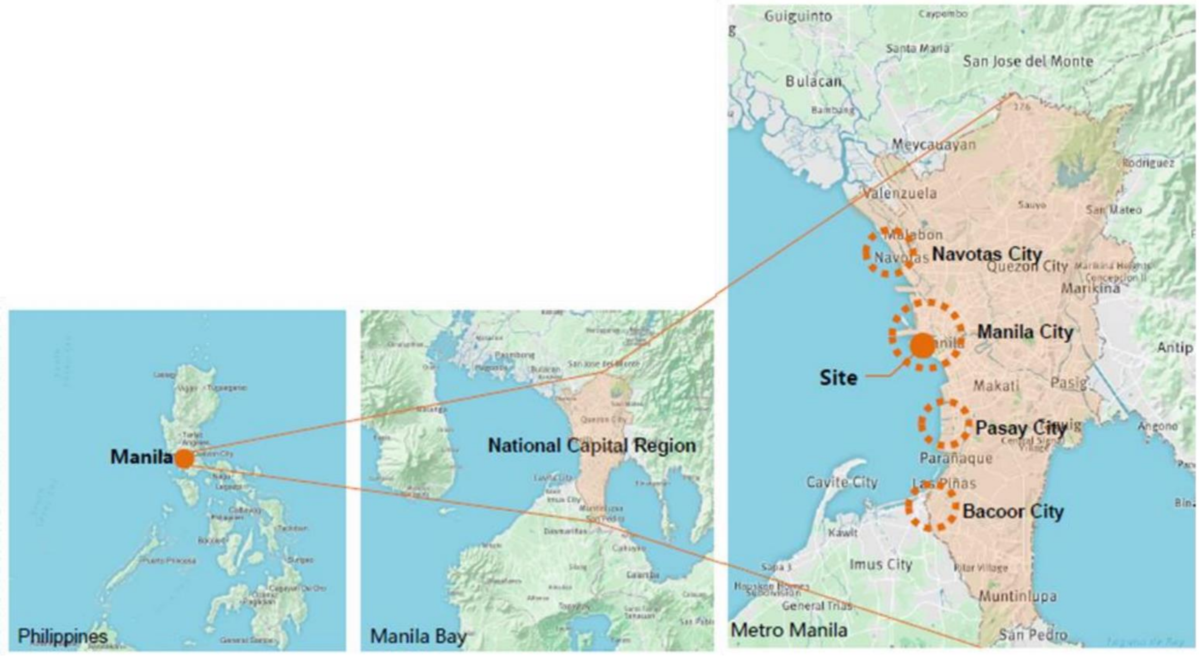


Figure 1-1. Project Location

The proposed project is bounded by the coordinates as presented in **Table 1-1.**

Table 1-1. Geographic Coordinates of the Project Area

Corner	Easting	Northing
1	277250.361	1612309.191
2	277471.930	1612062.423
3	277691.133	1611827.254
4	277910.336	1611592.086
5	278129.538	1611356.918
6	278348.741	1611121.749
7	278495.614	1611121.744
8	278740.998	1611350.562
9	278986.383	1611579.380
10	279231.768	1611808.198
11	279477.152	1612037.016
12	279671.170	1612217.935
13	279675.614	1612567.459
14	279789.258	1612790.938
15	279902.358	1613013.344
16	279663.650	1613278.259
17	279435.495	1613523.028

Corner	Easting	Northing
18	279207.341	1613767.797
19	278996.081	1613571.279
20	278784.820	1613374.760
21	278472.439	1613190.316
22	278129.582	1613129.681
23	277835.720	1613129.681
24	277541.857	1613129.681
25	277247.995	1613129.681
26	277247.995	1612856.105
27	277247.995	1612582.529

1.1.1 Site Accessibility

The Project site is currently accessible using the 2nd Street which is a partially paved 1-lane road. The 2nd Street is connected to Bonifacio Drive which in turn leads to Roxas Boulevard, which is a dual-3 major arterial road in Metro Manila. Both roads form part of the R1 radial road which convey traffic in and out of the city centre to Cavite in the south and other provinces.

To the north, 2nd Street is connected to the M. Roxas Jr. Bridge and subsequently to radial road R10. R10 road conveys traffic from the city center to the Northern provinces such as Navotas, Quezon City and Bataan. Other significant roads include Recto Avenue which forms part of C1 circumferential road. C1 runs through the city of Manila and eventually connecting back to Roxas Boulevard. The roadside friction on Recto Avenue is also very high, as is the case with Bonifacio Drive.

Figure 1-2. Existing roads around the Project Site

Apart from the road network described previously, the reclamation site is also located close to other forms of public transportation, namely the Light Rail Transit (LRT) and Pasig River Ferry Service. The LRT network consists of 2 lines, namely the LRT Line 1 and the LRT Line 2. Line 1 travels in a general north-south route over 17.2 km of fully elevated track while Line 2 runs east-west for 13.8 km. The stations that are closest to the development site are Central, Carriedo and United Nations which are on Line 1.

The Pasig River Ferry service is a water-based public transportation system that runs along the Pasig River. The Metro Manila Development Authority (MMDA) currently operates 15 boats along a route of 15 stations from Intramuros to Pasig, with stops in Makati. The closest station to the site is the Plaza Mexico Ferry Station in Intramuros. In addition, there are also ferry terminals to the south of the site such as the Mall of Asia ferry terminal. These ferry stations and terminals can be used to provide ferry services for the proposed development.

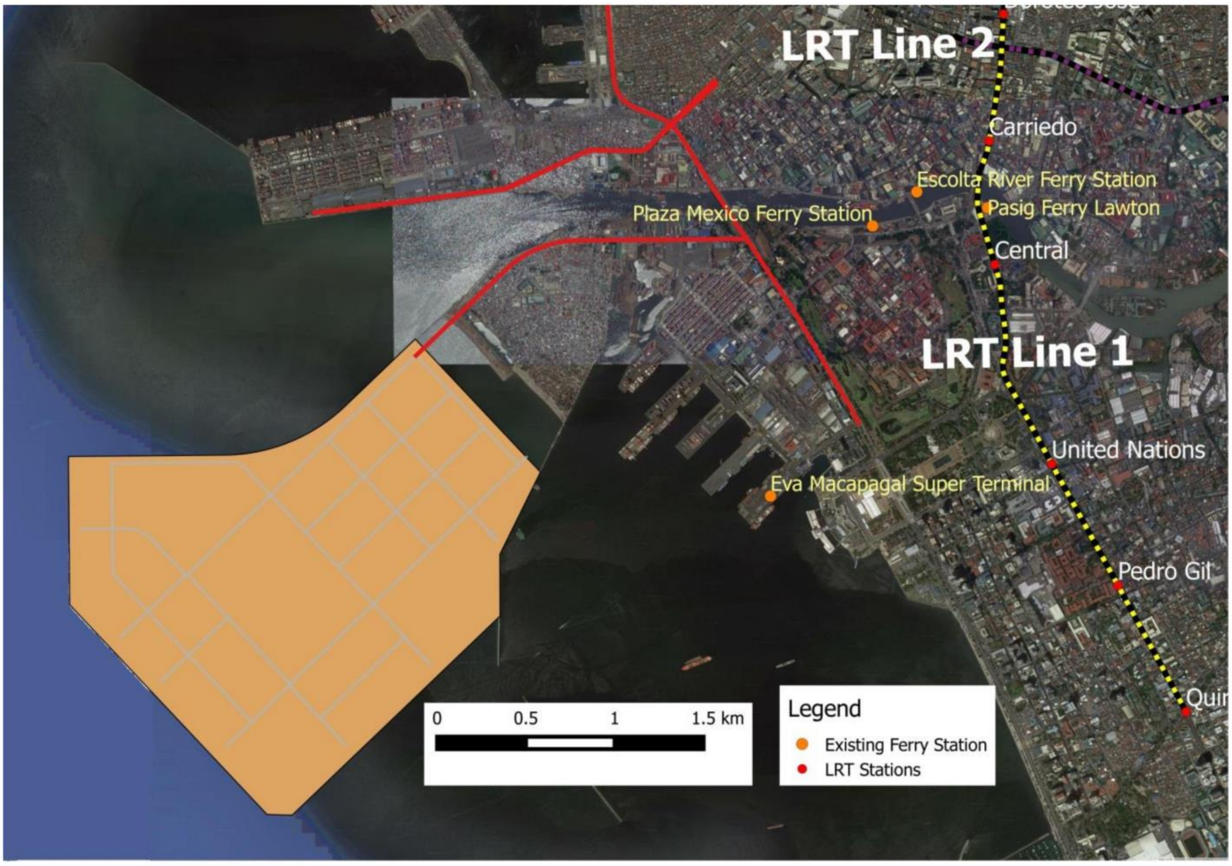


Figure 1-3. Public Transport Systems within Close Proximity of the Project Site

1.1.2 Delineation of Impact Zones

As per DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), the direct impact areas (in terms of the physical environment) are those areas where all project components are proposed to be constructed/situated which is the 407.42-hectare reclamation area.

On the other hand, the whole city of Manila is considered as the direct social impact area for the Project.

Module	Description	Direct Impact Area	Indirect Impact Area
Air Quality	Areas with projected Ground Level Concentration (GLCs) of emissions higher than the ambient standard based on air dispersion/transport modeling studies (worst case scenario)		(not applicable)
Water Quality & Quantity	• The extent of water body/ies areas where the water quality are projected to exceed the ambient standards based on relevant worst case scenario discharge modeling studies (sediment and pollutant discharges) • Areas using the groundwater that could possibly be contaminated by project activities involving the use and disposal of toxic chemicals and hazardous waste or construction of underground facilities. • Areas where there are existing users of the same source of natural resources (e.g. water) that the proposed project will be using.		(not applicable)
Land	Areas directly vulnerable to potential flooding or inundation that may be caused by the project	Areas where access roads that maybe used by the project during construction activities will not be inundated, on the contrary it will be provided with structures that will mitigate flooding and inundation.	(not applicable)
	Areas where there will be disturbance of habitat		(not applicable)
People	Directly affected areas based on the results of the socio-economic impact assessment studies conducted including ancestral domain of indigenous communities that may be affected, if any.		

Module	Description	Direct Impact Area	Indirect Impact Area
	The IIA on the other hand, shall be delineated for impacts on people and shall include those in the vicinity of the DIA who will either benefit or be affected indirectly by the project.		
Marine Ecology	Coastal waters, habitats and resources directly susceptible to stressors emanating from establishment and operation of the project, including identification of stressor pathways.	Nearshore coastal waters fronting the proposed project sites, i.e., coral reefs along the reef isobath; seagrass meadows, mangrove habitats, macro-invertebrate population and habitats, and plankton communities within the sphere of influence of potential issues from the project; fisheries resources and practices occurring within the coastal area in front of the project site; MPAs.	Offshore coral shoals and/or Marine Protected Areas within 1 to 3 km from the project site; mariculture zones (if any)

1.2 Project Rationale

The objectives of the Project are to create a new Central Business District (CBD) for Manila, encourage and promote tourism as well as provide a new lifestyle for the community. The objectives are further elaborated as follows:

New CBD for Manila:

- To reflect and enhance the historic value of the city.
- To build a new and vibrant urban center in the heart of Manila.

- To create a smooth transition between the old and new towns and facilitate city cultural inheritance.
- To introduce new city programs.
- To integrate surrounding areas with green and pedestrian networks.

Anchor for Tourism:

- To optimize site accessibility by providing a variety of transportation, such like shuttle bus, water taxi, cruise and yacht, etc.
- To create a waterfront entertainment zone and an Eastern Hollywood recreation avenue embracing the sea.
- To extend the tourism map of Metro Manila with new and unique attractions.
- To provide a full range and comprehensive services to support the tourism development.

New Lifestyle Community:

- To build an integrated development ideal for living, learning and working.
- To provide holistic community amenities on site, including schools, clinics and community centers.
- To provide a variety of housing options, such as bungalows, terrace house and mid & high-rise apartments in a well secured environment.
- To promote a waterfront lifestyle with a safe and relaxing living environment.

1.3 Project Alternatives

1.3.1 Siting

No other siting alternatives were considered for the proposed project. It is deemed strategically and economically advantageous for the proponent to develop and construct the project within the site based on the following considerations discussed in the succeeding sub-sections.

1.3.1.1 History

Manila's origin can be traced back to a small seaport established in the twelfth century at the mouth of the Pasig River. Captured by Spain in 1570, the city was declared capital of the Philippines. During World War II in 1941, President Manuel L. Quezon created the city of Greater Manila by merging Manila with Quezon City, San Juan del Monte and Caloocan.

Greater Manila expanded over the years into what is known today as Metro Manila, the National Capital Region of Philippines. There are 16 cities and 1 municipality in the metropolis that were established at different historical stages.

Metro Manila is sited on the island of Luzon and spreads along the eastern shore of Manila Bay at the mouth of the Pasig River. The growth of Manila along the banks of the Pasig River earmarked Manila as a hub for development and historical events. Manila Bay is one of the finest natural harbors in the world. The capital city is strategically located within the bay area which promotes commerce and trade between the Philippines and its neighbouring countries, serving as the Philippines' gateway for social-economic developments.

Figure 1-4. Transformation of Manila

1.3.1.2 Regional Structure

Metro Manila is the Philippines' center of economic, political, social, and cultural activity. It has an area of 638.55 square kilometers that is divided into 16 cities and one municipality. Once the first urban settlement in Manila, it is now the region's historic center and shipping gateway. Next to Manila along the Pasig River is the nation's financial and economic center, Makati CBD.

Because of the private sector's involvement in development, certain areas of Metro Manila, for instance Makati, Manila and Pasig stand out from the rest of the region, shaping a distinctive municipal identity.

The region's urban structure is similar to the Concentric Zone Model or Burgess Model, which depicts a Central Business District and "rings" of urban expansion with different land uses. This project is strategically located along the coast of Manila City, which could potentially be a success model for waterfront developments in the region.

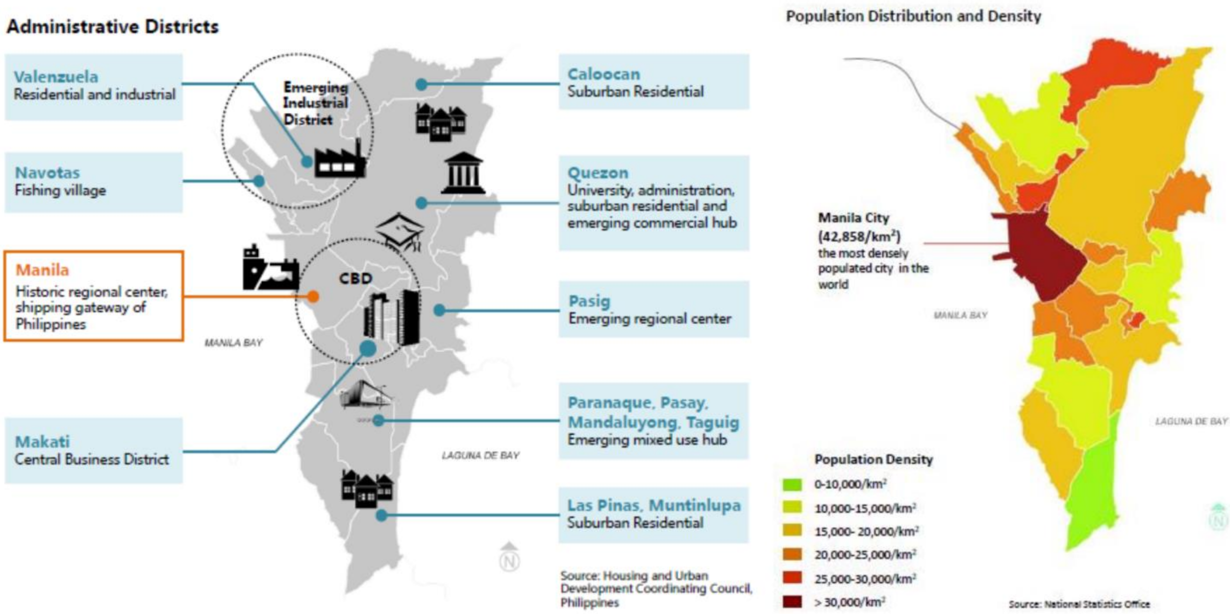


Figure 1-5. Regional Structure of Manila

1.3.1.3 Population Growth

Metro Manila is the most populous metropolitan area in the Philippines, and the 11th most populous in the world. It has a population of 11.8 million (2010), almost 13% of the nation's total population. Metro Manila's population density of 18,569 per square kilometer is among the highest in Southeast Asia. A majority of the population is concentrated in the inner suburbs. Manila City has a population density of 42,858 per square kilometer and is known as the world's most densely populated city.

Like most cities, the population density is significantly lower in the outer suburbs. The metropolitan area's population has been growing rapidly at around 2.11% annually. Should this rate continue, the region would reach a population between 45 to 50 million by 2050. This is approximately 10 million people more than today's world's largest metropolitan area, Tokyo.

The rapid population growth brings many challenges to the City such as employment and quality of life. Introducing new urban programs will be one of the key strategies to tackle these challenges.

1.3.1.4 Economic & Urban Growth

Metro Manila is the financial, commercial and industrial center of the Philippines, accounting for 33% of the nation's total GDP. It is the 2nd wealthiest urban agglomeration in Southeast Asia. GDP growth recorded a notable slowdown seen in the industrial sector with a fall to 3.5% in 2011.

Excellent protected harbor, manufacturing and export industries provide the nation with stable revenue. However, the region lacks technological development and the aviation industry is still in its infant stage.

To diversify from labor-intensive to value-adding industry, the country is investing in infrastructure and construction. The Philippines is currently one of the fastest growing economies in Asia. Metro Manila has a tropical wet and dry climate, with desirable living conditions along the coastal areas.

Over the years, many modern skyscrapers have been developed in the region while the surrounding areas are still predominantly slums. Uneven distribution of wealth depicts a significant contrast of urban environment throughout the region.

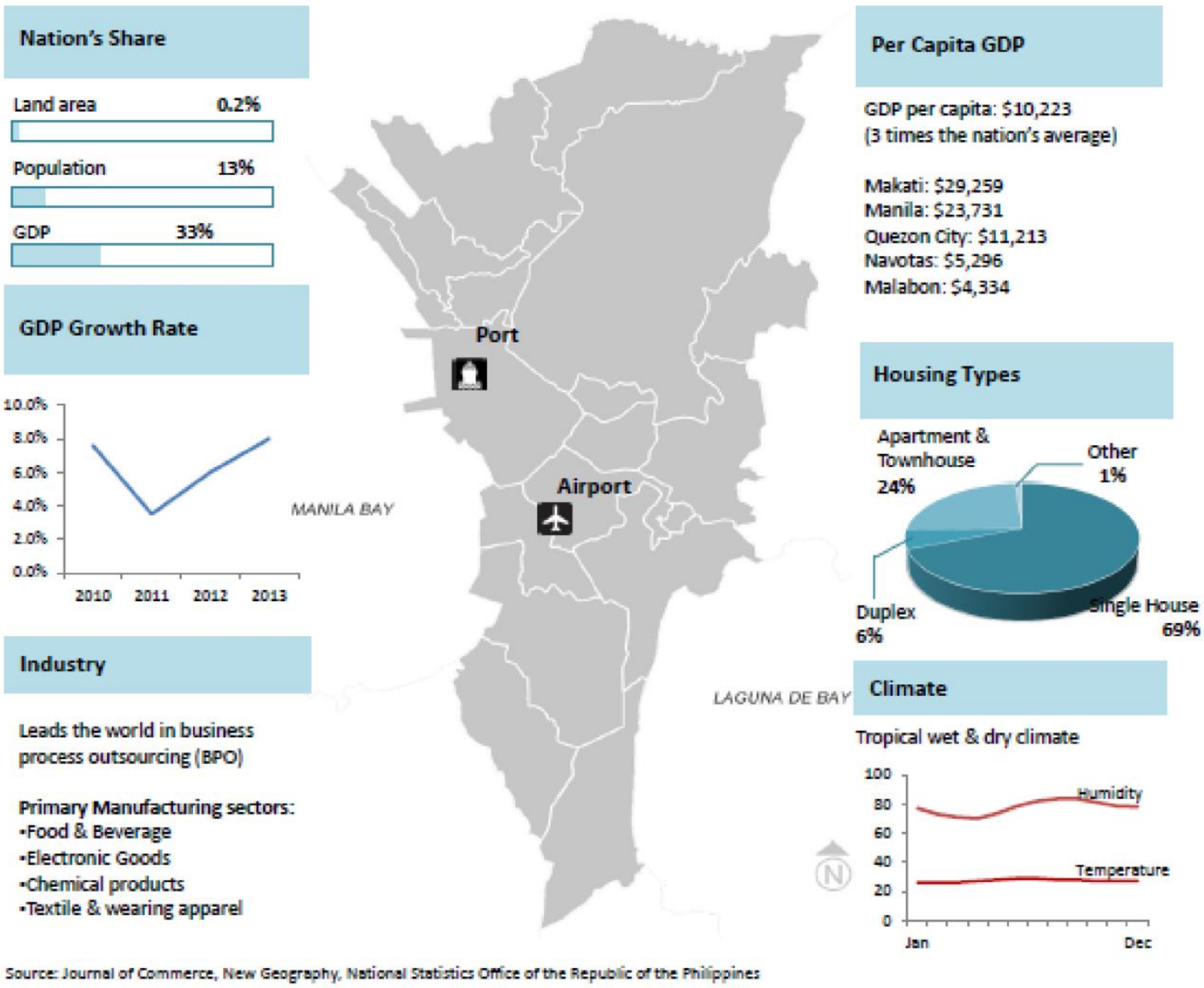


Figure 1-6. Economic Outlook of Manila

Despite a high population density, most of the residents live in single housing. This results in wide spread urban sprawl, placing immense stress on the provision of infrastructure and amenities.

1.3.1.5 Tourism Development

With more than 7,000 islands, the Philippines is a tropical island with eye-catching natural sceneries and underwater world. Nonetheless due to the unstable security situation in the country, typhoons and other natural disasters, the development of tourism in the Philippines lags behind other Southeast Asian countries. Most of the tourists travelling to the Philippines are from countries including United States, Japan and South Korea. The number of Chinese tourists has also grown rapidly over the years.

1.3.1.5.1 Improved Infrastructure

The City government has initiated more than 57 infrastructure projects including airport, expressway and railway upgrades. This greatly complements the growing tourism industry in the region.

Plate 1-1. Some of the Improved Infrastructures within and adjacent the City

1.3.1.5.2 Growing Tourism

In recent years, the Philippines tourism industry continues to grow. Manila's emerging hotel and entertainment developments have attracted global hotel giants around the world. The City is currently the center of the hospitality industry in the nation. There are many tourist attractions in Manila, including the Coconut Palace, a wide range of historic churches and the Asia's largest modern shopping centre. The City is gradually transforming into a popular travel destination in Southeast Asia.

Plate 1-2. Some of the Visited Tourism Sites in the City

1.3.2 Technology Selection / Operation Processes

1.3.2.1 Reclamation Study

Reclamation projects are always fairly large projects in terms of scale of the construction, financial commitment or environmental impact. Before implementation of any proposed reclamation scheme, studies have to be conducted to establish the feasibility of the proposed scheme or profile. This will include the design of the profile or layout, collection of data on the seabed levels and subsoil profile as well as characteristics through bathymetric survey, soil investigation and hydraulic model studies to determine the optimal profile of the proposed reclamation, which will yield the maximum land area with minimal disturbance to the existing flow conditions and surroundings.

In addition, the planning and design of the proposed reclamation will depend on the following factors:

- The proposed land use plan and development of the reclaimed land. This will affect the basic shape and size of the proposed reclamation.
- The type of marine facilities or structures to be provided along the proposed reclaimed profile. This will affect the type of revetment and/or shoreline protection to be adopted.
- The seabed conditions, depth of fill and the type of fill material available. This will determine the proposed reclamation method and type of ground improvement works.
- The current flow, tidal flow and the hydrodynamic regime in the vicinity of the proposed reclamation. The structure must be designed such as to avoid siltation of the surrounding waters and/or erosion to the existing shores or, in short, to minimize disturbance to the existing flow conditions and surroundings.
- The existing and future water quality and its potential effects on marine receptors. The design must maintain or minimize the impacts within acceptable limits to the current water qualities of the surrounding waters and/or waterways.

1.3.2.2 Design Objective

The design of dredging, reclamation and soil improvement works shall be safe, robust, economical, durable, with operation and maintenance costs reduced to a practicable minimum. It must balance reasonable cost, flexibility, functional effectiveness, ease of construction throughout many permutations of design.

The design shall address the durability of all elements of the structures. All elements of the coastal protection structures exposed to harsh marine environment shall be adequately protected, taking into consideration the deterioration of materials throughout the service life.

The design shall also take into consideration the temporary and permanent conditions of the structures in meeting the build ability requirements and account for effects of temporary conditions caused by the Contractors’ methods, techniques, sequences, procedures of construction and timing of works on the permanent works design. Adequate safeguards and checks against any locked-in stress and any loss in soil and rock strength during temporary and permanent conditions shall be clearly addressed in the design. Any innovative design should be tested within a safe-fail environment, through proof of concept or test-bedding.

1.3.2.3 Design Standards and Code of Practices

The design of all works shall comply with the appropriate local Standards and/or the internationally accepted standards. These shall include but not be limited to the Standards below:

Table 1-2. Design Standards for the Reclamation

Reference No.	Title
BS 5400	Steel, Concrete and Composite Bridges
BS 6031	Code of Practice for Earthworks
CP 4	Code of Practice for Foundations
BS 8002	Code of Practice for Earth Retaining Structures
CP 65	Code of Practice for Structural Use of Concrete
CIRIA C683	The Rock Manual

1.3.2.4 Shore Protection Design

A shore protection structure is defined as a shoreline structure whose primary purpose is to protect the reclamation area against erosion or alleviates flooding as a result of potential storm surge or monsoon events. Depending on the formation level, land use adjacent to the coastline and types of proposed marine facilities, the most appropriate shore protection structures can be designed to accommodate these developments. The Project will involve several types of shore protection structures to protect the various types of developments and facilities and these structures are further elaborated in the following sections:

1.3.2.4.1 Gravity Wall

Gravity wall in the form of concrete block work is proposed to be constructed at the outer marina as shown in **Figure 1-7**. The primary purpose of proposing the gravity wall at the outer marina is to protect and seclude yachts or vessels from strong waves and currents. The wall can be coupled with floating pontoons to cater for berthing of yacht and vessels and serves as a platform or pedestrian walkway to bring visitors or tourist around the marina.

Figure 1-7. Location of proposed gravity wall

Figure 1-8. Typical example of gravity wall

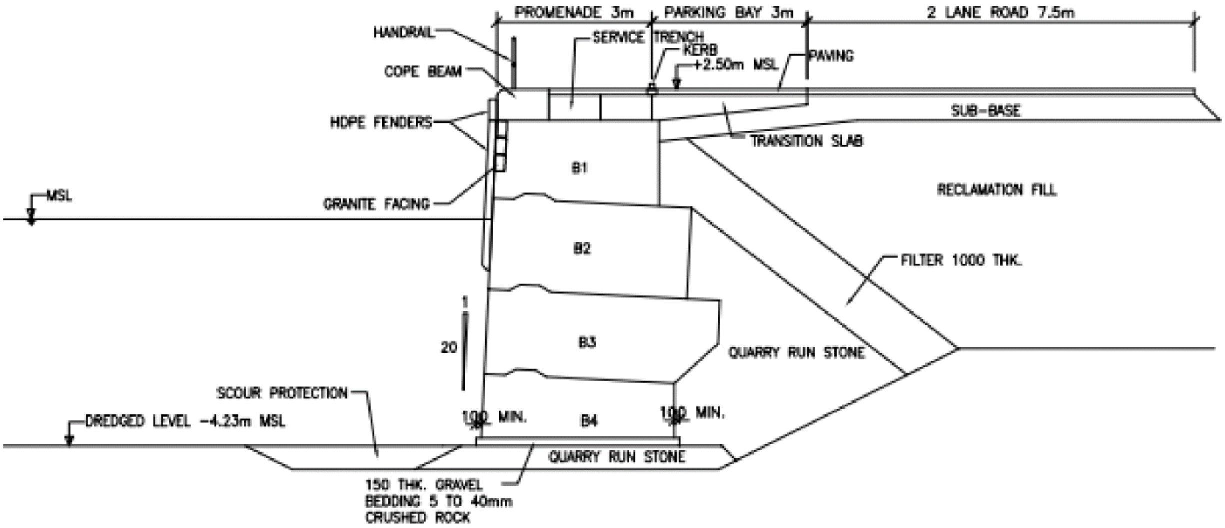


Figure 1-9. Typical cross section of concrete blockwork.

1.3.2.4.2 Steel Sheet Pile Wall

Steel Sheet Pile (SSP) wall is generally applied in many types of temporary works and permanent structures to withhold and retain the reclaimed fill. It has been widely used in many engineering applications and structures such as river control structures and flood defense, ports and harbors, bridge abutments, basements and underground car parks and containment barriers (**Figure 1-10**).

Figure 1-10. Example of SSP constructed along the Marina and Riverbank.

SSP is proposed to be constructed along the inner marina in view of providing retention and stabilization to the marine facilities and structures as shown in **Figure 1-11**. SSP is susceptible to corrosion especially in a marine environment where seawater is often found to be very corrosive. The degree of corrosion and whether protection is needed depends on the nature of the working environment. In a marine environment, there are several exposure zones of different aggressivity namely the below the bed-level, seawater immersion zone, tidal zones, low water zone, splash and atmospheric zone and the corrosion performance of the SSP in these zones would have to be considered differently. Nevertheless, corrosion measures such as application of protective organic coatings or concrete encasement and cathodic protection can be considered to increase the effective life of a SSP wall and mitigating corrosions.

Figure 1-11. Location of proposed SSP.

1.3.2.4.3 Sloping Revetment

A sloping revetment is a facing of stone, concrete units or slabs, or other materials built to protect the embankment, natural coast or shoreline against erosion by wave action, storm surges and currents. A sloping revetment normally consists of three major components namely a stable armour layer, a filter cloth or underlayer and toe protection. The primary armour layer is the outermost layer of a revetment structure and is directly exposed to wave impacts. The filter and underlayer support the armour yet offer a passage for water to pass through the structure. The toe protection prevents the undercutting and provides support and stability for all the layer materials within the revetment structure itself.

Sloping revetments are mainly proposed along the entire perimeter of the reclamation site as shown in **Figure 1-12**. The revetments provide a vital protection to most of the residential and commercial developments within the project site. It is also deemed favorable to propose sloping revetments as compared to vertical seawall due to most of the site perimeters are furnished with walkways and promenades. Due to the scarcity and shortage of rock source in Manila Bay, the revetment structure will have to be engineered and constructed in a different way by replacing rocks with alternative materials such as concrete blocks or concrete mattress as shown in **Figure 1-13**. Though the concrete revetment may not be as aesthetically pleasing as the rock revetment, the concrete revetment can still be designed in such a manner to improve the interlocking feature of the concrete blocks such that it will minimize the overall visual impacts of the structure. A typical cross section of a sloping revetment is also illustrated in **Figure 1-14**.

Figure 1-12. Location of sloping revetment

Figure 1-13. Examples of sloping revetment (left: concrete blocks, right: concrete mattress)

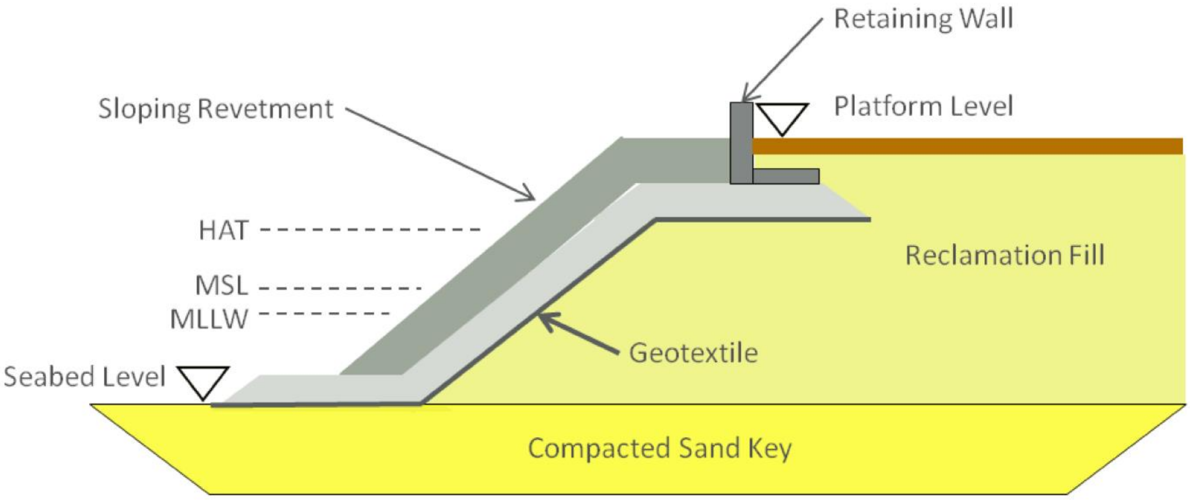


Figure 1-14. Typical cross section of sloping revetment

1.3.2.4.4 Soil Improvement

The most important outcome of any reclamation project is to create stable and good quality land that is able to withstand its proposed or envisioned developments. This can be achieved by sourcing sand from good borrow pits whereby the sand material is of high quality. However, this is often not possible and is rarely achieved due to some geophysical factors and seabed conditions posing difficult constraints. For instance, some of the good dredged materials may not be sourced successfully even with the help of the latest dredging equipment and technology as they are only present in borrow pit areas that are too deep. Even with the assumption that good fill material can be sourced to reclaim the site, the overall quality of the reclamation site may still be subject to scrutiny as the existing underlying soil may be poor and not of good quality. Aside from this, it is also common to understand that ground settlement and land subsidence may occur not only due to the reclaimed fill but also of the existing underlying soil itself. The rate of the settlement is hence dependent on the type of the existing ground stratification.

Wide variations in terms of the condition of the underlying soil layers can be expected at a large reclamation site. Reclamation works increase the load on these soil layers, which may result in a widespread settlement. The duration taken for the natural settlement of the land will be extremely long which may increase the reclamation cost of the project significantly. To avoid this, soil improvement techniques can be implemented to accelerate the consolidation of soft soil layers and dredged materials and improve the overall soil properties. With this, the consolidation period can be shortened and the reclamation cost can be reduced significantly. The aim of utilizing these soil improvement techniques is as follows:

- To increase the load-bearing capacity and/or the shear strength,
- To reduce both absolute and differential settlements or in certain cases, accelerate them, and,
- To mitigate or remove the risk of liquefaction in the event of an earthquake or major vibrations.

Several soil improvement techniques can be utilized for this project such as vacuum consolidation, installation of Pre-fabricated Vertical Drains (PVDs) and application of surcharge. However, for the purpose of this project, installation of PVDs and surcharge application are proposed and these techniques are further elaborated in the following sections:

Pre-fabricated Vertical Drains (PVDs)

Pre-fabricated Vertical Drains (PVDs) or Wick Drains are commonly used to accelerate the ground settlement which in turn may reduce the construction duration and cost of a reclamation project. These drains are usually placed at regular intervals to create drainage paths for uniform dissipation of excess pore water pressure. Soil consolidation is achieved by removing the excess pore water pressure within the soil layer. Pore water pressure normally refers to the groundwater pressure that exists within the voids of soil particles. Without the use of PVDs, the settlement of ground may take a long period to dissipate the existing groundwater as the permeability or hydraulic conductivity of soft soils such as clay or silt is very low. By introducing PVDs, the drainage paths are shortened and thus the time taken for the dissipation of pore water pressure will be reduced significantly.

PVDs are often coupled with other soil improvement techniques such as the application of surcharge to enhance and expedite the consolidation process. By applying surcharge on soft soil layer, the soft ground is compressed significantly by the additional loadings, thus able to dissipate the excess pore water pressure effectively.

Figure 1-15. Installation of PVDs.

Surcharge Treatment

Surcharge treatment is a method that goes hand in hand with the installation of PVDs as elaborated in the above section (**Figure 1-16**). Surcharge mounds are usually overlaid on the soil improvement area as additional loadings to exert pressure onto the ground. This process will compress the soil layer and allow a greater dissipation of excess pore water pressure via drainage paths that are created by the installation of PVDs. Sand or good earth materials can be utilized as surcharge materials to improve the properties of reclaimed fills and underlying soils. The quantity of surcharge required as well as the height of surcharge mound needed will vary according to the existing soil conditions and settlement criteria. As such, preliminary desktop studies and soil investigations are very important as they provide crucial information on the soil condition which allows a more effective and practicable soil improvement techniques to be adopted for a reclamation project.

The advantage of utilizing surcharge treatment is that it can be carried out easily by contractors with the help of conventional earthmoving construction equipment such as excavators or dump trucks. However, surcharge treatment may not be applicable at small reclamation sites where space is a constraint as surcharge fills will need to be extended horizontally at least a certain width beyond the perimeter of the planned construction site. In addition, transportation of large quantities of surcharge fills may also be required to provide an effective consolidation treatment to the soil improvement area depending on the existing soil condition. However, with a better planned construction and transparent soil investigation results, the application of surcharge treatment together with the installation of PVDs can be carried out in an effective and efficient manner.

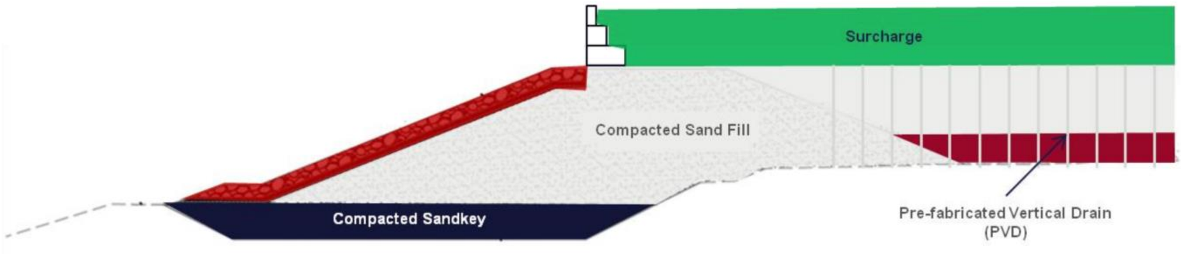


Figure 1-16. Typical cross section of surcharge with PVDs Installation

1.3.3 Site Access Option

Based on the review of the existing road into the site, it is clear that having 2nd Street as the only access into the site will be inadequate. New roads would have to be built to provide connection to the existing road network. **Figure 1-17** illustrates the options for site accesses that were considered.

The first option considered is to build a bridge from the south of the site to South Road. The bridge would be crossing the navigation channels of ships entering and leaving the Manila South Harbor Port. Therefore, the columns of the bridge would need to be spaced wide enough and the deck will need to be constructed high enough for ships to safely pass under. Furthermore, a large area of land on the development site would be needed for the bridge landing due to the height and maximum gradient of 8%.

The second option aims to build a new elevated highway over 2nd Street and Roxas Boulevard. The highway would have landings at the south of Roxas Boulevard and after M. Roxas Jr. Bridge. The elevated highway over Roxas Boulevard would bypass the heavily congested road and provide an exclusive road for the development. However, the traffic along Roxas Boulevard and Bonifacio Drive would be severely disrupted during construction of the new highway. Furthermore, local stakeholders would likely be against the highway disrupting views along Roxas Boulevard.

The third option is to construct an elevated highway from the site, along Pasig River, and landing at Magallanes Drive. The advantage of this option is that the newly constructed road will only serve the development. Also, the construction of the highway would have minimal disruptions to the existing traffic. However, the height of the elevated highway could restrict the views from the historic area of Intramuros which will need approval from the Intramuros Administration.

The fourth option is to build an elevated highway across the current Baseco Compound and a new bridge to cross Pasig River which lands at Claro M. Recto Avenue. The bridge would exclusively serve the development and bypass the congested traffic on Bonifacio Drive.

Figure 1-17. Options for Access Roads into the Project Site

1.3.4 Resources

A sand source located within a 30 km radius from the site such as the San Nicholas Shoal (SNS) has been planned for this Project as the borrow area for fill materials (**Figure 1-18**). The sand from the borrow area will be dredged using a Trailing Suction Hopper Dredger (TSHD) and transported to the site once the hopper is fully loaded with the sand material. At the site, a bow coupling unit will be utilized to serve as a special link between the TSHD and floating pipelines for pumping the sand material ashore to fill the reclamation area.

Preliminary studies indicate that the majority of the fill materials are silt or clay with fine content more than 40%. However, soil investigations will need to be carried out at a later stage to determine the quality of fill material, volume of the reserve pit as well as the depth of the pit area.

Aside from the San Nicholas Shoal, other alternative sources of borrow material may be considered from the foreshore area in Mariveles, Bataan and lahar deposits from Pampanga and Zambales area. The source to be tapped for borrow material will undergo detailed geotechnical study and pre-screening process to ensure that the material is appropriate to be used as fill materials in the reclamation site and that these are not contaminated.

Figure 1-18. Proposed borrow area of the Project

1.3.5 Environmental Impacts of Each Alternative for Facility Siting, Development Design, Process / Technology Selection, Resource Utilization

The overall design aim of the proposed reclamation is such that the profile is not expected to significantly impede known formal navigation channels. During construction however, it is conceivable that the construction activities may present elements which form an additional obstacle to navigation above those present under existing conditionals. Such construction activities may include installation of silt screens, mooring of construction vessels and demolition of existing breakwaters. For any such potential hazards, the proponents should liaise closely with the relevant stakeholders in order to ensure that the appropriate mitigation measures are in place. Mitigation may include publishing of the changing conditions in port marine circulars or notices and the installation of marker buoys to demarcate the position of any possible obstructions. The construction vessels must at all-time follow the procedures set out by the local port authorities.

Sediment plume may be generated by the process of dredging, infilling or dewatering discharge. Sediment plume may affect local ecological (such as coral reefs, seagrass beds), industrial (intakes or maritime facilities) or recreational facilities. The degree to which such effects may cause harm to these receptors can be managed through detailed Environmental Impact Assessment (EIA) including numerical sediment plume modelling and operational monitoring during construction under and Environmental Management Plan (EMP). An EMP may include daily hindcast modelling to quantify the realized effects of reclamation activities through a feedback approach, supported by observations from instrumentation deployed in strategic locations.

The effects of the construction on the local communities should also be considered in detail. Negative effects arise from noise and decreased air quality, while expected to be minor, may affect the local informal and formal settlements. Noise effects bay be mitigated by installing sound barriers or restricting disruptive construction activities to daylight hours. Noise compliance checks may be carried out on machinery with noise meters installed and operated under the EMP to check for compliance. Effective strategies for air pollution control include watering areas of exposed earth which may potentially generate airborne dust, proper storage of dust producing materials, machinery exhaust compliance and good practice driving habits (for example, compliance with speed restrictions and shutting down machinery which is not in use). Likely increased traffic to and from the construction areas should be countered by close liaison with local traffic authorities and installation of improved signage to reduce the risk of accidents and forewarn of possible congestion. Safe traffic control measures should be employed.

There is a risk that hazardous and non-hazardous waste could be generated by the construction activities. The waste may be generated from land-based or marine activities including accidental oil spill). The implementation of a robust waste management plan involving proper storage, handling and disposal procedures for each potential waste stream should be development. In addition, an emergency response plan should be implemented to address any accidental spills of waste. The construction contractors should implement a reduce recycle and reuse hierarchy. Dredged material from the Pasig River has been disposed on the seabed in the footprint of the proposed reclamation. The dredged material was ‘capped’ using an underwater placement with over-depth capping (UPOC) technique to reduce the risk of the dredge spoil being released into the marine environment. Therefore, construction activities that involve dredging directly into the UPOC area should be avoided. For reclamation activities which involve infilling directly on top of the OPOC area, it should be generally assumed that this infilling effectively acts to add a further capping to the Pasig dredge spoil. Finally, the geotechnical stability of the existing seabed, with respect to the potentially contaminated Pasig dredge spoil should be undertaken as part of the standard design analysis.

1.3.6 No Project Alternative

The ‘no-go’ alternative is the option of not proceeding with the proposed reclamation project. This alternative will result in the continuation of the project site’s current state.

Despite its location in the heart of the National Capital Region and near to historic origins of the old city, the site faces challenges pertaining to safety, health, transportation and inadequate infrastructure. Lack of port channels, land size limitations and other restrictions also lead to the existing Manila South Port facing intensive competition from neighboring ports in the region. However, given the waterfront location and proximity to Manila City, The New Manila Bay area is expected to experience rapid urban growth. This facilitates the site transformation from an underdeveloped settlement area into a robust urban center.

The proposed reclamation project will offer substantive socio-economic benefits not only for the host local government of Manila City but also to the regional and national levels as well. Without the project, the urban development expansion to accommodate the urban development requirements needed by the projected increase in population of Manila City will be constrained primarily due to the very limited land area available for the City.

Currently, a large number of the City’s urban population lives along the coastal areas with depressed social and environmental conditions. Without the planned reclamation project, these communities will be deprived of opportunities for an improved access to improved and well-planned settlement areas.

The lack of urban spaces also reduces the City's attractiveness as an investment haven for the private business sector. This in turn negatively affects the ability of the City government to generate its own-source revenues thereby consequently reducing its local fiscal performance and financial autonomy. The absence of additional space for business opportunities also will deter the availability of potential employment and downstream livelihood opportunities from an improved business climate resulting from the additional urban space that can be accorded by the proposed reclamation project.

1.4 Project Components

A 407.42 ha land reclamation is proposed to be carried out at the area adjacent to Manila South Harbor Port, City of Manila, Philippines. The area is proposed to be filled up to a platform level of +4.4 m above MLLW. Based on the proposed platform level, an estimated volume of 48,000,000 m^3 of sand is required to meet the target platform level. Figure 1-19 provides the extent of reclamation planned for the project, while Table 1-3 provides the summary of the project components, which are discussed in the succeeding sub-sections.

Table 1-3. Summary of project components

Component	Materials	Size/Capacity	Safety Features
1. Reclamation area	Borrow filling materials	48,000,000 m^3	Platform level at 4.4m above MLLW estimated based on effect of climate change for several return periods (50 years) determined by a combination of the Highest Astronomical Tide (HAT), seasonal variation, storm surges and Sea Level Rise (SLR) Use of proper navigational equipment and safety gears
2. Shore protection structures			
• Sloping revetment	Concrete blocks or concrete mattress	9,000m (to be finalized after detailed design)	Use of proper equipment and Personal protective Equipment (PPE)

Component	Materials	Size/Capacity	Safety Features
• Steel Sheet Pile (SSP)	Sheet piles	400m (to be finalized after detailed design)	Use of proper equipment and Personal protective Equipment (PPE)
• Gravity wall	Concrete block	400m (to be finalized after detailed design)	Use of proper equipment and Personal protective Equipment (PPE)
3. Access Roads	Sub-base materials, concrete and asphalt pavement materials	Final specifications to be determined after detailed design	Use of proper equipment and PPE
4. Utilities Drainage, water, sewer, power lines	Reinforced concrete pipes UPVC or PE pipes	Final quantity and size to be determined after detailed design	Use of PPE

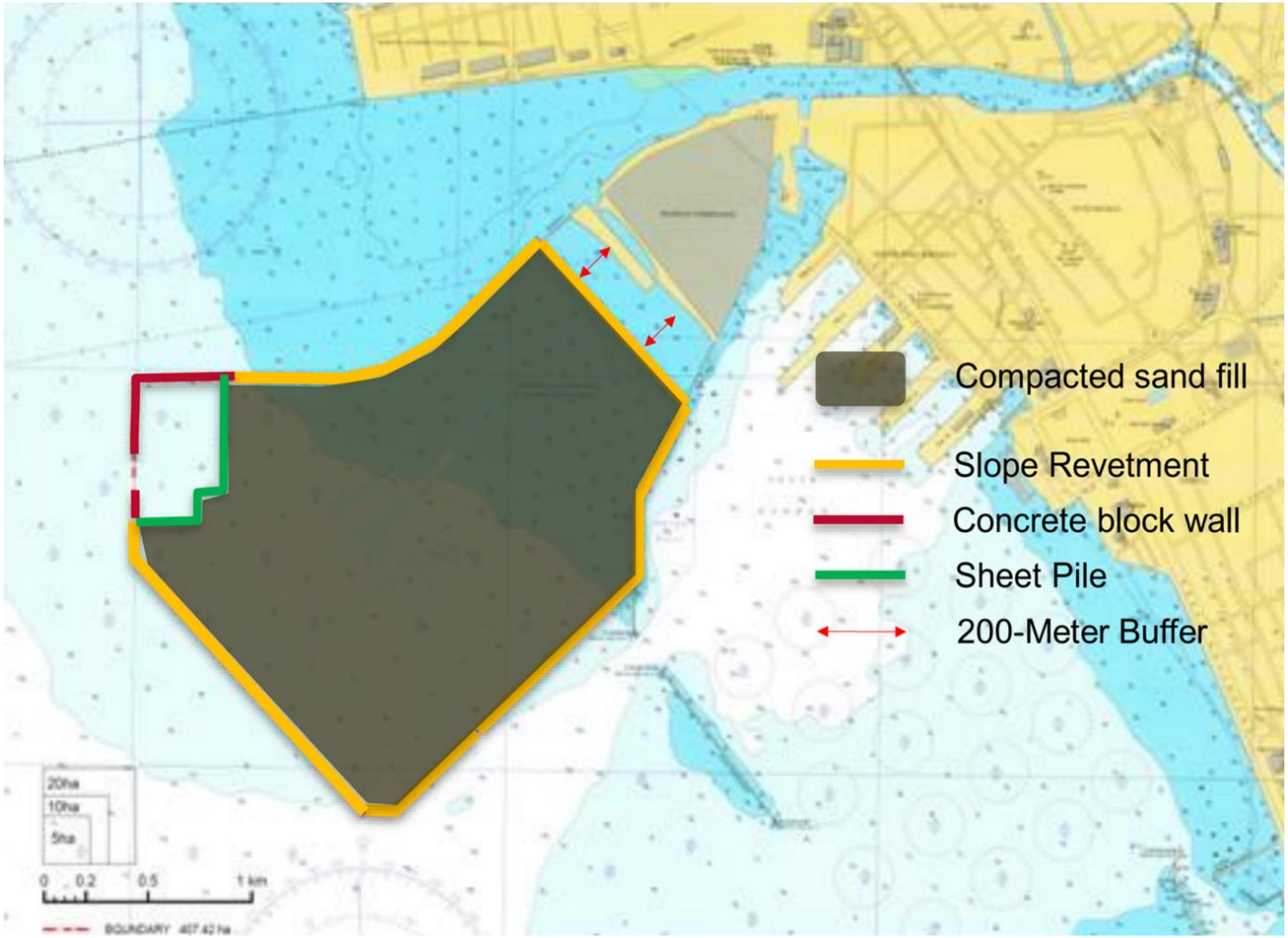


Figure 1-19. Proposed Reclamation Extent of the Project

1.4.1 Proposed Land Use Plan

The land use of the proposed 407.42 ha Project (**Figure 1-20** and **Table 1-4**) is developed based on a review of the initial Conceptual Master Plan Report prepared right at the onset of this Project, taking into account other key considerations such as land allocation between the Developer and the government of the City of Manila. The land use developed includes the MICE Manila (Convention Center), Commercial & Business Complex, Green Park, Public Facilities and High-end Residential Developments. Public Facilities will provide retail, education, culture, leisure, sports and health care services to meet residents' daily requirements. The Baseco Compound and South Port will be redeveloped into Tourism & Recreation and CBD Zones. Tourism & Recreation Zone comprises of Eastern Hollywood and New Manila Quay.

Table 1-4. Proposed land use for the Project

Land use	Area (ha)	Percentage (%)
Residential 1	13.15	3.2
Residential 2	184.98	45.4
Commercial	18.55	4.6
Hotel	7.40	1.8
MICE (Convention Center)	20.28	5
Education	14.64	3.6
Social amenities	2.02	0.5
Worship	6.18	1.5
Park	38.61	9.5
Water park	4.39	1.1
Green park	25.46	6.2
Water	19.60	4.8
Dyke	5.92	1.5
Road	46.24	11.3
Total / Boundary	407.42	100

According to different stakeholders' expectations and requirements, the land use distribution for the 407.42 ha reclamation area will be divided into two parts, to be taken charge of by the developer (60%) and the local government and authorities (40%) respectively. With the high cost involved in reclamation projects, the planning of the land use must be optimized to achieve strong economic outputs for the local government, and the planning and design of residential developments must be attractive to both developers and buyers.

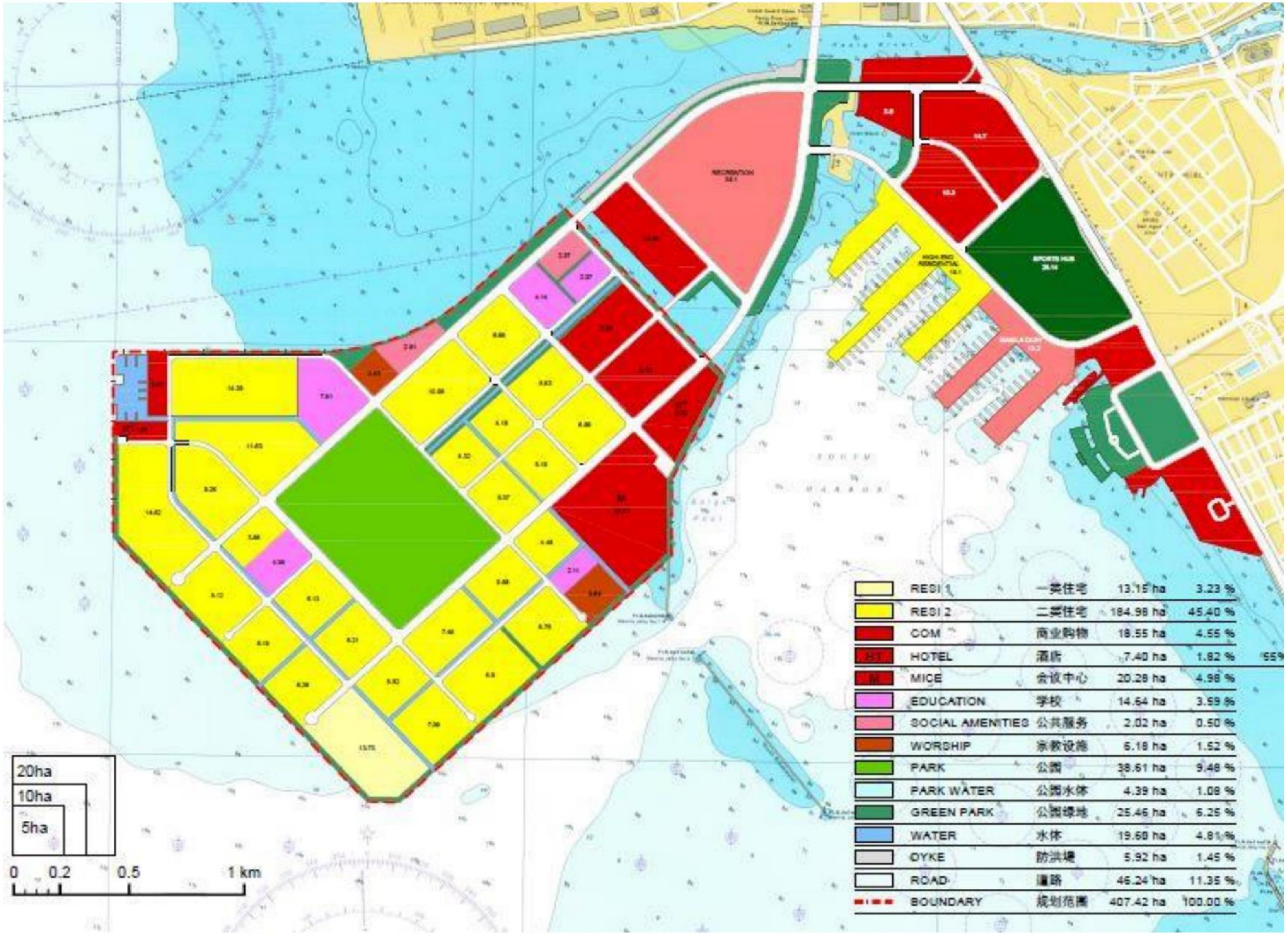


Figure 1-20. Proposed Broad Land Use Plan for the Project Site

1.4.2 Major Facilities

1.4.2.1 Reclamation area

The project proposes to carry out land reclamation over an area of 407.42 ha adjacent to Manila South Harbor Port, City of Manila, Philippines. The reclamation profile has been studied and modified hydraulically such that it will not affect the existing hydraulic condition, navigation channel, as well as nearby harbor operations.

To develop the land mass for the proposed New Manila Reclamation Project, the following components/activities will required.

1.4.2.1.1 Platform Level

The platform level is defined as the level of the reclamation development at the moment the defects liability periods ends or at the moment the Contractor hands over the works to the Client.

The required platform level considering the effect of climate change for several return periods can be determined by a combination of the Highest Astronomical Tide (HAT), seasonal variation, storm surges and Sea Level Rise (SLR) as shown in **Table 1-5**. The HAT is taken to be 1.57 m and is deemed appropriate to be considered for the marine frontage (facing Manila Bay) of the entire development. A maximum seasonal variation water level is adopted to be 0.62 m based on the National Oceanic and Atmospheric Association (NOAA) website whereas several storm surge levels are presented for the different return periods. Different sea level rise levels are also considered in this case which are deduced from the Fifth Assessment Report (AR5) by the Intergovernmental Panel on Climate Change.

Table 1-5. Expected Platform Level considering the Impact of Climate Change of the Various Return Periods.

Parameters	Return Period (Yr)				
	1	5	10	25	50
Highest Astronomical Tide (m)	1.57	1.57	1.57	1.57	1.57
Seasonal Variation (m)	0.62	0.62	0.62	0.62	0.62
Storm Surge Level (m)	1.17	1.35	1.56	1.70	1.84
Sea Level Rise by IPCC	-	-	0.03	0.17	0.32
Proposed Platform Level (m)	**3.40**	**3.60**	**3.80**	**4.10**	**4.40**

Based on the table above, a level of +4.40 m CD or higher can be considered as a design platform level for the proposed reclamation area when it comes to long term development. This is to accommodate the expected impact of climate change for the 50 years return period or more.

1.4.2.1.2 Dredging and Reclamation

Dredging operation involves the removal of unsuitable materials within the project area and in the burrow materials source. The operation also involves extraction of suitable marine burrow materials from the source to be utilized in the reclamation area.

During the course of dredging and reclamation, various equipment is needed to ensure that the project is carried out in a safe and efficient manner. The types of equipment proposed for this project are TSHD, Backhoe Dredger (BHD) and tug boats. The characteristics of these equipment are further elaborated in the following sections:

1.4.2.1.2.1 Trailing Suction Hopper Dredger (TSHD)

A TSHD is a hydraulic dredger that utilizes centrifugal pumps to raise the material out of the water and store in its hopper before transporting to the proposed fill site. TSHDs are commonly used in maritime construction and maintenance projects. These includes maintenance dredging of ports to widen the navigation channel or turning basins and transportation of large quantity of fill material to another reclamation site that requires millions of cubic meters of sand. They are normally used for dredging loose materials such as sand, clay or gravel.

A TSHD is a self-propelled ship which consists of a hopper that is used to store the fill material from the seabed. A TSHD is normally equipped with two suction pipes which are attached with drag heads at the end of the pipes. These drag heads act like giant suction or vacuum cleaners which suck up the material from the seabed as the ship slowly moves forward. The dredged material is transported upwards via a pump system and stored within its hopper.

There are several options that the TSHD can use to offload the dredged material from its hopper at a reclamation sites. These include direct offloading by opening the bottom hatches, rainbowing by pumping the sand ashore in a high position (preferable used for beach nourishment or coastal protection projects) and pumping of sand via submerged or floating pipelines. For this project, the dredged material will be pumped ashore via a series of floating pipelines and bow coupling units. If the distance between the TSHD and the proposed fill site is relatively far, booster pumps may need to be installed along the pipeline to provide extra pump capacity for ensuring that the dredged material is continuously pumped throughout the entire reclamation process.

Figure 1-21. Typical TSHD (Source: IADC, 2014)

1.4.2.1.2.2 Backhoe Dredger (BHD)

A Backhoe Dredger (BHD) is a water-based excavator which is equipped with a hydraulic excavator on a pontoon. Three spuds are normally installed to stabilize and secure the pontoon at a certain locations for dredging operations (**Figure 1-22**). The BHD is considered as a universal dredger as it can dredge several types of material such as sand, clay, boulders, stones, gravels and many others. A BHD is mainly used for dredging river banks for foreshore protection and harbor channels that are difficult to dredge using large dredging vessels. A majority of BHDs are towed to the site with tugboats, although some BHDs are self-propelled which offers greater mobility during dredging operations.

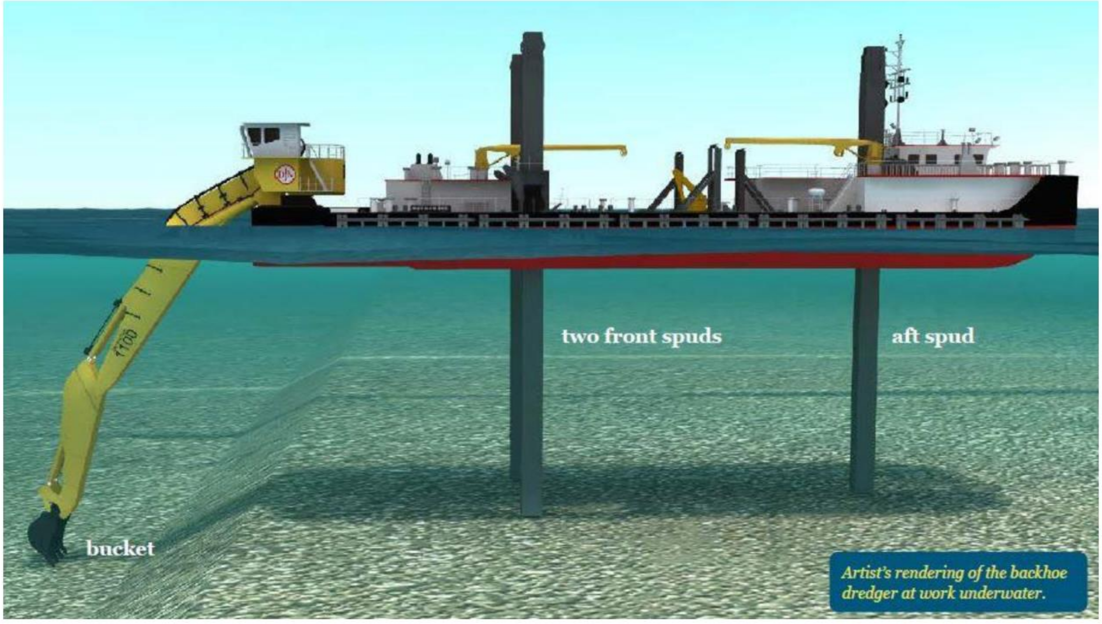


Figure 1-22. Typical BHD (Source: IADC, 2014)

For this project, BHDs will be utilized primarily for the dredging of the sandkey foundation. A hopper barge will be moored along with the BHD to store and fill the dredged material (**Figure 1-23**). Once the barge is fully loaded, the dredged material will be discharged into the reclamation site with the help of tugboats and BHDs. Depending on the distance between the dredging locations and filling site, the BHD has the capability to dredge the material from the existing seabed and discharge directly onto the reclamation site.

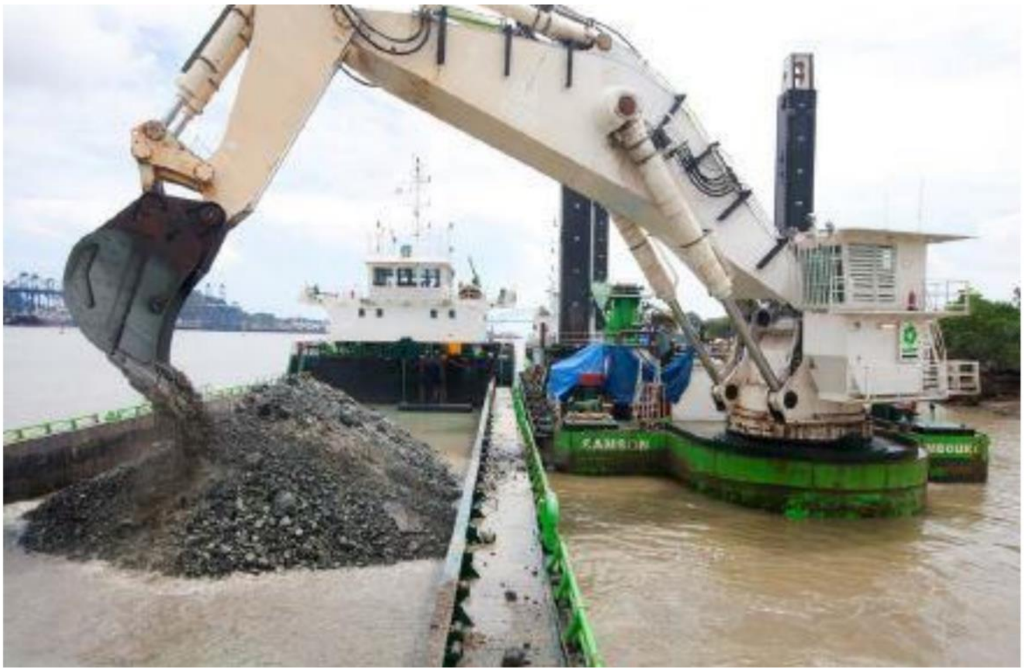


Figure 1-23. Illustration of loading operations using BHD and Hopper Barge (Source: IADC, 2014)

1.4.2.1.2.3 Hopper Barge

A hopper barge is a type of non-mechanical vessel that is unable to maneuver by itself. It requires tugboats to assist the loading and unloading operations. For this project, the hopper barge will serve as a temporary holding area for dredged materials that is filled by the BHD before unloading at the fill site by using an excavator. **Figure 1-24** below illustrates a typical excavator unloading the materials from a hopper barge.

Figure 1-24. Typical excavator unloading the materials from a Hopper Barge (Source: IADC, 2014)

1.4.2.1.2.4 Tugboat

A tugboat is a type of vessel that maneuvers other big vessels by towing them to the required locations. For this project, tugboats are mainly used to tow the backhoe dredger along the proposed sandkey dredging locations as well as to maneuver the hopper barge back and forth from the dredging location to the fill sites. The required number and capacity of tugboat/pusher tug for this project will depend on the type and number of the BHDs and hopper barges used.

Figure 1-25. Typical tug boat

1.4.2.2 Shore Protection Structures

Various methods of shore protection are planned for the project to protect the reclamation area against erosion and to alleviate flooding as a result of potential storm surge or monsoon events.

1.4.2.2.1 Sloping revetment

Sloping revetments are proposed along the entire perimeter of the reclamation site, approximately 9,000m in length. The sloping revetment will be made of stone, concrete unit or slabs, or other materials to protect the embankment, natural coast or shoreline against erosion by wave action, storm surges, and currents. Due to the scarcity and shortage of rock source in Manila Bay, the revetment structure will have to be engineered and constructed in a different way by replacing rocks with alternative materials such as concrete blocks or concrete mattress

1.4.2.2.2 Steel sheet pile wall

Steel Sheet Pile (SSP) wall will be constructed along the inner marina in view of providing retention and stabilization to the marine facilities and structures. SSP is susceptible to corrosion especially in a marine environment where seawater is often found to be very corrosive. To mitigate potential corrosion and increase the effective life of the SSP, measures such as application of protective organic coatings or concrete encasement and cathodic protection will be considered for the project.

1.4.2.2.3 Gravity wall

Gravity wall in the form of concrete block work will be constructed at the outer marina. The primary purpose of the gravity wall is to protect and seclude yachts or vessels from strong waves and currents. This wall may be can be coupled with floating pontoons to cater for berthing of yacht and vessels and serves as a platform or pedestrian walkway to bring visitors around the marina.

1.4.2.3 Proposed Buffers

A 200-meter buffer zone will serve as space/open channels between the 407.42 ha and the existing Baseco Compound (**Figure 1-19**).

1.4.3 Support Facilities

1.4.3.1 Access Roads

Based on the analysis of the options mentioned in **Section 1.3.3**, roads are proposed (**Figure 1-17**). Two elevated dual-3 highway extend from the major arterials roads in the site. They meet at an interchange just before the new dual-3 bridge to cross Pasig River. The first access road continues as an elevated highway and connects to Bonifacio Drive and subsequently Roxas Boulevard. Meanwhile, the new bridge has two exit ramps on the northern bank. The first ramp (second access road) connects to a new elevated highway along the northern bank of Pasig River and connects to Magallanes Drive on the southern bank. The second exit from the bridge will connect to the third proposed access road which is the existing Recto Avenue. Together, these access roads will provide excellent connectivity and ease of access to the rest of Metro Manila. This in turn will enhance the attractiveness to prospective investors.

The first proposed access road is a modification of the aforementioned option 2. The difference lies in which the elevated highway over Roxas Boulevard is removed from the proposal due to the potential negative impacts. In order for this proposal to work, the roadside activities along Bonifacio Drive and Roxas Boulevard would need to be cleared. Among the measures that could be undertaken to increase the road capacities and improve traffic conditions are ban roadside parking, remove illegal roadside settlements and stalls, provide and enforce designated pedestrian crossings, provide proper bays for jeepneys and buses, reduce number of accesses connected to the major roads and optimize traffic signals along Roxas Boulevard.

The second access road is adapted from option 3, taking into consideration the effects on Intramuros. As such, the elevated dual-3 highway has been shifted to run along the north bank and connect to Magallanes Drive on the south bank. From there, drivers will have direct connection with P. Burgos Road which is a major road through the city centre. Several other radial roads such as the R8 R9 and R2 are connected to P. Burgos Road.

The third access road is essentially option 4 with a slight modification to the location of the bridge. The bridge landing has been shifted westward to avoid the existing church. Recto Avenue is chosen as an access point as it provides good connectivity to the rest of Manila via the C1 circumferential road. However, it would also require the same measures as mentioned above in order to increase the road capacity and handle the added traffic from the new development. These measures are in line with the recent policy measures of the Manila City authorities where streets in the Divisoria district, including Recto Avenue, were cleared of illegal vendors. Following this, many streets in other areas of Manila will also be cleared. The authorities could further improve the environment of the streets by planting trees and widen pedestrian footpaths.

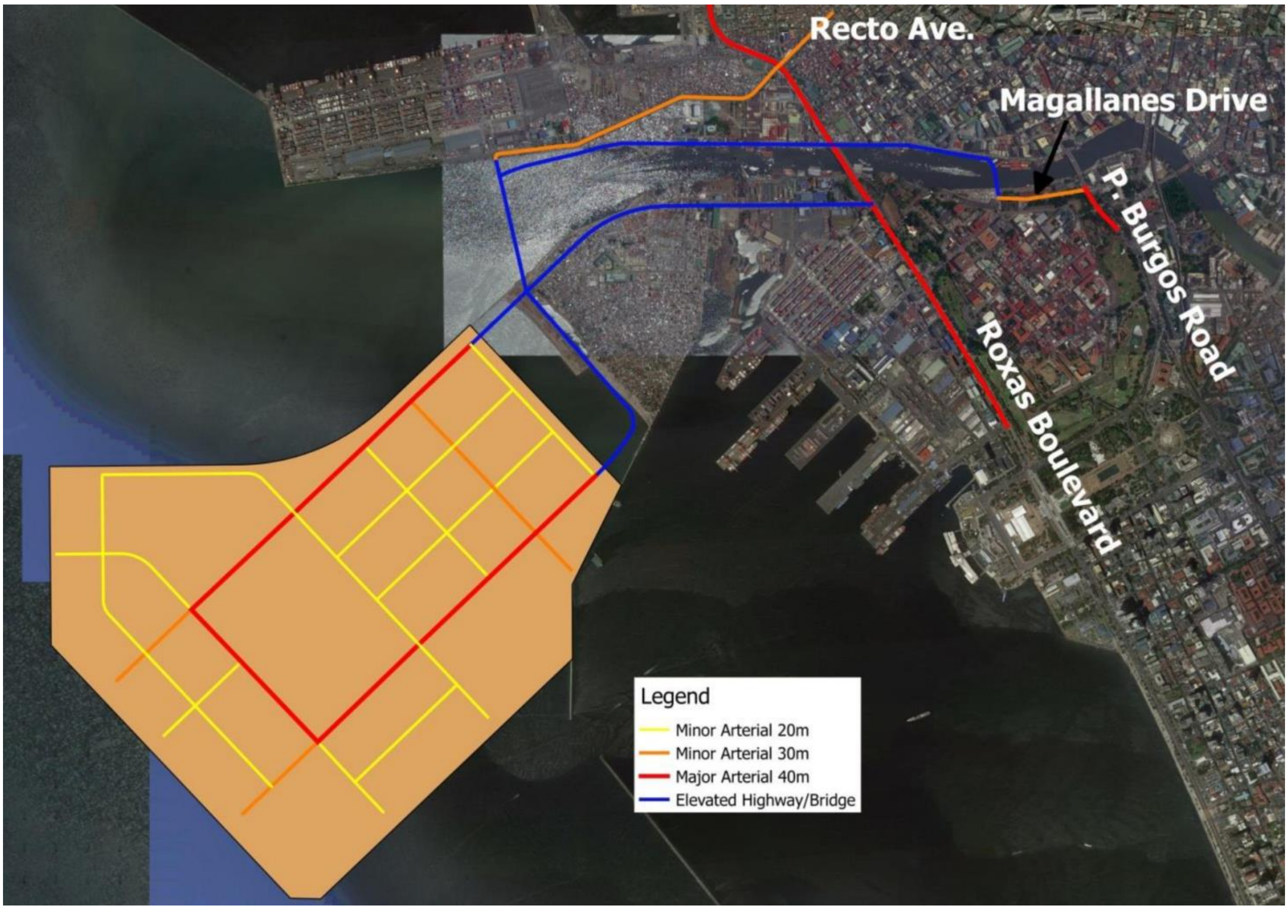


Figure 1-26. Proposed Access Roads for the Project Site

1.4.3.2 Drainage System

Manila Bay is a natural harbor which serves the Port of Manila (on Luzon), in the Philippines. Strategically located around the capital city of the Philippines, Manila Bay facilitated commerce and trade between the Philippines and its neighboring countries, becoming the gateway for socioeconomic development even prior to Spanish occupation.

Successive changes in and around Manila Bay are largely due to the intertwining impacts of continued industrialization, unrelenting increase in population, and the incessant human activities catering to livelihood and habitation. These factors are directly degrading the overall environment of Manila Bay and these impacts are manifested in the continued deterioration of the water quality within the bay.

It is critical to establish a sustainable drainage system within the site to convey the surface runoff to prevent flooding, erosion and to maintain the sea water quality.

The following documentation has been reviewed in drainage system planning:

- Rainfall Intensity - Duration Frequency Analysis Data by Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA); and
- Design Guidelines, Criteria & Standards by the Department of Public Works and Highways (DPWH) (March, 2015).

1.4.3.2.1 Planning Approach & Assumptions

Drainage planning for the development is based on the rainfall-intensity-duration-frequency (RIDF) data for Port Manila obtained from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). The planning approach takes reference from the DPWH Design Guidelines, Criteria and Standards.

The planning parameters adopted for the proposed drainage scheme are listed in table below:

Table 1-6. Drainage Design Parameters and Assumptions

Planning Parameters	Description/ Assumptions
Total catchment size	407.42 ha
Number of sub-catchments	5
Development type	Dense urban mixed use
Runoff Coefficient	0.85
Storm return period	10 years
Rainfall Intensity	210 mm/h

For preliminary sizing of the drains, sufficient freeboard needs to be provided to prevent waves or fluctuation of the water surface from overflowing the cope. Following DPWH Design Guidelines, Criteria and Standards, a freeboard equivalent to 15% of the drain depth is adopted.

The flow velocity is checked to ensure that it is higher than 0.8m/s to maintain self-cleansing of the drains and lower than 3.0 m/s to prevent excessive scouring or hydraulic jumps within the drains.

1.4.3.2.2 Proposed Drainage Plan

Five catchment areas have been identified for the planning area based on the canal discharge locations to the sea as shown in **Figure 1-27**, and the respective catchment sizes are shown in **Table 1-7**.

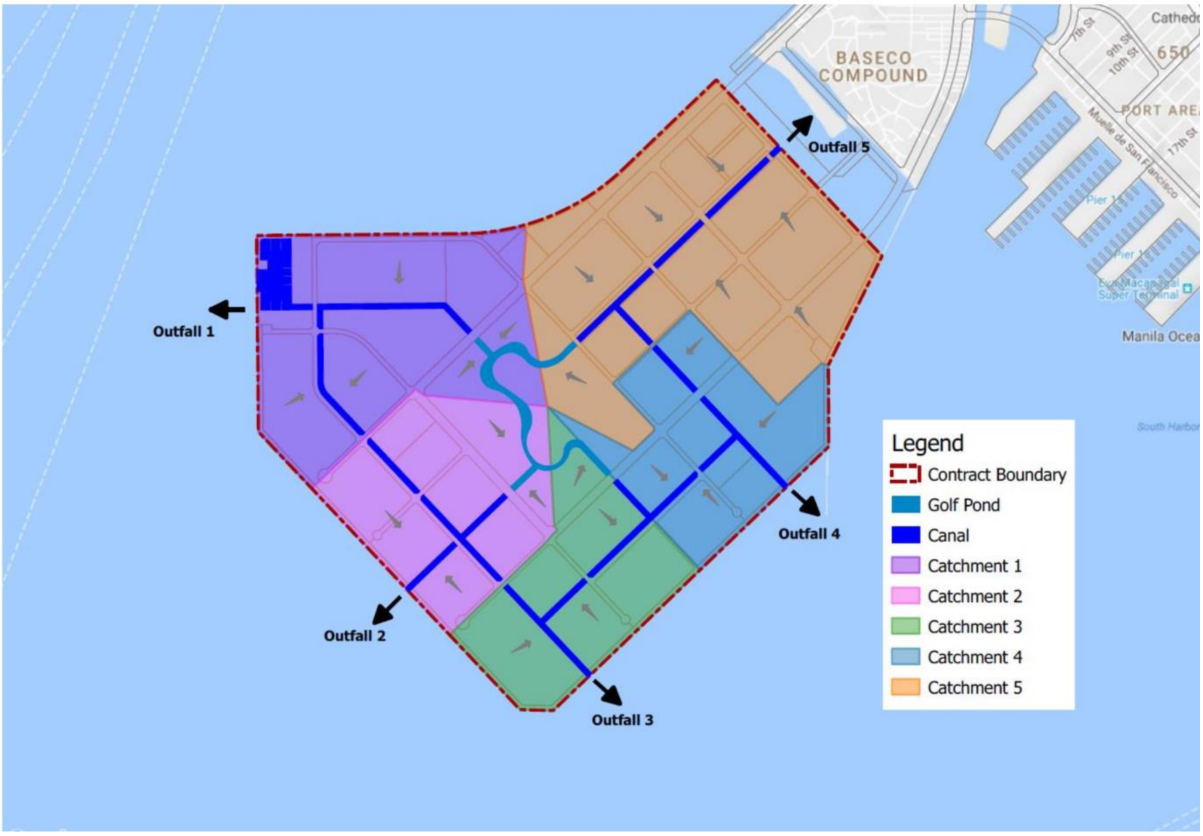


Figure 1-27. Proposed Catchment Plan

Table 1-7. Catchment Sizes

Catchment No.	Catchment Size
Catchment 1	95 ha.
Catchment 2	66 ha.
Catchment 3	58 ha.
Catchment 4	59 ha.
Catchment 5	129 ha.

The proposed drainage system consists of concrete open drains (1.0 to 1.8 m wide) along both sides of the roads, canals (waterways) channelling flow toward the sea, and a detention pond (water body as part of the golf course) as shown in **Figure 1-28**. The drainage network is designed such that the storm water runoff from the various land use plots and roads flows to the nearest drain, and then to the canals at the shortest possible distance, so as to minimize the drain size and depth. The canals serve as a collector which will then discharge the storm water out into the sea.

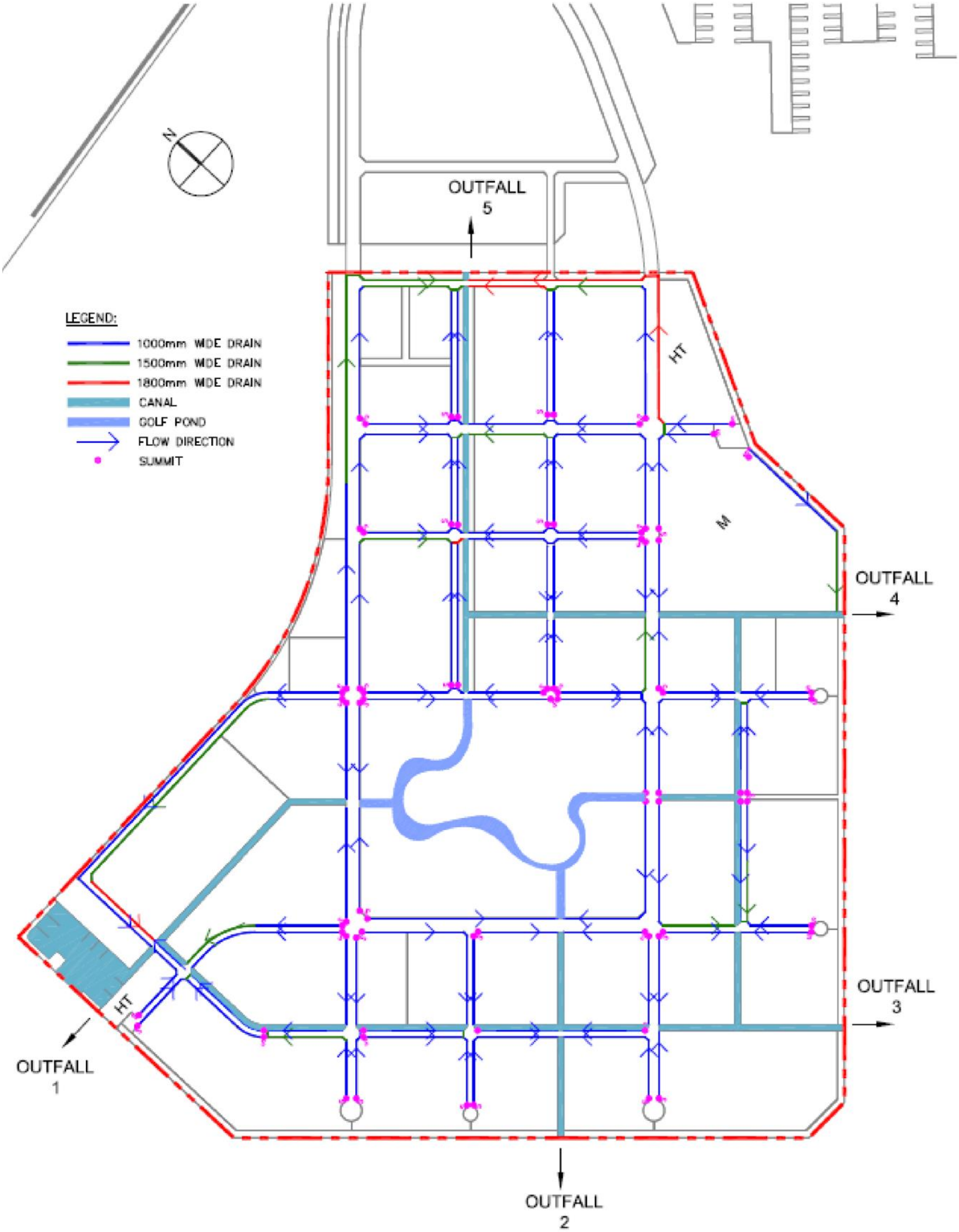


Figure 1-28. Proposed Drainage Layout

1.4.3.3 Water Supply System

Water supply in the project area is covered by the west concessionaire, Maynilad Water Services, Inc. (Maynilad) Access to the existing water supply network of Maynilad Access is identified to be at 2nd Street corner Bonifacio Drive based on a public utilities information in a letter dated 14 June 2016 from the Department of Engineering and Public Works. From this tapping point, it is assumed that water pipeline will be laid along 2nd Street towards the proposed development and will branch out into two pipelines into two proposed underground water storage tanks which hold the total backup storage for the development. The proposed water supply network plan is provided in **Figure 1-29**.

The proposed development is planned to have approximately one-day storage capacity for reliability of continuous water supply to the entire site. The project's estimated total water demand of 40,052 m^3/day is proposed to be stored in two (2) locations of underground water tank which has a storage capacity of 20,050 m^3 each.

Water tanks in general may be designed to be on-ground or underground. For aesthetic purpose, the water storage for this development is planned to be built underground to hide the huge structure of the water tank and leave only the pump house visible on ground. Although this is more expensive to build and maintain than an on-ground tank, it allows for utilization of the area above the massive underground tank as a green area.

The underground tank is estimated to require 0.5 ha of land, and above it, a 0.15 ha of land is allocated for pump house and some minor access roads. The rest of the area above may be landscaped to achieve desired attractive appearance.

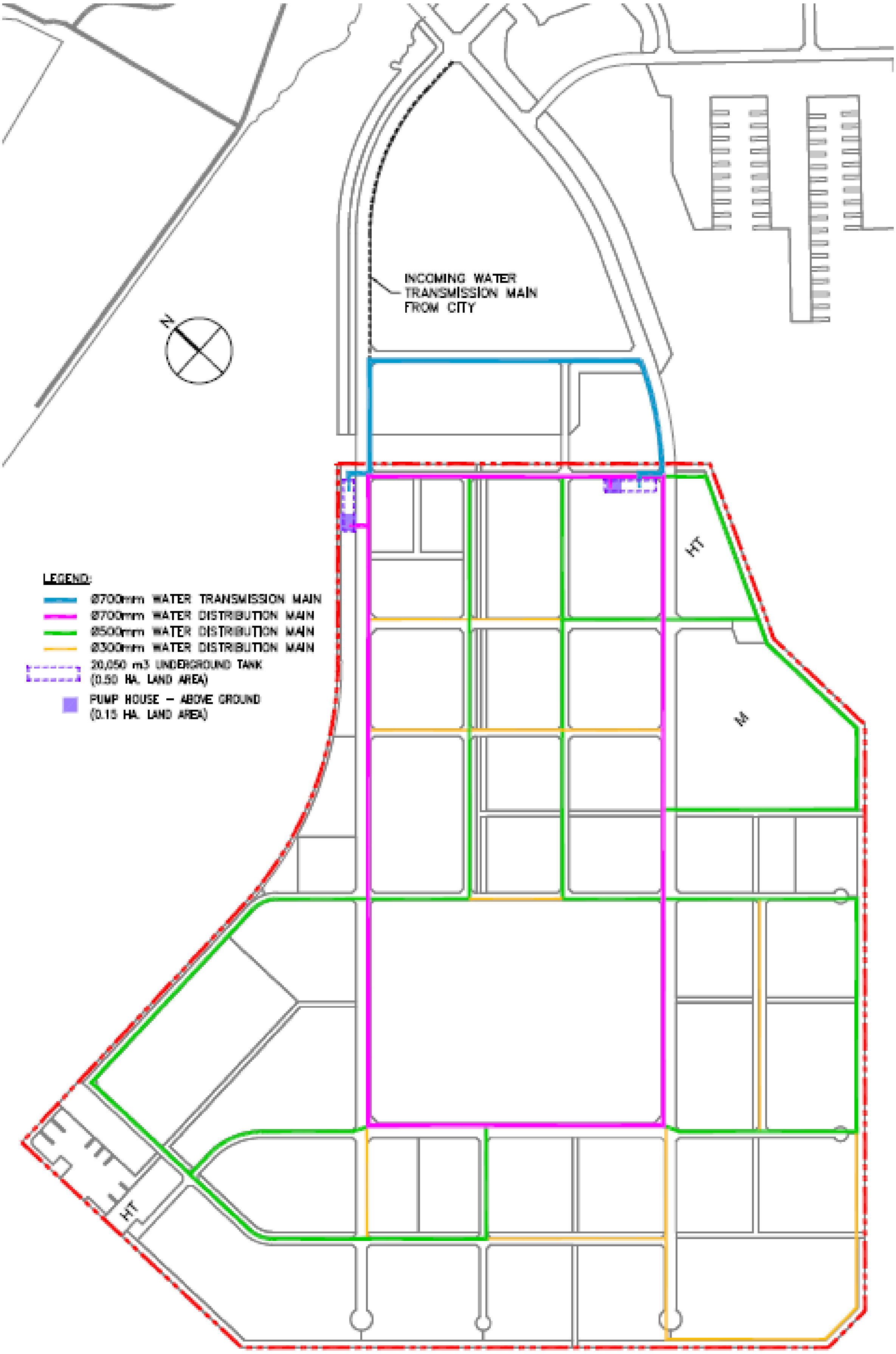


Figure 1-29 Proposed Water Supply Network Plan

1.4.3.4 Sewerage System

Based on the public utilities information as stated in letter from the Department of Engineering and Public Works to the Manila OIC City Engineer dated 14 June 2016, the area in Baseco is not covered by a sewerage system. No plans of the nearest existing sewerage network in the area has been shared by the authorities and no further information regarding existing or future sewer lines have been made known.

As such, the project will have its own on-site Sewage Treatment Plants (STP) and sewerage network. For this project, land use optimization is of primary concern, so a wastewater treatment technology with compact footprint and minimum environmental impact would be proposed. To minimize the need for sewage lifting stations, which also require additional land take, the entire development site will be divided into various subcatchments, so as to allow for gravity flow sewers with reasonably shallow depth.

The sewage flow for the development is estimated based on the assumption that 80% of the water consumed would be collected by the sewerage system. The total sewage flow is estimated to be 25,633 m^3/day (**Table 1-8**).

Table 1-8. Sewage Flow Projection

Land Use	Water Demand (m^3/day)	Sewage Flow (m^3/day)
Residential Villa	121	97
Residential Condo	18,442	14,754
Retail and Shopping Mall	4,050	3,240
Hotel	5,855	4,684
Convention Center (MICE)	2,908	2,326
Education	463	371
Social Amenities	106	84
Place of Worship	97	78
	32,042	25,633

The proposed sewerage plan is designed based on gravity flow. The sewerage network conveys the municipal sewage from residential and commercial areas to its respective STP per catchment. The proposed sewerage network consists of sewer pipes of various diameters ranging from 250 to 650 mm with a maximum depth of 6m.

The project area will be divided into four (4) sewage sub-catchments, each one having an on-site STP of its own. Utilizing distributed STPs requires smaller land area which is easier to accommodate with minimal disruption to the intended land use. The proposed sewerage network plan is provided in **Figure 1-30**.

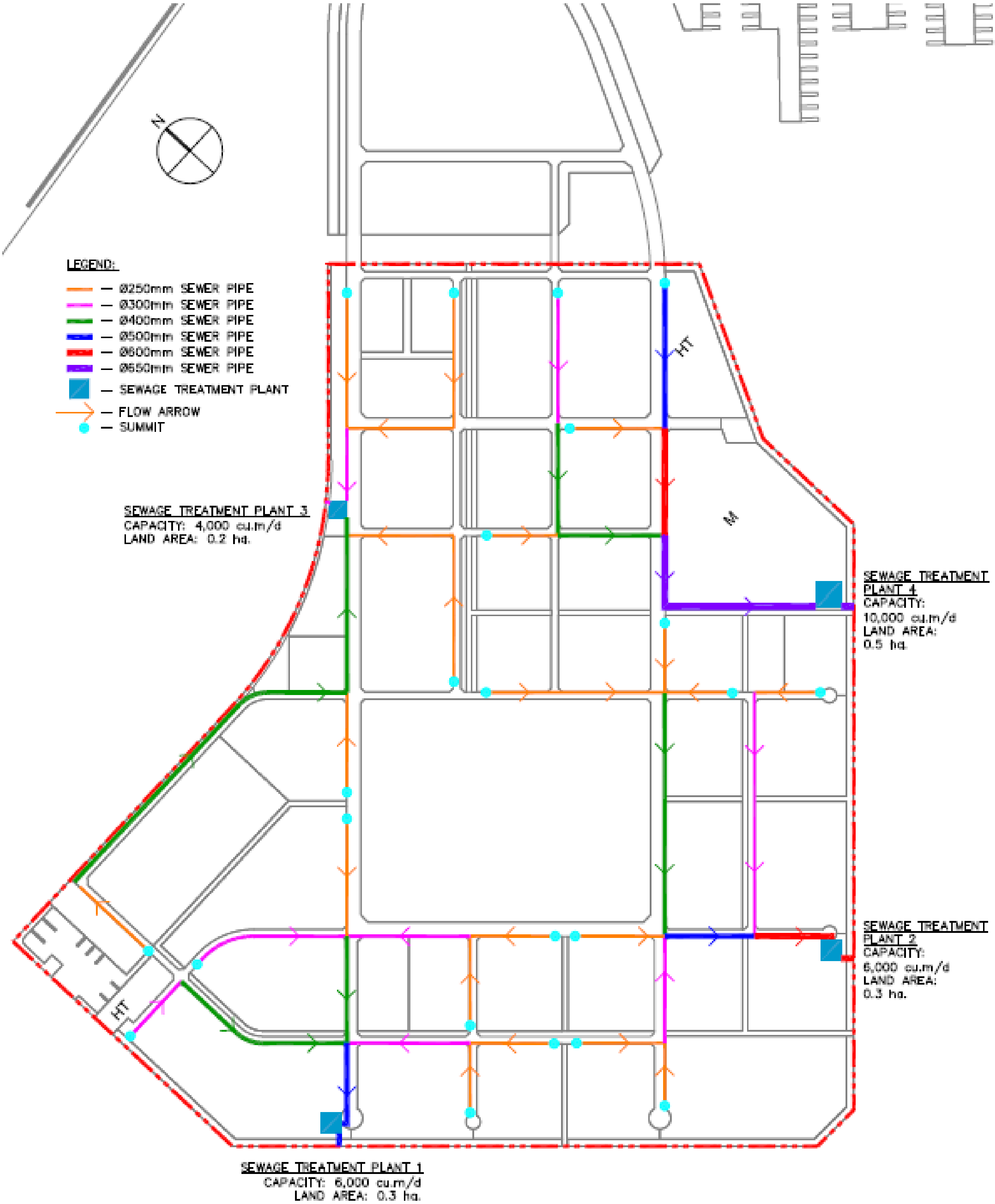


Figure 1-30. Proposed Sewerage Network Plan

1.4.3.5 Power Supply System

The power supply requirement of the project will be supplied by the Manila Electric Company (MERALCO). Two 69 kV incoming transmission lines will be connected to the 69/13.8 kV substations located right at the entrance of the project area, adjacent to the major roads connecting the reclaimed area to the main island. These substations will then distribute power to four 13.8/4.16 kV substations located within the project area via 13.8 kV underground cables. The project is considering that power supply be through an underground distribution network. In this case, the power lines within the development area will be less affected by extreme weather conditions.

1.4.4 Pollution Control Devices and Waste Management System

1.4.4.1 Wastewater

This will essentially be generated by personnel on board the sea crafts (dredging vessels and rock haulage barges) which are self-contained having their individual toilet and waste collection facilities. Waste water will be discharged through third-party waste treaters.

On site portable toilets and wash rooms may be planned for the soil stabilization phase of the reclamation works.

1.4.4.2 Air Pollution Control Device

In general, air pollution may be due to fugitive dust during construction works and from operation of heavy equipment and generators. Air pollution is anticipated to be temporary and short-lived. The mitigating measures or devices in place are as follows:

- The sea crafts will have their individual smoke stacks to serve as control device which will be connected to the exhaust of the pump engines.
- Use of well-maintained equipment and vehicles
- Use of efficient fuels

1.4.4.3 Other Wastes

Dredging operation in the borrow materials site and in the project area will generate unsuitable materials. This may cause disturbance of the sea bed and potentially increase turbidity and total suspended solids in the vicinity of the project area. Silt is of major concern, which is the solid waste from dredging of undesired sea bed materials. Silt curtains will be used as waste management method to contain the dispersal of these materials.

Waste management procedures for hazardous, solid and domestic wastes generated during construction period are as follows:

- Used oil will be collected and put inside sealed drums, stored in a designated storage area inside the project area or inside the vessel used. It will be transported and treated by a DENR accredited TSD facility.
- Busted Fluorescent Bulbs will be put in a container, stored inside the designated storage area until there is sufficient inventory for proper disposal through a DENR accredited TSD facility.
- Contaminated rags and gloves will also be put in bags, stored inside the designated storage area in accumulation until there is sufficient inventory for proper disposal through a DENR accredited TSD facility.
- Used equipment and service vehicles batteries will be traded-in to designated suppliers.
- Solid Wastes will be properly segregated and collected and disposed in the Materials Recovery Facility of the City of Manila.
- Domestic Waste will pass to a temporary septic tank that will be constructed or portable toilets will be delivered to the job site and be maintained by DENR accredited waste management company.

The construction contract will specify requirements for the contractor including the use of environmentally safe materials, construction methods that minimize waste including the use of reusable concrete formwork, the collection of solid waste materials and their deposition in clearly marked and segregated receptacles for removal from site to a place of proper disposal.

1.5 Process / Technology

The proposed 407.42 ha reclamation area is proposed to be filled up to a platform level of +4.4 m above MLLW. The summary of the reclamation activities is provided in **Table 1-9**. An estimated volume of 48,000,000 m^3 of sand is required to meet the target platform level. The reclamation works will be carried out in one go – one off development, and will commence from the land side towards the sea side. A sand source located within a 30 km radius from the site such as the San Nicholas Shoal (SNS) is proposed as the borrow area. Other areas that may be considered as alternative source of borrow fill are the foreshore area in Mariveles, Bataan and lahar deposits from Pamapanga and Zambales. Majority of the reclamation area will be protected by sloping revetments, whilst gravity walls and Steel Sheet Pile (SSP) walls are proposed at the marina to seclude and protect the yachts and vessels from potential high wave actions.

The bottom topography of Manila Bay is gently sloping from its mouth at about 1 m per km of horizontal distance. Manila Bay is mostly shallow with an average depth of 17m and about 64 percent of its surface has less than a 10m depth. The proposed project area is considered as a shallow area with water depth varying from 1 to 10m.

Table 1-9. Summary description of reclamation activities

Item	Quantity	Remarks
Dredging and reclamation	48,000,000 m^3	Assume 0.6 m settlement
Sloping revetment	9,000 m	-
Concrete block wall	400 m	-
Sheet steel pile	400 m	-
Channel dredging	11,000 m^3	Assume minimum depth 3.0 mMLLW, width of 30m
Sand key dredging	6,000,000 m^3	Assume 8m sandkey depth, 20m bottom width

The general process flow of the project is provided in **Figure 1-31** and discussed in the succeeding sections.

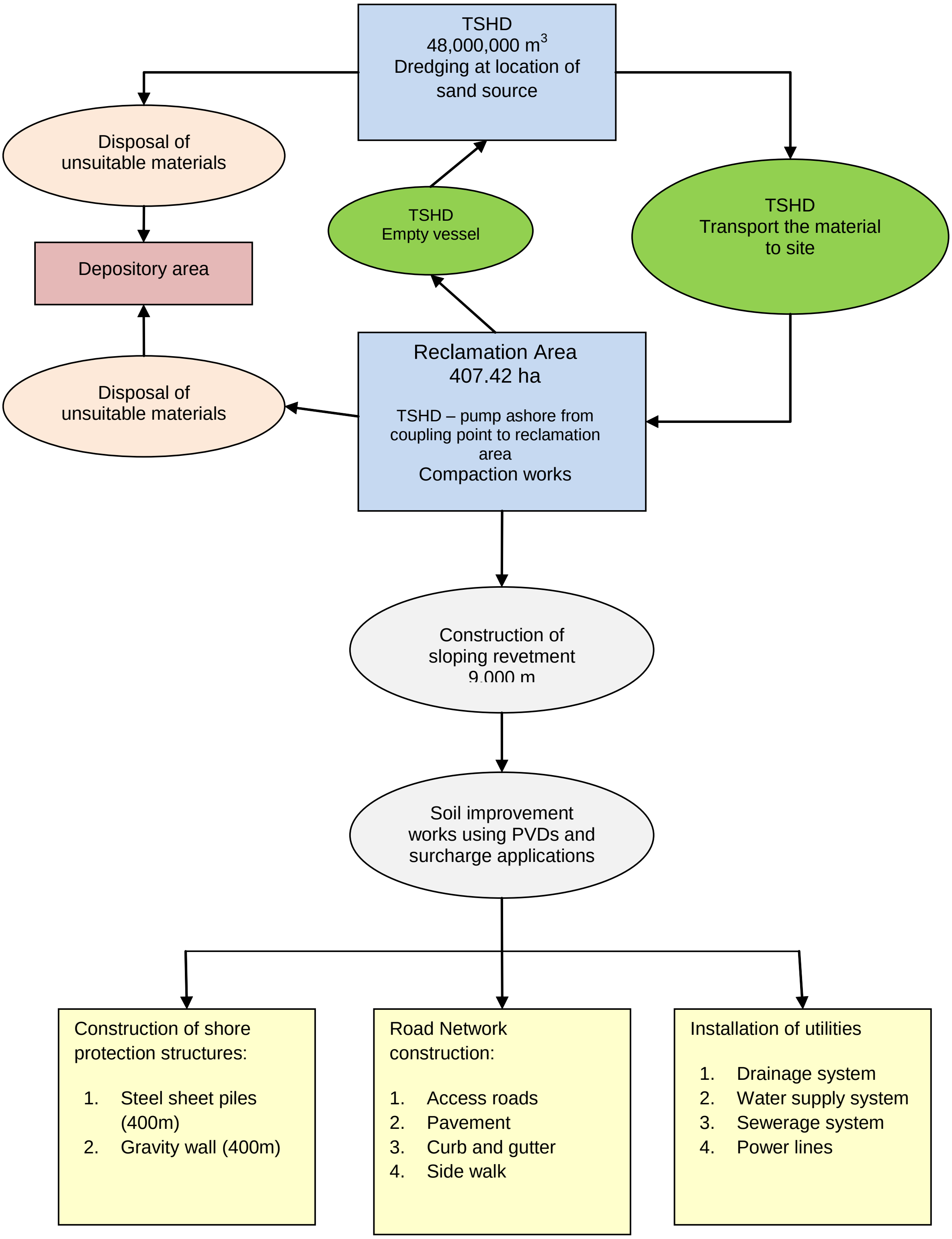


Figure 1-31. Process flow of the proposed New Manila Reclamation Project

1.5.1 Dredging and Reclamation

The dredging considerations for this project are as follows:

- To maximize the production while complying with the spill budget requirement.
- To minimize the impact to the surrounding environment.
- To comply with the conditions imposed by relevant authorities such as instructions from the Port Master's Department.

Two types of dredging activities are proposed for this project, namely dredging at the borrow area to fill the reclamation area with good fill material and dredging of sandkey foundation to cater for shore protection structures. These activities are elaborated in the succeeding sections:

1.5.1.1 Dredging at Proposed Borrow Pit

A sand source located within a 30 km radius from the site such as the San Nicholas Shoal (SNS) has been planned for as the borrow area for the fill material. The sand from the borrow area will be dredged using a TSHD and transported to the site once the hopper is fully loaded. At the site, a bow coupling unit will be utilized to serve as a special link between the TSHD and floating pipelines for pumping the sand material ashore to fill the reclamation area. After the hopper is fully unloaded, the THSD will sail back to the borrow area and continue to dredge the material and proceed to the fill site once is fully loaded. This dredging and filling process is repeated until the project site is fully reclaimed up to the proposed platform level.

1.5.1.2 Sandkey Dredging for Sloping Revetment and Gravity Wall Foundation

Sandkey dredging is a method that is commonly used in the field of coastal engineering to provide a firm foundation for shore protection structures. The provision of a firm foundation will ensure that structures are structurally safe and stable against high wave actions as a result of potential storm surge and monsoon events. Preliminary studies show that the existing soft and compressible underlying soil may pose foundation and structural stabilization issues to structures. As such, it is vital to create a strong and firm foundation for these structures by dredging away the soft material to form a trench which is then replaced with good granular fill material.

After the filling of the trench, the sandkey foundation will have to be compacted to a certain required standard compaction limit. This can be achieved by utilizing several types of compaction techniques such as compaction via bulldozer or vibratory roller, dynamic compaction or vibrofloatation. The primary purpose of conducting compaction is to enhance the soil stiffness and density by closing the gaps or voids between the soil particles. This will provide a strong and firm foundation which may prevent liquefaction and subsequent damage to structures in earthquake sensitive regions.

1.5.2 Reclamation Methodology

The reclamation works are proposed to be commenced from the land side adjacent to the existing Baseco Compound and continue progressively towards the sea side. This sequence of work is recommended as it will minimize and prevent potential loss of fill material during the reclamation duration. The proposed reclamation sequence is elaborated as follows:

1. Commence the construction of sand bunds using excavators from barges.

2. Continue the construction of sand bunds and commence the construction of the sandkey foundation. The construction of sand bunds and the sandkey foundation will be carried out in a progressive manner.

   The construction steps of the sandkey foundation are elaborated as follows:

   a) Dredge the existing seabed for the sandkey along the perimeter of the reclamation site using Backhoe Dredgers (BHD) and hopper barges.
   b) Fill the reclamation site with the sandkey material using excavators operating from the hopper barges.
   c) Replace the existing seabed material with good fill material from the borrow area.

3. Commence the construction of the sloping revetment.

4. Start to fill the reclamation area up to the proposed platform level with sand material from the borrow area using TSHDs.

5. Commence soil improvement works using PVDs and surcharge applications.

6. All construction works including the SSP and gravity wall will move progressively and simultaneously as stipulated above until the entire reclamation area is filled and the shore protection structures are constructed accordingly.

The above reclamation sequence is summarized in **Figure 1-32**.

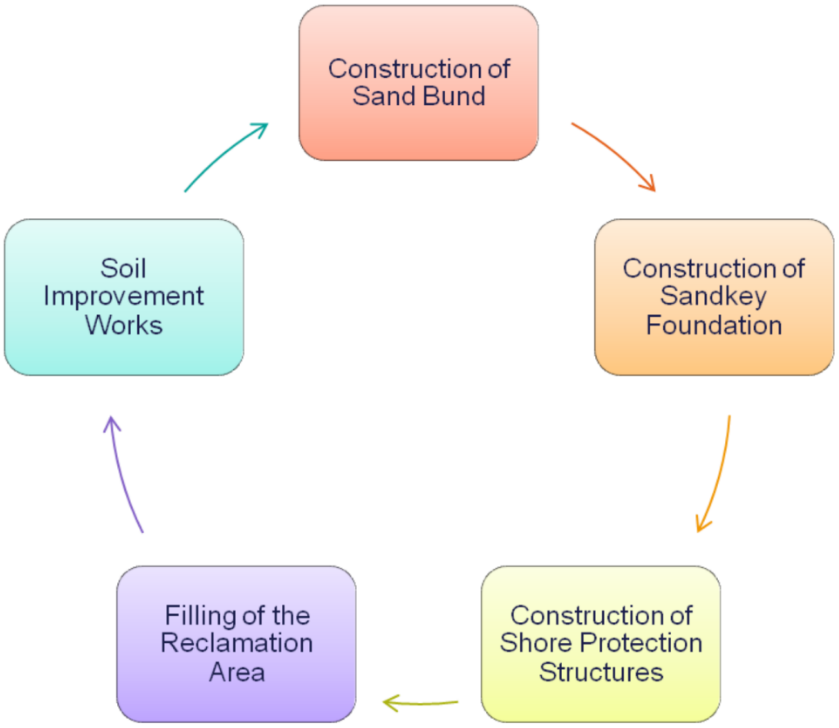


Figure 1-32. Reclamation cycle

1.5.3 Materials Handling and Transport

Trailing Suction Hopper Dredgers (TSHD) and Backhoe Dredgers (BHD) are the main dredging equipment to be utilized during the course of dredging and reclamation. The sand from the borrow area will be dredged using a Trailing Suction Hopper Dredger (TSHD) and transported to the site once the hopper is fully loaded with the sand material. After the hopper is fully unloaded, the THSD will sail back to the borrow area and continue to dredge the material and proceed to the fill site once is fully loaded. This dredging and filling process is repeated until the project site is fully reclaimed up to the proposed platform level.

For the shore protection structures, specifically the installation of sheet pile, a suitable driving system will be selected to ensure successful pile installation with due regards to safety. Materials for the shore protection structures will be delivered through Manila Bay and stock piled near the piling area.

Materials that will be used for the construction of the utilities will be delivered on site and stocked near the place of installation through Manila Bay or by land after completion of the access roads. The concrete and asphalts mixture will also be delivered by the supplier in stored in an appropriate location within the project site.

1.5.4 Project Infrastructure

As discussed in Section 1.4.3, various infrastructure elements such as water supply, sewerage, drainage and power supply are also studied for the proposed reclamation. For water supply, two underground main water tanks with pump houses will support the overall water demand of the Project, whereas 4 units of sewerage treatment plans are proposed to be installed to manage the waste products. Concrete open U-drains and open canals or waterways are proposed to divert the water flow to 5 outfalls or discharge outlets. For water supply, 2 units of 69 kV /13.8 kV and 4 units of 13.8 kV/4.16 kV substations are proposed to regulate the power supply of the entire Project site. The infrastructure works will be carried out concurrently with the road works, the overall infrastructure works are expected to be completed within a 3.5 year period.

In terms of accessibility, 3 access roads are proposed to connect the Project site to the existing roads. The first is an elevated dual-3 highway over 2nd Street, connected to Bonifacio Drive. The second road is an elevated dual-3 highway from the bridge, running along the northern bank of the Pasig River and connected to Magallanes Drive on the southern bank. The third access is to connect the new bridge over Pasig River with Recto Avenue. The connectivity of the development is also further enhanced with the public transportation system such as shuttle bus and ferry services. Preliminary studies show that the traffic levels on existing roads during morning and evening peak will be of acceptable levels with the proposed development, subject to implementation of traffic control measures such as removal of illegal roadside parking, provision of designated pedestrian crossings, reduction in number of accesses into major roads and synchronization of traffic lights on the same stretch of road. The road works will also be carried out concurrently with the infrastructure works within the 3.5 year period.

1.5.5 Description of the Operations and Maintenance of Facility

Prior to commencement of operations and upon completion of the project, the developer will turn over the site to the project's management team. The management team will consist of highly skilled management staff, engineers, and skilled personnel for roads and utilities maintenance, as well as security and emergency response staff. The facilities that the operations team will manage consist of:

- Water reservoir equipment
- Sewage treatment facility
- Electrical sub-station
- Materials recovery facility

As the project has a perpetual lifespan, continuous maintenance, enhancement and upgrading will be done to be environmentally-compliant and ensure safety of the facilities. Structures and equipment will be assessed regularly.

The operations phase will also involve the construction of buildings and structures by various locators and the operation of their activities. This phase is not included in the scope of this EIS and in the application for an ECC.

The locators will be required to follow the design concept of the reclaimed area based on its containment or carrying capacity. All locators will also be required to comply with all existing ordinances of the City Government of Manila.

1.6 Project Size

The proposed 407.42 ha reclamation area is to be filled up to a platform level of +4.4 m above MLLW. An estimated volume of 48,000,000 m^3 of sand is required to meet the target platform level.

1.7 Development Plan, Description of Project Phases and Corresponding Timeframes

1.7.1 Pre-Construction Phase

The City Government of Manila has accomplished various pre-construction tasks in support of the proposed Reclamation Project. These tasks are necessary to ensure compliance with government regulations. The following items are included in the pre-construction tasks:

- Survey and Soil Investigation Works
- Detailed engineering designs
- Philippine Reclamation Authority Memorandum of Agreement
- Application of Notice of Proceed
- Calling for Construction Tender

1.7.2 Construction and Operation Phase

After completing the pre-construction tasks, the City of Manila will then proceed with the construction and procurement phase of the project. The City of Manila, through its designated general contractor, shall implement the following construction and procurement activities for the project:

- Establishment of a camp site for construction personnel and equipment, including temporary lodging (with sanitation facilities), material and equipment storage, and field office;
- Upgrading, improvement and construction of necessary access roads and drainage systems;
- Site preparation for warehouse;
- Construction of the administration office, laboratory, and control room; and
- Procurement and commissioning of reclamation equipment.

Figure 1-33 shows the reclamation schedule for the project which is planned to accomplished within a period of three years from start of mobilization.

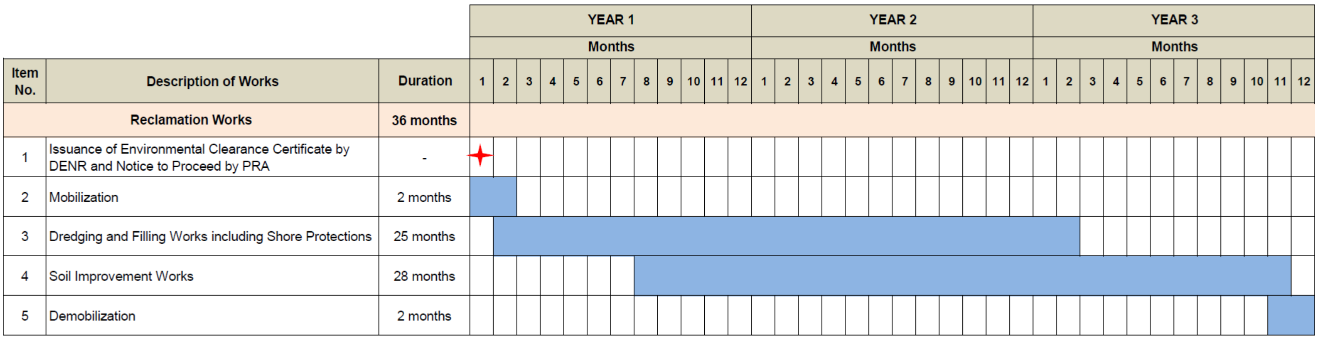


Figure 1-33. Reclamation Schedule

The reclamation works will be carried out in one go – a one off development, and will commence from the land side towards the sea to the extent of the reclamation profile.

The reclamation profile has been studied and modified hydraulically such that it will not affect the existing hydraulic condition, navigation channel as well as nearby harbor operations. Overall, the entire reclamation project is proposed to be completed within a 36-month period inclusive of soil improvement works.

The following reclamation sequence will be applied for the project:

1. Construction of Sand Bund
   The construction of sand bund to be done using excavator that operated from a barge.

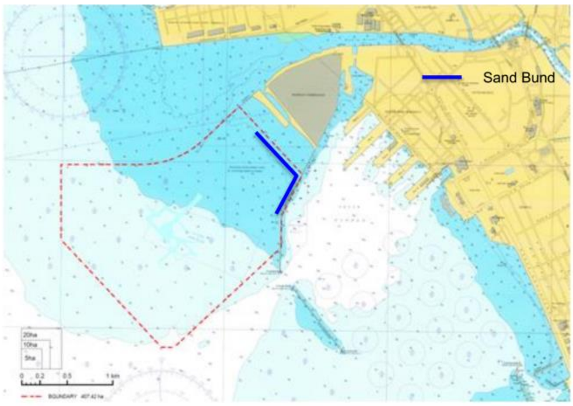


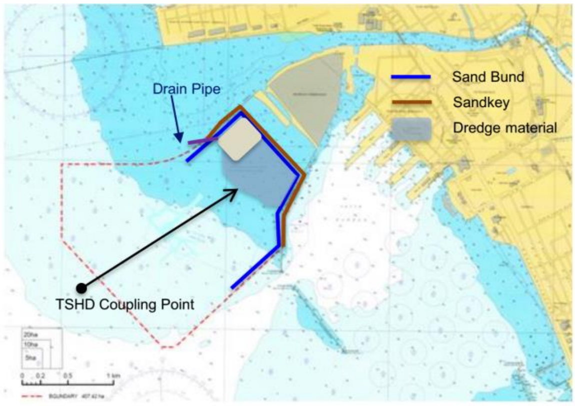
Figure 1-34. Construction of Sand Bund

2. Continuing the Construction of Sand Bund and starting the Construction of Sand-Key.

a. Dredging the existing seabed for sand-key at the boundary location using backhoe dredger.

b. Filling the reclamation area with the sand-key dredging material (not more than 2 m thickness).

c. Replace the existing seabed material with good material from borrow area.



Equipment	Total	To date
TSHD	1	1
Tug Boat	4	2
Backhoe dredger	3	2
Excavator	4	1
Bulldozer	4	0
Clamshell and barge	2	0
Wheel loader	4	0
Vibratory Roller	4	0

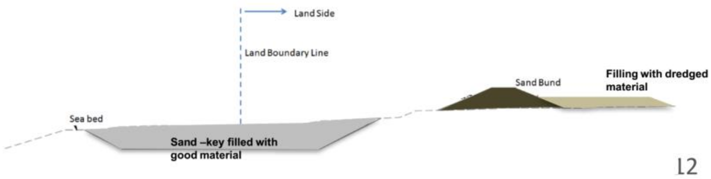
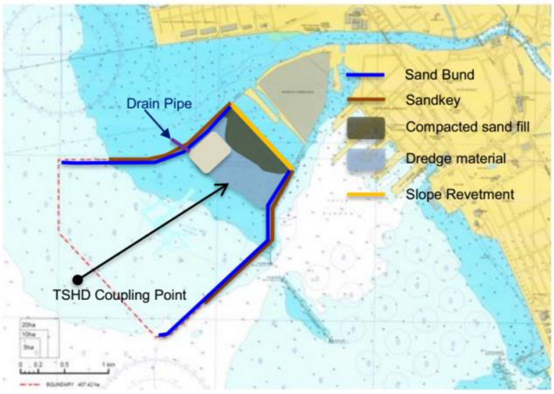


Figure 1-35. Continuing Construction, Dredging and Reclamation

3. Continuing the sand bund and sand key construction, starting the slope revetment construction.

Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4



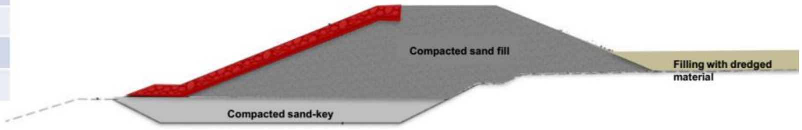
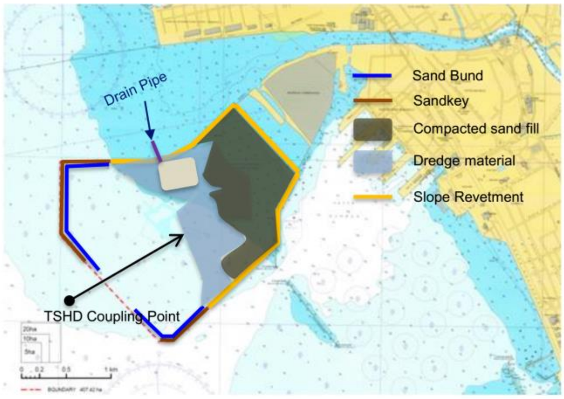


Figure 1-36. Continuing Sand bund and sand key construction

4. Start to fill the reclamation area with sand from borrow area to the reclamation level +4.40 m MLLW.

Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4



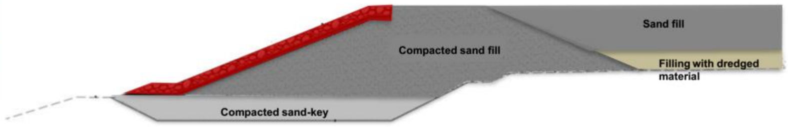
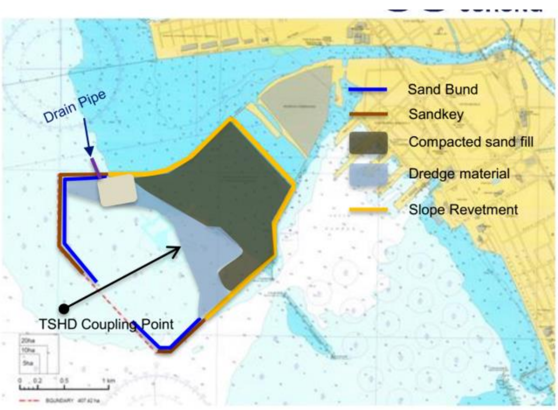


Figure 1-37. Start of Filling the Reclamation

5. Continuing the previous works, starting soil improvement with PVD and Surcharge.



Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4

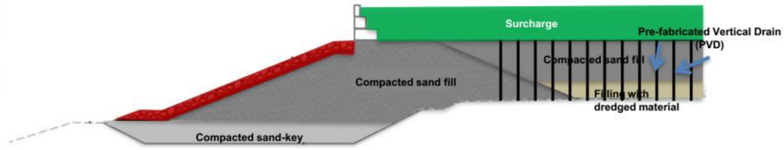
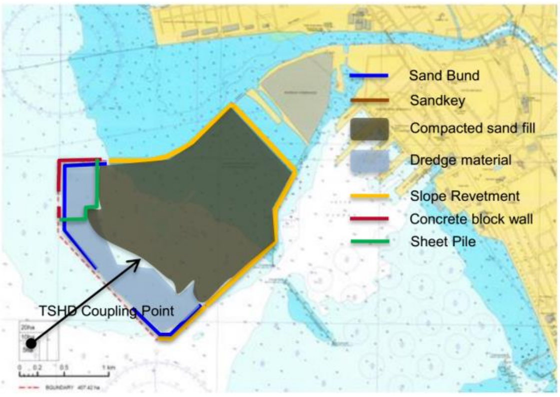


Figure 1-38. Continuing Construction

6. Continuing the previous work, starting the construction of concrete block wall and sheet pile.



Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4

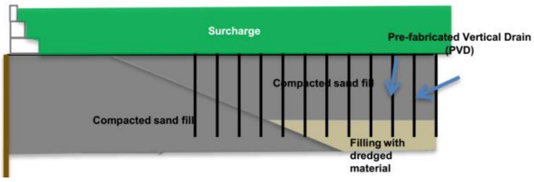


Figure 1-39. Start of Construction of Concrete Blocks

7. Continuing the previous works until the whole area filled and all the coastal protection constructed.

Equipment	Total	To date
TSHD	1	0
Tug Boat	4	1
Backhoe dredger	3	0
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	1
Wheel loader	4	4
Vibratory Roller	4	4

Figure 1-40. Continuing Construction until completion of reclamation

1.7.3 Decommissioning and Abandonment Phase

The project is foreseen to have a perpetual lifespan, and as such, continuous maintenance, enhancement and upgrading will be done to be environmentally-compliant and ensure safety of the facilities. However, should there be a need to decommission or abandon the project; the formulation of the detailed decommissioning plan will be done by the proponent within the specified timeframe as part of the post-ECC requirement. It will be submitted for approval to the concerned government agencies. The locators within the project site will also be required to formulate a decommissioning plan in compliance with their respective ECCs, which will also be in accordance with the agreement between locators and project proponent.

An Environmental Site Assessment will be conducted to determine contaminants left by the operation, as well as appropriate methods and equipment to be used during dismantling of structures, clean-up and demobilization. Demobilization will be conducted by the contractors as per city government requirements, which will include activities and costs for the transport of all construction equipment used, excess materials, disassembly and transport of temporary facilities used during construction, removal and disposal of all debris and general clean-up of the site. The city government will also require its contractor to post performance bond together with the 10 percent retention to cover any defects and damages left behind after demobilization.

The following are possible options that will be considered during the abandonment phase:

- Removal of site infrastructure and waste;
- All civil structures and associated infrastructure will be removed;

- All remaining materials and hazardous waste will be removed;
- All waste will be disposed of in an appropriate manner; and
- Reusable materials will be resold or recycled.

1.8 Manpower

1.8.1 Manpower Requirement

The total manpower for the raw land reclamation (construction and operation) is estimated to be about 1,095 employees and workers (direct and indirect). The personnel will be mostly composed of operators of reclamation equipment and construction workers for support facilities and administrative personnel. The manpower requirements for construction will mostly entail male workers because of the physical nature of the work.

Table 1-10. Manpower requirements

Project Phase	Workforce	Number
Pre-construction	Specialist, engineers, Surveyors, Geologists, Professional Electrical engineer, Professional Mechanical engineer, Sanitary Engineer, CAD Operators, etc.	115
Construction and Operation	Project Manager, CAD Operator, Laboratory Technician, Drainage Engineers, Surveyors, Quantity Surveyors, Inspectors, Dredging Operators, Barge Operators, Crane Operators, Dozer and Backhoe operators, DT Drivers, Vibro compactors, etc.	980
Total		**1,095**

1.8.2 Scheme for Sourcing Locally from Host and Neighboring LGUs

The proponent shall give priority hiring to locals whose skills and experience match the project's specific needs. A local hiring scheme will be established in close coordination with the concerned barangay Local Government Units (LGUs). In general, the proponent will provide a list of anticipated job requirements with corresponding qualifications to the concerned barangay LGUs. These potential opportunities will be promoted by the barangay LGUs in their respective jurisdictions and potential applicants will be forwarded to the proponent, for further review and evaluation by the Human Resources office.

Consultations shall be made with the LGUs and host communities to finalize a scheme for hiring residents from host communities. Qualified local residents will be given priority in hiring. For technical positions not available in the host communities, the proponent reserves the option to source its manpower requirements elsewhere.

Compensation terms and the process of hiring will comply and adhere with existing labor laws, rules, and regulations.

There is no indigenous group/people present in the project area.

1.9 Indicative Project Cost

The estimated project investment cost for the Reclamation Works is PhP 43.7 billion and about 13.6 billion for Infrastructure and Transport Planning Works.

The summary breakdown for the total project cost is presented in the following table:

Table 1-11. Estimated Cost Breakdown

Item	Description	Amount
Reclamation Works		
I	Preliminaries	PHP 3,783,600,000.00
II	Hydrographic, Side Scan Sonar, and Topographic Survey	PHP 16,700,000.00
III	Dredging (for Channel and Sandkey)	PHP 19,564,900,000.00
IV	Site Preparation and Reclamation Filling including transportation	PHP 6,940,200,000.00
V	Wharf Structure and Slope Protection Works	PHP 7,666,900,000.00
VI	Ground Improvement Works	PHP 3,571,100,000.00
VII	Soil Instrumentation	PHP 29,200,000.00
VIII	Navigational Aids	PHP 4,000,000.00
IX	Compliance to the Environmental Requirement (CEMP and EMMP)	PHP 42,400,000.00
Sub-Total (I - IX)		PHP 41,619,000,000.00
Contingency (5%)		PHP 2,081,000,000.00
GRAND TOTAL		**PHP 43,700,000,000.00**
Infrastructure and Transport Planning Works		
I	Water Supply	PHP 1,890,000,000.00
II	Sewerage	PHP 315,000,000.00
III	Drainage	PHP 525,000,000.00
IV	Power Supply	PHP 1,260,000,000.00
V	External Road	PHP 8,925,000,000.00
VI	Internal Road	PHP 630,000,000.00
Sub-Total (I - VI)		PHP 13,620,600,000.00
GRAND TOTAL		**PHP 13,620,600,000.00**

The Study indicated that a conservative land value was adopted at Php 150,000 per m^2 based on reference to the price of the reclaimed land sold at the more developed Mall of Asia. This area is currently the site for SM Development Corporation's "Shell Residences Project". The BIR zonal valuation at Barangay 649 was set at Php 90,100 per m^2 dated 26 Jan 18[1].

[1] BIR Zonal Values (2017). Retrieved from https://www.bir.gov.ph/index.php/zonal-values.html.

2 Assessment of Environmental Impacts

2.1 Land

2.1.1 Land Use and Classification

The study and investigation of land use and land classification of the project site employed the review of existing documents, maps, plans and reports.

2.1.1.1 Existing Land Use of Manila City

The City of Manila encompasses a land area of 4,045.8 hectares including all reclaimed areas along Manila Bay with a coastline length of 190 km. At 14° 38' latitude and 120° 60' longitude, it is strategically located on the eastern coast of Manila Bay at the mouth of Pasig River which runs on an east-west course through the center dividing the city into the northern and the southern sections. Manila is bounded by seven other cities and municipalities: on the north by Navotas and Caloocan, on the northeast by Quezon City, on the east by San Juan and Mandaluyong, on the southeast by Makati and on the south by Pasay City.

Table 2-1 presents the existing land use of Manila City based on its Comprehensive Land Use Plan covering year 2005 to 2020:

Table 2-1. Land Use Allocation of Manila City

Land Use	Area in Hectares	Percentage (%)
Residential	867.29	20.69
R3-MXD	867.29	20.69
Commercial	1,719.19	41.01
C2-MXD	675.85	16.12
C3-MXD	1,043.34	24.89
Industrial	96.72	2.31
IND-1	96.72	2.31
Institutional	780.74	18.62
INS-1 (general)	149.74	3.57
INS-2 (university clusters)	631.00	15.05
POS	258.85	6.17
POS-GEN	129.88	3.1C
POS-CEM	128.97	3.08
T/U and Unclassified Lands	469.47	11.20
TOTAL	**4,192.25**	**100.00**

NOTE:
T/U and Unclassified Lands - shall mean those of Transport and Utilities Uses, Water Zone, some unclassified lands, and other areas

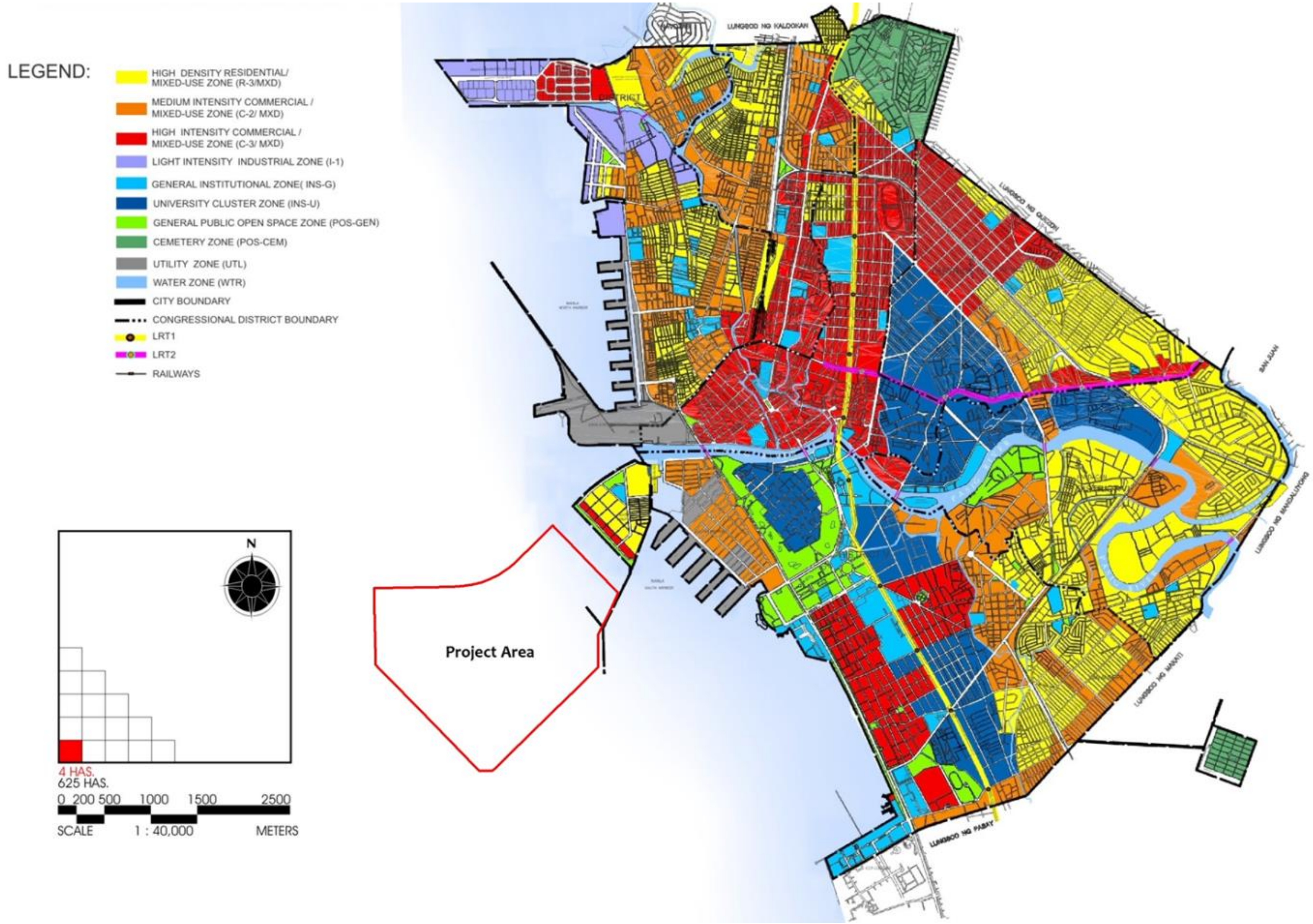


Figure 2-1. Land Use Map of Manila City

Source: Comprehensive Land Use Plan, 2005-2020

Barangay 649, the impact barangay for the Reclamation, is zoned and classified under four zoning classifications such as High Density Residential Mixed Use Zone (R-3/MXD, GENERAL Institutional Zone (INS-G). General Public Open Space Zone (POS GEN) and High-Intensity Commercial Mixed-Use Zone (C-3/MXD) as per Ordinance No. 8119 entitled, Manila Comprehensive and Land Use Plan and Zoning Ordinance of 2006 which was enacted by the City Council on 16 March 2006 and approved in 16 June 2006. The Official Zoning Map of the barangay is presented in **Figure 2-2**.

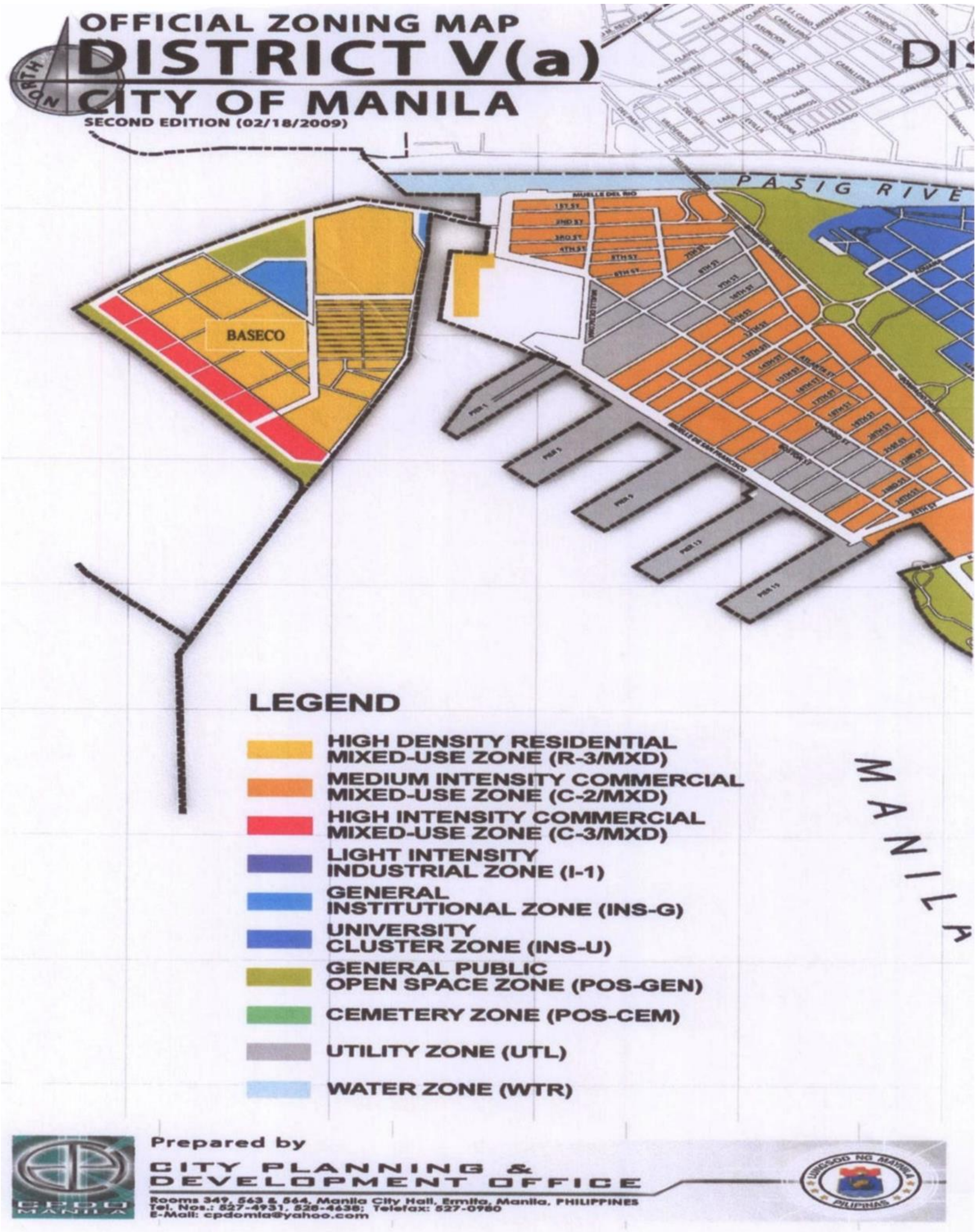


Figure 2-2. Zoning Map of Barangay 649, Baseco, Manila

2.1.1.2 Environmentally Critical Area (ECA)

The project area is situated in the coastal area of Barangay 649. As such no CARP or CADC/CADT areas were identified within or near the area of the project. The proposed project site is situated at Manila Bay and may be vulnerable or susceptible to natural hazards.

The proponent should then ensure that the project management plan is compatible with the Manila Bay Management Plan by the Supreme Court Mandamus. In addition to this, proper mitigating measures and wastes disposal plan should be strictly implemented so as not to compromise the water quality and the current multiple use of Manila Bay.

2.1.1.3 Potential impacts and options for prevention, mitigation and enhancement

2.1.1.3.1 Change/Inconsistency in the Land Use / Water Use

Land use and water use change and inconsistencies associated with project development will commence during the construction phase and remain permanent during the operation phase.

2.1.1.3.2 Encroachment in the ECA

Under DENR DAO 2003-30, there are 12 categories for environmental critical areas (ECA). Of the 12 categories, only one (1) is present within the project area: Areas frequently visited and or hard-hit by natural calamities, and Under DAO 2003-30 Environmentally Critical Projects (ECP) whether located within ECA or not are required to prepare an Environmental Impact Statement (EIS). The City Government of Manila complies with the requirements with the submission of this EIS to the DENR Central Office.

2.1.1.3.3 Impairment of Visual Aesthetics

Various stages of Project development will inject new elements into the existing landscape and visual environment. During the pre-construction and construction phases, the heavy equipment for dredging and reclamation will have the temporary potential to impact on the visual aesthetics on site, including the iconic sunset view of Manila Bay.

The establishment of the reclaimed land, however, will result in permanent changes to the visual landscape of the area.

There is a risk that hazardous and non-hazardous waste could be generated by the construction activities. The waste may be generated from land-based or marine activities (including accidental oil spill). The implementation of a robust waste management plan involving proper storage, handling and disposal procedures for each potential waste stream should be development. In addition, an emergency response plan should be implemented to address any accidental spills of wastes. The construction contractors should implement a reduce recycle and reuse hierarchy.

2.1.2 Geology / Geomorphology

2.1.2.1 Surface landform / Geomorphology

2.1.2.1.1 Topography and Drainage

The City of Manila is a relatively flat land that lies between two main physiographic units: the Manila Bay in the west and the Sierra Madre Mountain Range in the east. It is perceived to be prone to flood especially during the rainy season and during high tide.

The length of its shoreline is approximately 9 km with clusters of squatters observed to be distributed along the shoreline.

It is bordered on the north by Navotas; on the south by Pasay City; on the east by Quezon City and on the west by Manila Bay.

Pasig River is the biggest body of surface water draining the City of Manila. The general topography and the different bodies of surface water draining the City of Manila and its vicinities are shown in **Figure 2-3**.

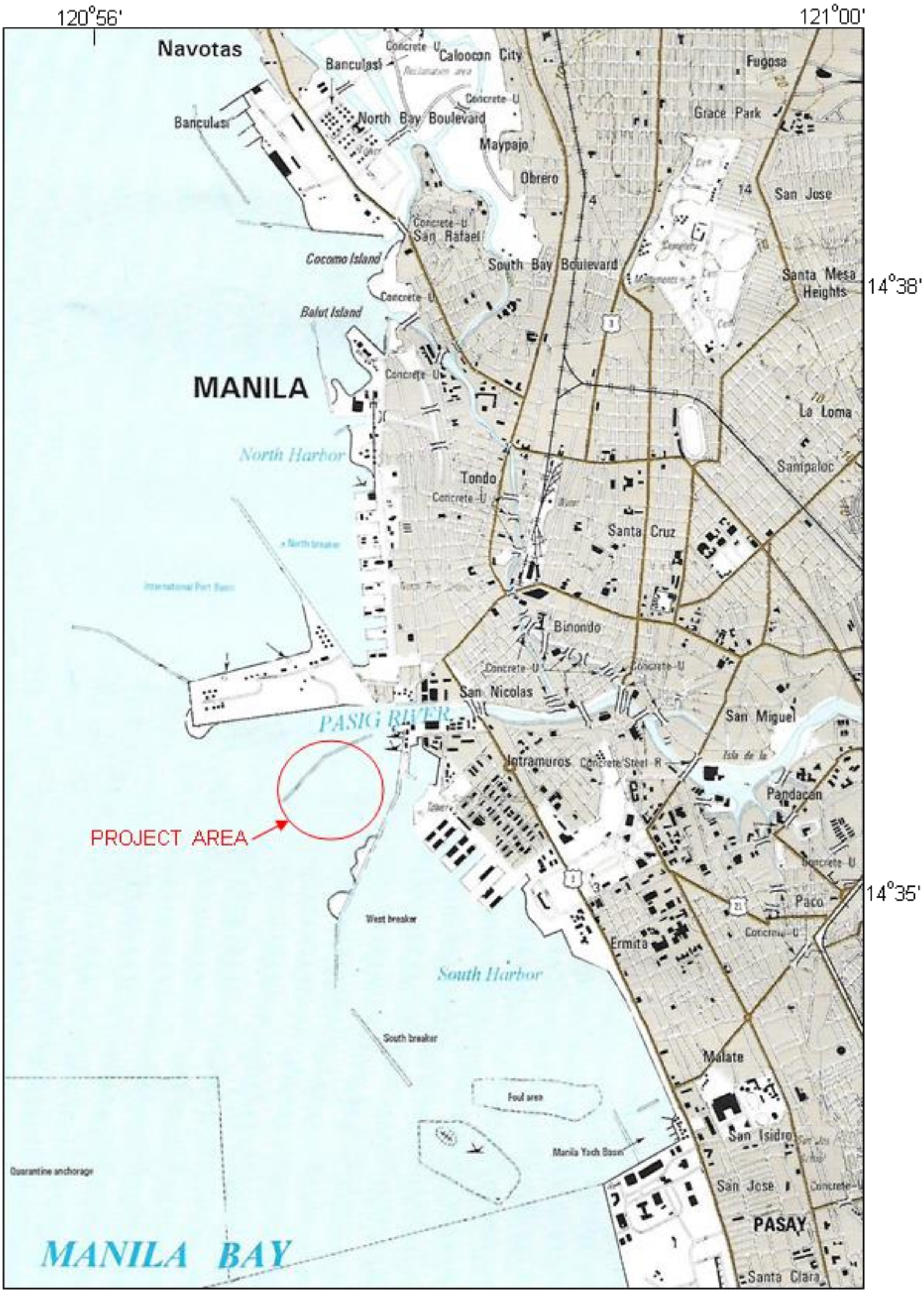
2.1.2.1.2 Coastal Geomorphology

The watershed area of the Manila Bay encompasses the southern half of the Central Plain of Luzon; a 150 km long and 60 km wide north-northwest trending flat terrain bordered along the southwest by the Zambales Range and along the northeast by the southern portion of the Central Cordillera, Caraballo and Sierra Madre mountain ranges.

The bottom topography of Manila Bay is gently sloping from its mouth at about 1 m per km of horizontal distance. The bay is mostly shallow with an average depth is 17 m and about 64 percent of its surface has less than a 10-m depth, mainly at the northern half. The southwestern sector of the Bay is deeper with depths greater than 100 m. Spots of shallow areas, with depth of less than 5 m, are found along the coastline. At its mouth, depth of the Bay is about 50 m, except in the narrow channel north of Corregidor Island, where depth is approximately 90 m.

The seabed bathymetry shown in **Figure 2-4** indicates that the water along the coastline of Manila is generally shallow. The depth of water in the project area varies from 5m to more than 10m. Manila Bay is the catchment for numerous river systems that drain the surrounding land areas. In addition to the Pampanga River and Pasig River, other major rivers discharging directly into Manila Bay are: Meycauayan, Navotas-Malabon-Tullahan-Tenejeros, Talisay (Bataan), Imus (Cavite) and Maragondon (Cavite). Thus, deposition within the Bay is very active.

Depositional features found in the Bay are the sand spit of Cavite and numerous beach and sea bar deposits. The thicker sedimentary sections in the northern parts of the bay are composed of pyroclasic materials extruded by Mt. Pinatubo. Substrate of Manila and adjoining areas of Navotas and Malabon is predominantly estuarine deposits and beach/sand bar deposits.



Source: NAMRIA

Figure 2-3. General Topography and Natural Drainage in the City of Manila

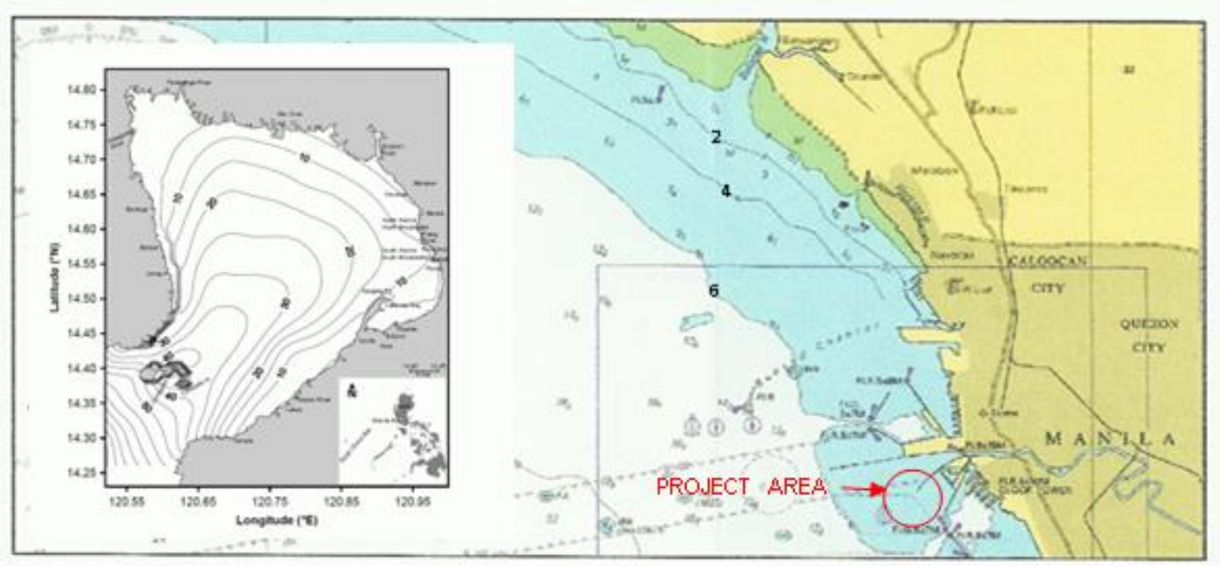


Figure 2-4. Seabed Bathymetry along the Coastline of Manila and Navotas

Source: Admiralty Chart 4491

The project area mainly consists of unconsolidated deposits of Quaternary period. This formation is a result of erosion and re-deposition of former sediments which generally consists of unsorted fluvial and river deposits. Both the effects of climate processes and tectonically young activities caused alluvium of different types, thickness and grain sizes to be formed. The subsoil is generally weak (soft or loose) with thick sequence of Quaternary alluvium made up principally of unconsolidated strata of silty clay and plastic clay.

2.1.2.2 Sub-surface Geology

The Guadalupe Plateau, east of Manila is underlain by the Guadalupe Formation, composed of interlayered pyroclastic flows, lahar deposit, airfall tephra, fluvio-deltaic sediments and paleosols deposited under terrestrial to partly sub-aqueous conditions.

The volcanics range from agglomerate to fine ash, while the sandstone unit grades from very fine to conglomeratic. The pyroclastic flow units are massive to moderately consolidated while the tephra deposits range from massive to thinly laminated and are well consolidated to porous. The presence of paleosols indicates time gaps in depositional events for formational units.

The flat areas near Manila Bay are underlain by unconsolidated sediments deposited during the Quaternary Period. The lithology belongs to Manila Formation named by Purser and Diomampo (1996) based on the result of subsurface investigation using borehole logs. The Manila Formation is composed of unconsolidated sequence of fluvial, deltaic and marine deposits. To the west, the Manila Formation is overlain by beach sand which blankets the coastline of Manila Bay. Further to the east, the Manila Formation overlay the Proto-Pasig Delta deposit that includes transitional, marine transgression sediments and the Modern Coastal Deposits mainly recent marine sand/silt, recent stream deposits and fill materials.

Figure 2-5 presents the Geologic Map of Western Manila while **Figure 2-6** presents the Geologic Map of Metro Manila.

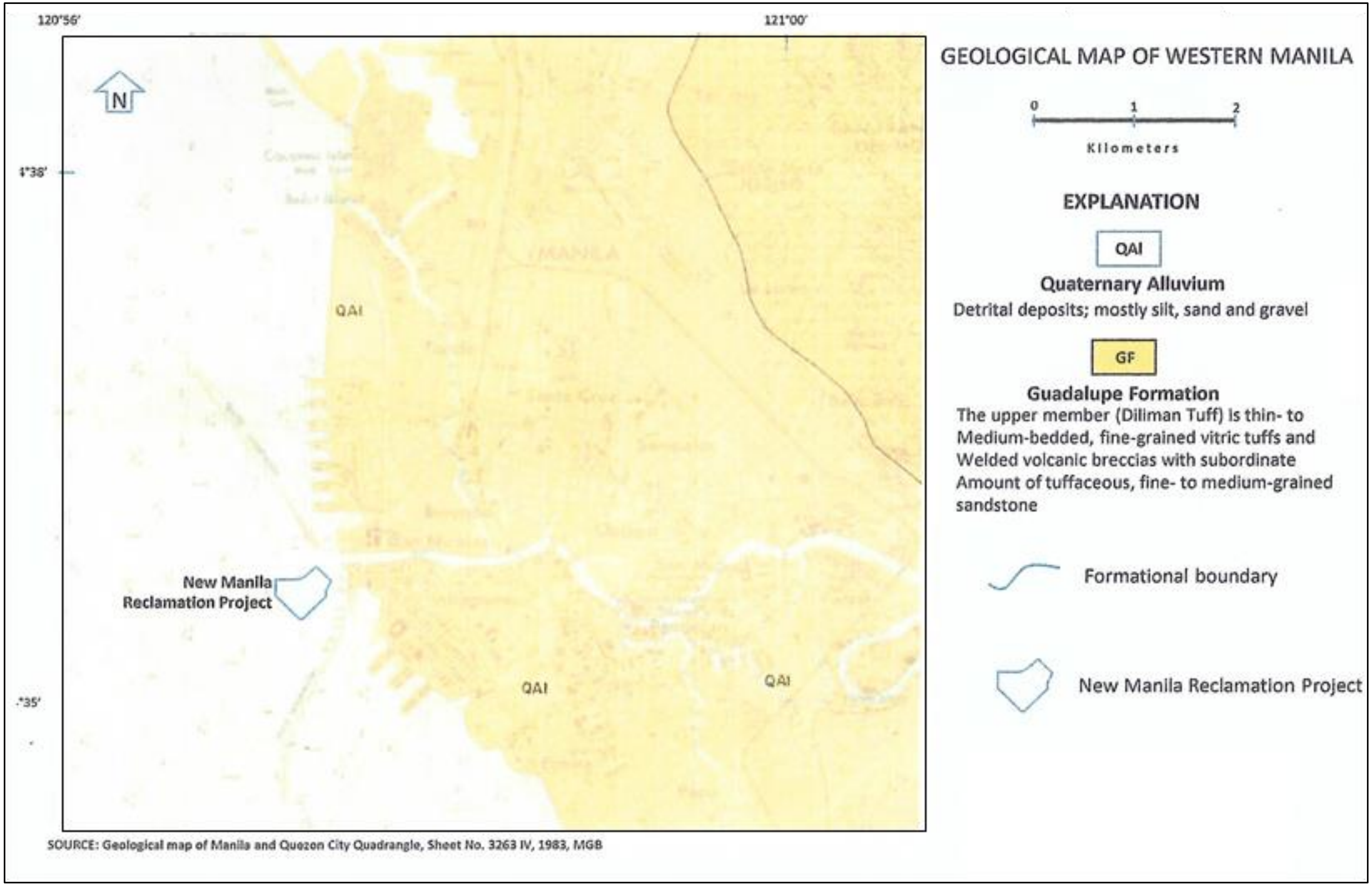
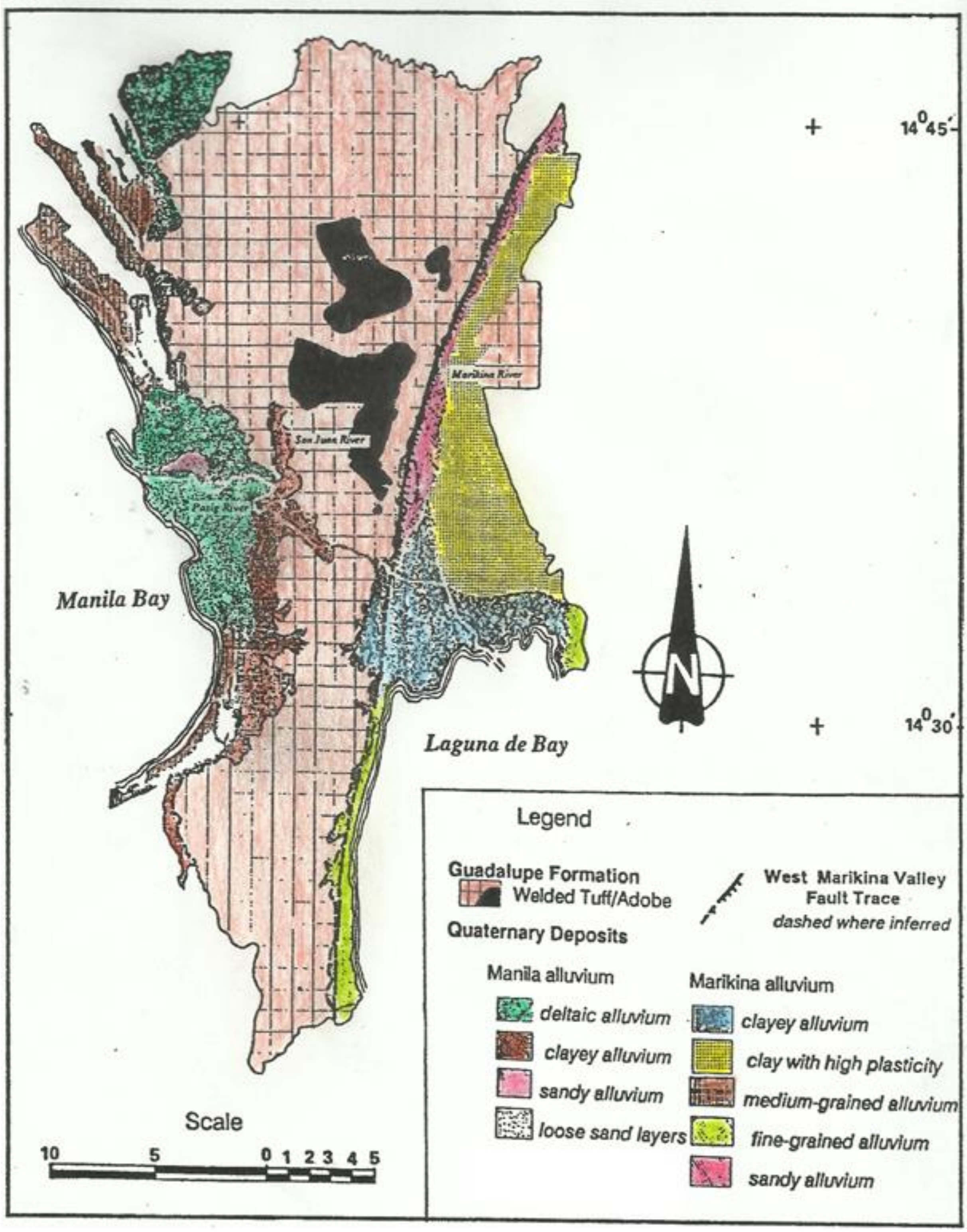


Figure 2-5. Geologic Map of Western Manila



Source: PHIVOLCS, Modified from MMA 1985

Figure 2-6. Geologic Map of Metro Manila

2.1.2.2.1 Local Geology

The City of Manila is generally underlain with recent (Holocene) marine sediments, consisting of sand bars and sand-spits from tidal inundation and delta deposits to form lagoons from the recent river flows. The area and its immediate vicinity used to be a wide estuary that was filled-up with fill materials of varying composition. The tidal surface consists mainly of alternating layers of sand, silt and clay (Holocene age) about 200 years ago.

The geological profile of the City of Manila consists of reclaimed landfill, Holocene deposits and Pleistocene deposits in order from the ground surface.

2.1.2.3 Geologic Hazards

2.1.2.3.1 Tectonic Setting

Since the 15th century up to the present, Metro Manila and its neighboring provinces have been shaken by more than 20 major earthquakes generated from several major and minor fault systems within the archipelago.

The Philippine Archipelago is situated at the convergence of the Eurasian Plate and the Philippine Sea Plate which belongs to an active trench-arc complex. It consists of several areas of rifts and opposing trench-arc systems. **Figure 2-7** shows the different seismic zones and the rift and arc systems in the country as follows:

Zone I – Related to Manila Trench, dipping east
Zone II – Related to East Luzon Trough, dipping west
Zone III – Related to Sulu Sea Trench and Antique Trough, dipping east
Zone IV – Related to Philippine Trench, dipping west
Zone V - Related to Cotabato Trench, dipping east
Zone VI – Related to Philippine Fault
Zone VII – Related to Agusan-Davao Trough, dipping west

Based on the Seismic Zone Map, the project area falls under Zone VI, related to Philippine Fault.

The geologic setting of the Philippines makes it prone to various types of seismic-related hazards. The high level of seismicity within the Philippines, averaging about five detectable earthquakes per day, is attributed to movements caused by the interaction of major tectonic plate boundaries along the subduction zones and those generated from active faults.

Figure 2-8 shows the project area relative to the locations of major earthquake generators.

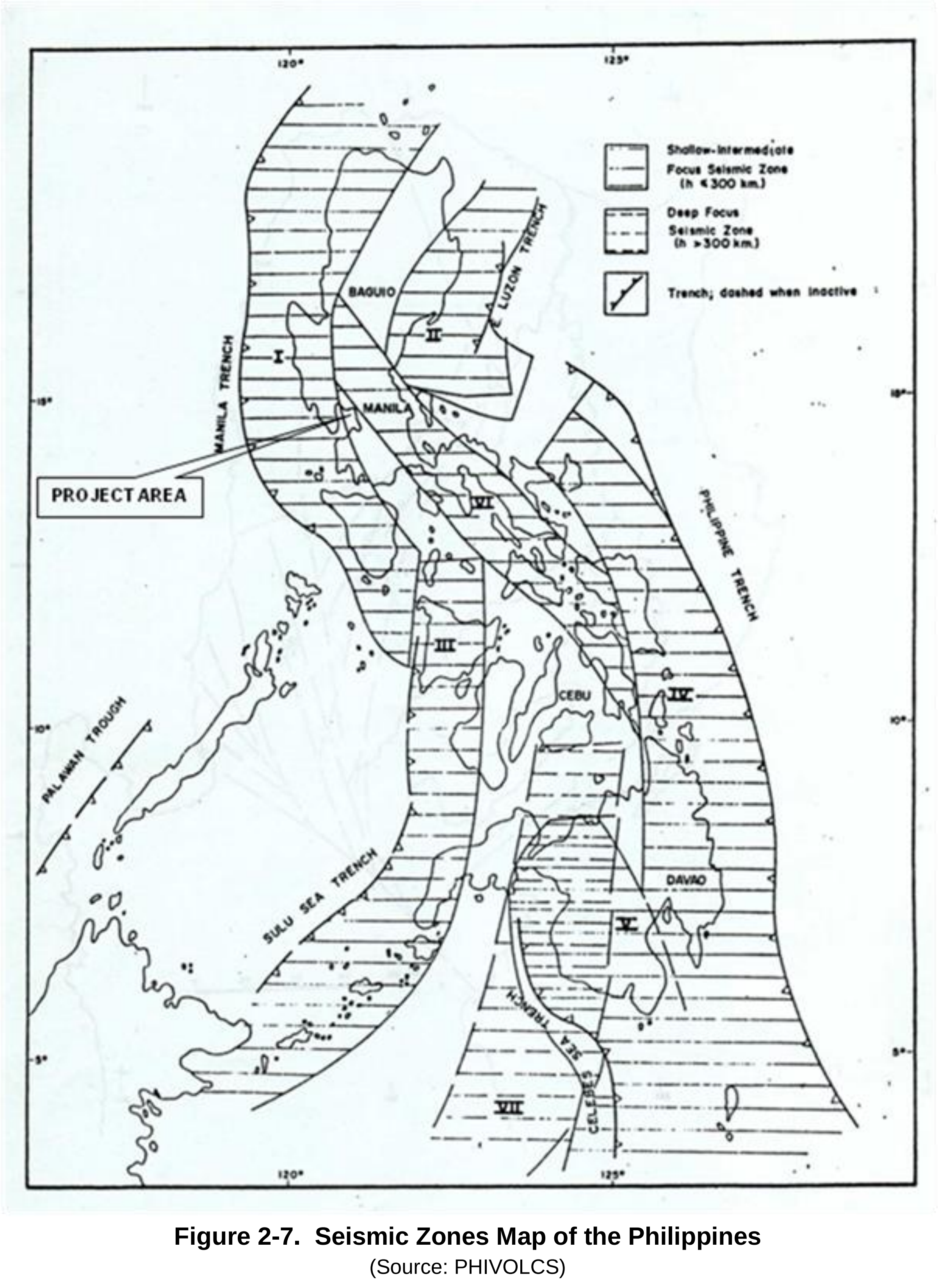
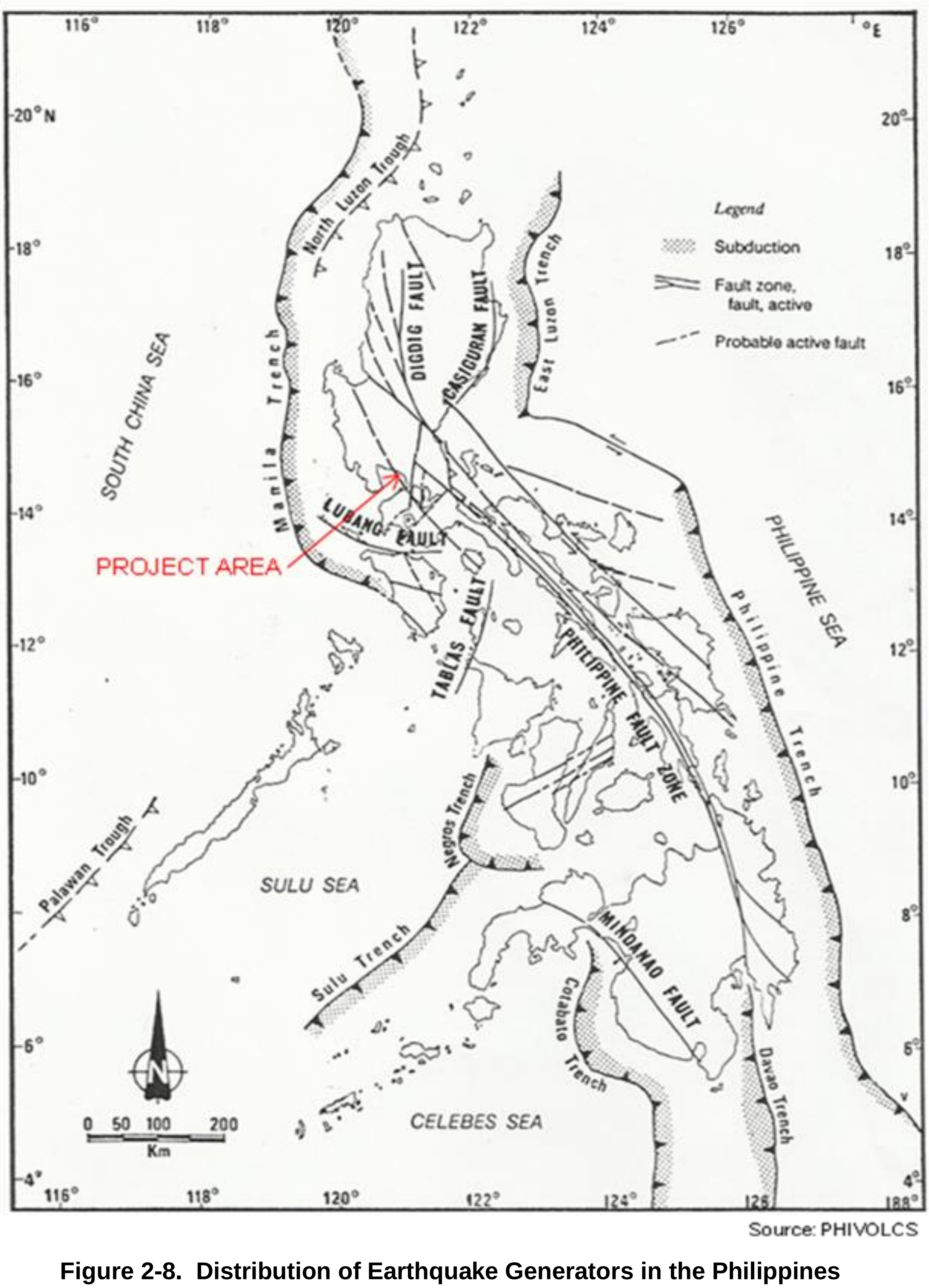


Figure 2-7. Seismic Zones Map of the Philippines
(Source: PHIVOLCS)



Source: PHIVOLCS

Figure 2-8. Distribution of Earthquake Generators in the Philippines

2.1.2.3.2 Potential Sources of Earthquake

Based on historical and instrumental data, the following have been identified to be the locus of major earthquakes that have significantly impacted the metropolis and nearby areas in the past: 1) West Valley Fault System, 2) Philippine Fault Zone, 3) Lubang Fault, 4) Casiguran Fault, and 5) Manila Trench.

West Valley Fault System (WVFS). The West Valley Fault System, a newly classified active fault based on recent mapping and trenching work conducted by Punongbayan and others (1990), is a potential earthquake source located about 17.43 km east of the project area (**Figure 2-9**). Mapped extent of surface rupture associated with the WVFS is about 40 km suggesting a potential magnitude in the order of 7, although a higher magnitude of 7.5 is not unlikely as possible extensions of the fault remains to be mapped. Based on the extent of damage in Manila inflicted by the 1599, 1601, and the 1885 events, the possibility that this fault could have generated these earthquakes cannot be totally ruled out. However, no recent seismicity can be attributed to the WVFS.

Philippine Fault Zone (PFZ). Several destructive earthquakes that have impacted several localities in the country were generated from the Philippine Fault Zone, a 1,300 km long strike-slip fault transecting the Philippine archipelago. Having generated earthquakes with intensities of X (modified Mercalli Scale) within the epicenter area (e.g. 1645 & 1796 events) in the past, a future earthquake in the order of at least 7.5 from this structure is possible. The magnitude of the 1990 earthquake generated from northern segment of PFZ was 7.8. A segment of this fault is about 70 km east of the project area.

Lubang Fault. Lubang Fault is an active strike-slip fault and about less than 95 km southwest of the project area had been the source of large earthquakes in the past, notably that of 1852 and 1972. However, the periodic stress release along this structure lessens the potential for a major earthquake to come from this earthquake generator in the near future.

Casiguran Fault. This fault zone is the most active zone in the northern Philippines having produced four Ms >7 earthquakes since 1970. Located about 130 km northeast of the project area, this fault has generated about 30% of the destructive earthquakes that have affected Metro Manila and nearby areas. The 1880, 1968, 1970 and 1977 earthquakes were all felt at Intensity IX in the epicentral area and Intensity VII – VIII in Metro Manila.

Manila Trench. Historical data indicates that the 1677 earthquake could be attributed to movements along the Manila Trench. During this earthquake, a tsunami was reported in the South China Sea. The 1863 earthquake of submarine origin is strongly indicated by the documentation of a tsunami that rocked several ships anchored in Manila Bay. Though no damage was reported along the coastal areas of Manila Bay, destruction was said to be widespread, most of which was due to strong ground shaking. A large number of structures, including most churches within Manila, Cavite, Laguna and Bulacan collapsed. Extensive fissuring, liquefaction and seiche were observed along the Pasig River. A segment of this trench is about 190 km west of the project area.

Source: PHIVOLCS

Figure 2-9. Relative Position of the Project Area Relative to the West Valley Fault System

2.1.2.3.3 Historical Seismicity

Available records indicate that Metro Manila has been affected by numerous earthquakes in the past although only about 28 of these can be considered as major earthquakes. The listed major earthquakes had intensities ranging from Intensity VII to IX in Manila. On the average, the metropolitan area is likely to be hit by a perceptible (Intensity IV) earthquake every year and by a destructive earthquake once every 15 years. A rough estimate of the average return period for an Intensity VIII such as that which affected Baguio City and the rest of Luzon on July 16, 1990, is about 79 years based on five events that occurred from 1599 to 1970. At least four extremely strong earthquakes (Intensity IX) occurred from 1645 to 1863 with an average return period of 54 years. It is apparent that the metropolis has not been shaken by an extremely strong earthquake for the last 130 years. **Table 2-2** presents the major earthquakes from 1599 to 1990 that have affected Manila and vicinity.

Table 2-2. Major Historical Earthquakes that have Affected Manila and Vicinity (1599 - 1990)

Event	Intensity in Manila	Impacts
1599 Jun	VIII	Violent earthquake: damaged main buildings in Manila including the Sto. Domingo Church located on bedrock (adobe), other effects include fissuring of the stone vault of the Society of Jesus and other principal edifices in the city.
1601 Jan	VIII	Violent earthquake, completed destruction wrought by the 1590 June earthquake, damage to the city was immense, destroying many stone houses, churches and injuring/killing an unspecified number of people.
1645 Nov	IX	Described as one of the most destructive earthquakes ever to hit Manila, most buildings in the city were ruined including the Manila Cathedral which was leveled to the ground, casualties estimated at 3,000.
1658 Aug	IX	Most buildings in Manila, mainly made of wood and timber were wiped out; several persons killed/injured.
1677 Dec	VII	Tsunamigenic; ground fissuring was reported in places, damaged old and unstable buildings. 2 persons reportedly killed
1684 Aug	VII	Strong earthquake: many injured but minimal damage inflicted in Manila
1767 Nov	VII	Strong earthquake, minimal damage
1770 Dec	VII	Strong earthquake, minimal damage
1771 Feb	VII	Strong earthquake: damage in Ermita, church of

Event	Intensity in Manila	Impacts
1796 Nov	VII	Strong earthquake; no serious damage.
1824 Ocl	VIII	Destructive earthquake: several churches and many private houses and bridges were demolished; military barracks were leveled to the ground.
1828 Nov	VII	Strong earthquake but no considerable damage.
1829 Dee	VII	Strong earthquake: partial damage to several buildings.
1830 Jan	VII	Strong earthquake: no serious damage to the city; 1
1852 Sep	IX	Destructive earthquake, serious damage to public buildings, churches, monasteries and private houses: at least 3 casualties and 1 reported missing
1862 Mar	VII	Strong earthquake: slight damage to houses and buildings.
1865 Jun	IX	More than 1.000 buildings suffered partial to total damage including centuries-old churches and well-built edifices that survived past earthquakes, more than 500 families and at least 400 persons injured; extensive fissuring, liquefaction and possible seiche at Pasig River; tsunami reported from China Sea.
1869 Oct	VII	Strong but no considerable damage.
1880 Jul	VIII	About 30 public buildings (eg., government edifices, churches and convents) and 200 private residences were partially/totally damaged, most damages were incurred by tile-roofed buildings; ground fissuring and possible liquefaction parallel to Pasig River near present site of Malacanang Palace estuaries of Binondo, Sta. Cruz, Quiapo, Pandacan, and Sta Ana
1885 Nov	VII	Strong earthquake but no serious damage; strong sub-terranean noise observed in Marikina and other suburbs of Manila.
1937 Aug	VII	No considerable damage inflicted; cracks, subsidence in some areas reported
1968 Aug	VII	One six-storey building totally collapsed: a number of other major buildings (mostly in Manila proper) located north and south of the Pasig River delta plain incurred moderate to severe non-structural and structural damage: property damage reached several million dollars

Event	Intensity in Manila	Impacts
1970 Apr	III	Considerable damage to buildings on alluvial ground in Manila. 14 casualties reported with hundreds injured: communication lines temporarily disrupted
1972 Apr	VII	Several buildings incurred partial damage.
1972 May	VII	Damage, though slight, was concentrated (o buildings in central Manila and areas fronting Manila Bay
1973 Mar	VII	Minor damage to high-rise buildings in Manila compared to extensive damage within the epicentral area
1977 Mar	VII	Twenty-two buildings sustained cracked walls and broken windows, mostly within Manila proper. 1 died of electrocution.
1990 Jul	VII	Minor damage to buildings: subsidence in reclaimed areas.

The Seismicity Map of Metro Manila showing the locations of earthquakes with magnitude of 4 and above from 1996 to 2015 is presented in **Figure 2-10**.

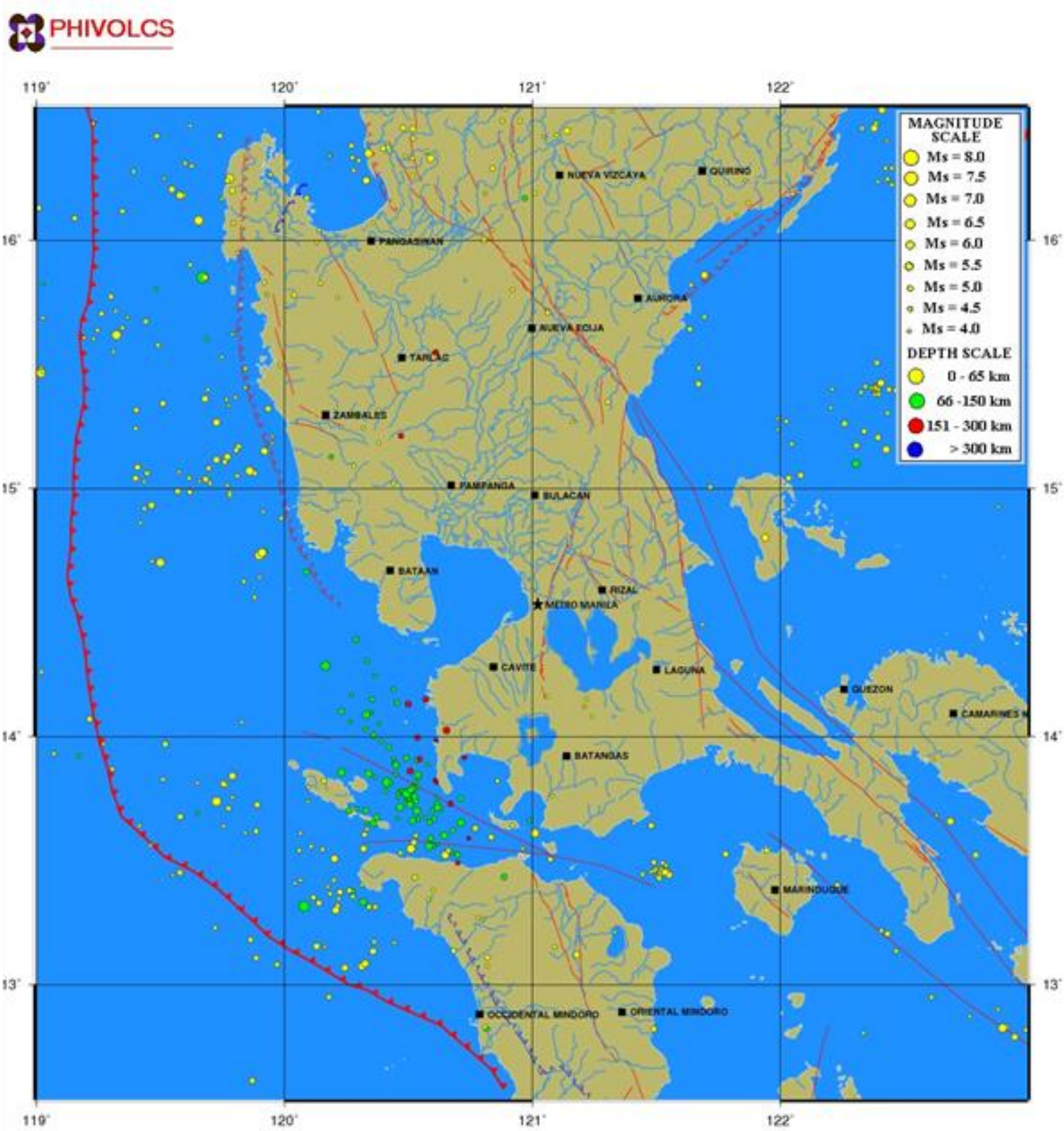
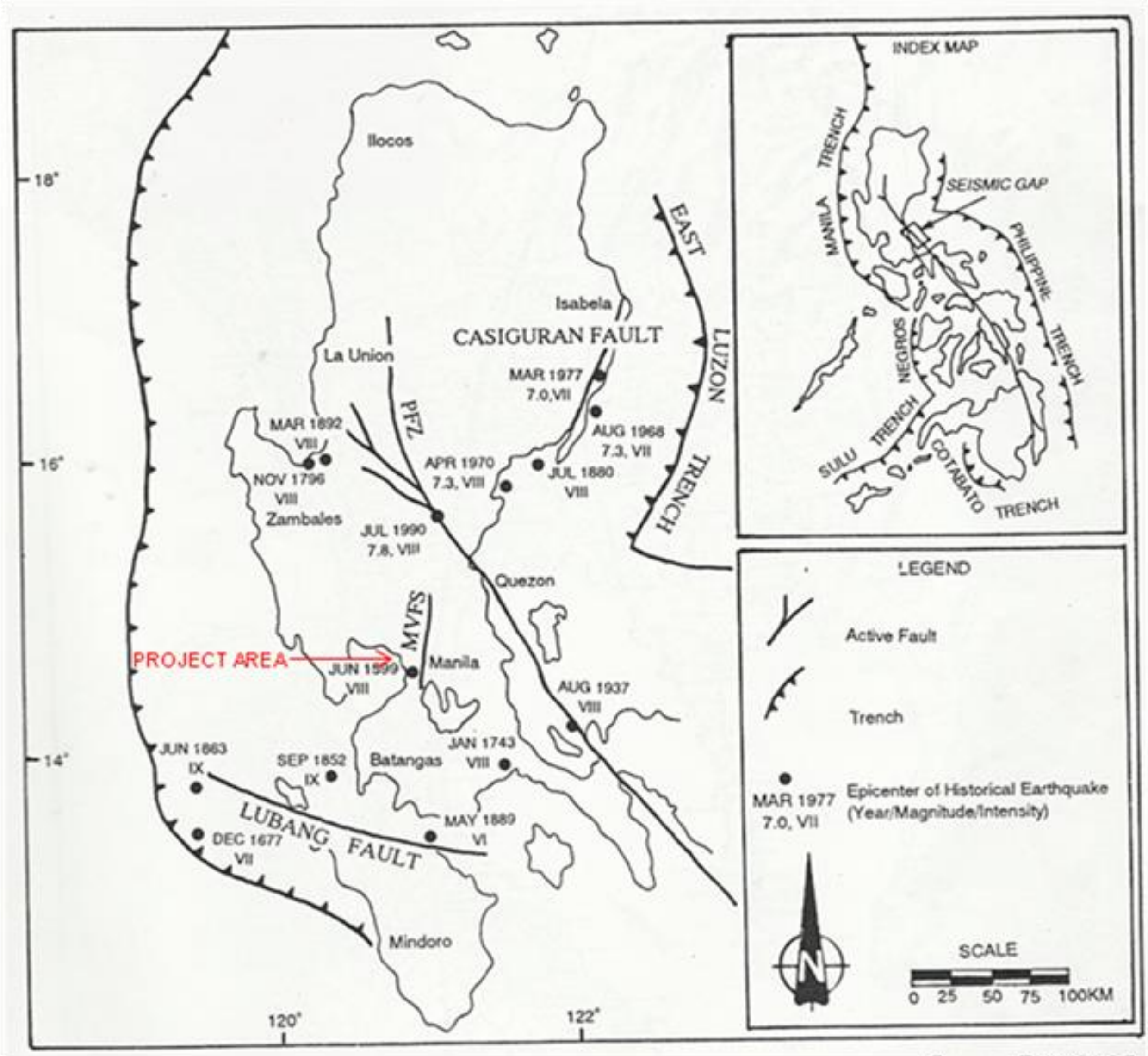


Figure 2-10. Seismicity Map of Metro Manila with Earthquake Magnitude of 4 and Above (1996-2015)



Source: PHIVOLCS

Figure 2-11. Map of the Distribution of Some Historical and Recent Earthquakes which have Affected Metro Manila and Vicinity

2.1.2.3.4 Active Volcanoes near the Project Area

2.1.2.3.4.1 Mount Pinatubo

Mount Pinatubo whose highest peak is 1,749 masl prior to 1990 eruption is located about 85 km northwest of the project area. The volcano is made up of Quaternary andesitic to dacitic volcanic deposits composed mainly of ashfall and pyroclastic deposits that probably originated from a number of volcanic centers near its peak. No record of historical eruptions of this volcano exists prior to its eruption in 1990. However, radiometric dating indicates that Mount Pinatubo has been active since 1.1 ka with its youngest eruption that happened 450 years ago.

The 1990 eruption of Mount Pinatubo was ranked as the largest and most destructive within this century for the Philippines. The eruption affected more than 1.2 million people, left 847 casualties, 184 injured and 23 missing. Damage to properties and infrastructure was at least 10 billion pesos.

The eruption produced 7–11 billion cubic meters of pyroclastic flow deposits that blanketed and devastated the upper and midslopes of the volcano. A centimeter thick of ashfall was deposited more than 30 km away from the vent. Metro Manila as well as other nearby provinces received ash showers of about 2–3 mm thickness.

2.1.2.3.4.2 Taal Volcano

Taal Volcano is an island located near the center of Taal Lake in Batangas Province situated about 70 km south of the project area. Despite its diminutive height of only 311 masl, it is considered as one of the most destructive and violent volcanoes in the Philippines. Nestled within Taal Lake, this volcano has a central main vent with numerous other craters that have been the locus of its past eruptions.

Taal Volcano had several catastrophic eruptions in the past. Its first recorded eruption dates back to 1572. Since then Taal had erupted more than 30 times. Within historical times, Taal had four major devastating eruptions, in 1749, 1754, 1911, and 1965.

The 1749 eruption, though short-lived, produced a hundred million cubic meters of volcanic tephra. It devastated the whole volcanic island and nearby lakeshore areas. Undetermined numbers of people were killed in the process.

The 1754 eruption lasted for six months. It completely destroyed the old settlements for Sala, Lipa, Tanauan and Taal which were formerly located along Taal Lake and were subsequently located to their present sites.

During the 1911 eruption, about 1,300 people were killed while some 800 others were wounded as a result of a base surge or a rapidly expanding cloud at the base of the eruption column which was about 15 km high. The base charge devastated the whole Volcano Island and other areas across Taal Lake. The solid ejecta produced by the eruption which was estimated to be around 80,000,000 cubic meters spread over an area of 230 km^2 while ashes spewed from the volcano reached as far as Manila.

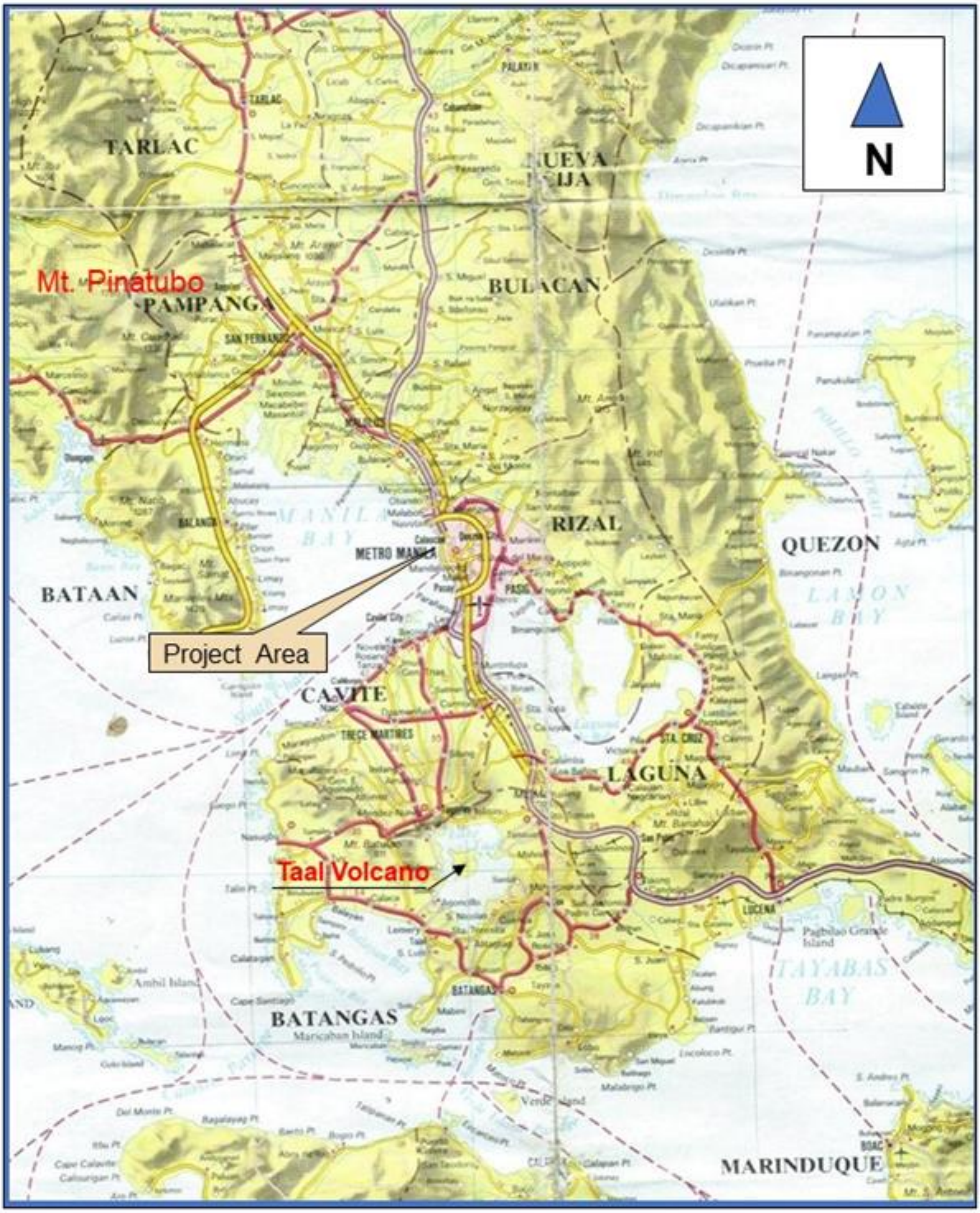


Figure 2-12. Relative Position of the Project Area from Mount Pinatubo and Taal Volcano

Source: Published 1:1,000,000 Road Map of the Philippines, published and exclusively distributed by the National Bookstore, Inc.

The 1965 eruption killed 180 people and displaced some 55,000 evacuees from the Volcano Island and nearby settlements surrounding Taal Lake. Eruption clouds rose

15 – 20 km high, depositing fine ash on downwind areas up to 80 km away. The eruption blanketed an area of about 60 km^2 with 25 cm of ash.

2.1.2.3.5 Seismic Hazards

Major causes of damage during earthquakes include hazards due to 1) ground shaking, 2) liquefaction, 3) landslide, 4) surface rupturing, and 5) tsunami. The first two hazards are directly related to actual ground movements while the others are mainly due to the indirect effects of the earthquake shocks.

2.1.2.3.6 Ground Shaking Hazard

Most of the damages incurred during earthquakes mainly result from strong ground vibrations that are caused by the passage of seismic waves from the earthquake source to the ground surface. The intensity of ground shaking is generally influenced by the magnitude of the earthquake, distance of the site from the earthquake generator, and the modifying effects of subsoil conditions. Observations of effects of large magnitude earthquakes have shown that ground shaking on bedrock is less in intensity than on areas of soft foundation made up of sediments as gravel, sand, silt and/or clay. **Figure 2-13** shows the general relationship between near-surface earth material and amplification of shaking during a seismic event.

The project area is prone to ground shaking hazards due to the presence of several earthquake generators. The site is considered as high seismic area and has a recorded and experienced intensity of VI during the July 1990 Luzon earthquake (**Figure 2-14**).

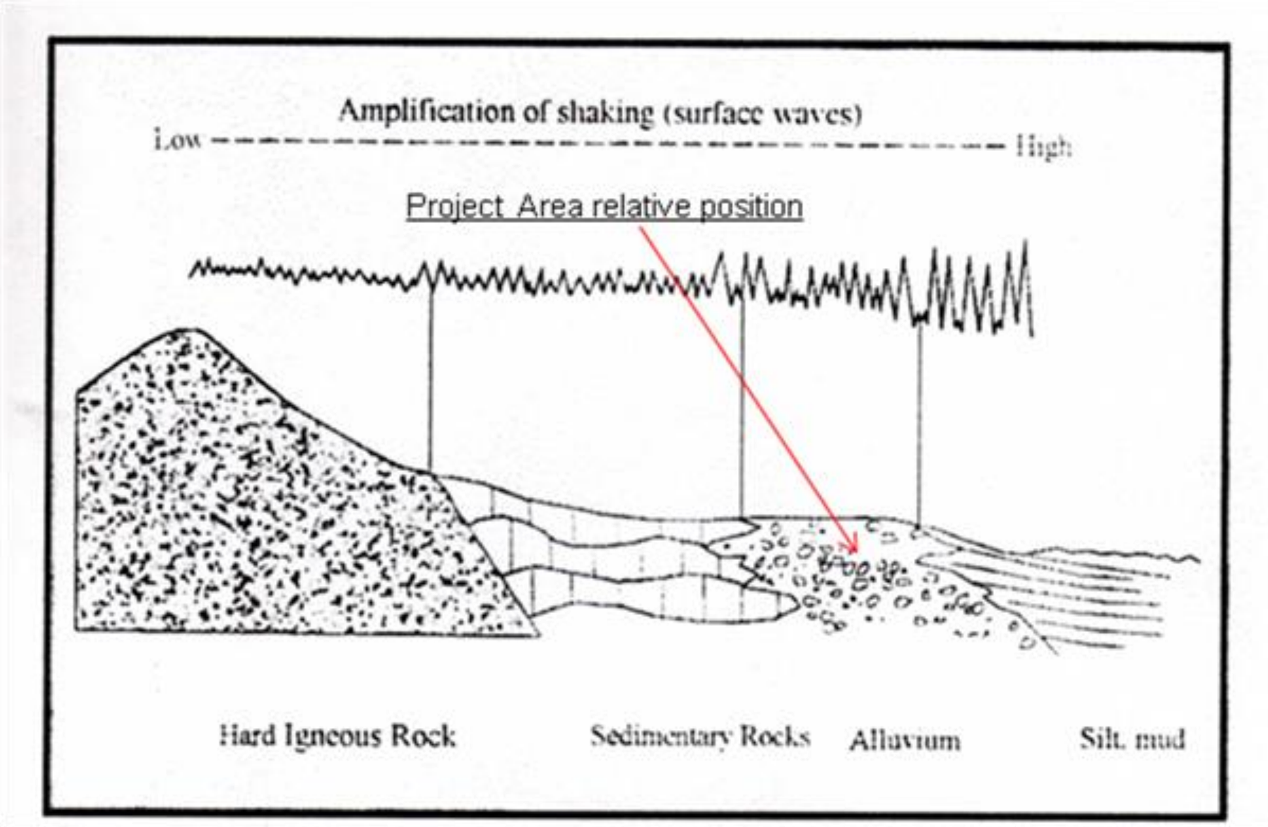
Table 2-3 presents the different areas Metro Manila which are vulnerable to ground shaking and within the identified zones. The zone where ground shaking is expected to be below average is more or less defined by the outline of the tuff deposit of the Guadalupe Formation which corresponds to the bedrock in Metro Manila. The areas underlain by soft and thick sequence of fine sediments will most likely experience average to above average levels of ground shaking depending on the thickness of the soft materials. Areas covered with 10 m or less of these deposits are expected to experience average levels of ground shaking while those underlain by soft materials in excess of 10 m may experience above average shaking.

Table 2-3. Areas Vulnerable to Strong Ground Shaking in Metro Manila

Possible Level of Ground Shaking	Area
Above Average	Manila proper inclusive of the reclaimed areas along Manila bay, the municipalities of western Malabon, Navotas, eastern Pateros, Marikina (valley side) and the eastern section of Pasig
Average	Pasay City, western portion of Makati, northeastern and eastern Quezon City (within the Marikina Valley), the extreme southwestern part of Caloocan City, eastern Malabon,

Possible Level of Ground Shaking	Area
	western section of Valenzuela, the coastal and northern portions Paranaque and Las Pinas, and the lakeshore areas of taguig and Muntinlupa
Below Average	Areas within Diliman Plateau

Figure 2-15 presents the ground shaking and surface rupture hazard map of Metro Manila.

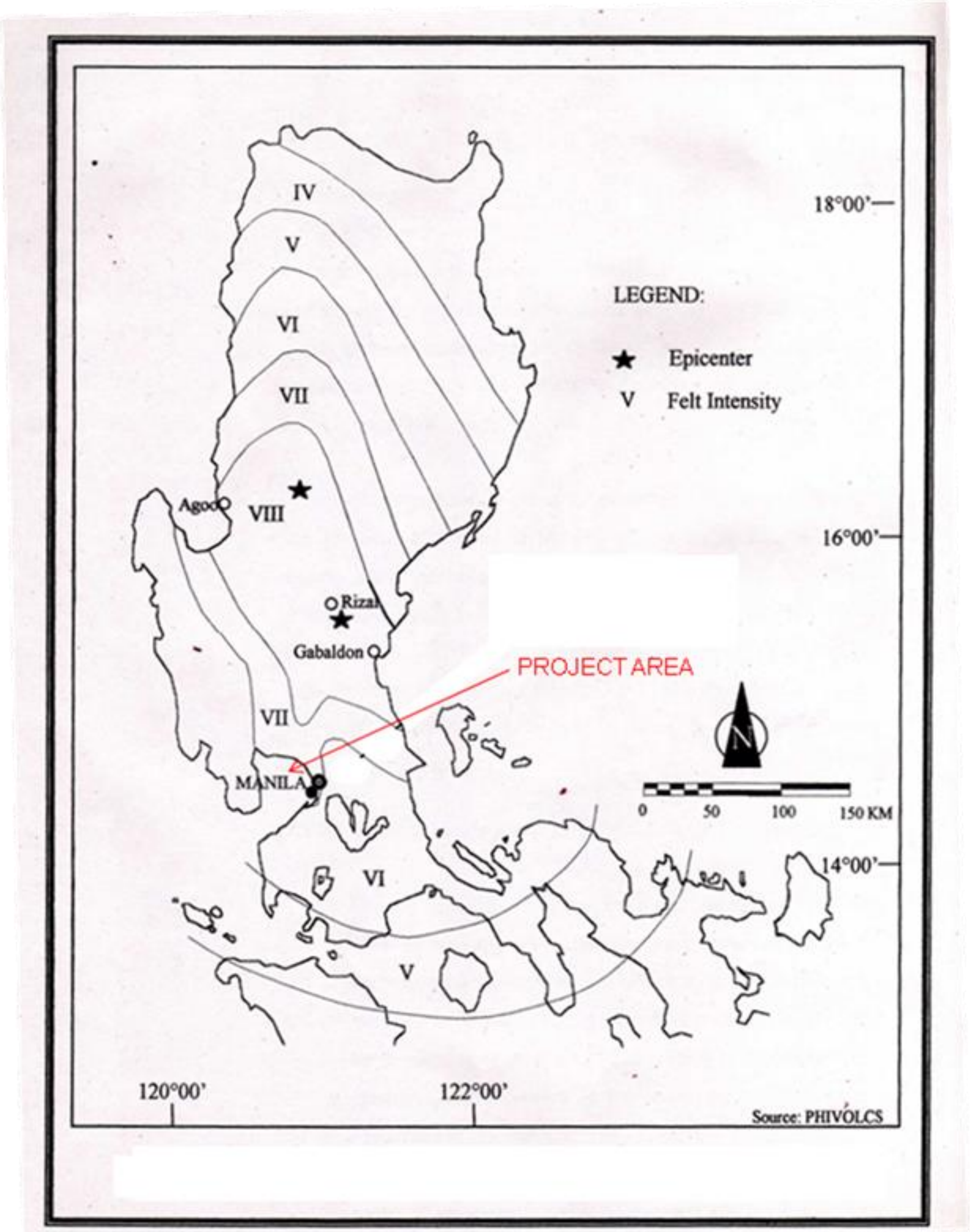


Source: (Keller, E. J., 1996)

Figure 2-13. General Relationship between Near-surface Earth Material and Amplification of Ground Shaking during a Seismic Event

2.1.2.3.7 Surface Rupturing

Surface or ground rupturing is a result of significant movement along faults. It occurs within zones of active fault. Damage can be severe for structures directly straddling and located within a narrow zone of the active fault traces. For the 1990 Luzon earthquake, the deformation zone was within 5 m from the surface rupture. The location, pattern and style of surface faulting generally appear to occur along pre-existing active fault traces, thus, a precise delineation of these traces is very important in mitigating damages due to surface rupturing.



Source: PHIVOLCS

Figure 2-14. Intensity Map of the July 1990 Earthquake

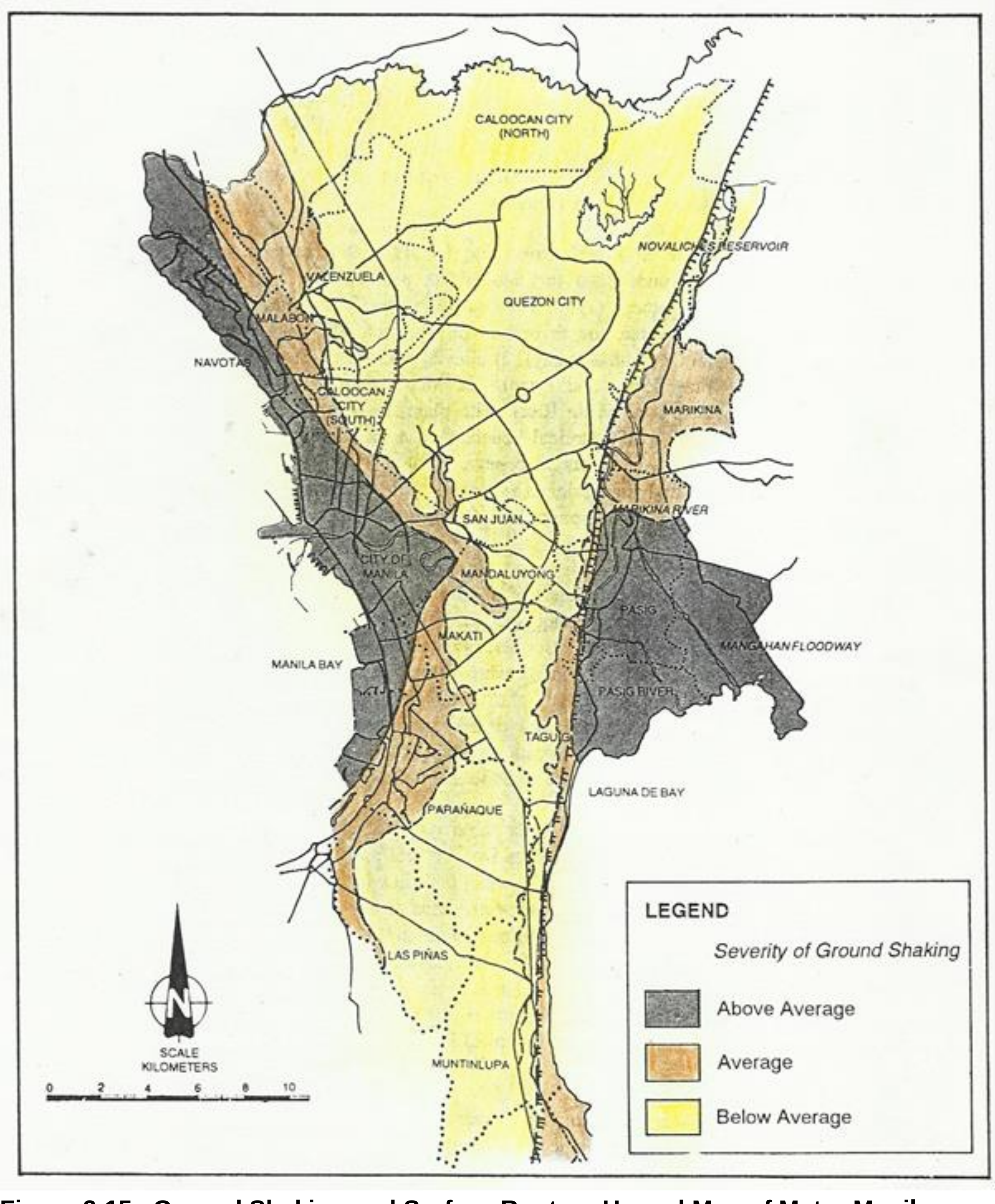


Figure 2-15. Ground Shaking and Surface Rupture Hazard Map of Metro Manila
Source: Philippine Institute of Volcanology and Seismology, Department of Science and Technology, Disaster Prevention and Mitigation in Metropolitan Manila, UNCHS (Habitat) Project

2.1.2.3.8 Ground Acceleration

Since the Philippines is a tectonically active place with noted active faults that are usually the sources of major earthquakes, the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and the United States Geological Survey (USGS) conducted ground motion hazard mapping in terms useful to engineering design using modern probabilistic methodology. In their study, the peak horizontal ground acceleration that have a 10% probability of being exceeded in 50 years have been uniformly estimated for rock, medium soil and soft soil site condition. Results of their study show an estimate on rock ranging from a low of 0.11g in Visayas to a high of 0.30g in the vicinity of Casiguran Fault in Eastern Luzon (Thenhaus, et al, 1994). Estimates for soft soil conditions are considerably higher and range between 0.27g for Visayas and 0.80g along the Casiguran Fault zone.

The estimated horizontal and vertical peak accelerations during an earthquake likely to occur in an area are useful information for designing buildings and other structures to withstand seismic shaking. Maps of Acceleration in Soft Soil, Medium Soil, Hard Soil and Rock are presented in **Figure 2-16** to **Figure 2-19**.

In order to determine the ground acceleration that a site can experience in case of a major earthquake, the attenuation model of Fukushima and Tanaka is applied (Thenhaus et al, 1994). A design earthquake is assumed to occur at a point along the causative fault that is nearest to the site. Correction factors are then applied depending on the type of foundation material.

The attenuation model of Fukushima and Tanaka (In Thenhaus, 1994) is written as:

$$\log_{10} A = 0.41M - \log_{10} (R+0.032\times10^{0.4M}) - 0.0034R + 1.30$$

where:

A = mean peak acceleration (cm/sec^2)
R = shortest distance between the site and the fault rupture (km)
M = surface-wave magnitude.

Correction factors are applied depending on the type of foundation material: rock, 0.6; hard soil, 0.87; medium soil, 1.07; and soft soil, 1.39.

The most logical causative fault is the Philippine Fault. It may be considered as a near-source earthquake generator. The Philippine Fault is probably the most active of earthquake generators in the country. Though presently inactive, both the West Valley Fault, the Lubang Fault and Casiguran Fault can also be considered as potential earthquake generators.

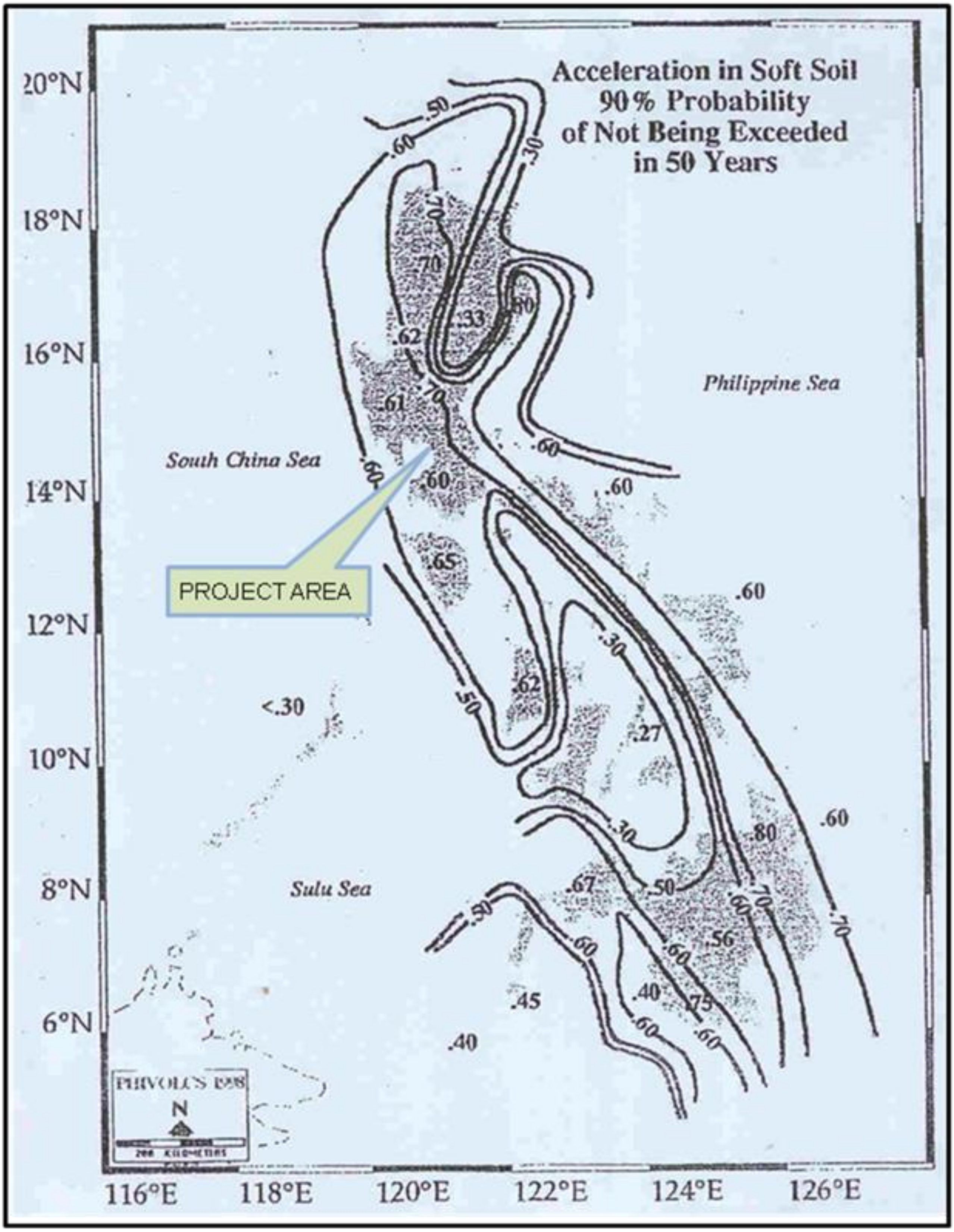


Figure 2-16. Ground Acceleration in Soft Soil
Source: PHIVOLCS, 1998

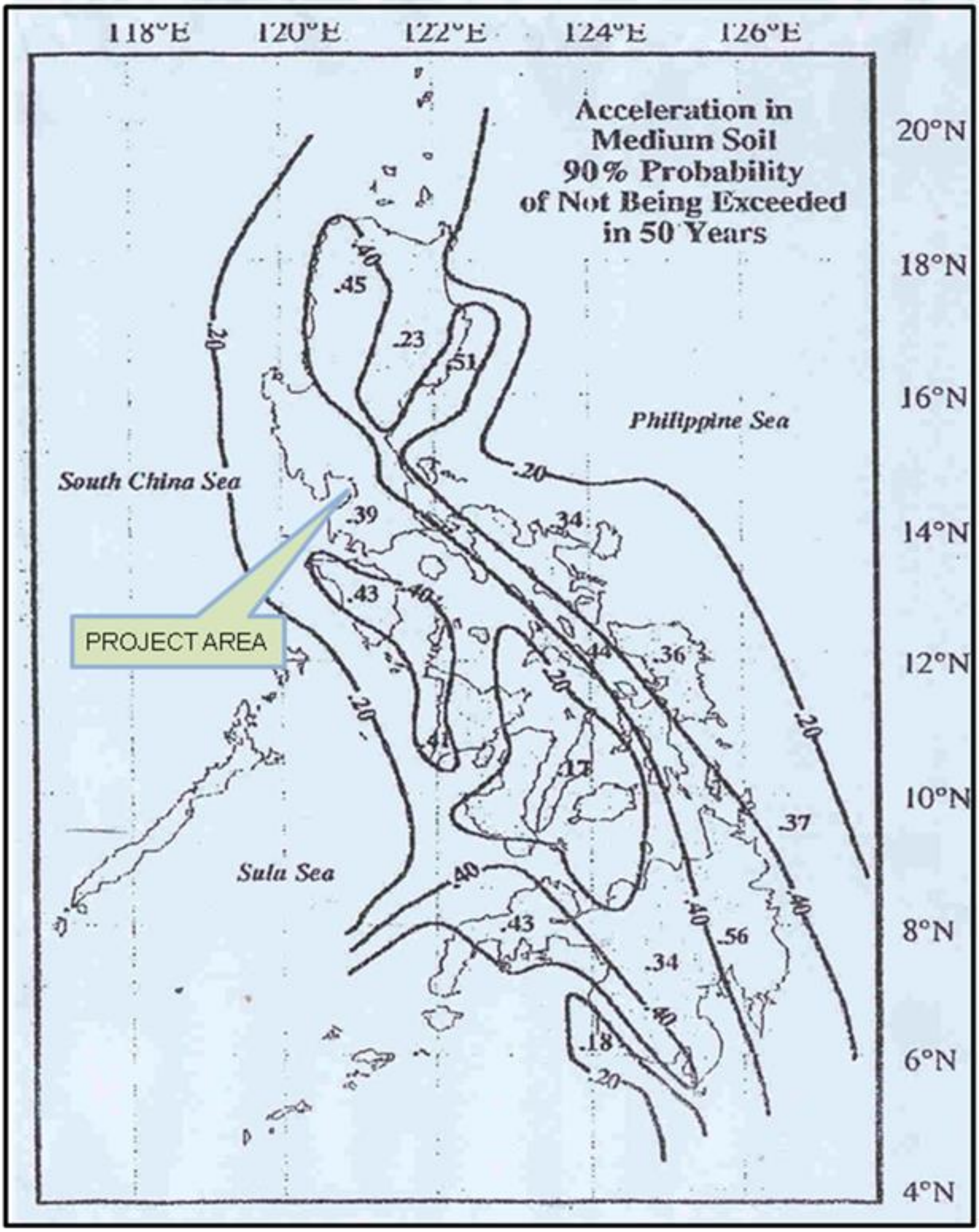


Figure 2-17. Ground Acceleration in Medium Soil
Source: PHIVOLCS, 1998

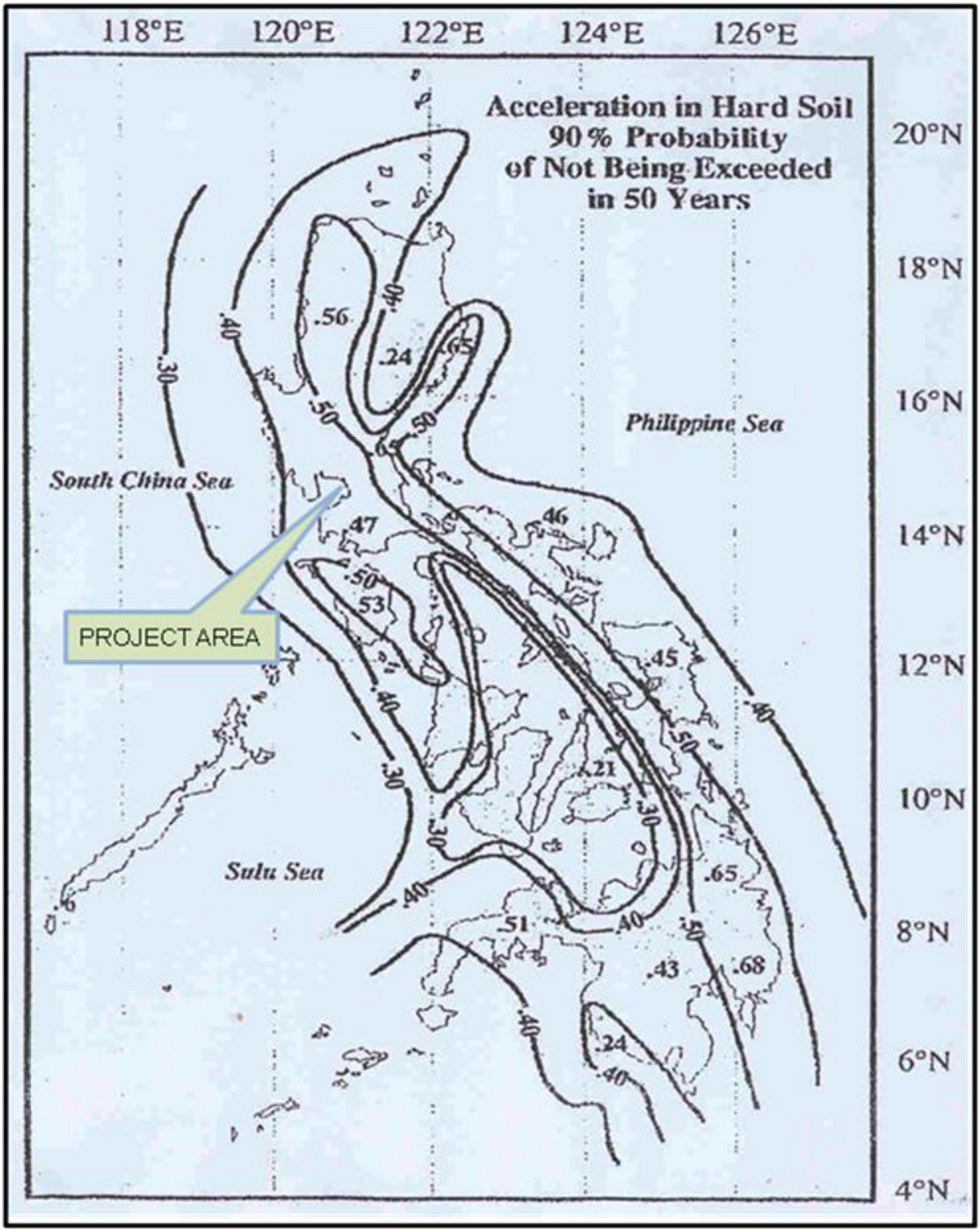


Figure 2-18. Ground Acceleration in Hard Soil
Source: PHIVOLCS, 1998

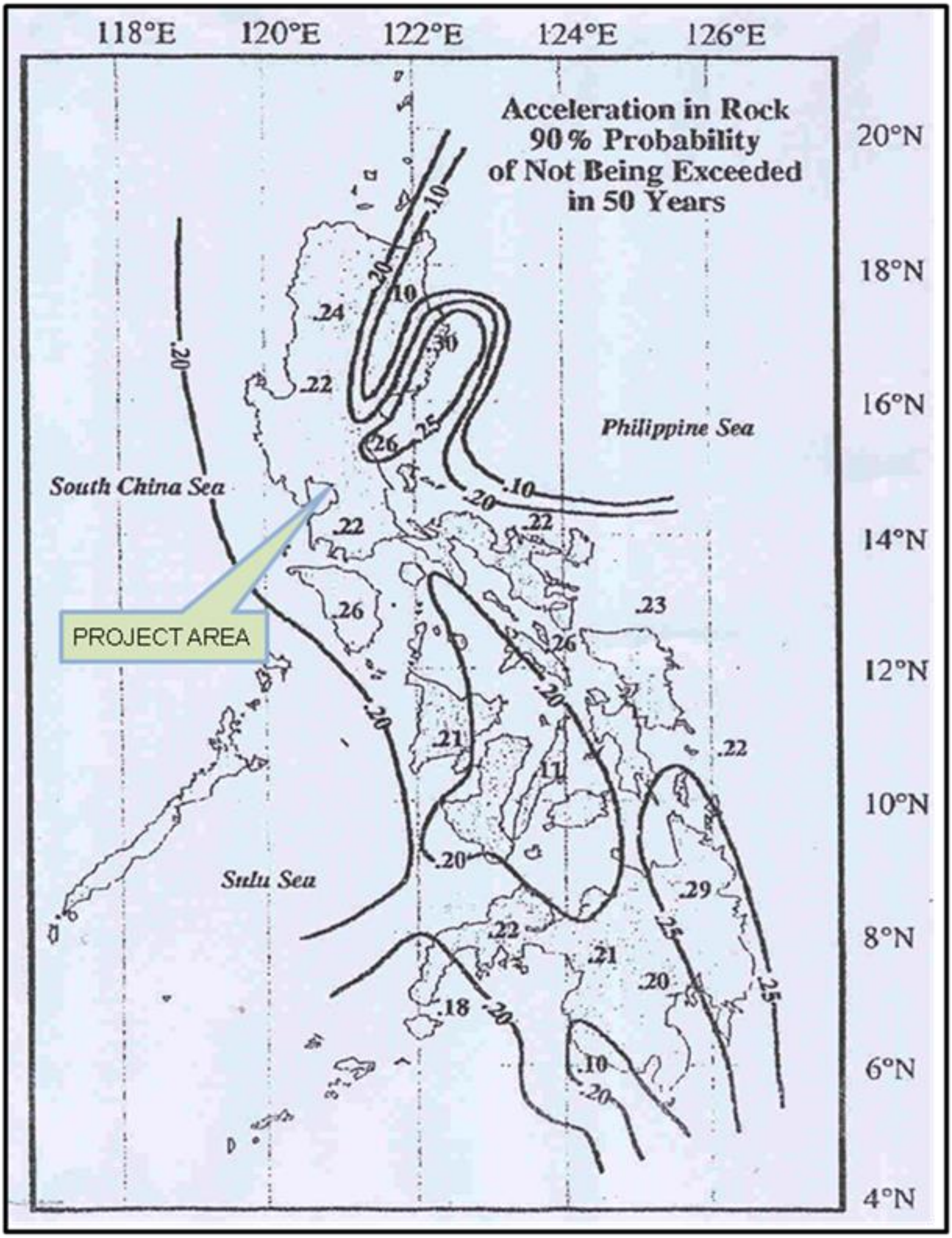


Figure 2-19. Ground Acceleration in Rock
Source: PHIVOLCS, 1998

Design Earthquake. The Philippine Fault is such a major fault that it is capable of generating a rare magnitude 8.0 earthquake. Magnitude 7.5 or 7.8 earthquakes might be more reasonable as design earthquake.

Peak Ground Acceleration. Assuming a distance of 70 km from the project area to the Philippine Fault, peak ground accelerations are estimated for different design earthquakes (magnitudes 7.6, 7.8, 8.0) and foundation conditions (rock, hard soil, medium soil, soft soil). Ground accelerations from earthquakes that can be generated from the West Valley Fault, Lubang Fault, Casiguran Fault and Manila Trench were also estimated. Excessively high acceleration values can be expected particularly from those earthquake generators which are relatively close to the project area.

Table 2-4. Computed Ground Acceleration (using Attenuation Model of Fukushima and Tanaka) for Earthquake Magnitudes of 8.0, 7.8 and 7.5 and Different Foundation Conditions

Earthquake Generator	R	M	PGA	Rock	Hard Soil	Medium Soil	Soft Soil
West Valley Fault	11.60 km	8.0	0.488	0.293	0.424	0.522	0.678
	11.60 km	7.8	0.472	0.283	0.411	0.505	0.656
	11.60 km	7.5	0.445	0.267	0.387	0.476	0.618
Philippine Fault	70 km	8.0	0.171	0.103	0.149	0.183	0.238
	70 km	7.8	0.154	0.092	0.134	0.165	0.214
	70 km	7.5	0.129	0.078	0.113	0.138	0.180
Lubang Fault	95 km	8.0	0.118	0.071	0.103	0.126	0.164
	95 km	7.8	0.105	0.063	0.091	0.112	0.146
	95 km	7.5	0.086	0.052	0.075	0.092	0.120
Casiguran Fault	130 km	8.0	0.073	0.044	0.064	0.078	0.102
	130 km	7.8	0.064	0.039	0.056	0.069	0.089
	130 km	7.5	0.052	0.031	0.045	0.056	0.072
Manila Trench	190 km	8.0	0.035	0.021	0.030	0.037	0.049
	190 km	7.8	0.030	0.018	0.026	0.323	0.042
	190 km	7.5	0.024	0.014	0.021	0.026	0.033

2.1.2.3.9 Liquefaction / Differential Settlement

In areas underlain by loosely compacted, water-saturated fine sediments such as sand and silt, strong ground vibrations could also cause the underlying foundation to temporarily assume a semi-liquid behavior. Such process is called liquefaction. The July 16, 1990 earthquake has opened opportunities to better understand the liquefaction phenomenon. The studies conducted by Torres and others in 1990 had identified and characterized at least three sedimentary environments that are favorable to liquefaction to take place, namely, 1) deltaic (e.g. Dagupan City and Aringay, La Union), alluvial plain (e.g. Tarlac), and sandpit environment (e.g. Agoo, La Union). Typically, these environments are characterized by the presence of thick accumulation of fine sediments that are water-saturated.

Metro Manila has suffered liquefaction in certain areas of the city in many of earthquakes that have affected it. Several occurrence of liquefaction within a certain area in Manila particularly near the vicinity of Pasig River were recorded in the past.

The identified liquefaction-prone areas have characteristically shallow water table (3 m or less) with thick (10m or more) piles of water-saturated fine sediments (sand to clayey sand). These areas are those on the shore areas of Manila including the newly-reclaimed areas, the Pasig River delta plain, the Marikina alluvial plains and those lying on the floodplain deposits and abandoned meanders of the Pasig and Marikina rivers. Various points within these areas have been subjected to liquefaction in the past and are therefore likely to be affected again in the future.

Liquefaction is generally accompanied by *differential settlement* as a result of withdrawal of materials beneath the ground surface. Buildings, houses and other structures built with no special engineering designs against this hazard tend to settle or sink as the underlying foundation losses strength. These structures normally remain intact though some may tilt.

Sand fountaining, lateral spreading, and ground undulation which may also cause damage to roads, bridges and other infrastructures are some of the effects associated to liquefaction.

Figure 2-20 shows the sites of historical liquefaction in Metro Manila

2.1.2.3.10 Subsidence / Differential Settlement

Subsidence is the motion of a surface (usually, the earth's surface) as it shifts downward relative to a datum such as sea level. Land subsidence can occur in various ways during an earthquake. Large areas of land can subside drastically during an earthquake because of offset along fault lines. Land subsidence and/or differential settlement can also occur as a result of settling and compacting of unconsolidated sediment from the shaking of an earthquake.

Many soils contain significant proportions of clay. Because of their very small particle size, they are affected by changes in soil moisture content. Seasonal drying of the soil results in a lowering of both the volume and the surface of the soil. If building foundations are above the level reached by seasonal drying, they move, possibly resulting in damage to the building in the form of tapering cracks. Any structures founded on soft clay are very susceptible to subsidence or differential settlement.

2.1.2.3.11 Tsunami

Tsunami or giant sea waves are produced as a result of faulting under submarine conditions at shallow depths. Tsunami can also be triggered by submarine landslides, volcanic eruptions and movements along subduction zones. Areas vulnerable to this hazard are the coastal zones fronting an open sea. The edge of the cities fronting Manila Bay may be exposed to potential tsunami.

Tsunami and earthquakes can happen anytime around the Pacific Ring of Fire - from California up and around Alaska down through Japan, Taiwan, the Philippines and Indonesia.

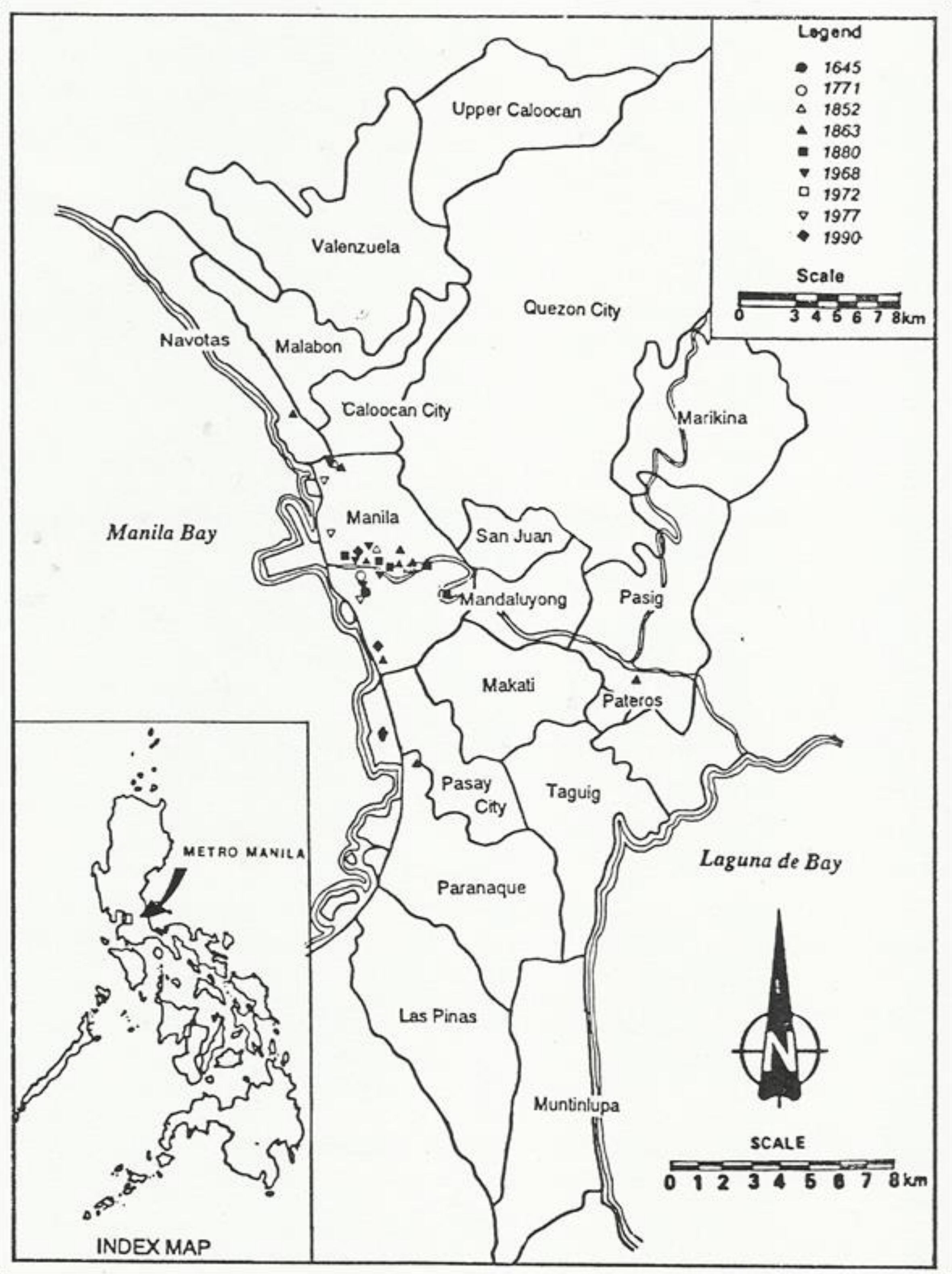


Figure 2-20. Sites of Historical Liquefaction in Metro Manila

The Philippines is no stranger to earthquakes - the Philippine archipelago was largely created by the tectonic squabble between the Eurasian and Pacific plates, forming the Philippine Plate as a distinct entity.

Tsunamis in the Philippines are extremely rare. The last significant tsunami in the Philippines occurred in the Verde Island Passage (between Batangas & Mindoro Island and affecting Puerto Galera) in 1976. The tsunami wave was minor (only 2-3 meters) when it reached land. Because tsunami in the Philippines are so rare, those who were drowned were actually opportunist beachcombers who were interested to extract goodies from the suddenly exposed deep coral pools, not realizing that the tsunami wave would follow the rapidly receding water.

Remarkable historical tsunamis that have affected Manila were those generated by the 1677 and 1863 earthquakes, possibly from the Manila Trench. During the 1677 event, Repetti (1946) reports of boats at sea almost submerged by waves. For the 1863 earthquake, a large wave coming from Manila Bay was reported by the same writer. Other accounts of the latter event describe a retreat of the sea and a subsequent rise in the height of incoming waves. In both cases there were no reports of any damage along the coastal areas of Manila.

The apparent low vulnerability of Metro Manila in terms of this hazard is attributed to the following factors.

1. The narrow configuration of the mouth of Manila Bay has an over-all abating effect to the incoming tsunami wave thus lessening any tsunami impact on the project area. However, coastal areas along the adjoining provinces of Cavite and Bataan near the mouth of Manila Bay are more likely to be highly-prone to this hazard.

2. The presence of the Island of Corregidor near the mouth of Manila Bay likewise tends to deflect and abate the effects of incoming tsunami waves.

3. For any moderate to strong tsunami to significantly affect Metro Manila, the earthquake source or hypocenter should be within the Manila Bay itself. Even considering a modest dip of 45o for the subducting layer of the Manila Trench, such a situation is highly unlikely as the descending tectonic slab would be too deep as an earthquake source and consequently, too weak to generate a sizable tsunami.

The hazard posed by tsunami is probably only comparable to, or less than that from storm surges.

2.1.2.3.12 Volcanic Hazards

Most of the hazards associated with the eruptions of Mount Pinatubo and Taal Volcano with the exception of ashfall, are very much localized and are generally confined within the immediate vicinities of these two volcanoes.

A violent eruption of Mount Pinatubo and/or Taal Volcano which may result into a base surge or a rapid expanding cloud at the base will definitely has severe effect at the areas close to them.

Only a minor quantity of ash has affected Metro Manila based on the review of the extent of impacted areas from the largest eruptions of Mount Pinatubo. It is thus conceivable that should Mt. Pinatubo will erupt with the same magnitude in the future, the same level of ashfall impact is expected to likely affect the island.

The 1911 eruption of Taal Volcano killed about 1,300 and wounded 800 people. The solid ejecta produced by the 1911 eruption which was estimated to be around 80,000,000 million cubic meters spread over an area of 230 km2 while ashes spewed from the volcano reached as far as Manila and nearby provinces.

The 1965 eruption killed 180 people and displaced some 55,000 evacuees from the Volcano Island and nearby settlements surrounding Taal Lake. Eruption clouds rose 15 – 20 km high, depositing fine ash on downwind areas up to 80 km away. The eruption blanketed an area of about 60 km2 with 25 cm of ash.

Based on the recorded hazards associated with the eruption of Taal Volcano, the project area being 70 km away from the said volcano could only experience minor ashfall.

2.1.2.3.13 Hydrologic Hazards

2.1.2.3.13.1 Flooding

Flooding is usually caused by heavy rains accompanying typhoons or the southwest monsoons. Flooding is a chronic problem, affecting large areas in Metro Manila, especially the low-lying areas like the City of Manila. Because of the local climate condition, the city is experiencing an average of 18 – 20 flood events yearly, although only a few of these caused severe damage.

In Metro Manila, floodwater is usually due to excessive rainfall particularly during the months of May to November when the southwest monsoon coincides with the typhoon season.

The flooding problems in Metro Manila are aggravated by rapid urbanization, inadequate or non-existent of drainage system, improper waste disposal, low river capacity and lack of maintenance, tidal transgression, reclamation activities and storm surges, squatter settlements, and constraints in the implementation of proper flood control facilities and countermeasures.

2.1.2.3.13.2 Storm Surge

Storm surge refers to the temporary increase at a particular locality in the height of the sea due to extreme meteorological conditions: low atmospheric pressure and/or strong winds. It is caused primarily by strong winds pushing on the ocean's surface causing the water to pile up higher than the ordinary sea level. The rise in water level due to the combined force of storm surge and normal tides could cause severe flooding in coastal areas.

Due to the combination of coastal configuration and seasonal wind regime, waves generated during the rainy southwest monsoon also raise tide levels by as much as 80% at the northern end of Manila Bay (Siringan and Ringor, 1998). Waves three meters high can be generated even along the limited western fetch. Southerly wind speeds at Manila can exceed 220 kph and waves 3.7 meters high have been recorded at Manila's port. PAGASA unpublished records shows storm surges occurred seven times between 1960 and 1972 (Rodolfo and Siringan, 2003).

Recent storms demonstrated wind induced waves breaking at the seawall of the reclamation area and Roxas Boulevard covering the strip with garbage. Portions of the seawall along Roxas Boulevard suffered damage due to consistent pounding of the waves.

As seen during Typhoon Pedring and reported unnamed and named typhoons, Manila Bay coastline is considered highly vulnerable to storm surges and coastal floods.

Table 2-5 presents the different reported storms surges that affected Manila Bay.

Table 2-5 Storm Surges that Affected Manila Bay

Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
June 29, 1589	Unnamed Typhoon	-	Manila Bay	-	-
Aug. 29, 1863	Unnamed Typhoon	-	Manila Bay	-	Destroyed Bagumbayan Drive due to inundation. Several houses were destroyed
Sept. 20-26, 1867	Unnamed Typhoon	-	Manila Bay	-	17 ships were tossed onto Santa Lucia and Tondo shores
Nov. 19, 1970	Typhoon Yoling	4	Manila Bay -	-	Destroyed $40M

Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
			southeast		properties, sank 21 fishing boats
June 23-25, 1972	Typhoon Konsing	-	Manila Bay	1	Several ships were washed ashore
July 2, 1983	Typhoon Bebeng	4	Bataan and at least 10 villages on Manila Bay's western bank	182	49,000 houses
Sept. 26-28, 2011	Typhoon Pedring	6	Coastal Areas of Manila Bay, Barangay San Rafael 3 and 4 in Cavite	12	Damaged the breakwater and seawall along Roxas Boulevard
Oct. 11, 2013	Typhoon Santi	-	Manila Bay	-	-

Source: Project NOAH – Compilation of Storm Surge occurrences in the Philippines, Feb. 4, 2014

1.4.1.1 Impacts and Mitigating Measures

Based on the conducted researches, review of the Feasibility Report of the New Manila Reclamation and Development Project, Report on the Disaster Prevention and Mitigation in Metropolitan Manila, other relevant technical reports and field investigation, the following conclusions and recommendations can be deduced:

- The subsoil is generally weak (very soft to soft) with thick sequence of Quaternary alluvium made up principally of unconsolidated strata of plastic silty clay and clay. Very stiff to hard clay layers are generally deeper.
- The project area may experience ground shaking of Intensity VI as felt during the July 1990 Luzon Earthquake.
- The seismic hazards to which the project will be exposed to are ground shaking, liquefaction and surface rupturing.
- In terms of ground shaking, five major earthquake generators, namely, the West Valley Fault, the Philippine Fault Zone, the Lubang Fault, the Casiguran Fault and Manila Trench have been identified as the most likely sources of future earthquakes that could affect the project. Of these sources, the WVF and the PFZ are most likely to generate the strongest levels of ground shaking. The worst-case scenario is a large magnitude event on the West Valley Fault.
- Three zones of average, below and above average levels of ground shaking have been identified in Metro Manila. Areas within the above average are those underlain by thick piles of water-saturated sediments. These include the reclaimed areas in Manila, Navotas, Malabon, eastern Pateros, the valley side of Marikina and eastern section of Pasig.
- Identified liquefaction-prone areas in Metro Manila are essentially within the zone of average to above average zone of ground shaking. Several areas in

Manila (particularly those close to the Pasig River), Navotas and Malabon have high potential to liquefaction.

- In addition to ground-shaking related hazards, surface rupturing may also occur from West Valley Fault. The surface rupture is expected to essentially follow the pre-existing fault trace and restricted to a narrow zone. For a magnitude 7.5 earthquake, the empirical data suggest an associated 70 km long surface rupture and maximum displacement of 2 to 3 meters along the fault trace. Damages as a result of this hazard is expected to be substantial for structures directly straddling and located within few meters from the rupture zone.
- Tsunamis may occur but are not expected to significantly impact the project area.
- The project area is 70 km away from Taal Volcano and 85 km from Mount Pinatubo and therefore not susceptible to major volcanic hazard even if violent eruption will happen. Based on the recorded hazards associated with the eruption of Taal Volcano, the project area being 70 km away from the said volcano could only experience ashfall.
- Only a minor quantity of ash has affected Metro Manila based on the review of the extent of impacted areas from the largest eruptions of Mount Pinatubo. It is thus conceivable that should Mt. Pinatubo erupt with the same magnitude in the future, the same level of ashfall impact is expected to likely affect the project area.
- Manila being situated in low grounds is very much prone to flooding.
- As seen during Typhoon Pedring and other previously reported storm surges that affected Manila Bay, Manila Bay coastline is considered highly vulnerable to storm surges and coastal floods.

2.1.2.4 Recommendations

- Study the likely impacts of the seismic and hydrologic hazards on the proposed project and consider them in the design and construction and locations of gravity walls, slope revetments, steel sheet filing and also in deciding the height of the fill of land reclamation.
- Proper planning and executions of dredging, removal of soft clay layers, filling and compaction of the fill materials have to be carried out by the proponent and the contractor/s to prevent the occurrence of subsidence or differential settlement. The proposed pre-fabricated vertical drains and surcharge will be of great importance in attaining the desired soil/fill compaction.
- Prepare clear plans, infrastructures and mitigations for possible disaster/s that might happen and affect the project.
- Flood control infrastructures for the onshore areas should be considered in the design and implementation of land reclamation.
- Designers and/or Engineers have to assess the structural resistance of the different infrastructures related to land reclamation.

- The designs of all the structures to be constructed by the proponent must conform to the National Structural Code of the Philippines. These structures should withstand an earthquake with magnitude of intensity VIII on the Rossi-Forel Intensity Scale.
- The Project should conform with the requirements, permits and clearances prescribed by the Philippine Reclamation Authority.

2.1.3 Pedology

2.1.3.1 Results

Geotechnical investigation is being conducted to explore the subsurface deposits, determine the types of materials underlying the project area, analyze the strength and deformation characteristics of the subsoil and specially to determine up to what depth shall be dredged and replaced with good quality fill materials.

Two boreholes (BH-37 and BH-38) which were completed last July 1, 2018 with depths of 40.50m and 40.00m, respectively will be used initially to have an idea on the subsurface condition of the proposed reclamation area. Other boreholes are still being drilled and will be drilled to have a more information on the actual subsurface condition. Being close to the Pasig River delta, majority of the encountered materials are clay and silty clay.

Based on the log of BH-37, the upper 1.55m is composed of loose, fine to medium-grained sand with shell fragments. The depths from 1.55m to 18.45m are characterized by dark gray, very soft silty or clay with little shell fragments in some sections. Dark gray, stiff silty clay was encountered at depths of 18.45m to about 25.55m with soft clay layer at depths of 22.00m to 23.55m. No samples were recovered from the depths of 25.55m to 26.55m. Dark gray, very stiff clay and silty clay were encountered from the depths of 26.55m to 37m. Dark gray, hard silty clay and clayey silt characterized the depths from 37m down to the drilling depth of 40.50m with a layer of dense silty sand at 38.55m to 39.00m.

The log of BH-38 revealed very soft layers of dark gray, silty clay and clay from ground level up to the depth of 18.00m. Firm to stiff dark gray clay and silty clay were encountered from 18.00m to 29.00m. Stiff clay and very stiff silty clay were encountered from 29.00m up to 38.55m. Hard clay characterized the depths from 38.55m up to 40.00m.

2.1.3.2 Impacts and Mitigating Measures

2.1.3.2.1 Construction Phase

2.1.3.2.1.1Soil Contamination

The fill materials will be the soil that will be transported to the reclamation site by sea. Possible contamination, especially with potential hazardous/toxic metallic elements, can be minimized through of the following:

- The fill materials will be sourced from within the body of the Manila Bay;
- Containment walls and/or silt curtains will be placed around the reclamation work areas to prevent the dispersal of the fill materials;
- Reclamation works will be undertaken in phases such that the impacts will be confined to small areas at a given time.

The undesirable seabed materials from the reclamation site to be dredged will be disposed most likely at a portion of the Manila Bay relatively near the project site. As the source and disposal site of these materials is the Manila Bay and further that the disposal site will be provided with containment structures, contamination of the disposal site is not considered as highly significant.

2.1.3.2.1.2 Soil Erosion

Soil erosion may occur during this stage. Sediment removal from the sea bed is necessary for the soil that is "undesirable" i.e., not possessing the quality needed for sound reclaimed land form. Improper storage of construction materials and indiscriminate disposal of fill materials and excavated soils may also affect erosion patterns.

To mitigate such impacts, the following mitigation measures are recommended:

- Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimize possibility of subsidence or differential settling; and
- Progressive ground preparation and clearing to minimize total area of land that will be disturbed at any one time, where practical.

2.1.4 Terrestrial Ecology

Terrestrial ecology is deemed not significant or relevant to the project as there are no terrestrial flora or fauna on the site.

2.2 Water

2.2.1 Hydrology / Hydrogeology

The Local government of Manila is planning to reclaim portion of the Manila Bay covering an area of about 4,678.0 hectares (ha) or 4.678 square kilometers (sq. km.). The proposed project site is adjacent to the drainage outlet of one (1) of the major river basins of the Philippines, the Pasig-Laguna Bay. Based on the Flood Hazard Map of Metro Manila prepared and published by Mines and Geo-sciences Bureau (MGB) (**Figure 2-21**) the major roads that connect the proposed reclamation project is within the flood prone area where the occurrence of flood is 50-100 year recurrence interval.

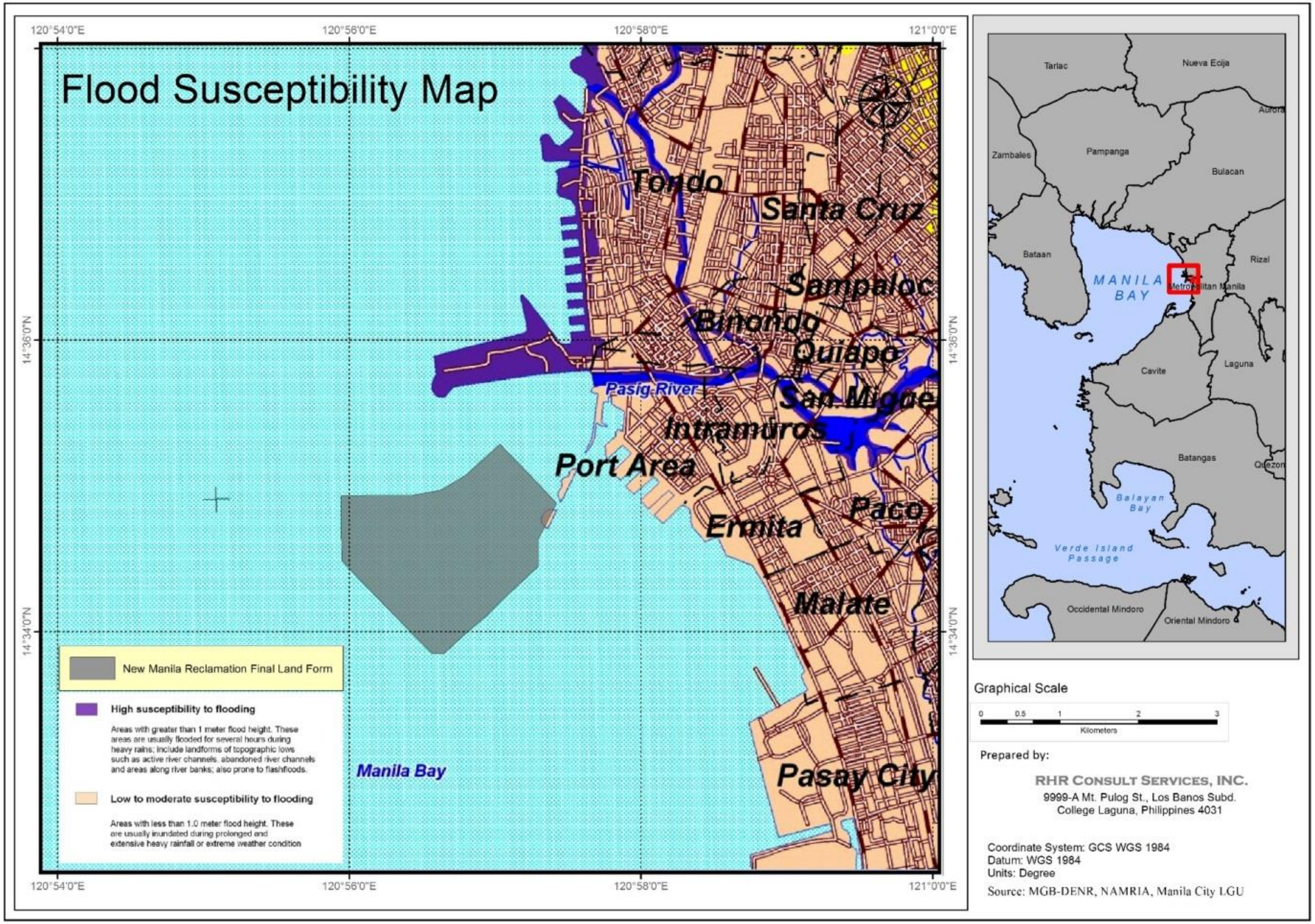


Figure 2-21. Flood Hazard Map of Metro Manila

The catchment area of Pasig-Laguna de Bay basin draining into the proposed project is about 4,393 square kilometers (sq. km.) with the Pasig river catchment covering about 668 square kilometer (15%) and Laguna de Bay catchment of about 3,725 square kilometers (85%). It should be noted that the two catchments are connected together through a man-made channel with control structures or barrage dams purposely for flood control to the Manila area.

About 23 percent (%) of the areas within the basin that have level to nearly level topography are susceptible to flooding which includes major roads that connect to the proposed project site. Roughly, areas prone to flooding include major roads are located in the City of Manila. The topography of most areas fronting and near the project site are level to nearly level terrain are prone to flooding. The prolonged occurrence of heavy rainfall in the basin will inundate the identified flood prone areas for several hours depending on the duration and intensity of the rainfall. The flooding problem will be aggravated with the rise of the sea level during high tide particularly during inclement weather condition.

The foregoing flood scenario is without the proposed project where major thoroughfares will always experience the effects of flooding since no structures are built to alter the natural existing condition or topography particularly during inclement weather condition. With the project, there could be some positive and negative impacts as far as flood situation is concerned. A mitigating measure will have to be formulated or conceptualized to address any negative environmental impacts as a result of the project.

2.2.1.1 Approach and Methodology

The following outline of major work elements was used for the conduct of the said undertaking. The outline is intended to establish the general scope and content of the activities to determine the extent of flooding and inundation of the flood areas fronting the proposed reclamation area and the effects of the project on the flood prone areas of located within Manila City.

2.2.1.1.1 Collection / collation of available secondary information

The activities may include but not limited to: collection of available rainfall data near the project site (Quezon City, Manila City, etc.), geo-hazard maps (flood susceptibility maps including depth of inundation, etc.), topographic maps (map scale 1:50,000) of Manila City and Quezon City), historical annual peak flow data of gaged river/s near the proposed project.

2.2.1.1.2 Delineation of Sub-watersheds of Major River Draining to the Project

The identified river major river system the Pasig River – Laguna Lake basin that is draining the project was delineated (**Figure 2-22**) using GIS software as a requisite in the flood frequency analysis and other hydrological analysis.

Figure 2-22. Pasig River-Laguna de Bay Catchments

2.2.1.1.3 Assessment/investigation of hydrological behaviour

The hydrological behaviour of Pasig River and Laguna de Bay areas that are frequently flooded particularly during occurrence of heavy rains were assessed and investigated.

This activity includes but not limited to;

- Assessment of type and hydrological behavioral flow of fluvial systems and other natural drainage waterways near the project site
- Identification of remnants of flood level on the site left by previous flood/s

Interviews with local people residing near and within the vicinity of rivers particularly those who actually witness the occurrence of large flood events like typhoon Ondoy and other major typhoons that visited the country. Information to be obtained include; approximate depth, extent and duration of inundation, areas covered by flood waters, etc.

2.2.1.1.4 Flood Analysis

- Using the NAMRIA topographic maps with the scale of 1;50,000 and geo-hazard maps prepared by MGB-DENR and other information obtained, areas near the project site that are susceptible to flooding will be identified.
- Determine other possible factors that contribute to flooding and inundation such obstruction of the flood flows (natural or man-made) and rise of sea level or high tide, among 0thers.
- Conduct Point flood frequency analysis to determine flood peaks with different return periods (5, 10, 25, 50, 100 and 200- year) of Pasig River draining to the proposed project.

2.2.1.2 Hydrological Analysis of Flooding

2.2.1.2.1 General features of Pasig-Laguna Bay River Basin

The Pasig-Laguna Bay River Basin is located in the northern portion of Water Resources Region 4 in the island of Luzon. The most unique characteristics of the basin is that it drains three distinct and sub-basins namely the Marikina River Basin, the Laguna Lake Basin, and the urban watershed basin which includes the greater Manila urban area embracing the cities of Manila, Pasay, Caloocan, Quezon, Makati, San Juan, Mandaluyong and Paranaque. The basin has an area of 4,393 sq. km.

The Pasig River which flows east to west through central Manila, is about 17 kilometers in length from the confluence of Marikina River and Napindan channel to Manila Bay. The river has fairly direct course toward the Bay, except for the double loop meander in the Punta-Sta. Ana area. One of the principal tributaries of the river is the San Juan River. It enters the Pasig River about 8 kilometers upstream of the mouth of the lower river meander. The Pasig River discharge depends upon the elevation of the water surface at the Pasig-Napindan junction, the lake stage of Laguna de Bay, the elevation of the tides of Manila Bay and upon the discharge from San Juan River. At certain periods of high tide in the Bay and low water lake stage during the dry season, the Pasig River reverses its flow. During high tide conditions and high flows from the San Juan River, a backwater effect slows down the flow of the Pasig River and causes overbanking.

Laguna de Bay is shallow lake situated immediately inland from the Manila Metropolitan area. It serves as a natural detention reservoir of discharges from the surrounding tributaries (Pila-Sta. Cruz, San Juan, San Cristobal, Pagsanjan and Sta. Maris Rivers. The lake's only outlet is via the Napindan channel and Pasig River. The Napindan River normally flows from Laguna de Bay to Pasig River, but it can and does flow in either direction, depending upon or river and lake levels. the lake stage of Laguna de Bay depend upon the seasonal variation in rainfall and yearly inflow of surface water, the relation between the Lake level and the tidal stage in Manila Bay, and the annual evaporation from the lake.

The Marikina River, a tributary of Pasig River, originates from the western side of the Sierra Madre Mountains about 35 kilometers northeast of Manila. At the municipality of Montalban, the river emerges from the mountain range turning and flowing southward through the Marikina Valley until it joins the Pasig River.

2.2.1.2.2 Rainfall Pattern

Rainfall data that are near or within the watershed of Pasig River were collected. Rainfall data obtained from rainfall station located Science Garden, Quezon City and at NAIA are synoptic. All stations are operated by PAGASA. On the other hand, the Science Garden rainfall station started its operation 1961 up to the present. The mean monthly rainfall of the two (2) stations is shown in **Table 2-6** and **Table 2-7.**

Table 2-6. Mean Monthly Rainfall of Science Garden Rainfall Station (1984-2013)

Month	Mean
January	41.6
February	33.2
March	61.2
April	40.3
May	217.8
June	392.8
July	442.5
August	645.9
September	565.2

Month	Mean
October	292
November	153.9
December	87.3
ANNUAL	**2,973.3**

Table 2-7. Mean Monthly Rainfall of Port area, Manila Rainfall Station (1981-2010)

Month	Mean
January	17.3
February	14.2
March	15.8
April	23.7
May	147.2
June	253.5
July	420.5
August	432.4
September	355.1
October	234.8
November	121.7
December	67.4
ANNUAL	**2,103.6**

The proposed project site, the whole Pasig River-Laguna de Bay basin and surrounding areas belong to Type 1 climate under the Corona's modified climate type classification. This type of climate has two (2) pronounced seasons; generally dry from November to April and wet during the rest of the year.

Typhoons or tropical cyclone crossed the Philippine Area of Responsibility (PAR) on the average of 19.8 typhoons per year. Most of the typhoons that visited the country brings heavy rains that resulted to large floods that damaged agricultural crops, damaged to life and properties costing several millions or billions of pesos.

The most recent catastrophic flood occurred in Metro Manila when Typhoon "Ondoy" hit the country on September 26, 2009. Based on the rainfall data obtained from the Science Garden PAGASA rainfall station rainfall started to occur at around 12 midnight. It started to intensify on the succeeding hours and at around 4:00 am; after 4 hours of continuous heavy rains, it accumulated a total rainfall depth of **229.50 mm**. This amount of rainfall generated a flood with a magnitude of **5,328 cms** over the 499 square kilometer (sq.km.) Marikina River watershed area. This extra-ordinary flood corresponds to 150 to 200 – year return period or recurrence interval. At around 8 am, 8 hours after, it registered a total amount of **406.50 mm**. The amount of rainfall generated a flood flow of **5,300 cms** equivalent also to 150 - 200- year flood. The extreme flood event inundated, damaged and devastated structures, properties and claimed thousands of lives, particularly of those residing within the flood plain areas of Marikina valley which are prone to flooding. **Table 2-8** shows the rainfall depth at Science Garden, Quezon City generated by typhoon "Ondoy" on September 26, 2009.

Table 2-8. Rainfall amount in millimeter (mm) during Typhoon "ONDOY" on September 26, 2009

Time	Rainfall, millimeter (mm)
0000 – 0100	6.0
0101- 0200	49.5
0201 – 0300	82.0
0301 – 0400	92.0 (**229.50**)*
0401 – 0500	55.0
0501 – 0600	63.0
0601 – 0700	40.0
0701 – 0800	19.0 (**406.50**)**
0801 – 0900	6.5
0901 -1000	11.0
1001- 1100	12.5
1101- 1200	12.0 (**448.5**)***
1201- 1300	0.0
1301- 1400	2.0
1401- 1500	4.0
1501- 1600	0.0
1601- 1700	0.5
1701- 1800	0.0
1801- 1900	0.0
1901- 2000	0.0
2001- 2100	0.0
2101- 2200	0.0
2201- 2300	0.0
2301-2400	0.00
TOTAL	**455.0 mm**

source: PAGASA forecasting center

legend:

* total rainfall after 4 hours

** total rainfall after 8 hours

*** total rainfall after 12 hours

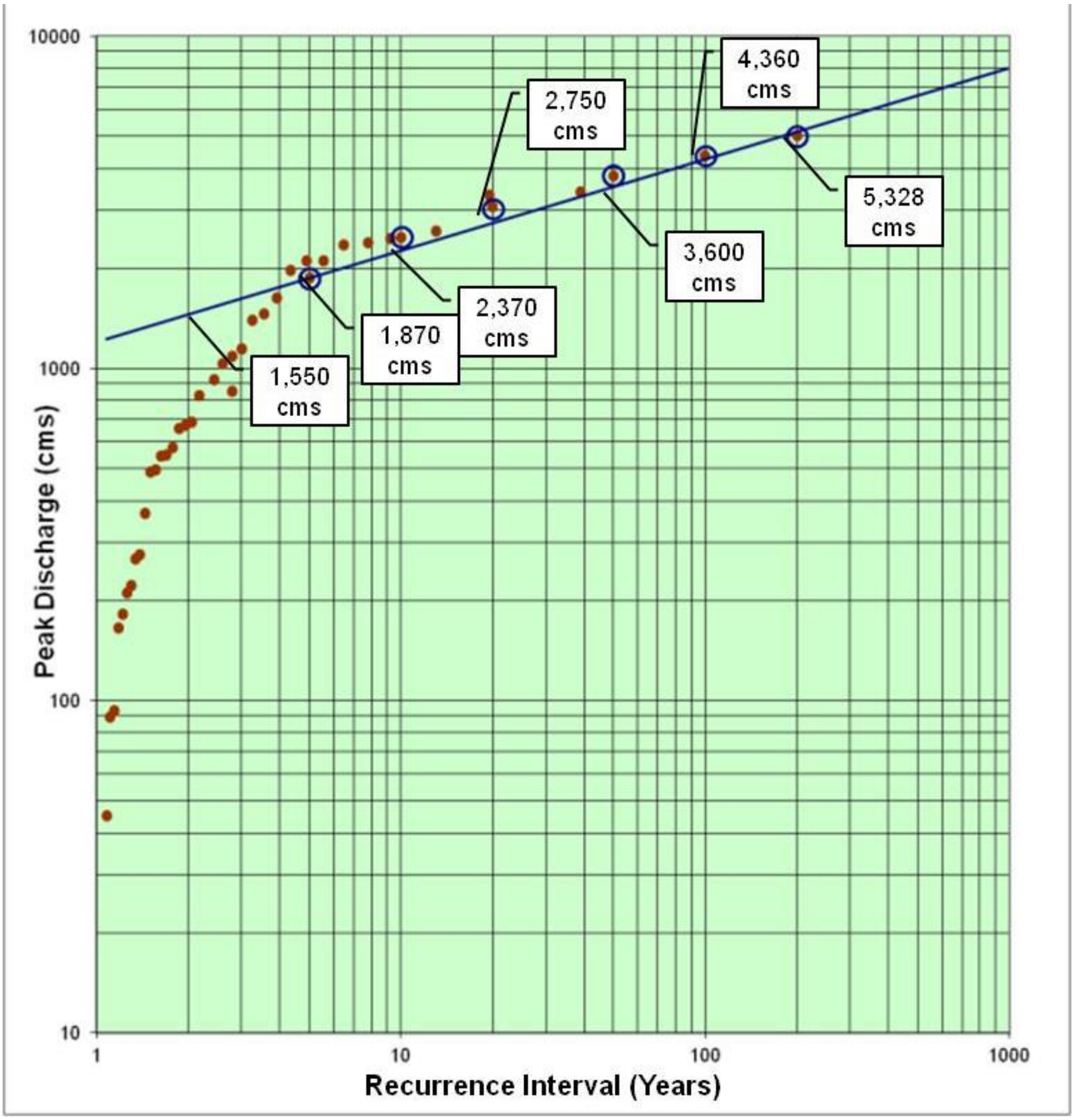


Figure 2-23. Flood Frequency curve of Marikina River at Sto. Nino, Marikina, Dainage area= 499 km^2

Table 2-9. Point Flood Frequency Analysis of Marikina River located at Sto. Niño, Marikina, Drainage Area= 499 sq. km. years of records, 1958-2010 (fragmentary)

Year	Peak discharge, cms	Descending Order (rank)	$(X - X_{mean})^2$	Plotting Position (n + 1/m)
1958	543	3,420 (1)	5,423,775.20	39
1959	**2,076**	3,306 (2)	4,905,782	19.5
1960	**2,348**	2,592 (3)	2,252,700	13
1961	1,460	2,460 (4)	1,873,900	9.25
1962	1,620	2,390 (5)	1,687,100	7.80
1963	1,145	2,348 (6)	1,579,800	6.50
1964	**2,100**	2,100 (7)	1,087,900	5.57
1965	824	2,096 (8)	970,028	4.875

Year	Peak discharge, cms	Descending Order (rank)	$(X - X_{mean})^2$	Plotting Position (n + 1/m)
1966	**3,420**	1,964 (9)	762,000	4.33
1967	**2,460**	1,620 (10)	279,735.20	3.90
1968	1,390	1,460 (11)	136,087.20	3.54
1969	575	1,390 (12)	89,341	3.25
1970	-	1,145 (13)	2,905	3.00
1971	-	1,083 (14)**	64	2.78
1972	1,964	1,030 (15)	3,733.20	2.60
1973	276	920 (16)	29,275	2.44
1974	274	853 (17)	56,692	2.78
1975	210	824 (18)**	71,289	2.167
1976	853	688 (19)	162,489	2.052
1977	2,592	674 (20)	173,372.40	1.95
1978	-	658 (21)	187,575.60	1.857
1979	-	575 (22)	266,359.20	1.773
1980	-	548 (23)	294,957.60	1.69
1981	-	543 (24)	300,413.60	1.625
1982	-	493 (25)	354,144.00	1.56
1983	-	485 (26)	376,357.20	1.50
1984	-	365 (27)	527,221.20	1.44
1985	493	274 (28)	667,652.40	1.39
1986	**2,389.70**	267 (29)	679,141.60	1.34
1987	165	221.35 (30)	756,465.10	1.30
1988	674	210 (31)	776,337.20	1.26
1989	1,030	181 (32)	828,282.00	1.22
1990	919.50	165 (33)	857,661.00	1.18
1991	930	93 (34)	996,203.60	1.14
1992	89	89 (35)	1,004,204.40	1.11
1993	-	45 (36)	1,094,325.00	1.08
1994	89			
1995	45.00			
1996	1,083.00			
1997	-			
1998	-			
1999	-			
2000	-			
2001	-			
2002	1,083.00			
2003	658.00			
2004	824.00			
2005	365.00			
2006	548.00			
2007	688.00			
2008	435.00			
2009	**3,306.00**			

Year	Peak discharge, cms	Descending Order (rank)	$(X - X_{mean})^2$	Plotting Position (n + 1/m)
2010	221.35			

Legend ** twice occurred
Number of data points = 38
Mean = 1,091.00 cubic meters per second (cms)
Standard deviation (unbiased) = 922 cms

Table 2-10 shows peak flows with corresponding return period were extracted based on the frequency curve of Marikina River, DA= 499 sq. km.

Table 2-10. Peak Discharge of Selected Return Period

Return Period	Peak Discharge
$Q_{2.33}$	1,550 cms
Q_5	1,870 cms
Q_{10}	2,370 cms
Q_{20}	2,750 cms
Q_{50}	3,600 cms
Q_{100}	4,360 cms
Q_{200}	5,320 cms

The various flood peaks and return period at the Sto. Nino gaging station was transposed at the mouth of Pasig River using the basin factor approach to have an idea on the response of the catchment on the intense rainfall for a period of 8 hours caused by typhoon “Ondoy”. The result is shown in **Table 2-11**. The estimated values assume the natural regime of the watershed.

Table 2-11. Estimated peak flows with corresponding return period of Pasig River Drainage area= 4,678 sq. km.

Return Period	Peak Discharge
$Q_{2.33}$	15,082
Q_5	18.193
Q_{10}	23,147
Q_{20}	26.675
Q_{50}	35,075
Q_{100}	42,423
Q_{200}	49,874

The extent of inundation of the flood equivalent to about 5,320 cms (200 year flood) at the Sto. Nino gaging station as a result of typhoon “Ondoy” is shown in **Figure 2-24**. This is extracted from the study conducted by Dr. Guillermo Q. Tabios III on Marikina River Flood Hydraulic Simulation during Typhoon Ondoy on September 26, 2009.

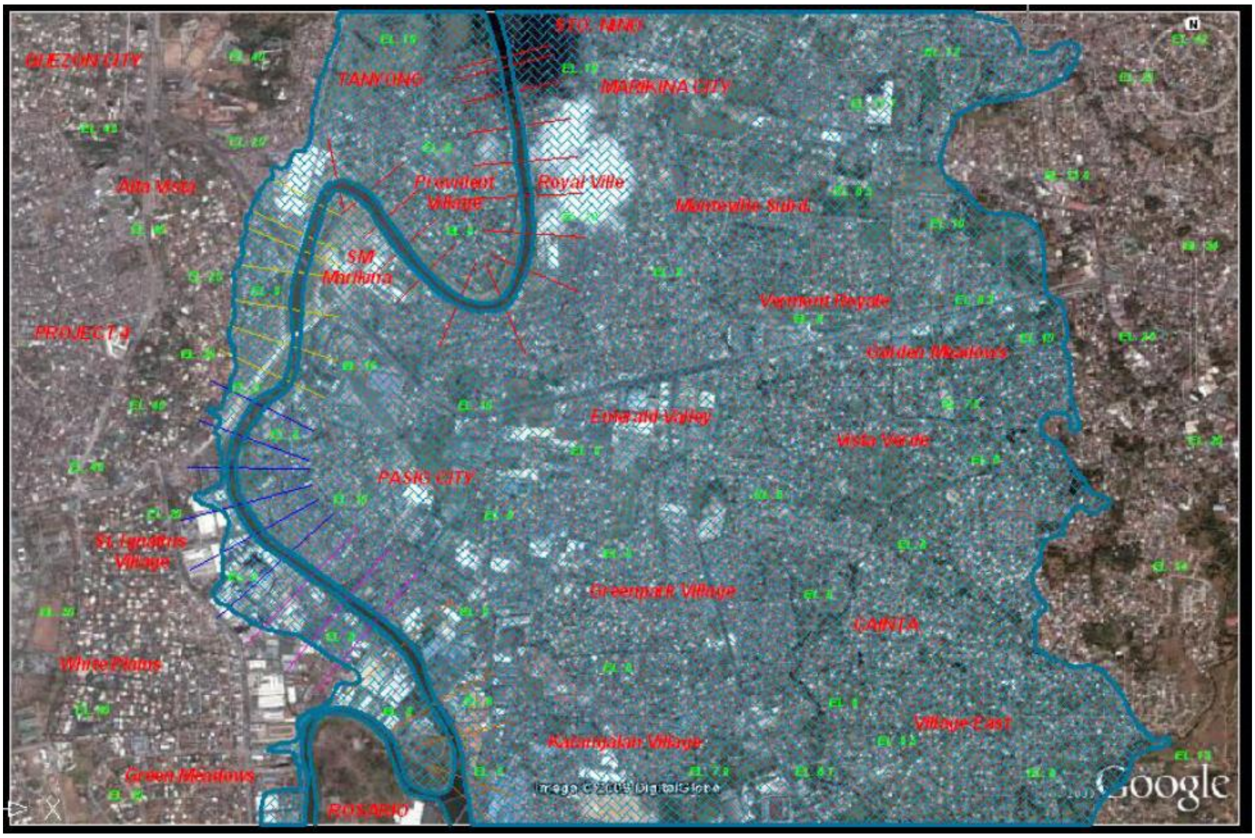


Figure 2-24. Extent of inundation of the Flood equivalent to 5,320 cubic meters per second as a result of typhoon "Ondoy"

Although the extent of flooding on the area near the project site is different from that at the upper Marikina River watershed since the latter has only few flood mitigation structures that are built on the river bank to protect residence who are residing near the river bank. In the case of the areas near the project site, inundation occurred due to rise of the sea level and bankful capacity of Pasig River has already been reached by flood waters where drainage cannot anymore drain its waters to the river or to the sea. As a result, flooding on level areas occurred. In some areas overbanking may have happened that aggravates flooding.

If we based on the available data collected and used on this study there is an indication that a change in flow regime as well as rainfall pattern. If we follow the analysis of Ripple one who devised the earliest and simplest synthesis techniques which assumes that future inflows (rainfall or streamflow) will be a duplicate of the historical record repeated in its entirety as many times end to end where future inflows can be similar but are unlikely identical to past inflows. In this case, there is possibility that the occurrence of extreme events like Typhoon "Ondoy" and Yolanda could occur again anytime, and we must prepare for the worst scenario.

In the upper Marikina River catchment, the most affected areas as far flooding is concerned is people residing near or within the flood plains of Wawa River and river sections of Marikina River in Montalban. The flood plains of these rivers are vulnerable to flooding. In the case of the areas near the project where access roads are within the flood prone areas, flooding is not mainly caused by the overbanking of flood waters from Pasig River. As stated earlier, is due to the drainage system that are not totally function properly since it cannot discharge its waters to the sea or to Pasig River.

2.2.1.3 Recommended Mitigating Measures

Include in the Feasibility Study the assessment and inventory of all drainage system of all roads that connect to the proposed reclamation project and conduct flood risk mapping on areas that are traversed by major roads that connects to the proposed project.

2.2.2 Oceanography

2.2.2.1 Methodology

2.2.2.1.1 Baseline Condition

Baseline data on bathymetry, tidal heights, and water currents were based on primary and secondary data gathered at the project site. Primary data gathering involved measurements of current patterns. Secondary data gathered were tidal heights and bathymetry for the whole Manila Bay as extracted from the tide table and bathymetric map of the NAMRIA. River inflows and discharges were also based from other studies conducted in Manila Bay.

2.2.2.1.2 Assessment of Impacts

To assess the impacts of the proposed Project to the existing environmental condition of the area, a hydrodynamic modelling was conducted using the EFDC-Explorer Version 8.3 Hydrodynamic.

CVLGRID and EFDC Explorer Version 8.3 were the models used in this study. CVLGRID was developed by Dynamic Solutions International, LLC (DSI) for use with curvilinear orthogonal models, such as EFDC_DSI, EFDC_SGZ, EFDC_EPA, and EFDC_Hydro Models (Craig, 2017). CVLGRID generates curvilinear grids following the shape of the modelling domains or study area for more accuracy and maintain orthogonality.

EFDC Explorer Version 8.3 is a Microsoft Windows™ based pre-processor and post-processor for the three-dimensional (3D) hydrodynamic model for the Environmental Fluid Dynamics Code (EFDC). EFDC was originally developed by Dr. John M. Hamrick at the Virginia Institute of Marine Science (VIMS) and School of Marine Science of The College of William and Mary. According to EPA's website (www.epa.gov/exposure-assessment-models/efdc), EFDC has "evolved over the past two decades to become one of the most widely used and technically defensible hydrodynamic models in the world”.

Based on the U.S.EPA’s website (www.epa.gove/ceam/), the “*EFDC has been validated using analytical solutions, simulations of laboratory experiments and verified prototype applications*” (please see **Plate 1** below). The U.S.EPA’s website also presented the referred journals, books, and conference proceedings of the EFDC.

Quality Assurance/Quality Control

The EFDC model has been validated using analytical solutions, simulations of laboratory experiments and verified prototype applications. An extensive bibliography of referred journal and conference proceedings articles exist. (See the document linked in the References of Published EFDC Applications and Uses section below.)

Source: https://www.epa.gov/ceam/environmental-fluid-dynamics-code-efdc#QAQC

Plate 2-1. Quality assurance and quality control for EFDC

2.2.2.2 Baseline Data

2.2.2.2.1 Bathymetry

The proposed Project is located at the northeast part of Manila Bay – a semi-enclosed estuary with its mouth facing the South China Sea. Based on the bathymetric map**,** the deepest part of Manila Bay is about 69 m located at the North Channel of Corregidor Island (**Figure 2-25**). Relatively shallower parts are found near the coast of Pampanga and Cavite City. At the proposed project site, the maximum depth is about depths 6.0 m below mean lower low water (MLLW).

2.2.2.2.2 2. Tidal Heights

Tidal patterns in Manila show are generally semi-diurnal or exhibiting two highs and two lows within the 24-hour period, though there are instances that diurnal tides occur depending on the moon phase. Pokavanich and Nadaoka (2006) suggested that the diurnal component of the tide may have screened at the mouth of the bay causing the tides to show semidiurnal patterns. The predicted and modelled tidal heights are shown in **Figure 2-38** and **Figure 2-39**.

2.2.2.2.3 2. Current Patterns

The current patterns at the project site and vicinities are highly influenced by tidal fluctuations in Manila Bay and to some extent, wind forcing at shallower areas.

Based on measurements conducted by RHR (2016, 2017) in coastal waters of Navotas City using continuous data logger and drogues, current patterns were generally parallel with the coastline and along contours or depths with same levels.

Further, current directions also appeared to change during flood and ebb tides, that is, northwesterly currents were observed during flood tide, and reverses in direction (or going towards southeast during ebb tide). These observations were consistent with the observations of local fisherfolks as interviewed during field survey.

On June 29, 2018, current patterns were determined using drogues around the proposed project site during flood and within two (2) hours after high tide. Drogue tracks show that current patterns during flood tide appear to flow towards the north-northwest direction (**Figure 2-26**). It also appears that currents flow toward the same direction during ebbing of tides within about two (2) hours after high tide. There were limited measurements during ebb tide due to strong waves brought about by intense southwest winds.

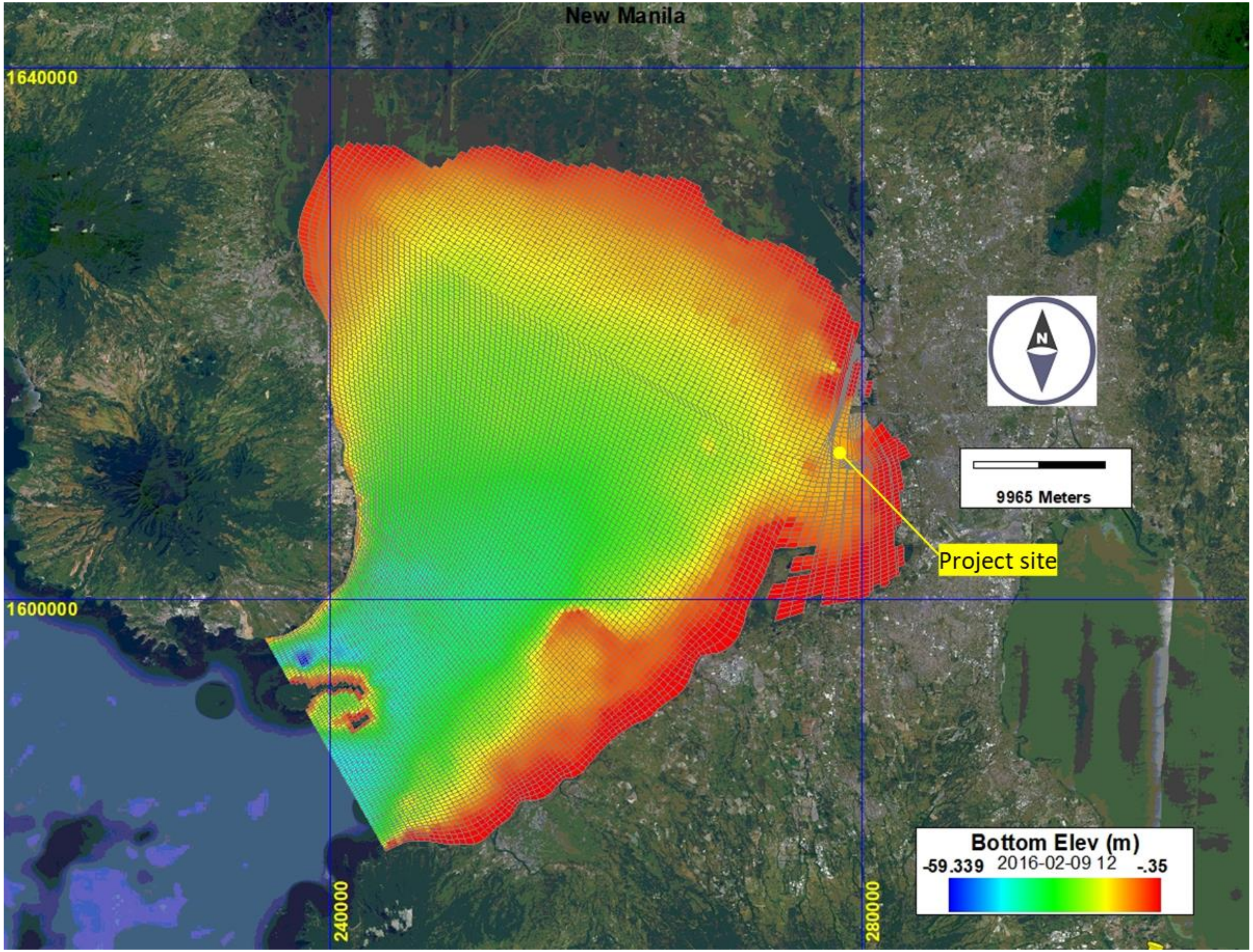


Figure 2-25. Generated bathymetry of Manila Bay using EFDC-Explorer

Figure 2-26. Observed current directions during flood tide and within 2 hours after high tide (or ebbing tide) on June 29, 2018

2.2.2.3 Impact Assessment and Mitigation Measures

2.2.2.3.1 Hydrodynamic Modelling

As discussed above, hydrodynamic modelling was conducted using two (2) models, namely: CVLGRID and EFDC-Explorer. The following presents in detail the modelling domain and input data used in the simulations.

a) Modelling Domain
b) Bathymetry or Bottom Elevation
c) Water Layers
d) Tidal Forcing
e) River Inflows
f) Meteorological Input Data

Note that waves were also included in the simulations using the internal wave model option of EFDC Explorer.

2.2.2.3.1.1 Modelling Domain

Figure 2-27 shows the extent of the modelling domain or calculation area, as represented by the generated curvilinear grid. The modelling domain extends to the mouth of Manila Bay as hydrodynamics in the project site are also influenced by tidal fluctuations along from the mouth of Manila Bay.

Three (3) sets of modelling domains or calculation areas were developed to compare the currents, tides and wave patterns in the area, as follows:

- Scenario 1 – without the proposed project (New Manila) and other proposed reclamation islands
- Scenario 2 – with the proposed project (New Manila); and
- Scenario 3 – with all reclamation sites of the City of Manila

The three (3) modelling domains were basically the same in terms of size and form (i.e., generated curvilinear grids), except that for Scenarios 2 and 3, grid cells representing the proposed project site were deactivated (or included as land mass) to represent the proposed reclamation projects.

Figure 2-28, **Figure 2-29**, and **Figure 2-30** show the orthogonal deviations of the curvilinear grids generated for the three (3) scenarios. Larger orthogonal deviations were computed along the western coast of study area (or Manila Bay) due to deviations of the coastal boundaries of Bataan with the shoreline along Cavite oriented S-W to N-E.

Further, as the reclamation projects of the City of Manila need to be represented as several grid cells for the Scenario 3 modelling, the curvilinear grids representing the reclamation islands were not “orthogonalize” as orthogonalization of the grids resulted to misalignment of the boundaries of the reclamation islands with curvilinear grid. Non-orthogonalization of the portion of this area, however, resulted to high orthogonal deviations along one (1) set of cells (or column), which is oriented from proposed reclamation project to the Pampanga (please see darkened cells oriented to WNW from the project site).

Note that the curvilinear grid representing the modelling domain was formed by connecting several curvilinear grids. One of the curvilinear grids as discussed above is the grid representing the reclamation projects of the proponent.

Cell maps representing the land and water cells for the three (3) scenarios are presented in **Figure 2-31, Figure 2-32**, and **Figure 2-33**. The cells that coincide with the reclamation sites were “deactivated” in the EFDC to represent the land masses within the modelling domains. The number of cells along the x and y-axis are identical for the three (3) scenarios, except that water cells are replaced as land mass, if the cells coincide with the locations of the reclamation sites (**Figure 2-32** and **Figure 2-33**).

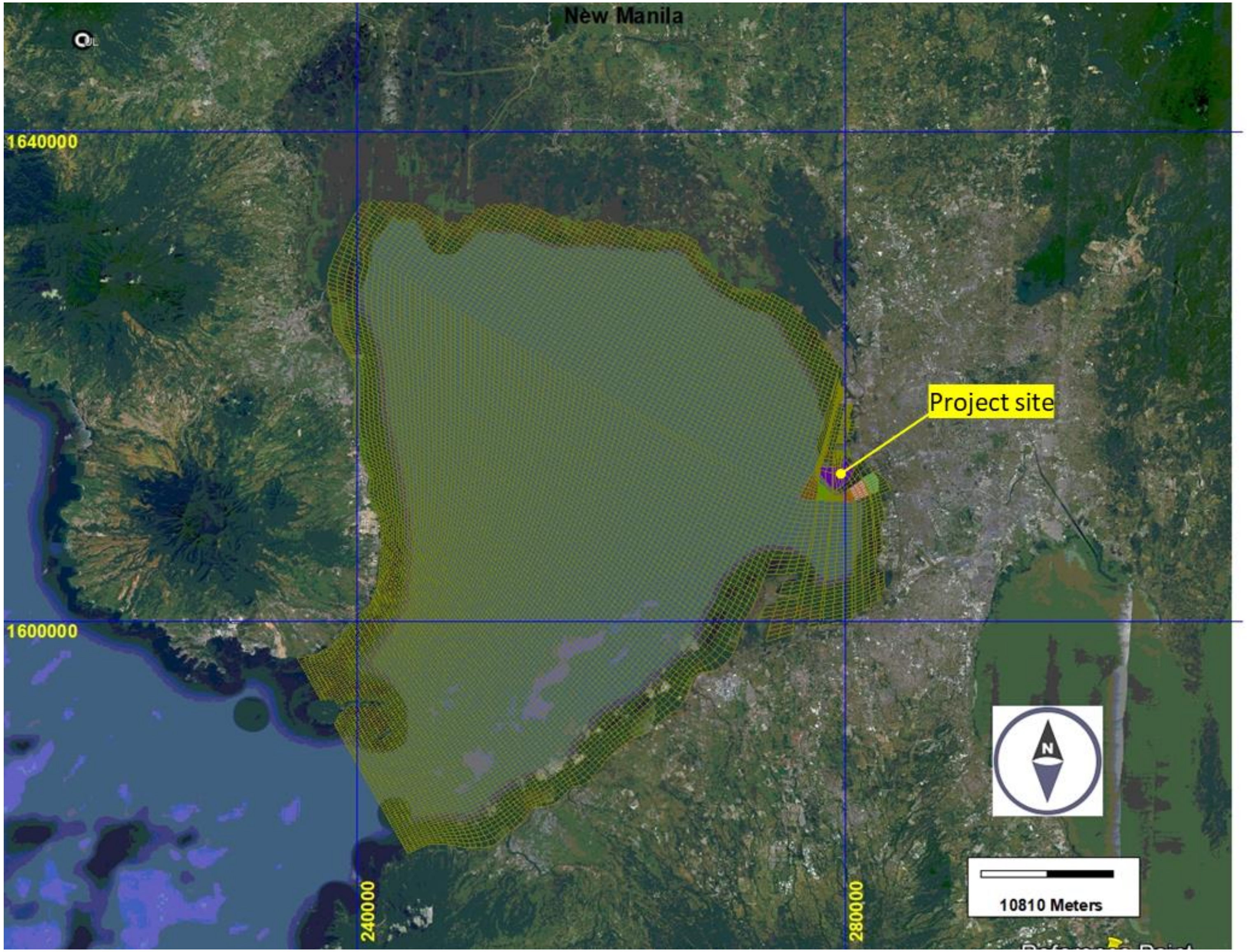


Figure 2-27. Extent of modelling domain or calculation area (represented as curvilinear grid)

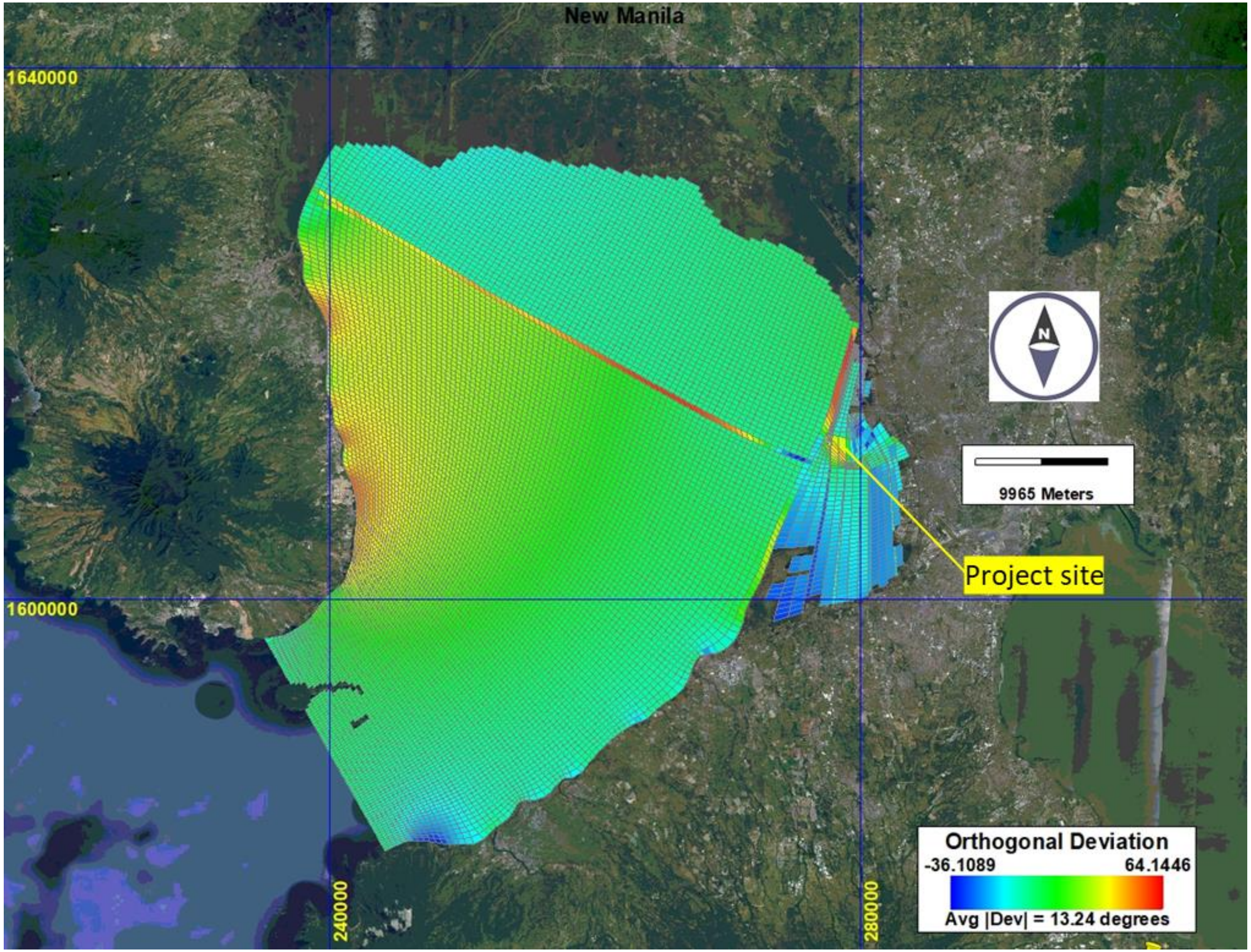


Figure 2-28. Orthogonal deviations in the modelling domain (Scenario 1 – without projects)

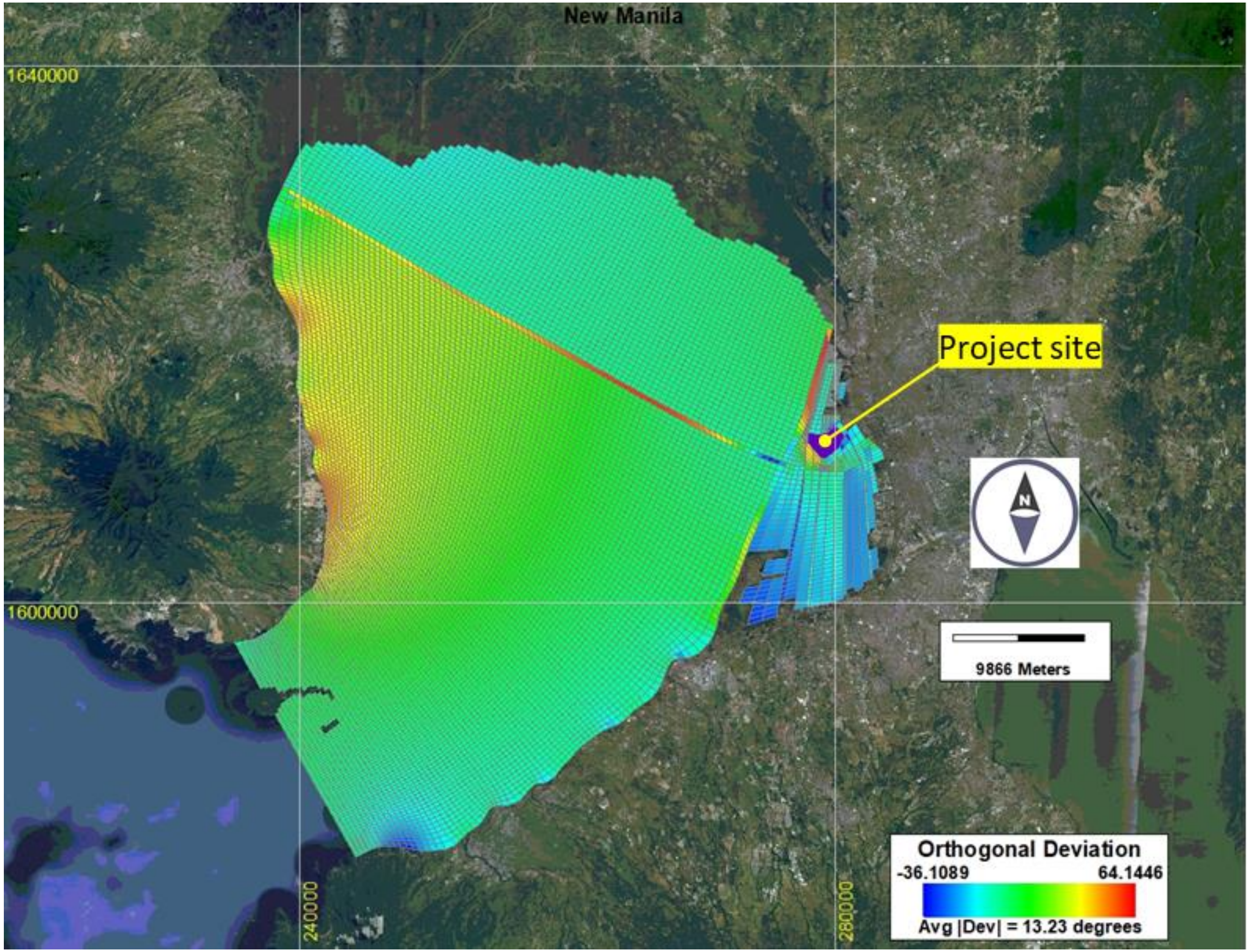


Figure 2-29. Orthogonal deviations in the modelling domain (Scenario 2 – with project -New Manila)

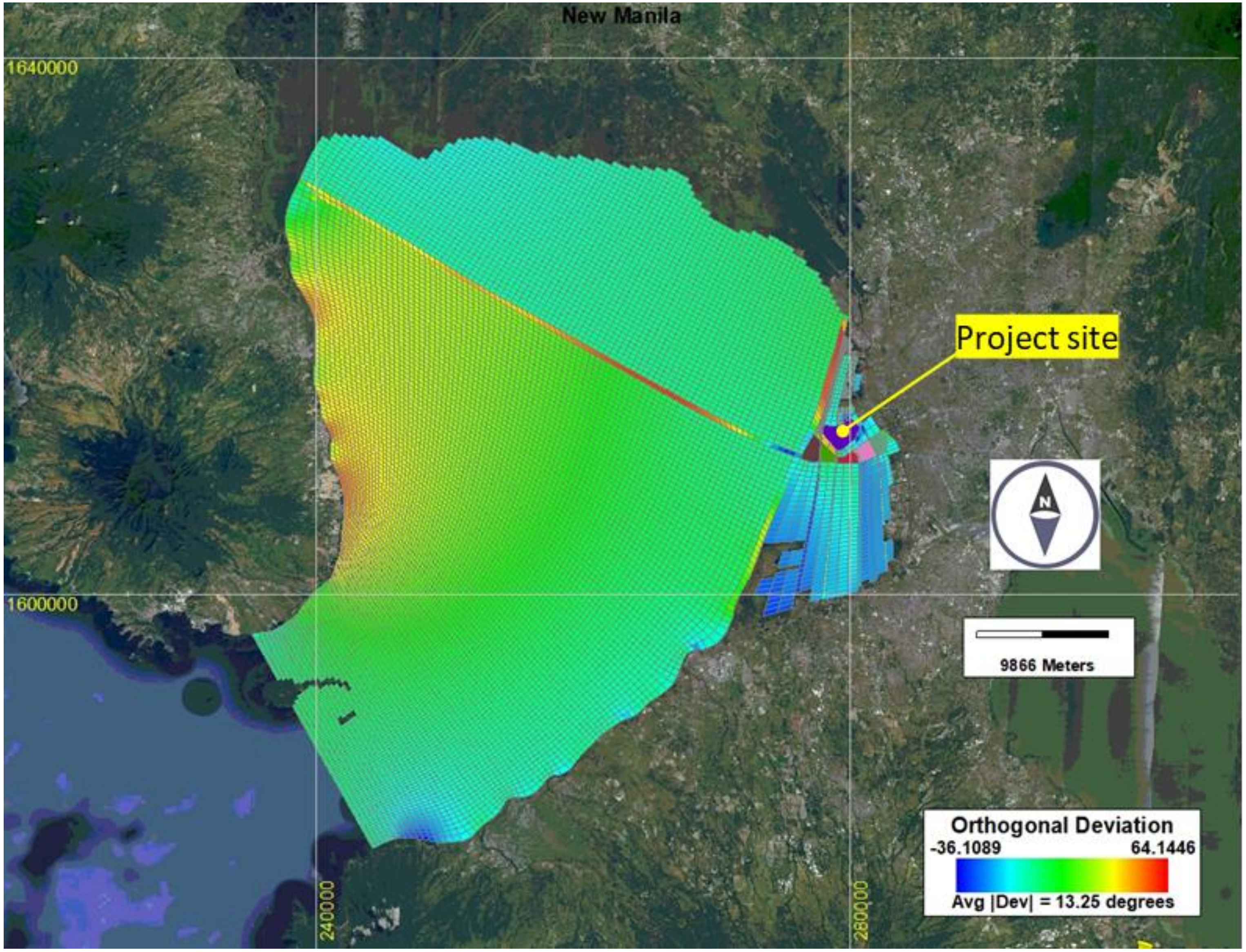


Figure 2-30. Orthogonal deviations in the modelling domain (Scenario 3 – with all projects)

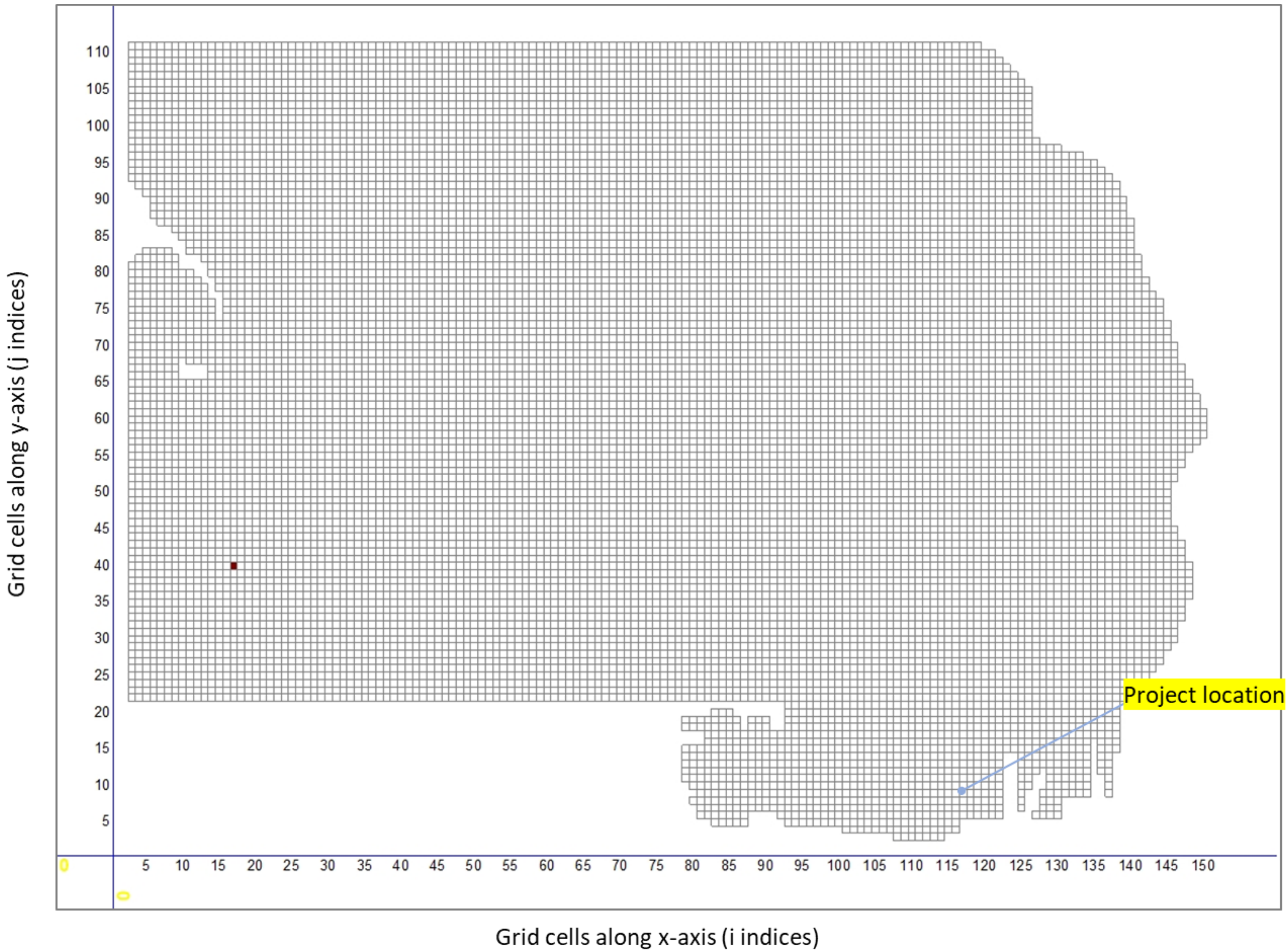


Figure 2-31. Cell map representing water and land cells (Scenario 1 – without projects)

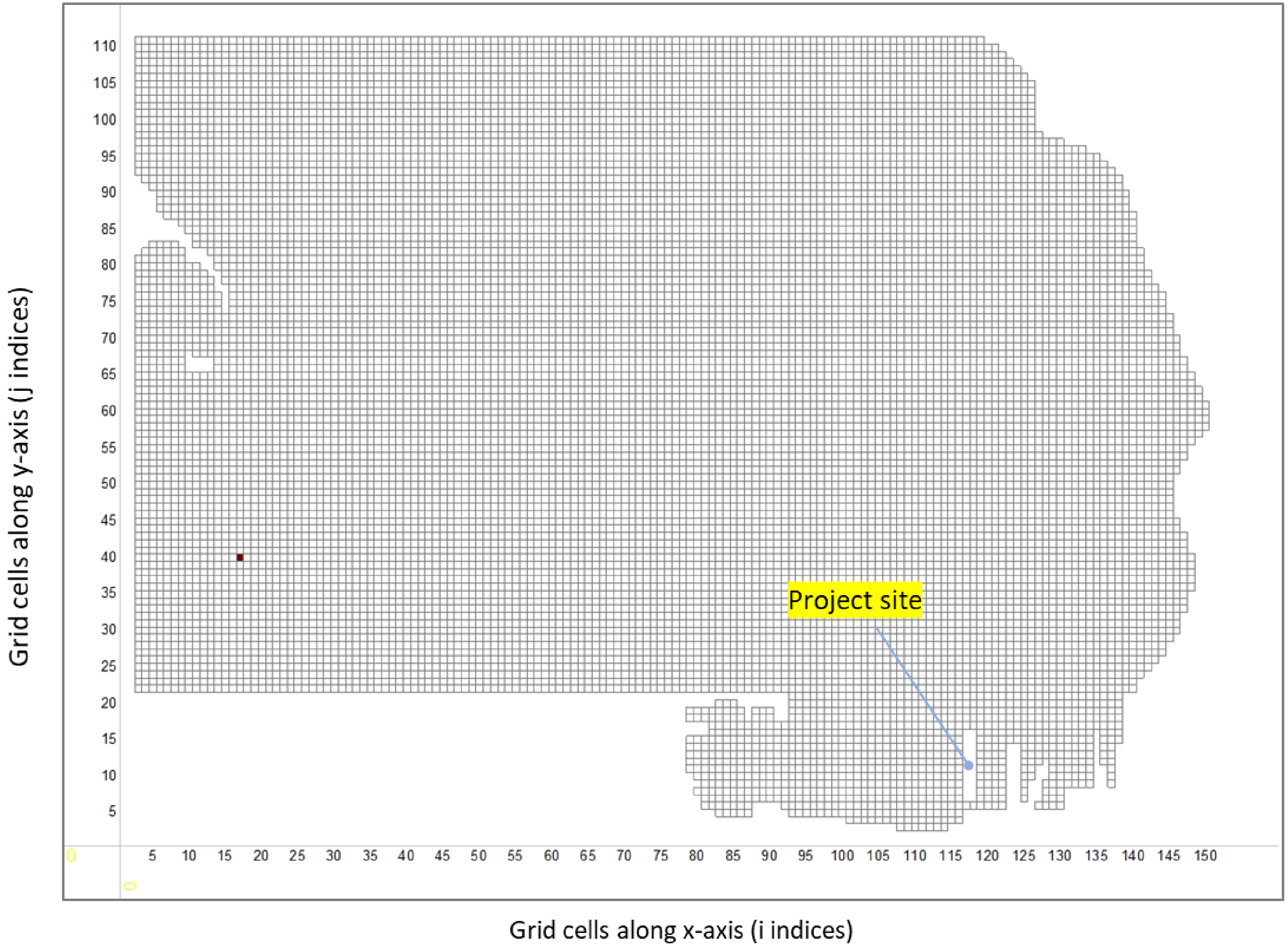


Figure 2-32. Cell map representing water and land cells without (Scenario 2 -With project -New Manila)

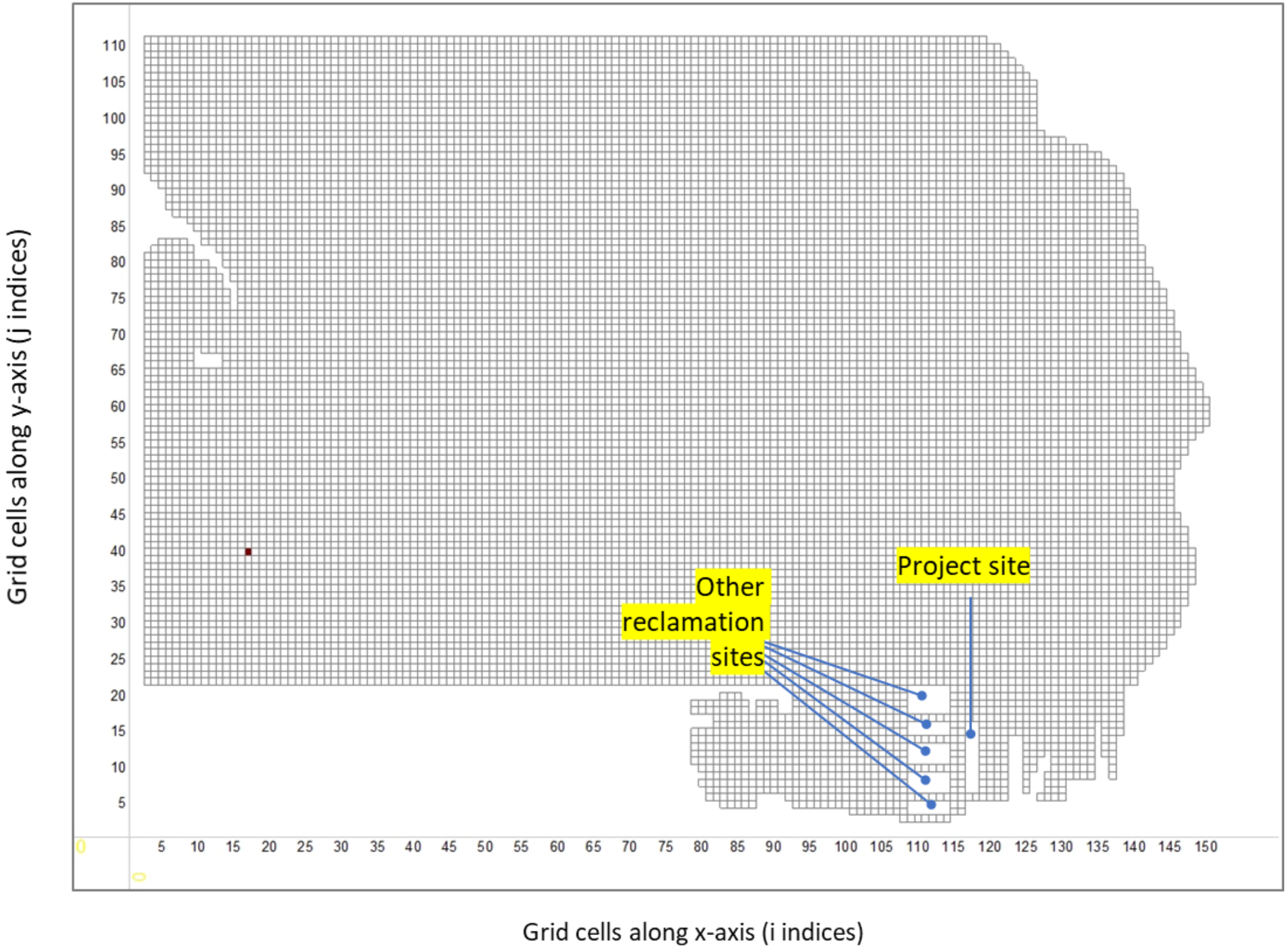


Figure 2-33. Cell map representing water and land cells without (Scenario 3 -With all projects)

2.2.2.3.1.2 Bathymetry or Bottom Elevation

Figure 2-34 to shows the bathymetry of Manila Bay as generated using EFDC Explorer. The depth contours and bottom elevations from NAMRIA maps were digitized and processed using mapping software to generate the x, y, and depth data. Minimum depth of 0.35 m was assigned at areas with depths of -0.35 m. Wetting and drying of intertidal areas were included in the simulations.

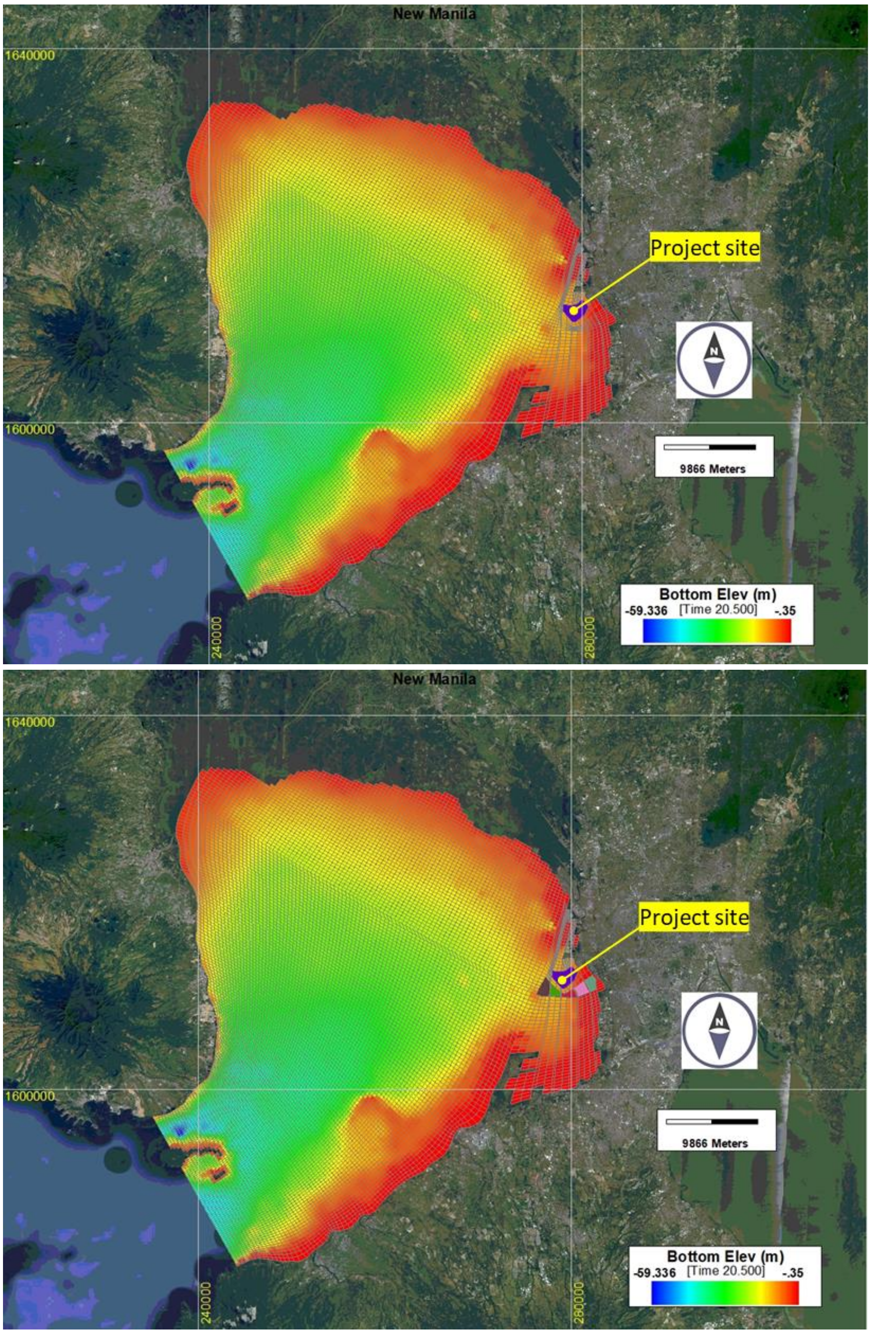


Figure 2-34. Bathymetry within the modelling domain (top-with project-New Manila and bottom – all projects)

2.2.2.3.1.3 Water Layers or Vertical Coordinates

Standard sigma coordinates generally follow the shape of the terrain allowing continuous representation of model fields, such as temperature and currents. This is contrary to the uniform the uniform vertical coordinates that intersect topography or bottom elevations, as shown in **Figure 2-35**. In this study, five (5) layers of standard sigma coordinates were used to represent the vertical water layers.

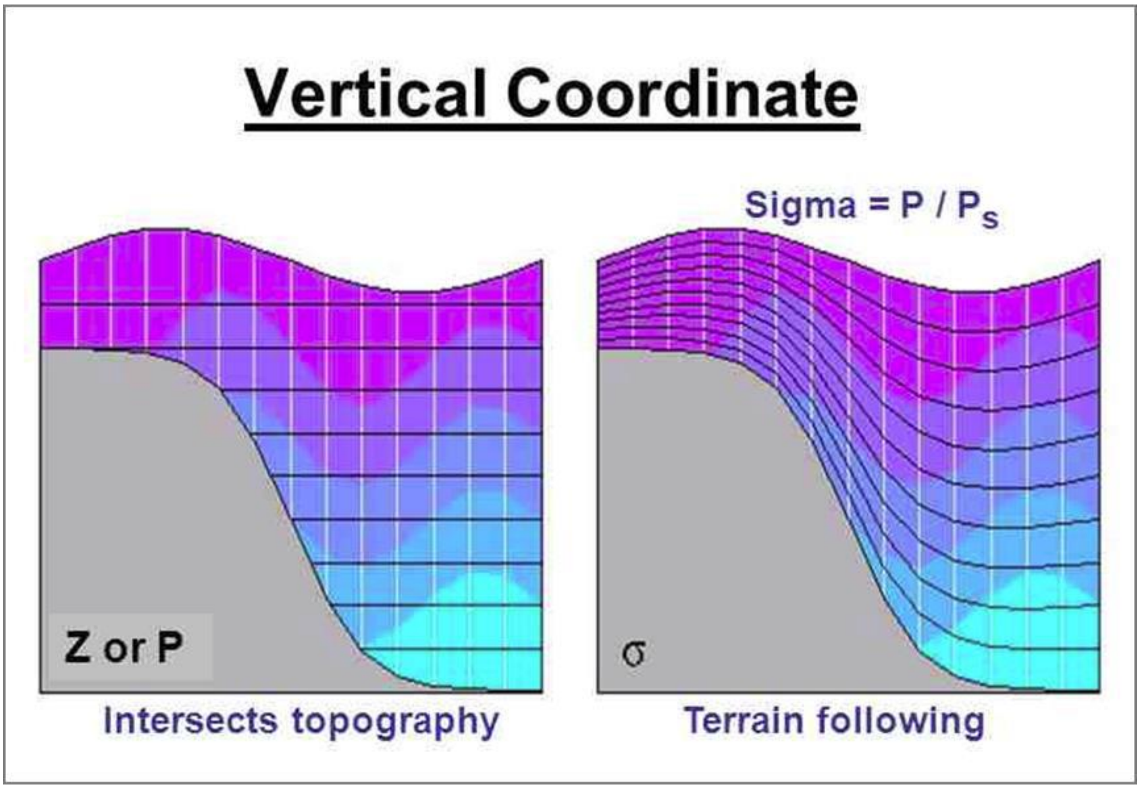


Figure 2-35. Representation of uniform (left) and sigma coordinate system (right)

2.2.2.3.1.4 Tidal Forcing

Hourly tidal heights were generated using the predicted high and low waters at NAMRIA-Puerto Azul Tidal Station. This tidal station was selected as it is the closest secondary tidal station of NAMRIA at the mouth of the Manila Bay. Tidal fluctuations or forcing were then assigned along the open boundary of the modelling domain (or along the mouth of Manila Bay) **(Figure 2-36**).

The hourly tidal heights were generated using a computer program based on a mathematical formulation of polynomial curves, namely: H-P1-M and M-P2-L (**Figure 2-37**). This graphical illustration only provides manual input to generate the tidal heights at any time of the day using the high and low waters.

Figure 2-38 and **Figure 2-39** show the generated hourly tidal heights at NAMRIA-Puerto Azul Station for the periods representing the northeast and southwest monsoons, respectively.

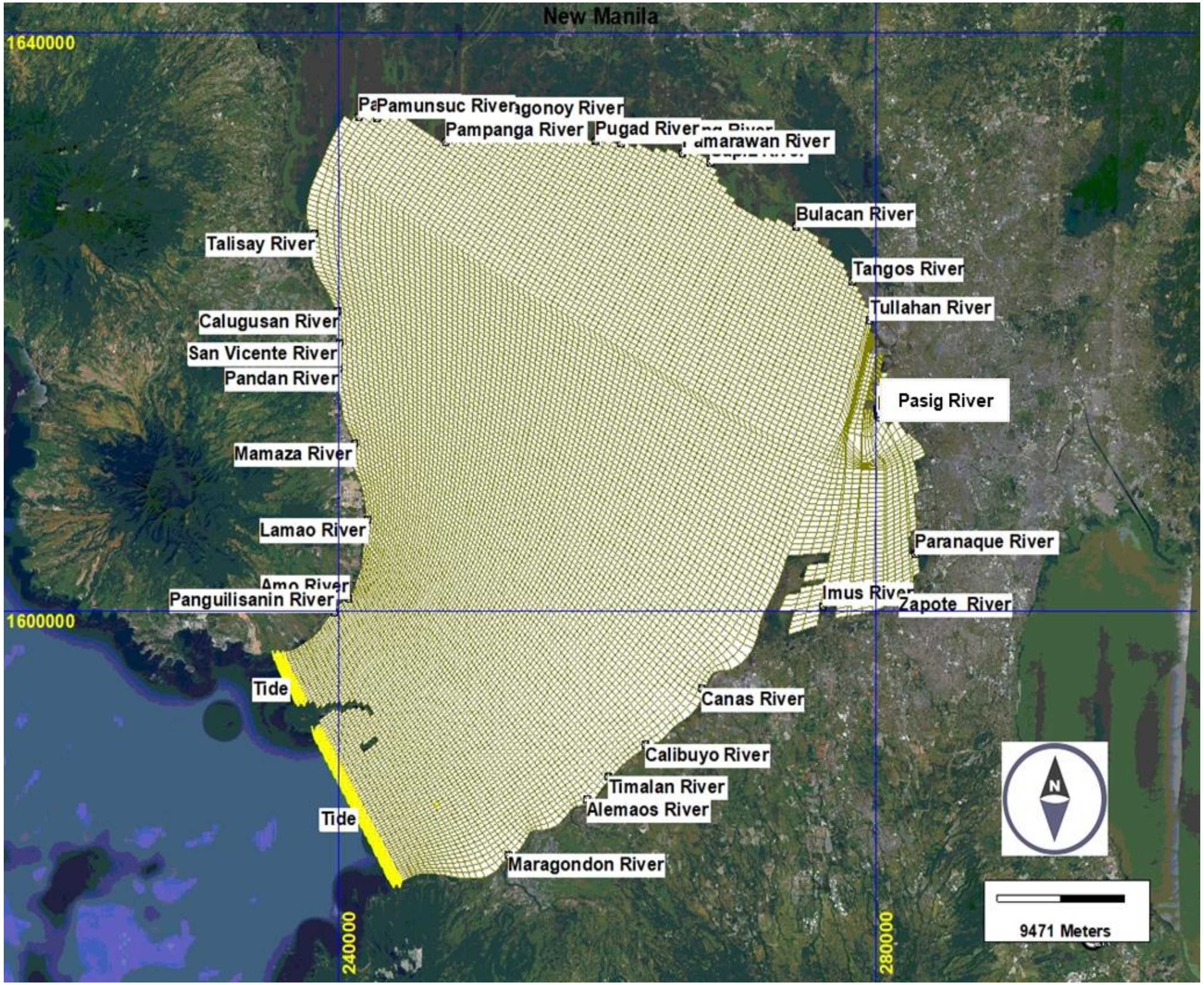


Figure 2-36. Tidal Open Boundaries and River Inflows

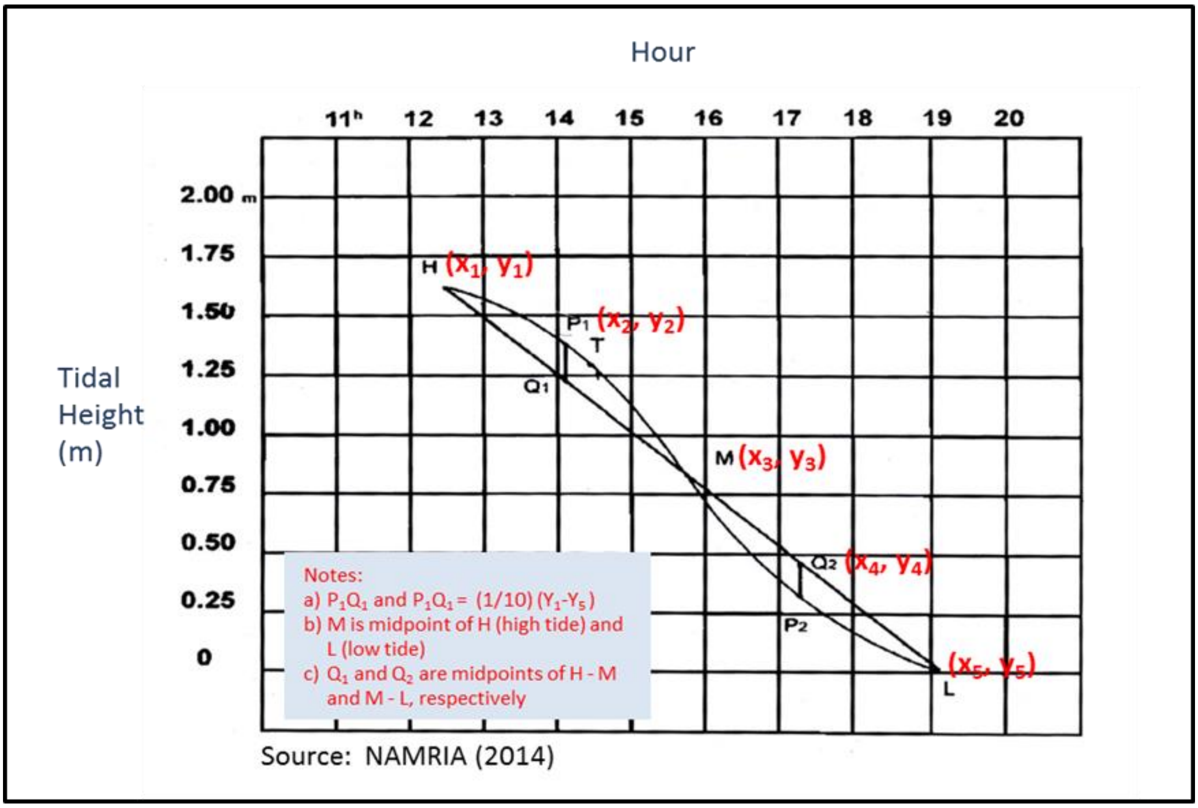


Figure 2-37. Atmospheric and Wind Forcing

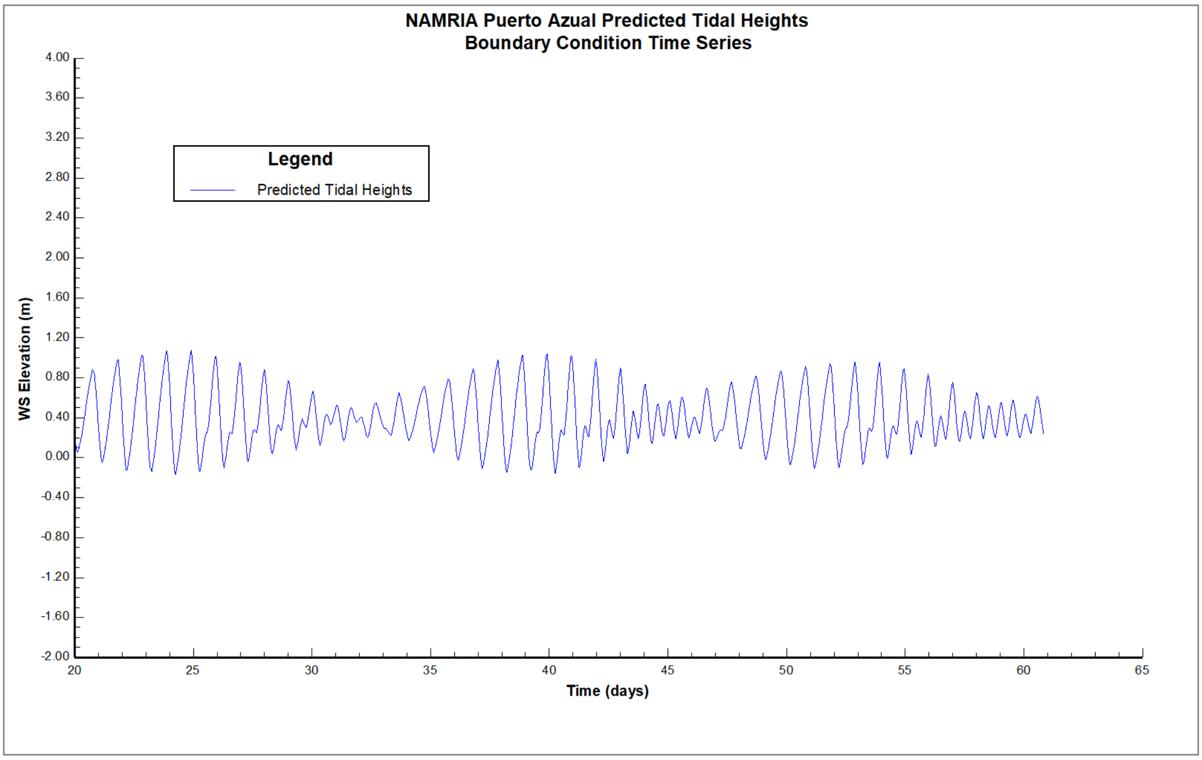


Figure 2-38. Predicted Tidal Heights at NAMRIA-Puerto Azul Tide Station from January 20, 2016 to February 29, 2016 (Data Source: NAMRIA Tide Table 2016)

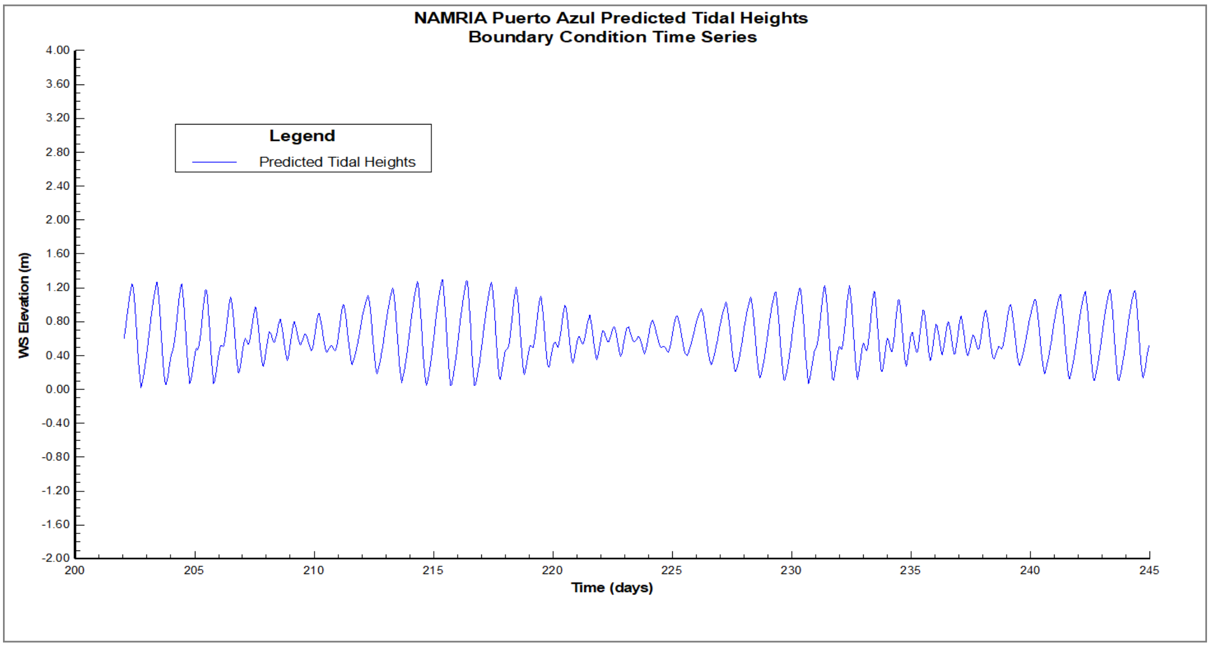


Figure 2-39. Predicted Tidal Heights at NAMRIA-Puerto Azul Tide Station from July 20, 2016 to August 31, 2016 (Data Source: NAMRIA Tide Table 2016)

2.2.2.3.1.5 River Inflows

Figure 2-40 shows the foreshortened screenshot of the input data card of some of the river inflows in the study area. Discharge flow rates were based on previous studies and data, such as Pokavanich and Nadaoka (2006), Siringan and Ringor (1998), and WB Solutions (2008). Increase in discharge flow of 67% was assumed during wet season, as based on data for Pasig and Pampanga Rivers. For minor rivers without discharge data, discharge flow rate of at 90 m^3/s and water temperature of 29.5 ºC were assumed in the simulations.

TSS concentrations were assumed at 20 and 50 mg/l for the dry and wet season, respectively. These values were roughly estimated from Michigan standards (www.michigan.gov) wherein it cited perception of water quality as clear when TSS concentrations are less than 20 mg/l, appear cloudy between 40 to 80 mg/l, and appears "dirty" at concentrations over 150 mg/l.

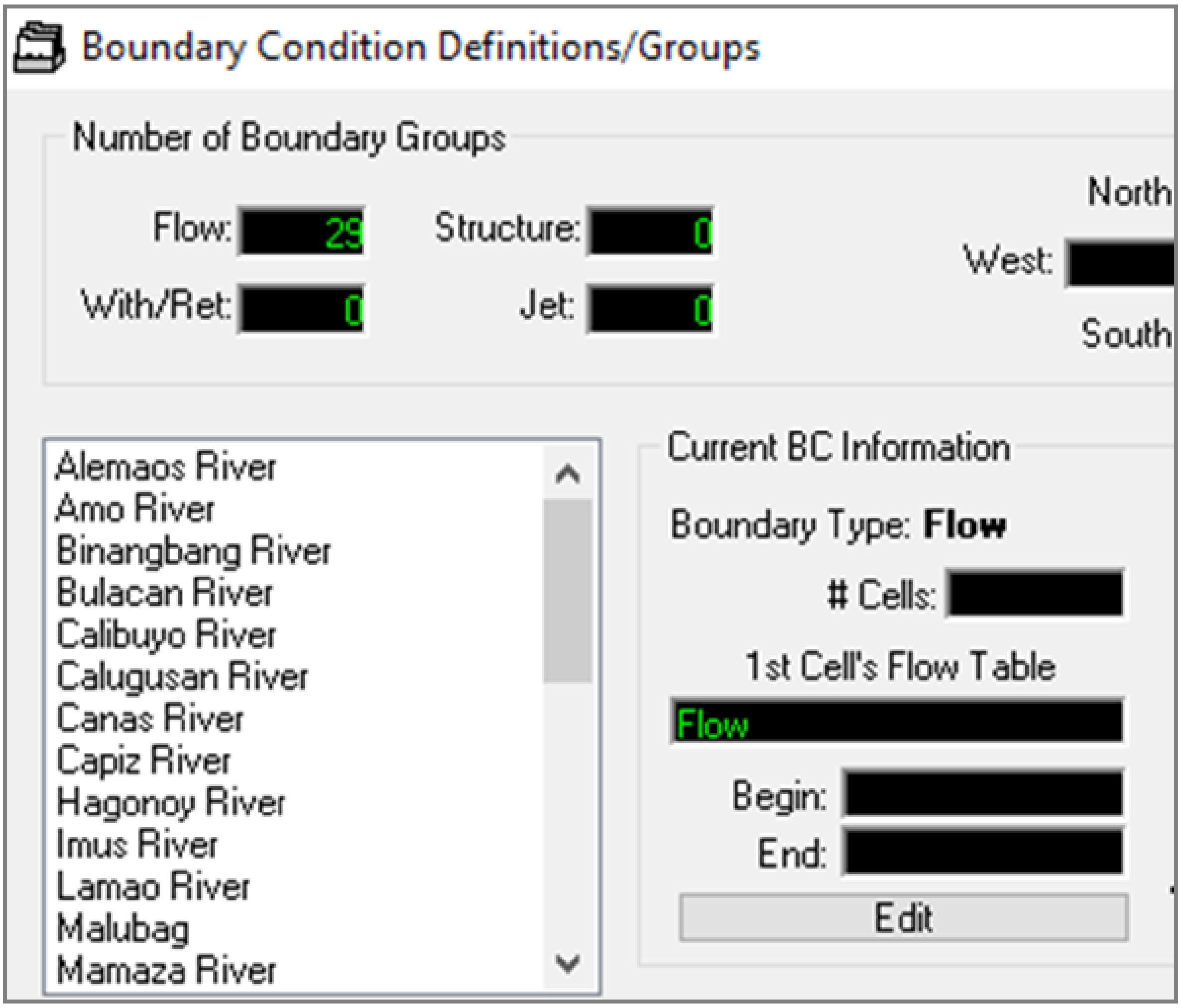


Figure 2-40. Foreshortened screenshot of data card for river inflows

2.2.2.3.1.6 Meteorological Input Data

Screenshots of meteorological input data for the period January 21, 2016 to March 2, 2016 and from July 21, 2016 to September 2, 2016 representing simulations for the northeast and southwest monsoon are **Figure 2-41, Figure 2-42,** and **Figure 2-43**, respectively. These data consist of cloudiness (okta), mean sea level pressure (mb), relative humidity (%), dry bulb temperature (ºC), wind direction (deg), wind speed (m/s) and rainfall (mm). For meteorological parameters, such as wet bulb temperature and solar radiation, these were calculated following Stull (2011) and Kasten and Czepak (1980), respectively.

Figure 2-42 and **Figure 2-43** show the wind roses for the northeast and southwest monsoon periods, respectively. It appears that the prevailing wind direction during the northeast monsoon period was from the east (**Figure 2-42**). Winds coming from the north-northwest and the north with frequency of occurrences of about 9 and 5% were also noted during this period.

During southwest monsoon season, the prevailing wind direction is from the southwest (about 23%). Winds from the north (about 15%) also appear during this period (**Figure 2-44**).

In addition, simulations were also performed for Scenarios 1, 2 and 3 with moderate to strong southwest winds covering a period of ten (10) days (**Figure 2-45**). This aimed to determine the wave heights with moderate to strong winds. These wind data, which range from moderate (5 to 8 m/s) to strong winds (13 to 16 m/s), were extracted from the wind rose for August at Port Area Manila (**Figure 2-46**).

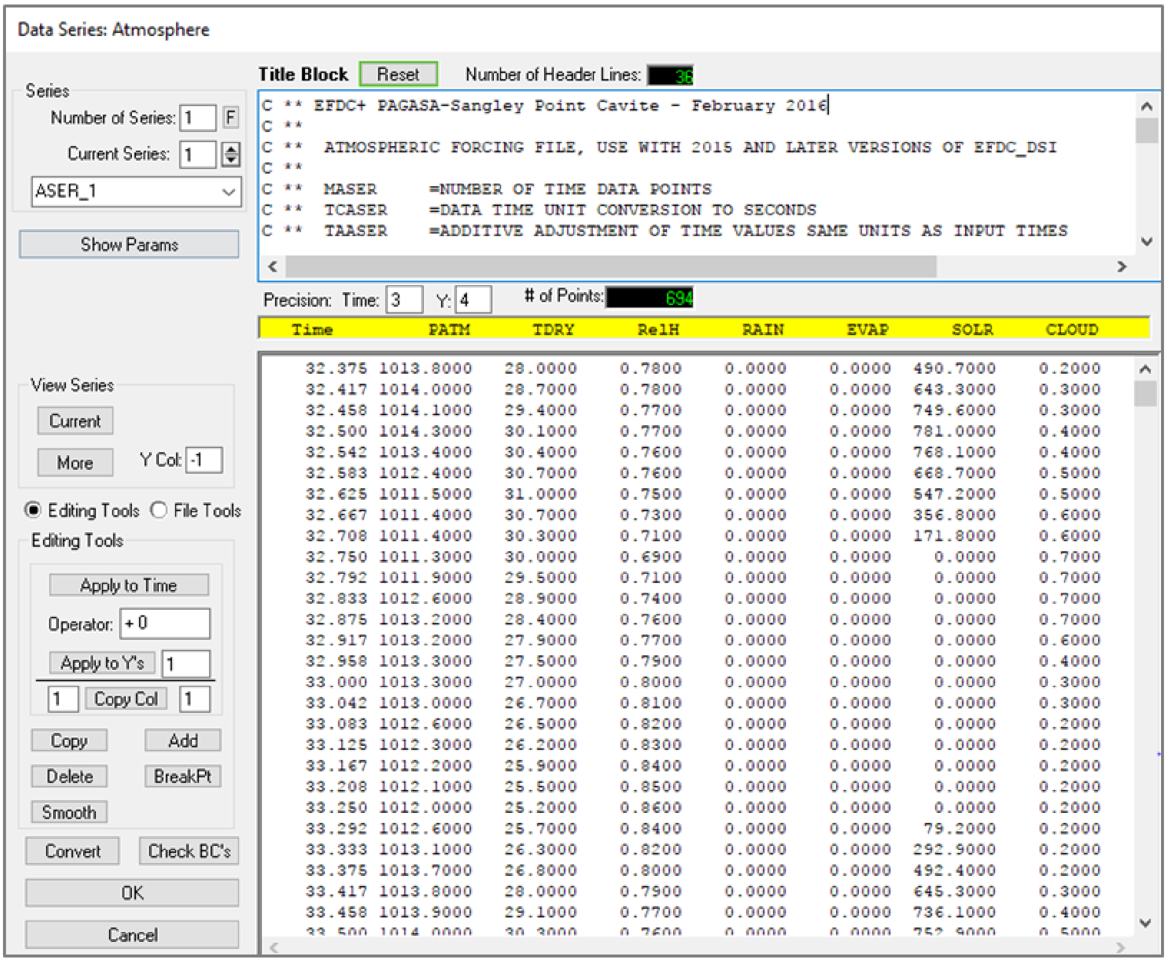


Figure 2-41. Foreshortened screenshot atmospheric data series for February 2016

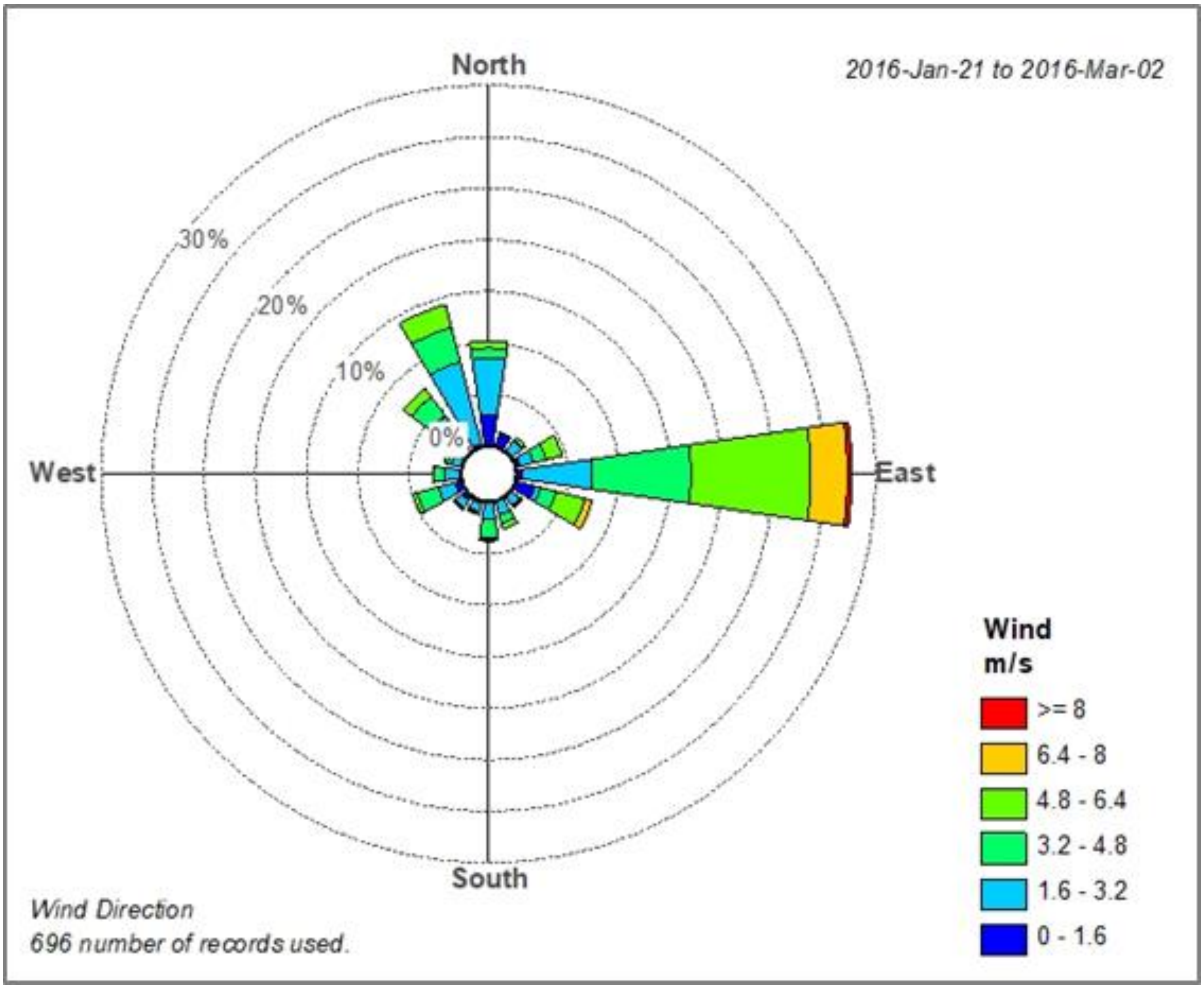


Figure 2-42. Wind rose for January 21, 2016 to March 2, 2016

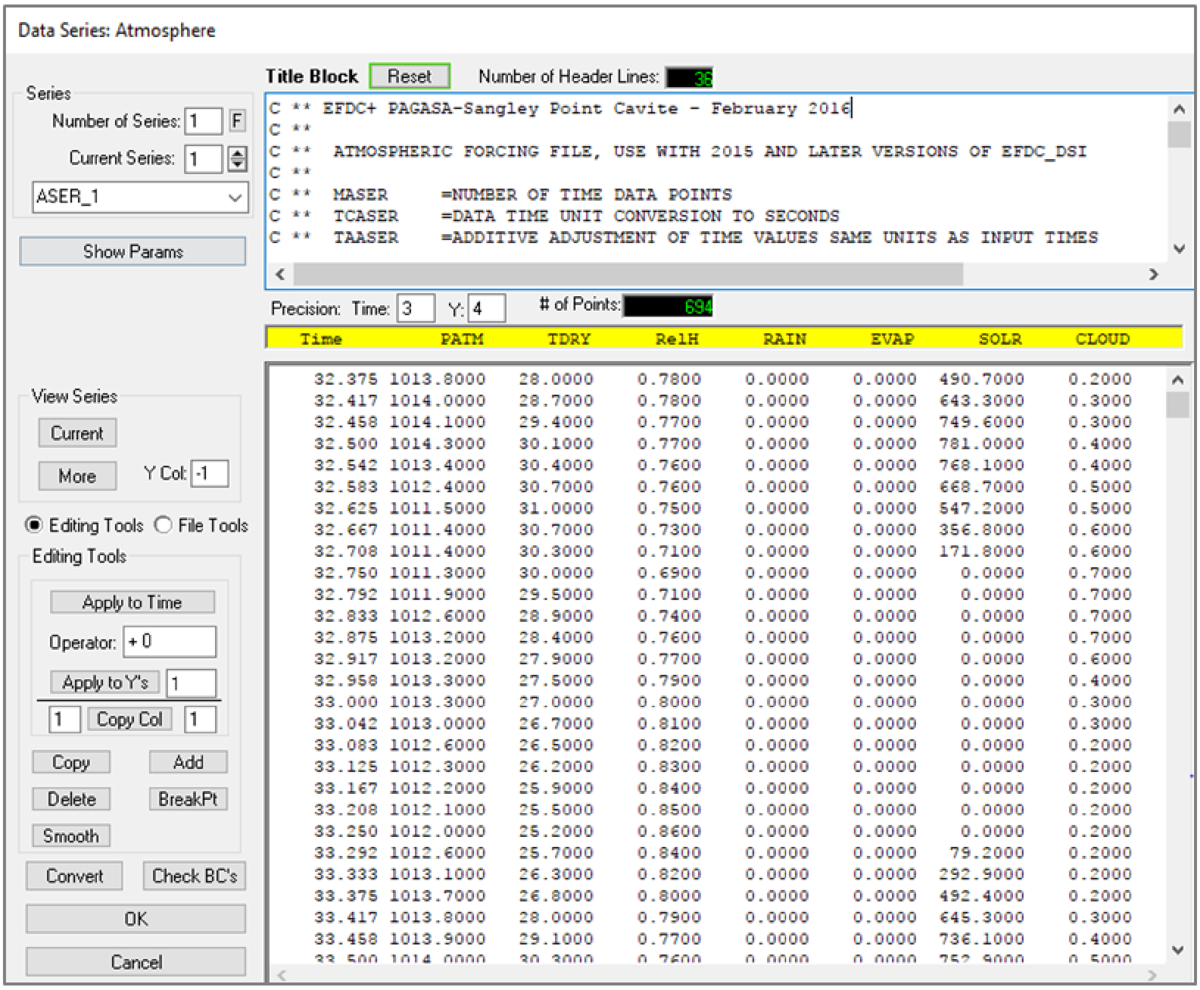


Figure 2-43. Foreshortened screenshot atmospheric data series for February 2016

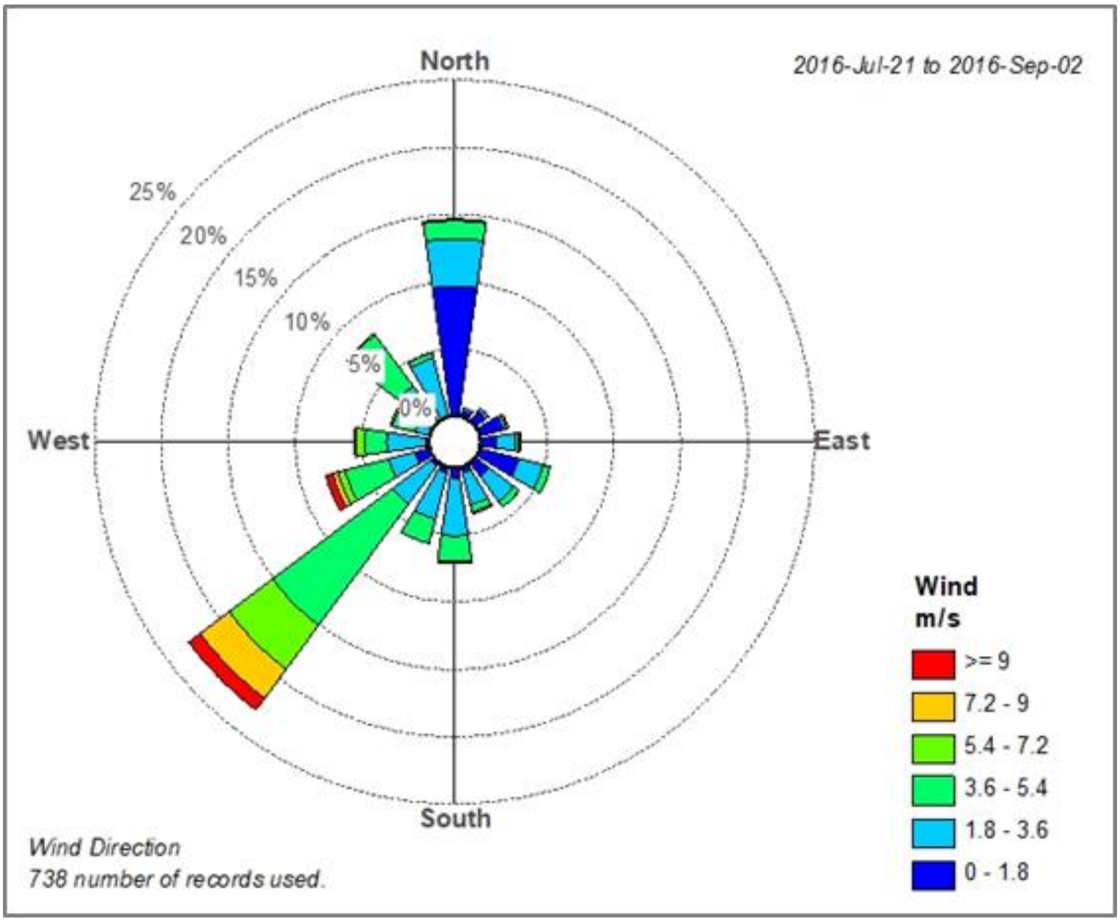


Figure 2-44. Wind rose for July 21, 2016 to September 2, 2016

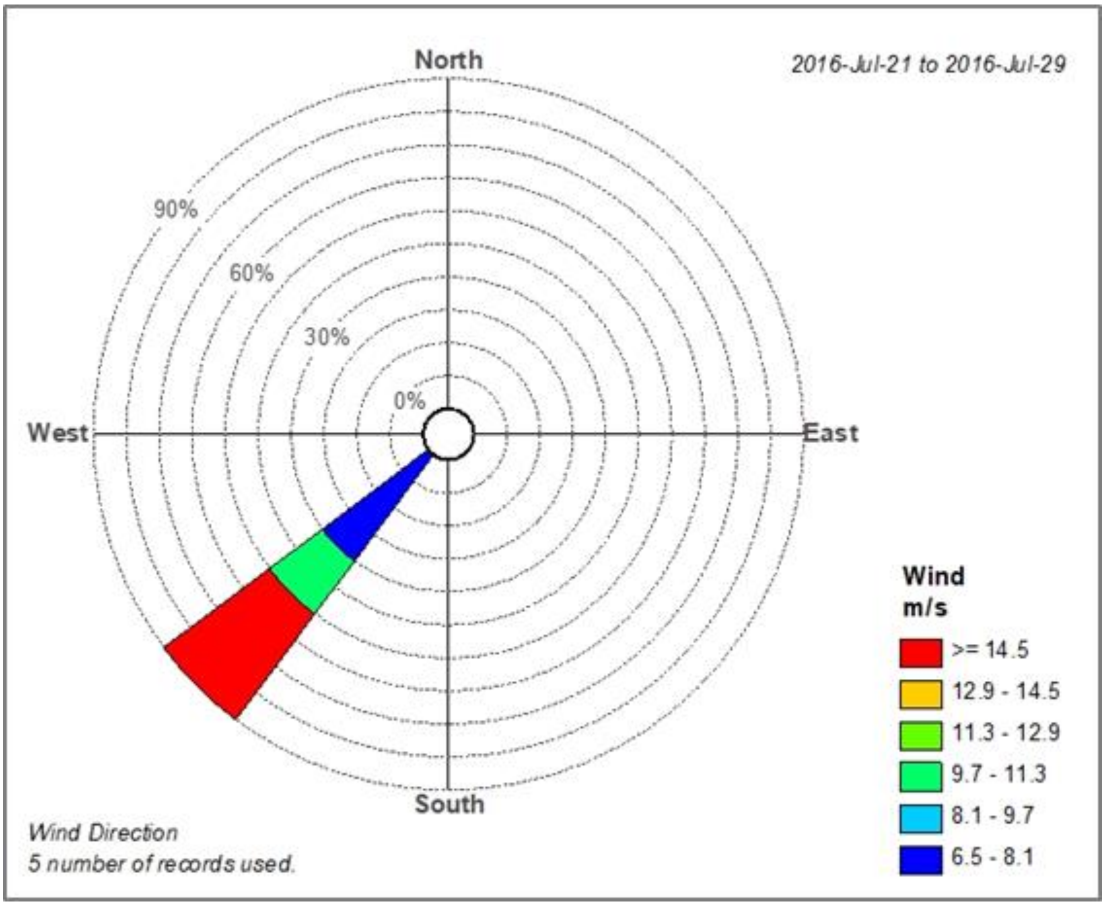


Figure 2-45. Wind rose for an assumed persistent southwest wind July 21, 2016 to July 29, 2016

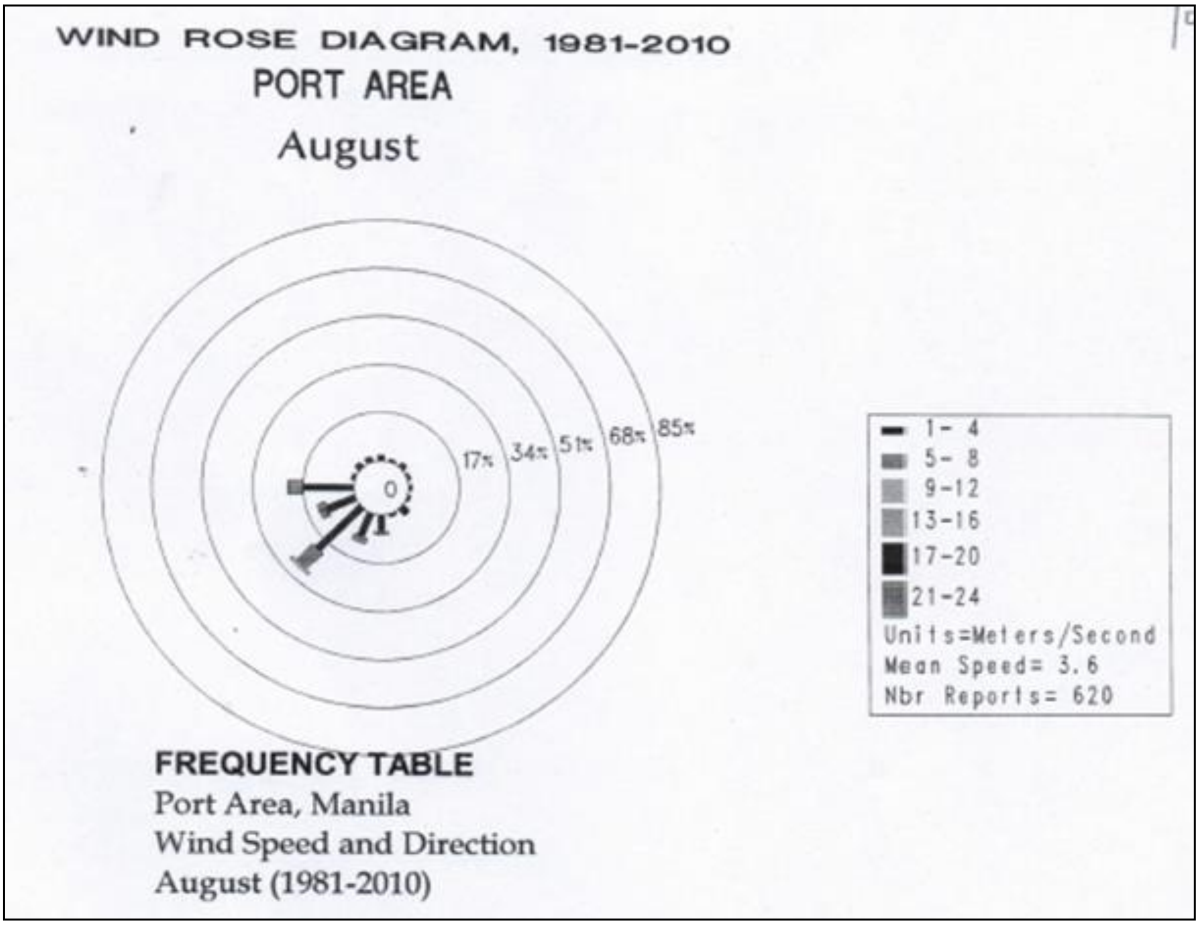


Figure 2-46. Wind rose diagram for August (Source: PAGASA)

2.2.2.3.2 Model Calibration and/or Validation

The results of the model, particularly tidal heights, were initially verified or validated with the predicted tidal heights at one of the tidal stations of NAMRIA (Navotas Station). This is to determine if the model is stable (particularly water levels) when simulated for longer period as hydrodynamic models when improperly set-up tend to be unstable or produce unrealistic results, i.e., tidal heights are not fluctuating.

Figure 2-47 shows the plots of the predicted (or hourly tidal heights based on NAMRIA Tide Table) and the modelled tidal heights at Navotas area using the predicted tidal heights at NAMRIA-Puerto Azul Tide Station as input data along the mouth of Manila Bay. It appears that the predicted and modelled tidal heights follow the same trend during the modelling period, though at the start of the simulation (about 1 day), there appears large discrepancies of the predicted and modelled tidal heights during the model “start-up”.

Calibration plots of the predicted and modelled tidal heights show good correlation of the predicted and modelled tidal heights (**Figure 2-48** and **Figure 2-49**). The r-squared for the predicted and modelled tidal heights are 0.8106 and 0.9858, respectively. Further, the Nash-Sutcliffe coefficients were closer to 1 for both the modelled (0.986) and the predicted (0.811) tidal heights indicating accuracy of the model, particularly on the tidal height simulations.

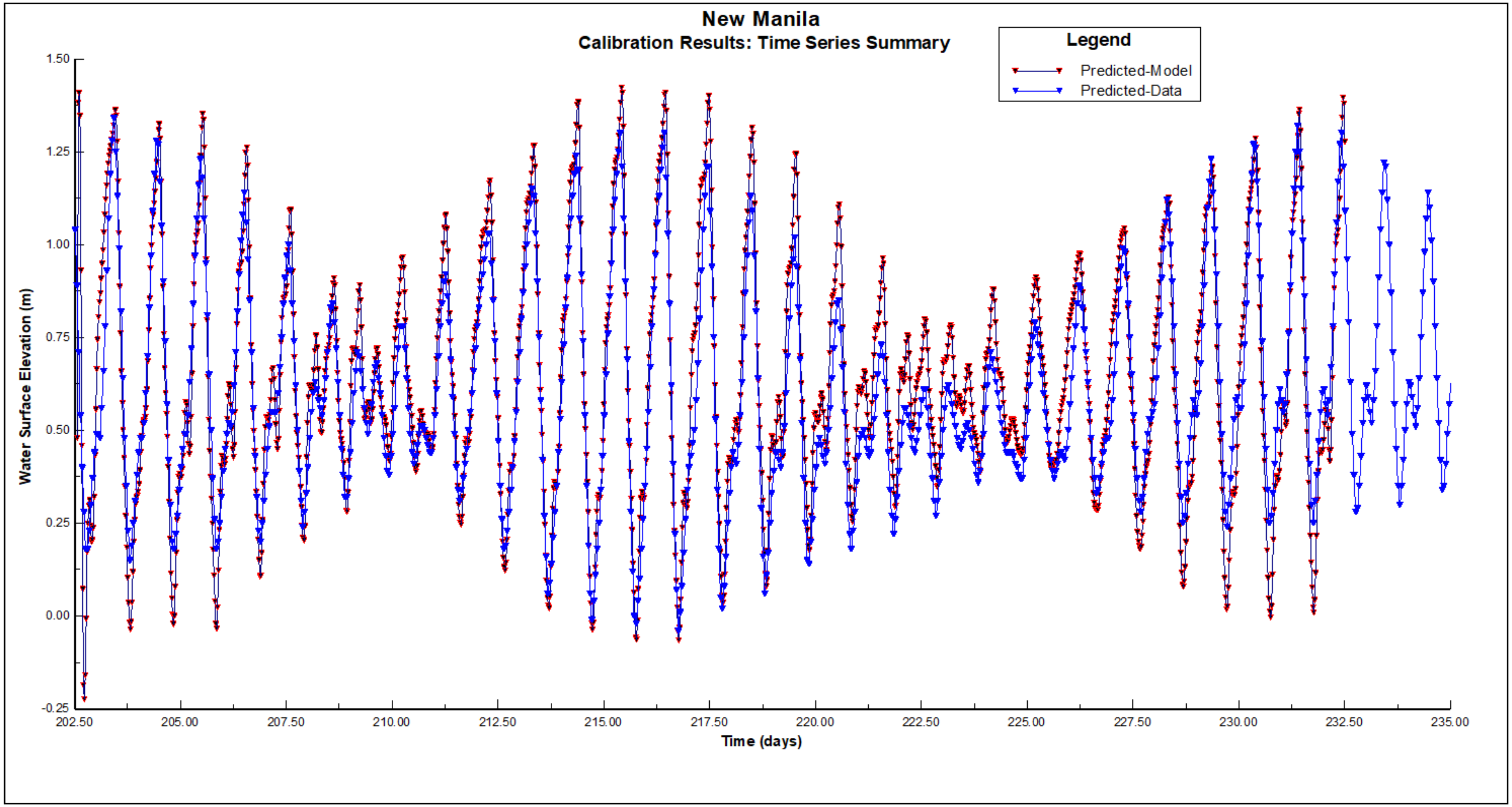


Figure 2-47. Predicted and modelled tidal heights at Navotas area

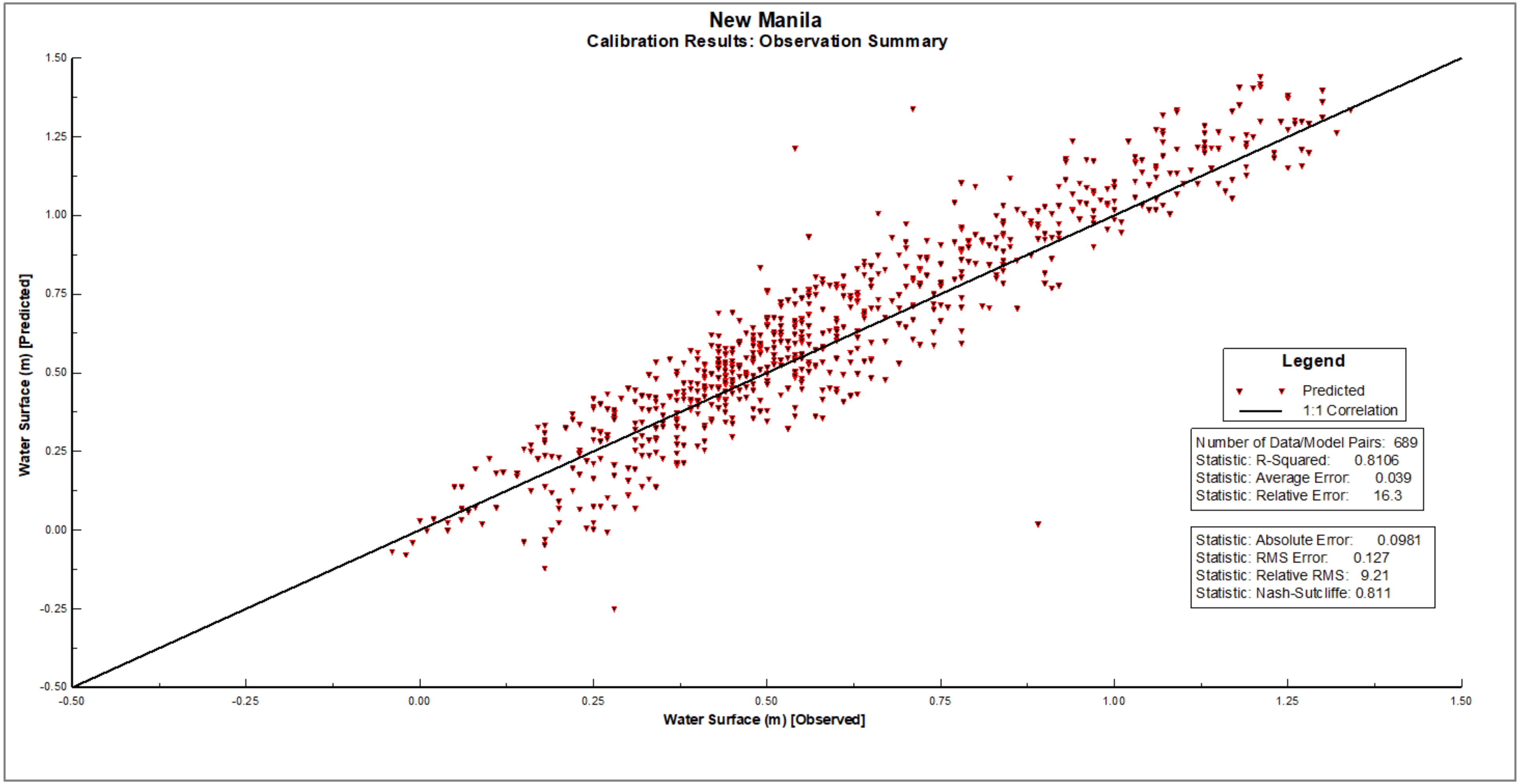


Figure 2-48. Calibration plot of the predicted tidal heights (July 20, 2016 to August 31, 2016)

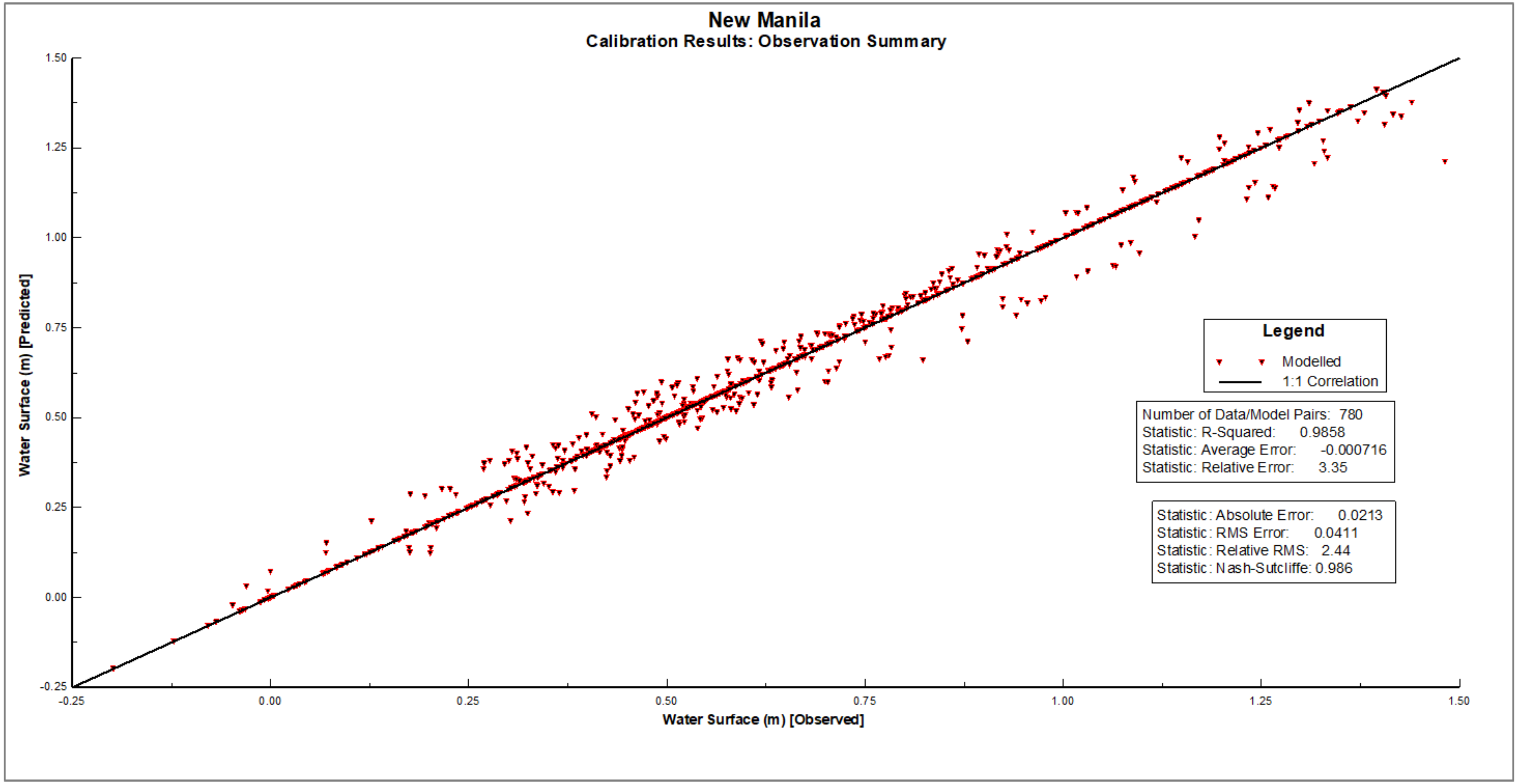


Figure 2-49. Calibration plot of the modelled tidal heights (July 20, 2016 to August 31, 2016)

2.2.2.3.3 Simulated Tides, Circulation and Sedimentation Patterns

2.2.2.3.3.1 Simulated Tidal Patterns

Tidal heights were simulated at three (3) cells or locations adjacent the proposed project site (New Manila) and between two (2) channels of the other reclamation sites of the proponent (**Figure 2-50**). The cell locations were the simulated tidal heights or water levels are as follows:

- 111, 17 – between two (2) reclamation islands located southwest of the proposed project site
- 116,10 – between the proposed project and the two reclamation islands southwest of the former
- 111, 6 – between two (2) reclamation islands located southeast of the proposed project site.

The above simulations aim to check if the reclamation projects could result to increase or decrease of water levels between the reclamation islands.

Results of tidal height simulations for Scenarios 1, 2 and 3 (**Figure 2-50** to **Figure 2-55**) were combined in one (1) graph for each of the northeast and southwest monsoon periods (**Figure 2-56** and **Figure 2-57**). It appears that the simulated water levels at the three (3) locations or cells without and with the reclamation islands were about the same elevations or heights throughout the simulation periods.

There were, however, slight differences during low tides for cell no. 116,10 and cell no. 111,6 during the northeast monsoon (**Figure 2-56**), but differences in water levels appear lower or insignificant during the southwest monsoon (**Figure 2-57**).

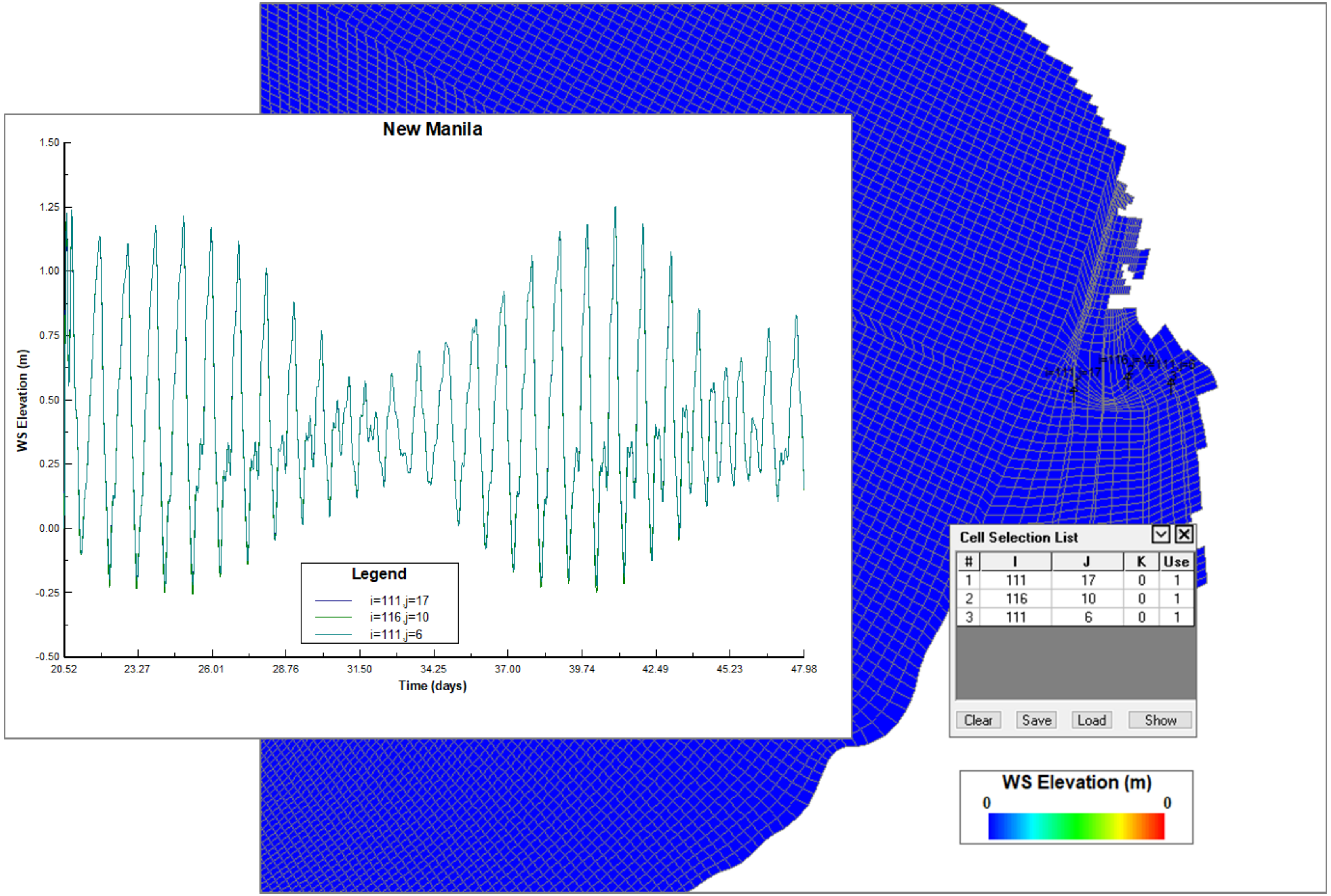


Figure 2-50. Simulated tidal heights during northeast monsoon (Scenario 1 - without reclamation projects)

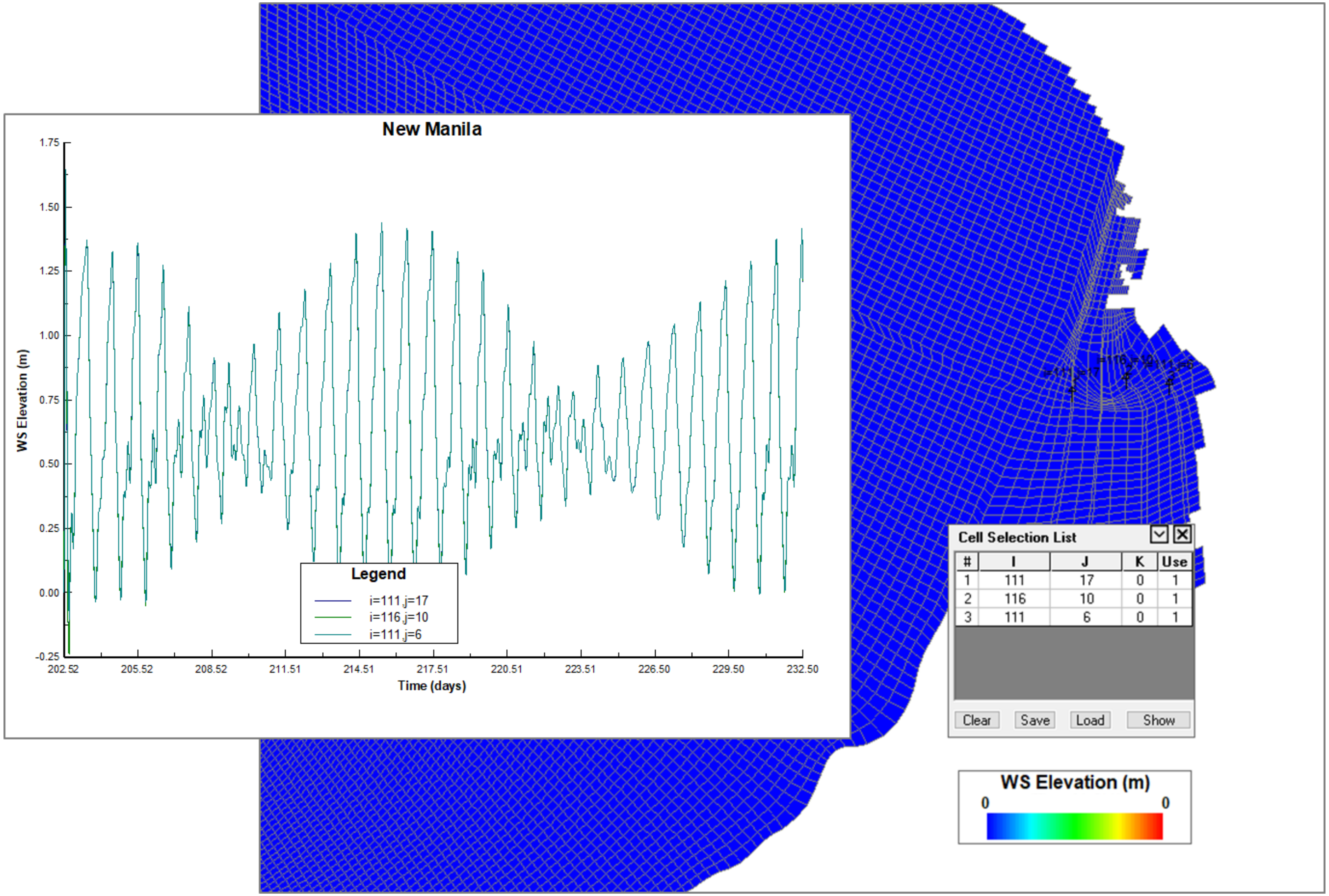


Figure 2-51. Simulated tidal heights during southwest monsoon (Scenario 1 - without reclamation projects)

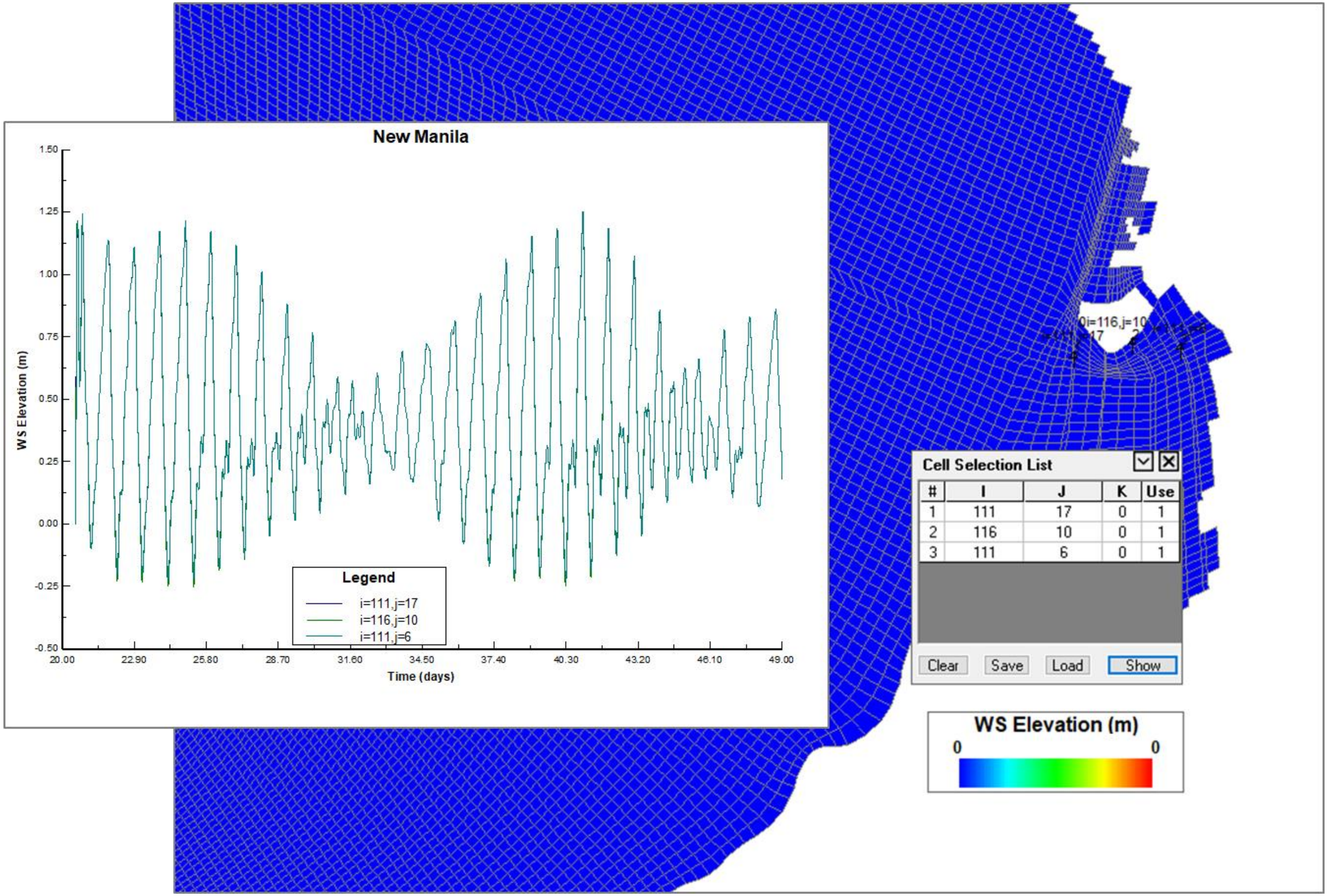


Figure 2-52. Simulated tidal heights during northeast monsoon (Scenario 2 – with project – New Manila)

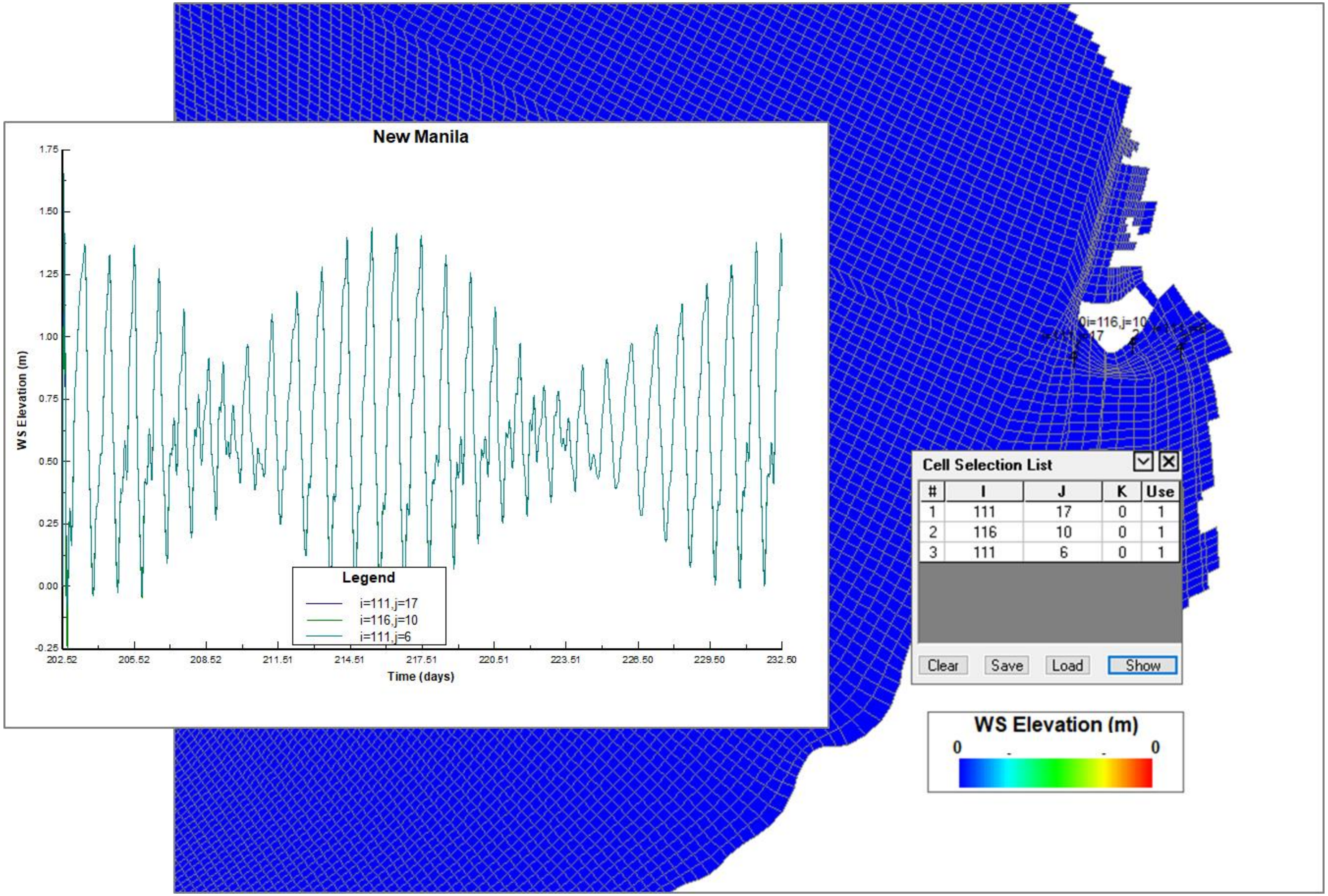


Figure 2-53. Simulated tidal heights during southwest monsoon (Scenario 2 – with project – New Manila)

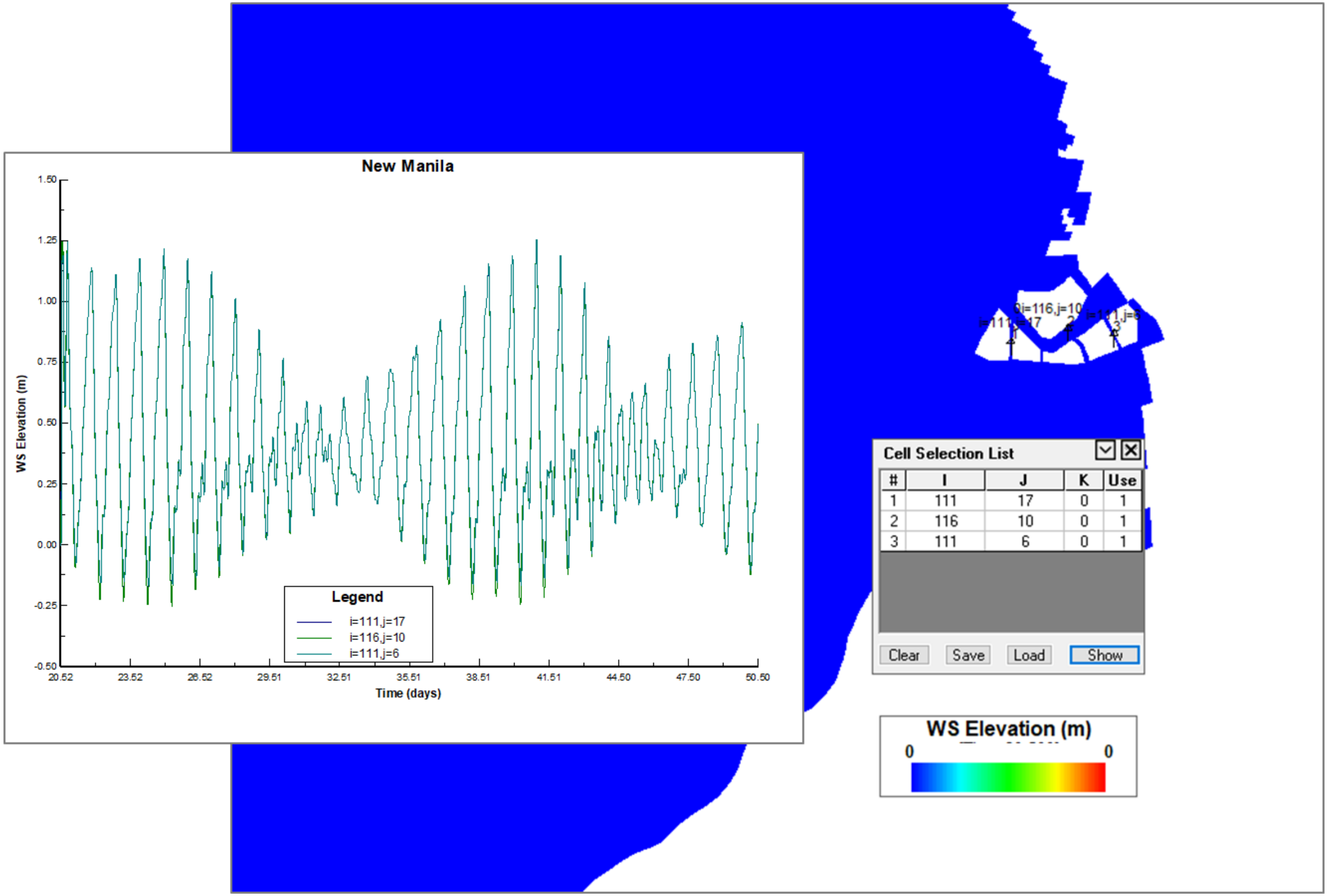


Figure 2-54. Simulated tidal heights during northeast monsoon (Scenario 3 – with all projects)

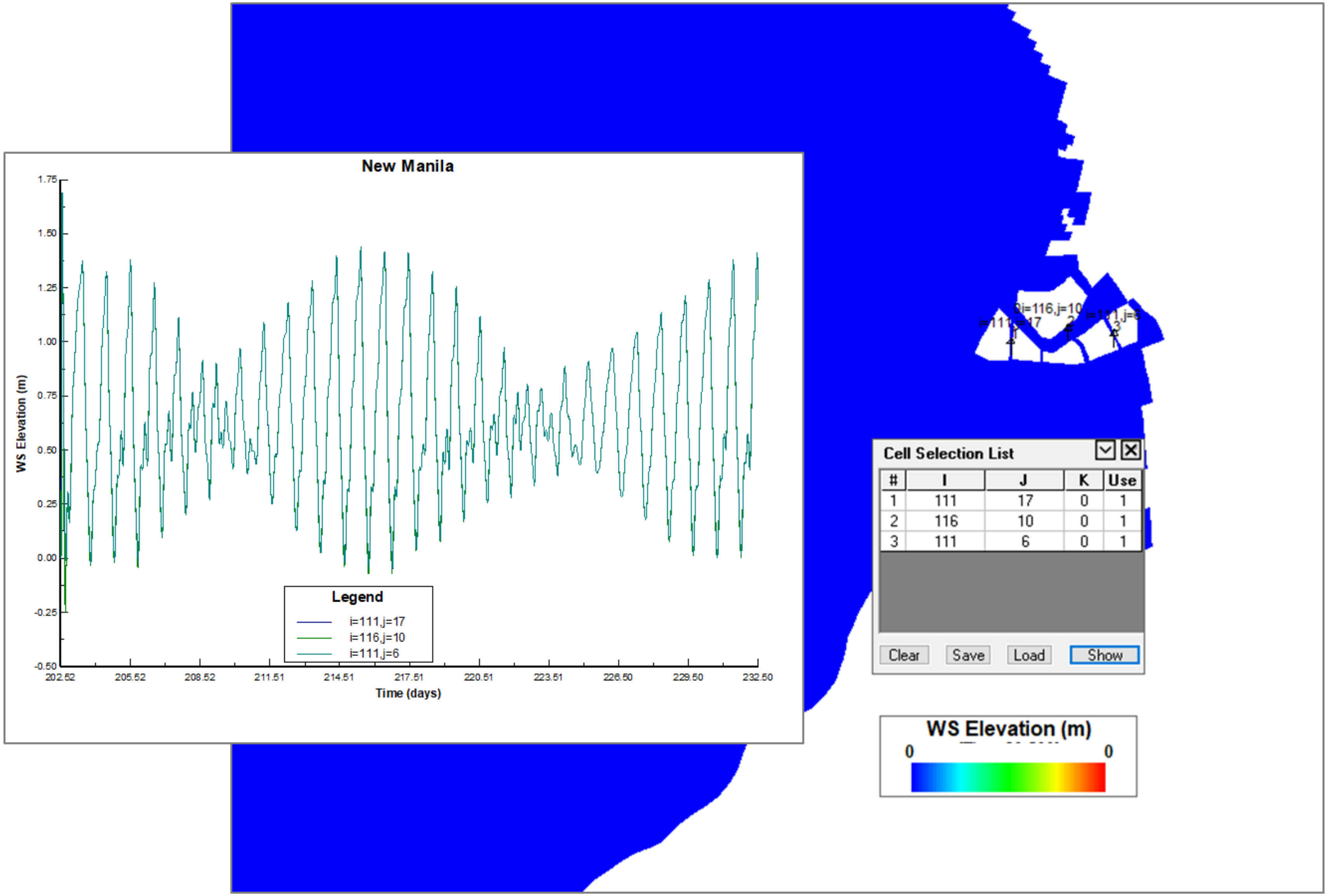


Figure 2-55. Simulated tidal heights during southwest monsoon (Scenario 3 – with all projects)

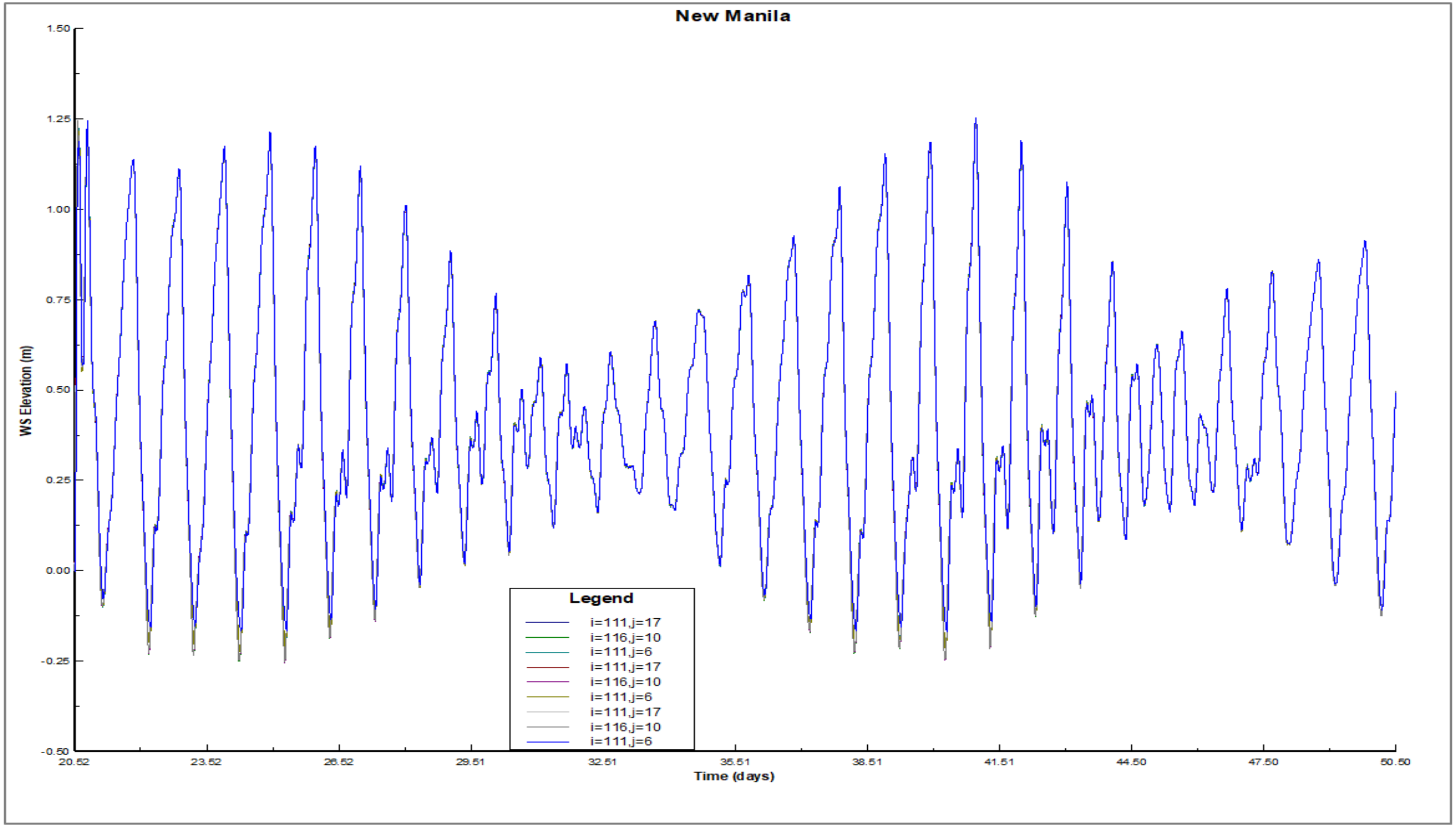


Figure 2-56. Simulated tidal heights during northeast monsoon (Scenarios 1, 2 and 3)

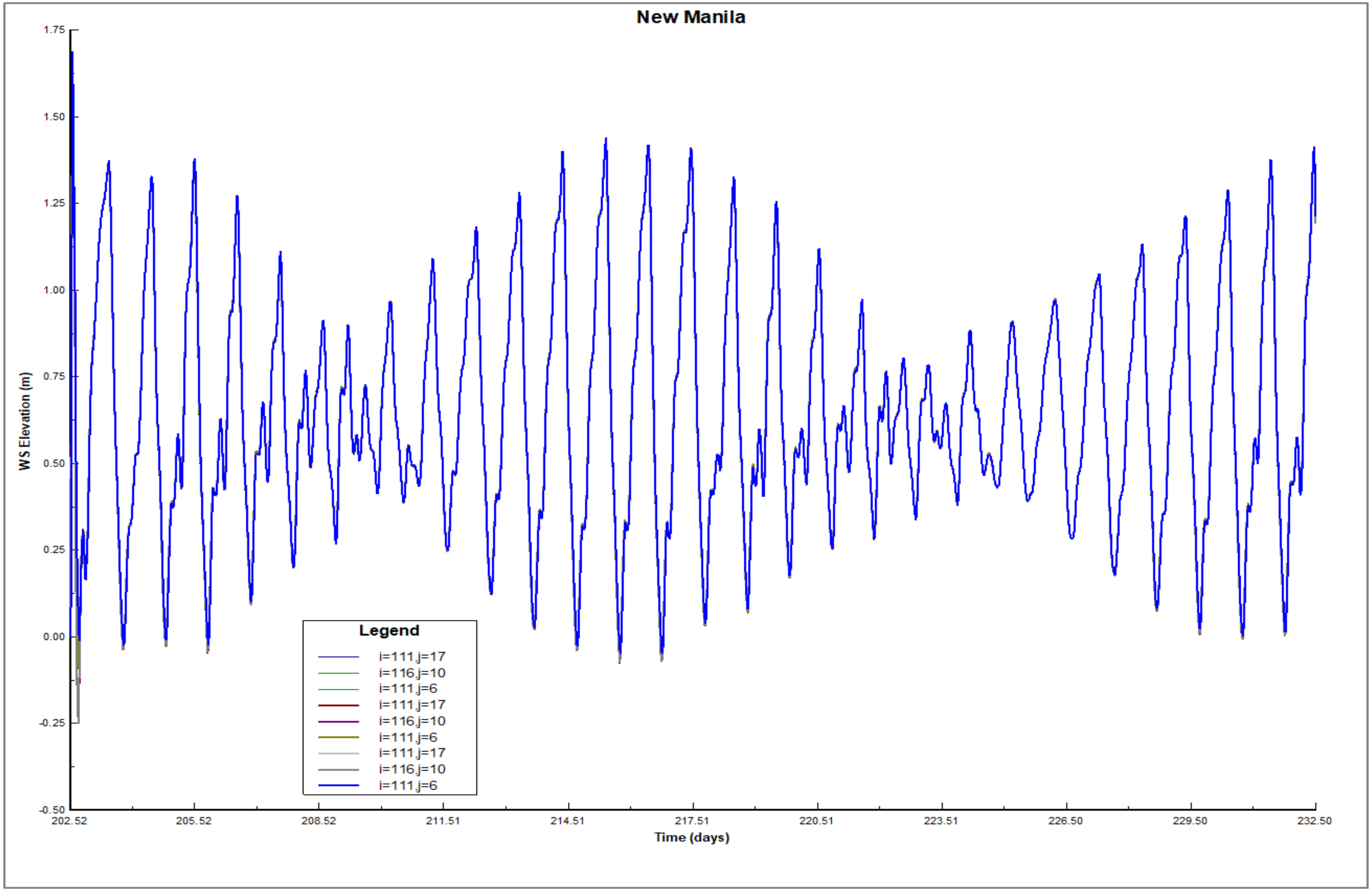


Figure 2-57. Simulated tidal heights during southwest monsoon (Scenarios 1, 2 and 3)

2.2.2.3.3.2 Simulated Currents

Current Patterns During Spring Tide

Plots of instantaneous simulated currents during spring tides on February 8, 2016 and August 2, 2016 are shown in **Figure 2-58** to **Figure 2-61**. During flood tides on both seasons (northeast and southwest monsoon), currents generally flow towards the inner part of the bay (N-NE quadrant) and reverses in direction during ebb tide (or towards the mouth of the bay).

Strong currents going out of Manila Bay were simulated during ebb tide. Current velocities during this period (ebb tide) at the mouth of the river ranged from about 0.3 to about 0.7 m/s. During flood tide, strong currents were noted at the northern part of the mouth of bay.

There appear, however, abrupt changes of current patterns along cells from the proposed project to the coast of Pampanga. This could be due to large orthogonal variations along this section, as shown in **Figure 2-28, Figure 2-29,** and **Figure 2-30**. The limitations of smoothing the curvilinear grids at the proposed reclamation sites to match the cells with the reclamation islands resulted to irregular current patterns along the said section.

Current Roses

Current roses show the prevailing current speeds and directions at a particular location. For this study, total of eleven (11) locations were assigned adjacent the proposed reclamation projects with most locations at channels or between reclamation islands.

a) Without the Reclamation Projects

Without the reclamation projects (Scenario 1) (Figure 2-62 and Figure 2-63), currents flows were generally tidal driven as seen on two (2) prevailing opposite current directions. At two cells located near the mouth of the Pasig River (cell no. 119, 15 and cell no. 118, 6), dominant current flows are to the west and the southeast directions, respectively, due to influence or effect of river discharges.

Further, simulated current velocities during the southwest monsoon were higher than those simulated during the northeast monsoon. Increase in wind intensity contributed to increase of current velocities at the project area and vicinities.

b) With the Reclamation Projects

With the proposed project (Scenario 2), there are changes on the directions of current flows because currents generally flow parallel to the coast (**Figure 2-64** and **Figure 2-65**). Changes in current flows are apparent at areas adjacent the proposed project site.

Furthermore, with the other reclamation islands (Scenario 3) (**Figure 2-66** and **Figure 2-67**), current roses are along the directions of the channels between reclamation islands. Relatively higher current speeds were noted along narrower channels between the other reclamation projects of the proponent.

In general, the generated current roses suggest that with the reclamation projects, the prevailing current directions are generally parallel with the project boundaries, and that there is substantial reduction of other current flows perpendicular (or intersects) with the project boundaries for scenarios without the project.

Current Roses with Moderate to Strong Southwest Winds

Current roses were generated at one (1) location southwest of the project site with moderate to strong southwest winds for Scenarios 1, 2, and 3 (**Figure 2-68**, **Figure 2-69**, and **Figure 2-70**). Results show higher current velocities with the moderate to strong winds than those generated with lower wind speeds. This suggests further that current velocities are also influenced by wind flows, particularly at shallow areas.

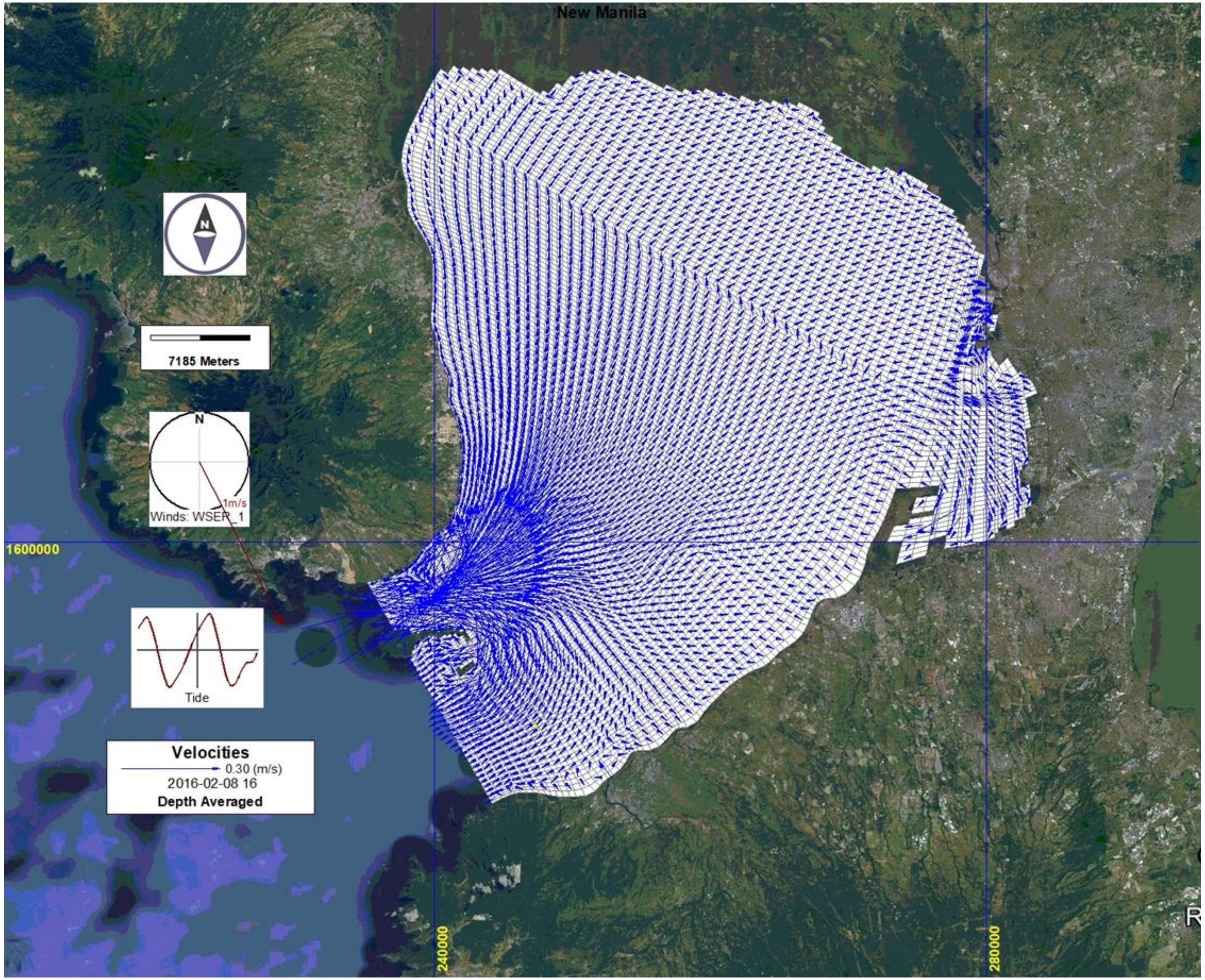


Figure 2-58. Simulated current patterns during flood tide on February 8, 2016 (without reclamation projects)

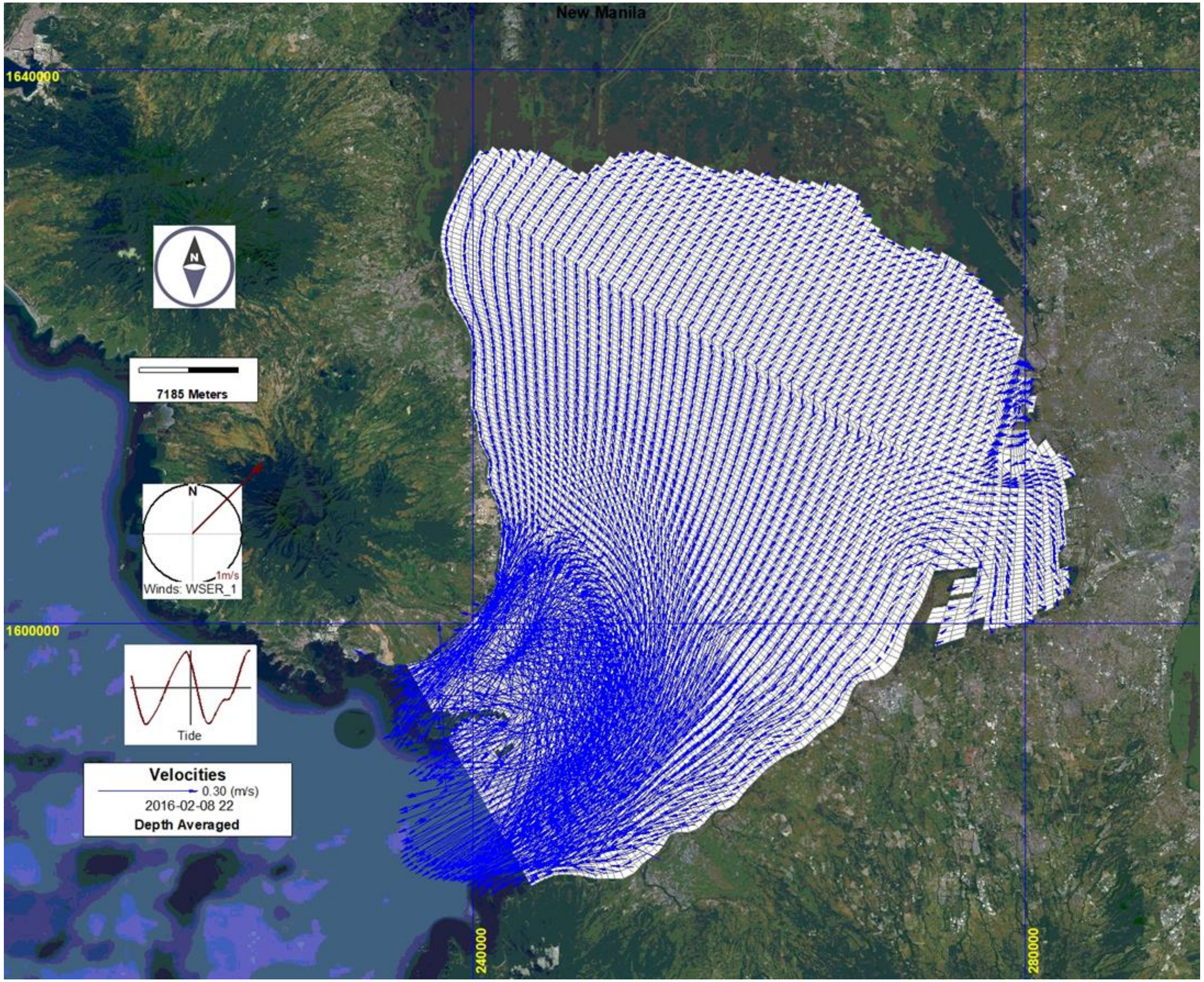


Figure 2-59. Simulated current patterns during ebb tide on February 8, 2016 (without reclamation projects)

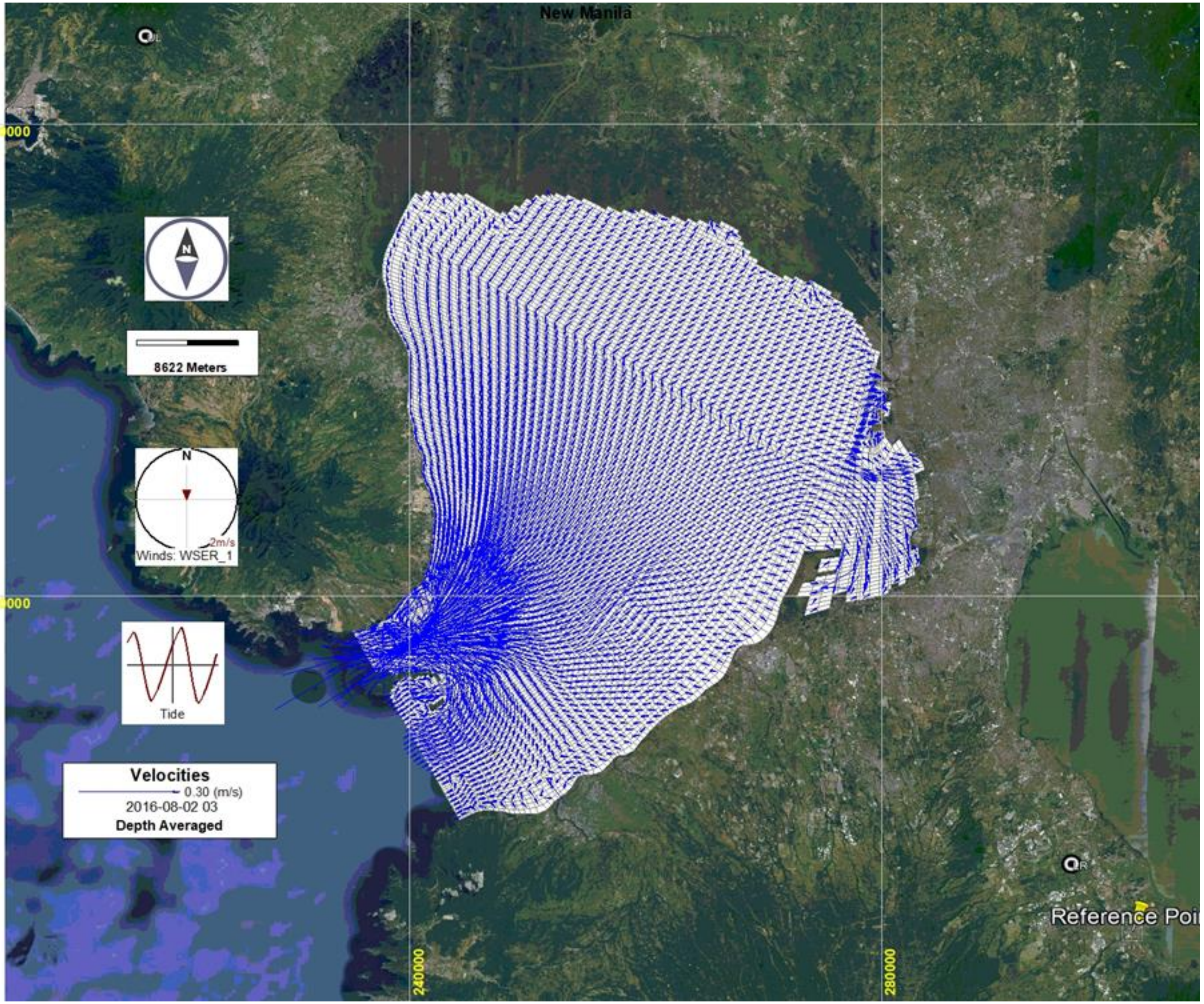


Figure 2-60. Simulated current patterns during flood tide on August 2, 2016 (without reclamation projects)

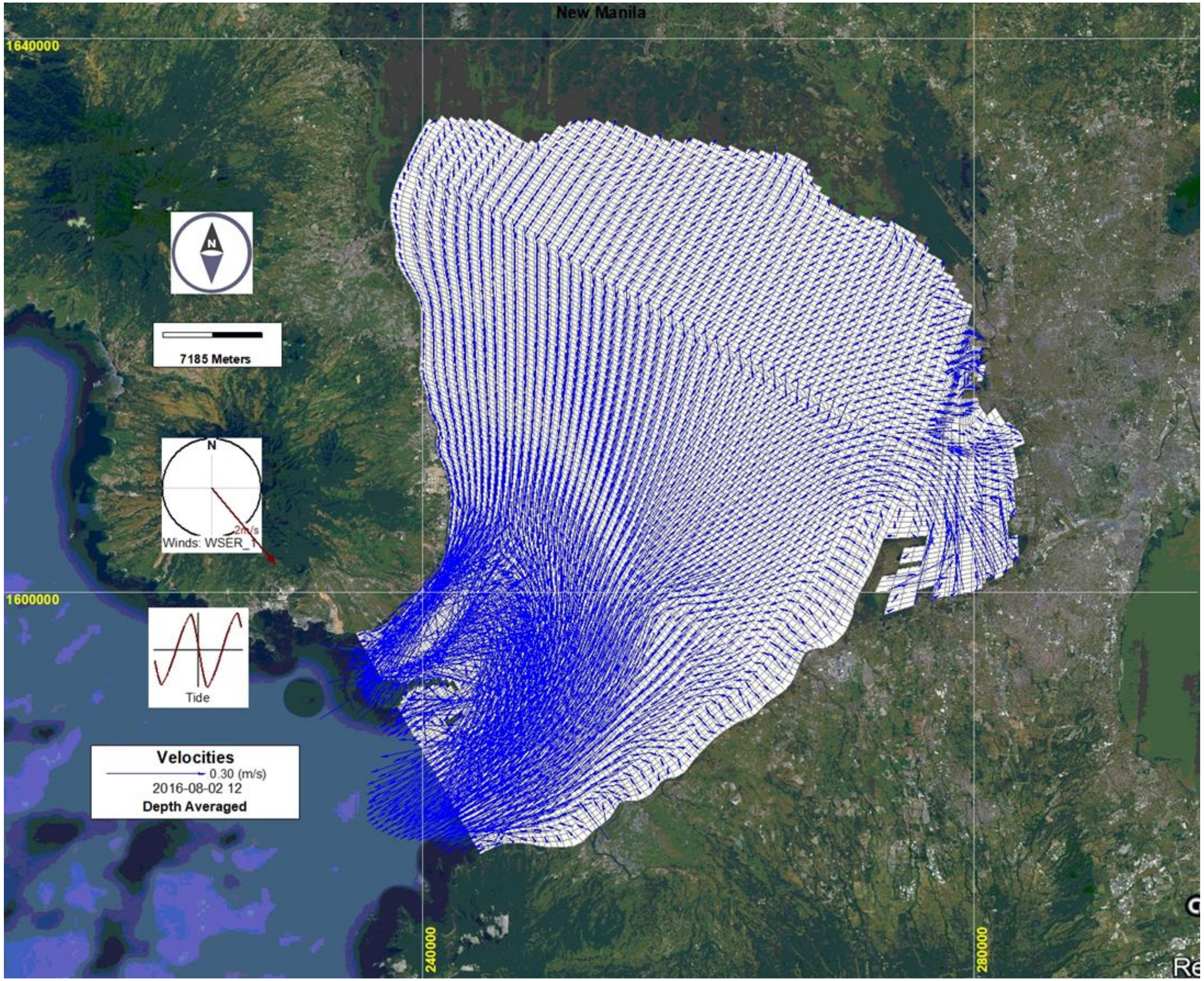


Figure 2-61. Simulated current patterns during ebb tide on August 2, 20 16 (without reclamation projects)

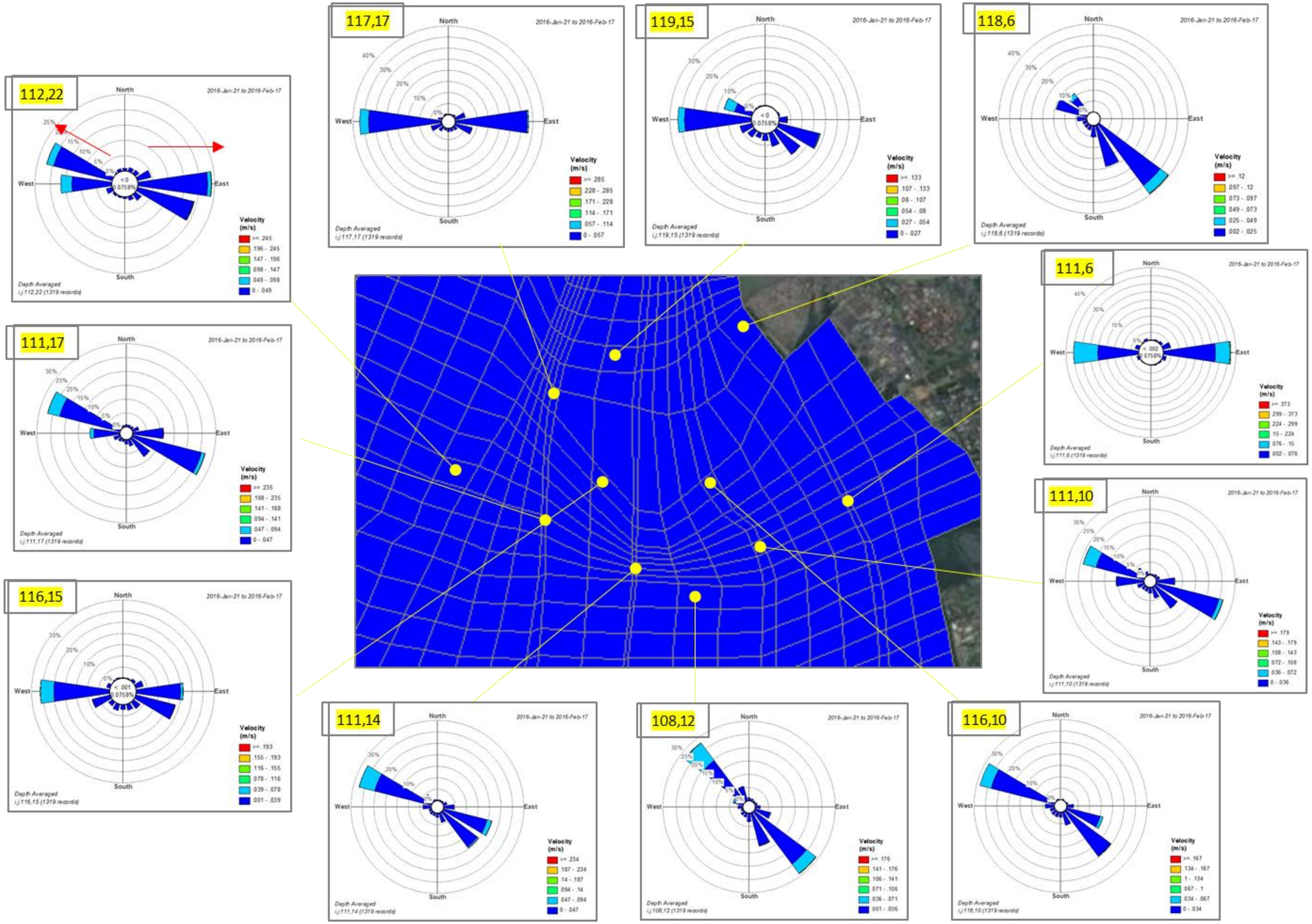


Figure 2-62. Current roses for January 21 to February 17 (Scenario 1 - without projects)

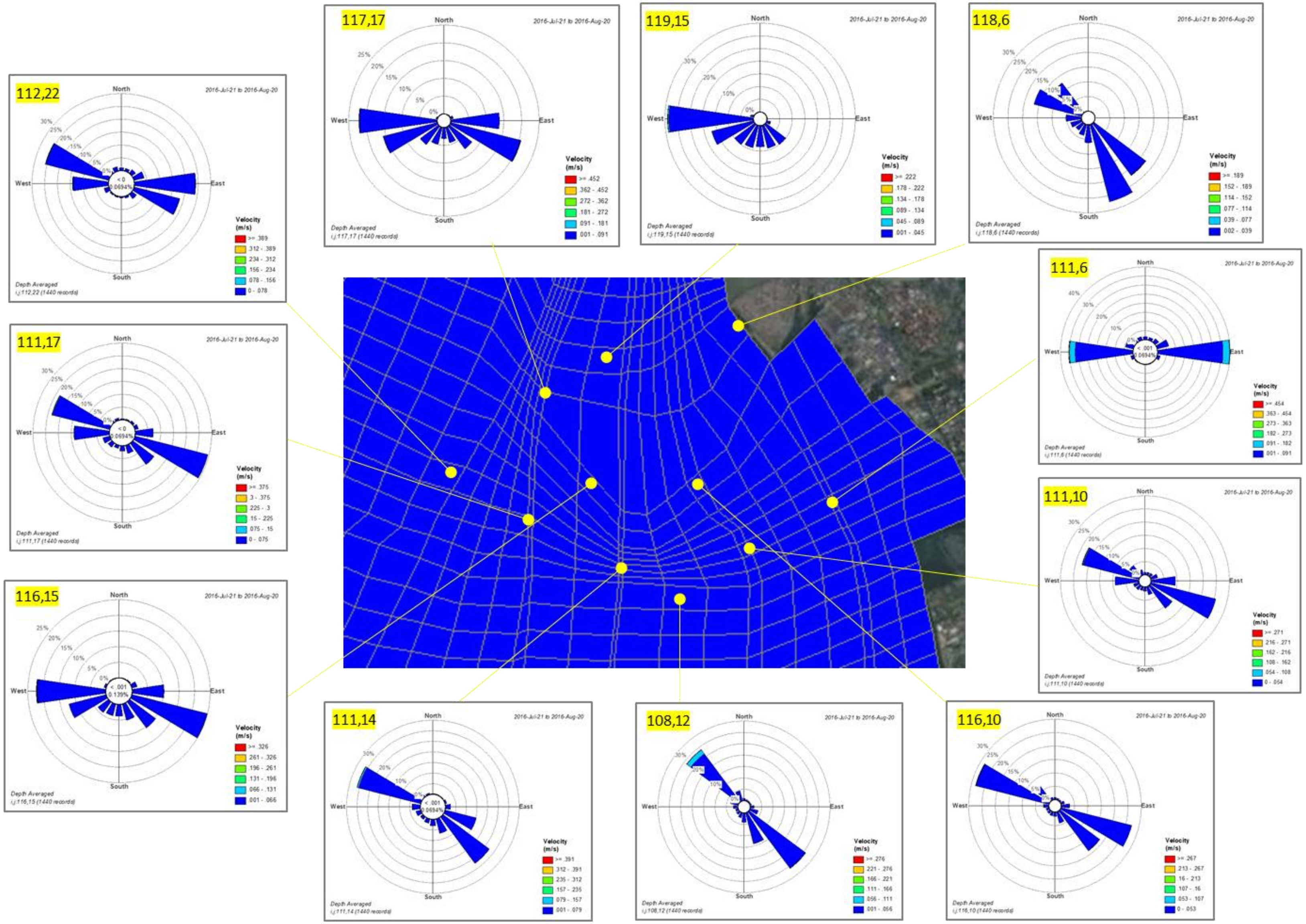


Figure 2-63. Current roses for July 21 to August 20, 2016 (Scenario 1 - without projects)

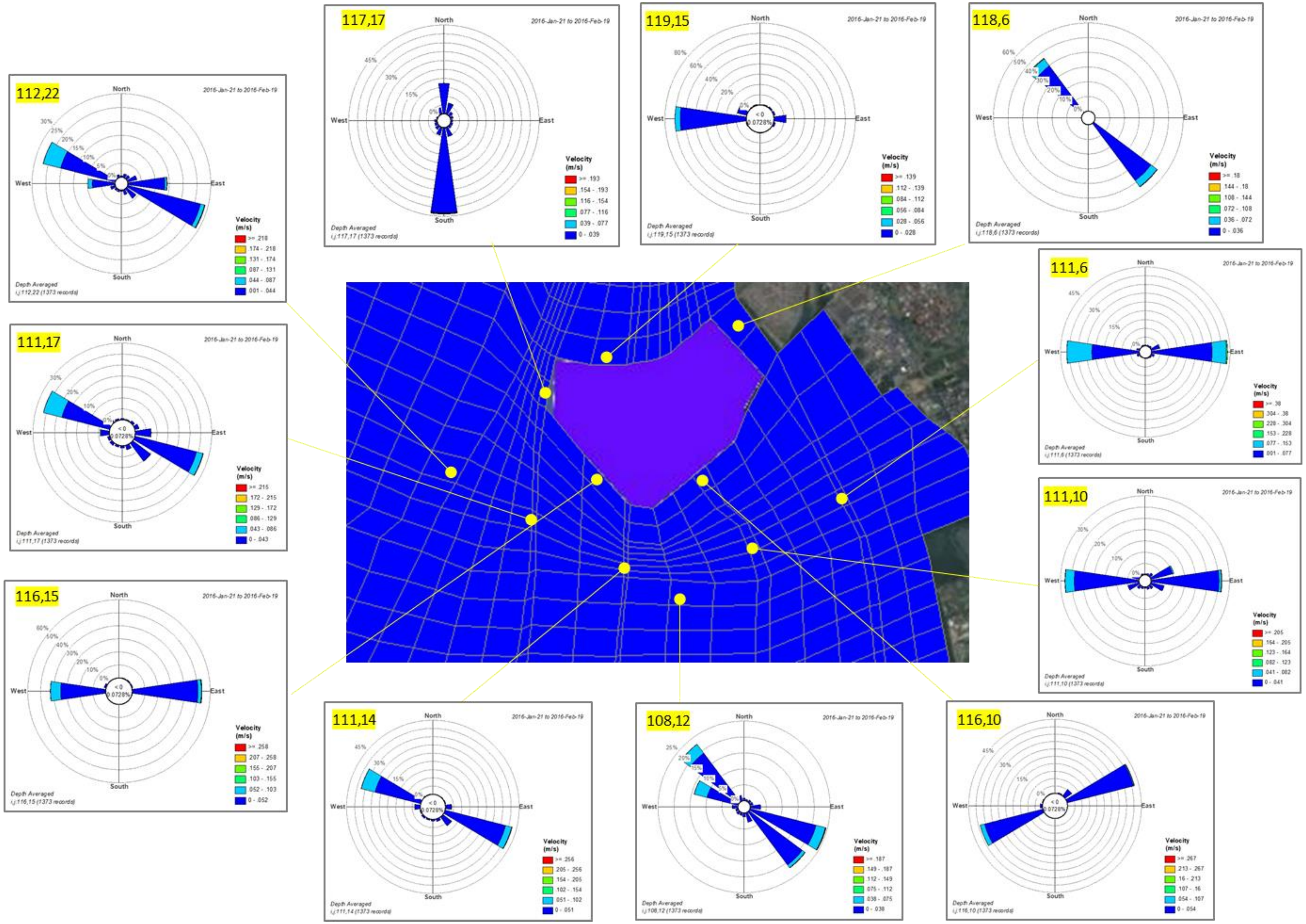


Figure 2-64. Current roses for January 21 to February 19 (Scenario 2 – with project – New Manila)

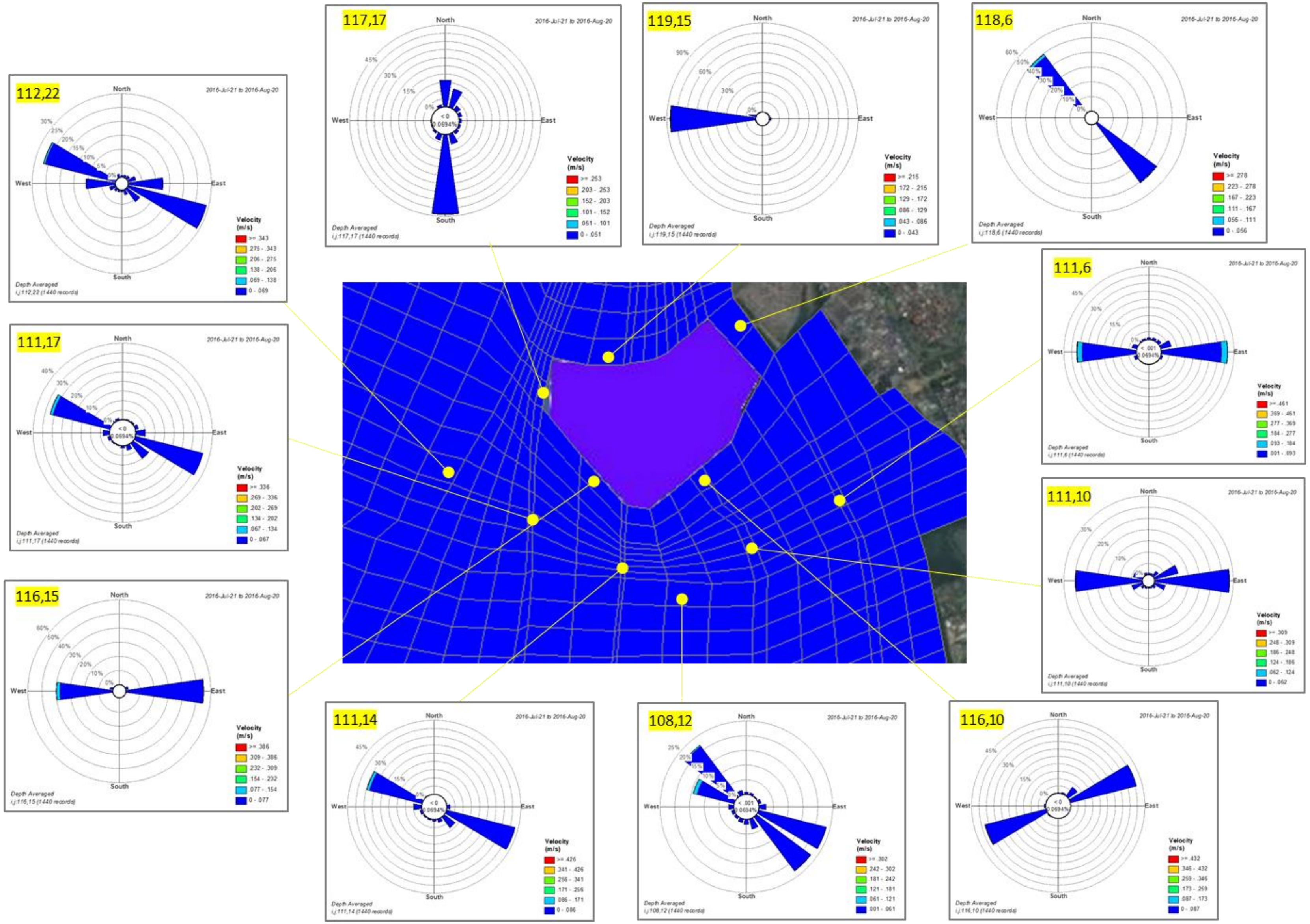


Figure 2-65. Current roses for July 21 to August 20, 2016 (Scenario 2 – with project – New Manila)

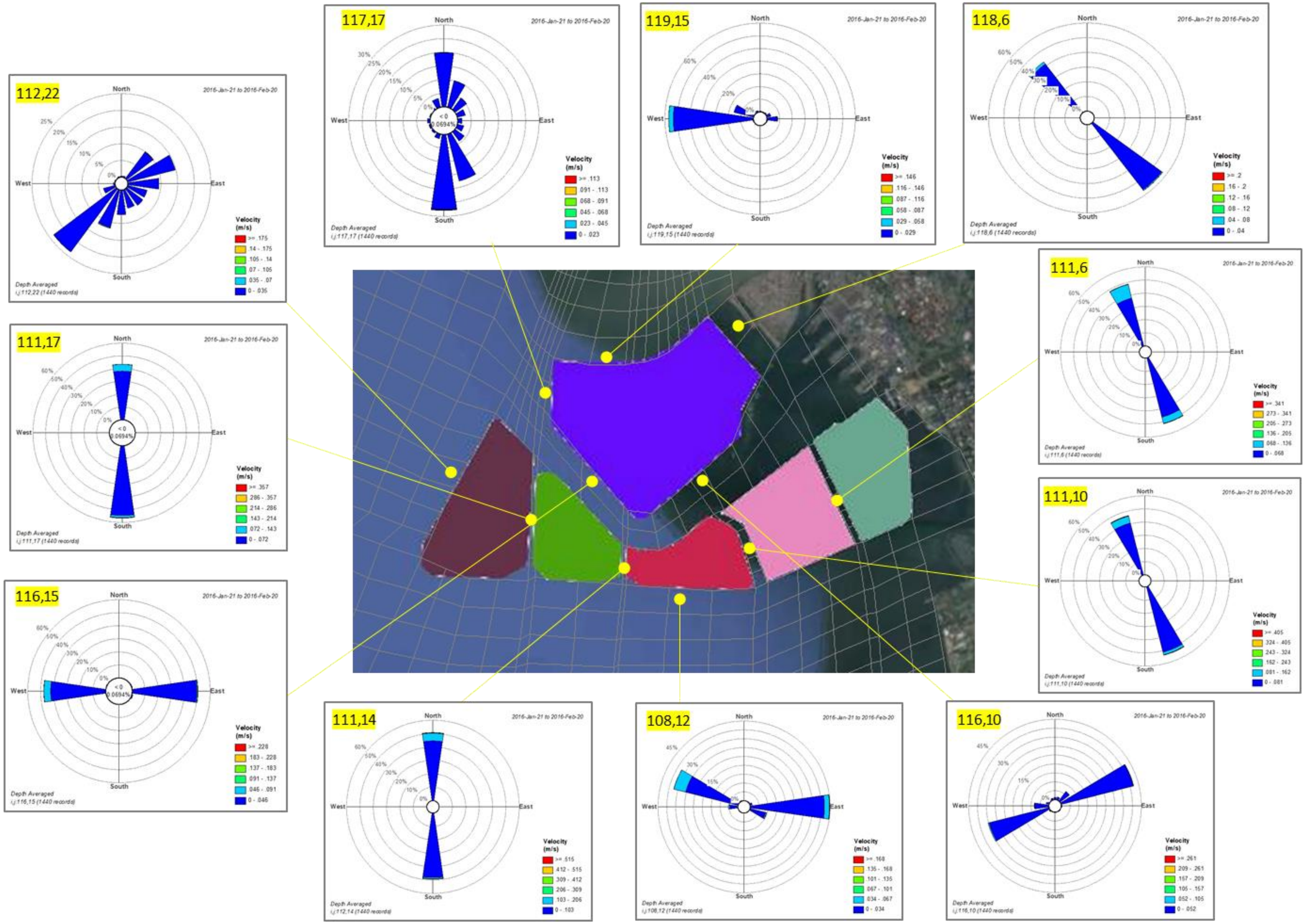


Figure 2-66. Current roses for January 21 to February 20 (Scenario 3 – with all projects)

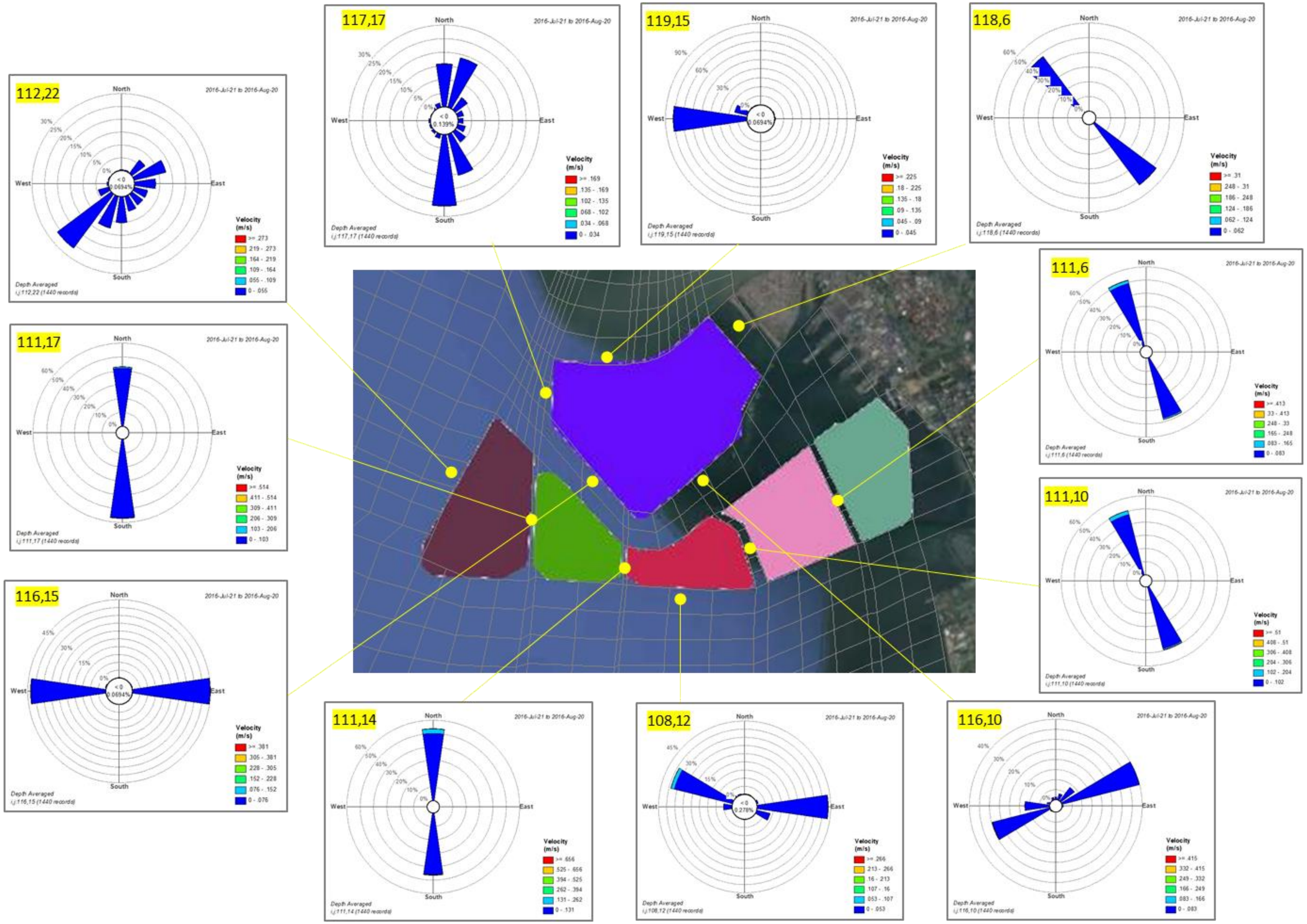


Figure 2-67. Current roses for July 21 to August 20, 2016 (Scenario 3 – with all projects)

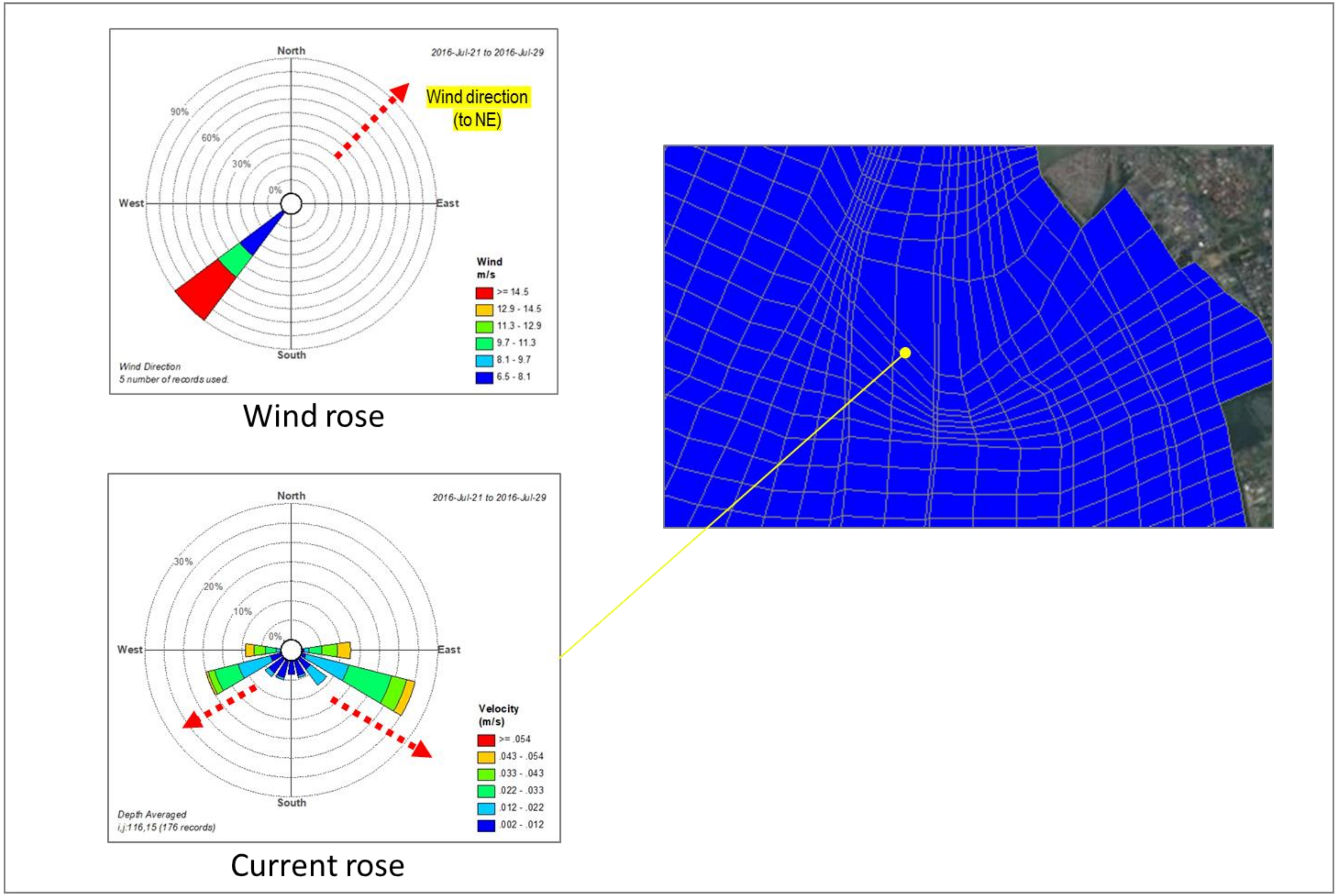


Figure 2-68. Current roses southwest of the proposed project site (cell 116,15) during persistent strong southwest winds (Scenario 1 – without project)

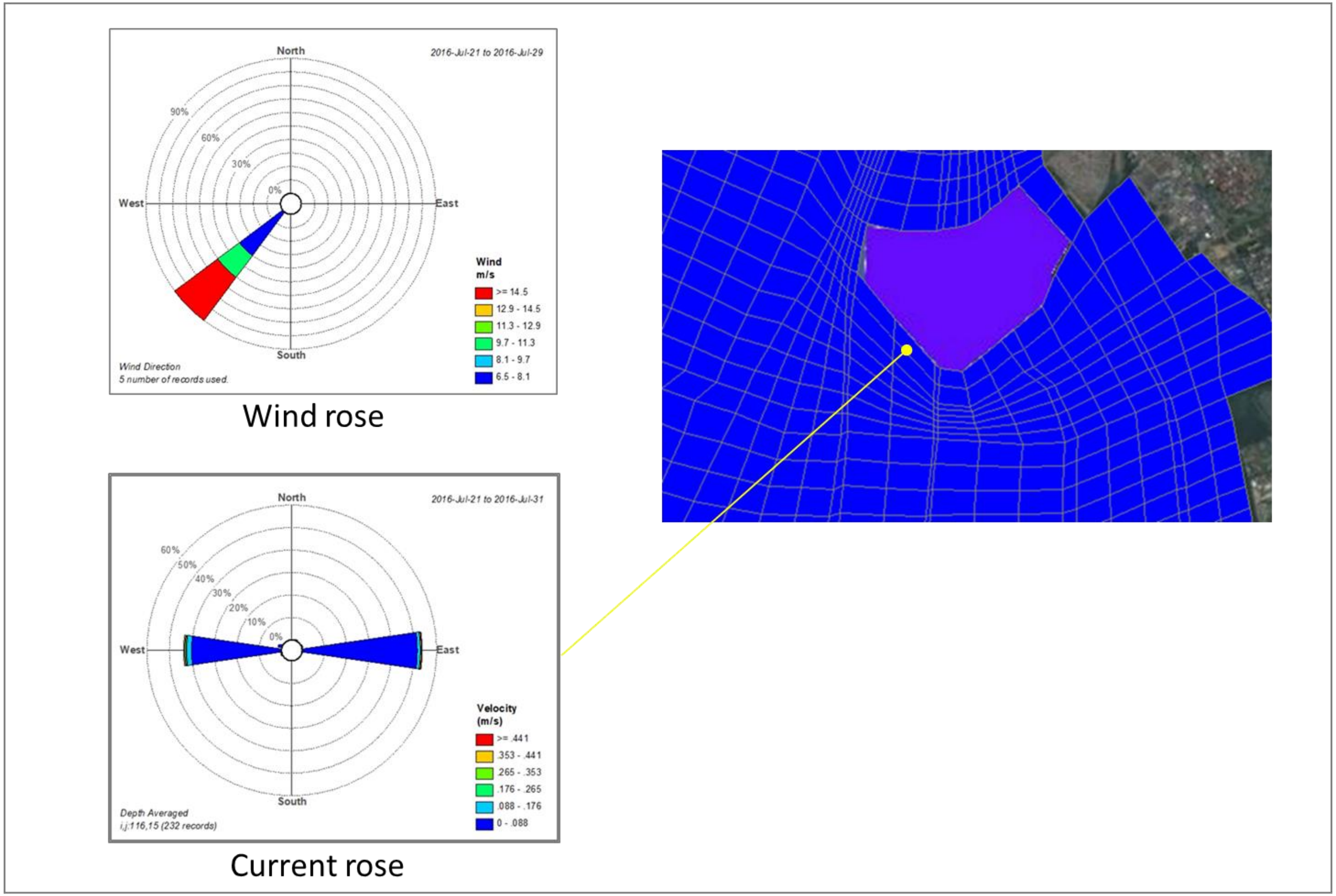


Figure 2-69. Current roses southwest of the proposed project site (cell 116,15) during persistent strong southwest winds (Scenario 2 – with project – New Manila)

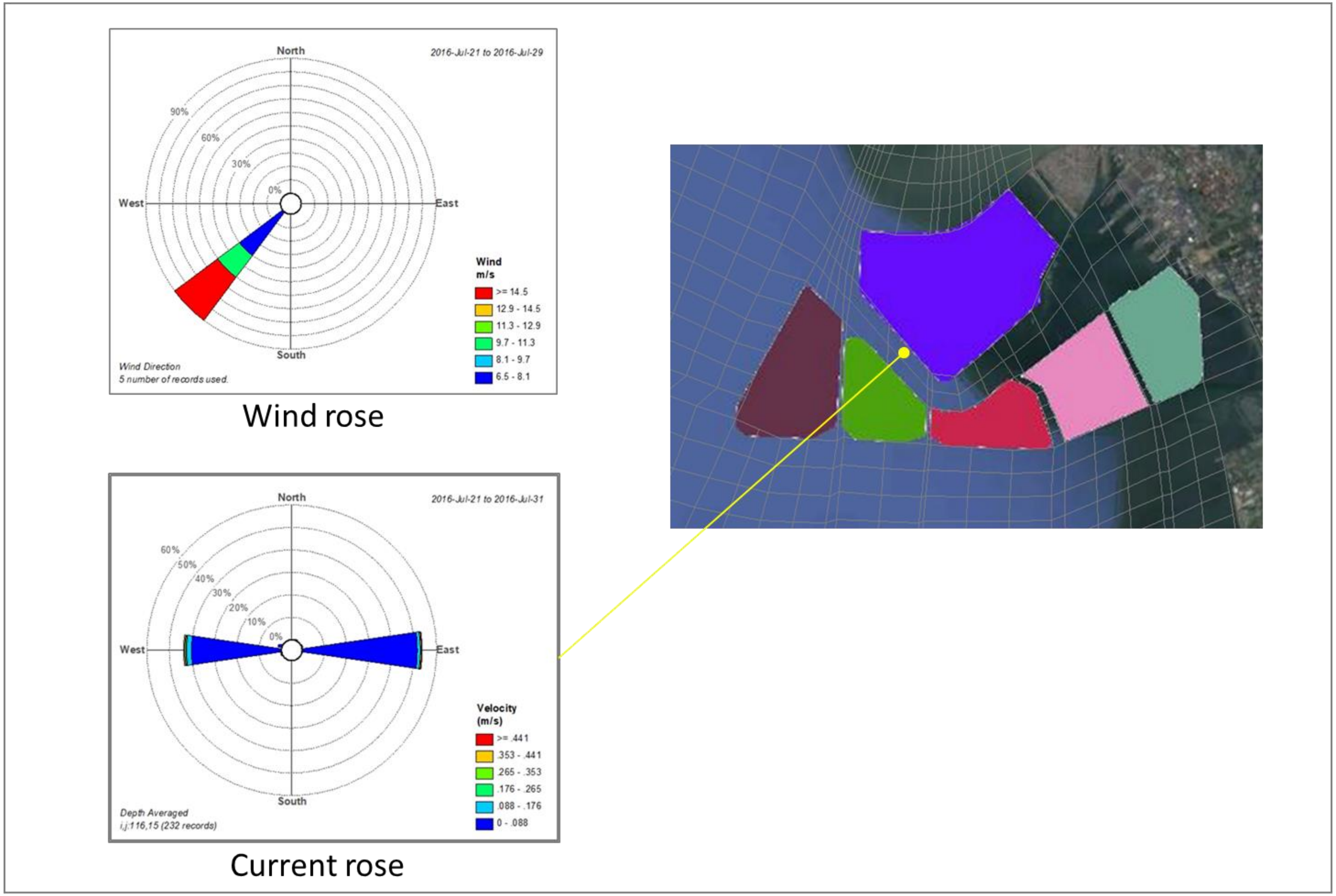


Figure 2-70. Current roses southwest of the proposed project (cell 116,15) during persistent strong southwest winds (Scenario 3 – with all projects)

2.2.2.3.3.3 Simulated Wave Heights

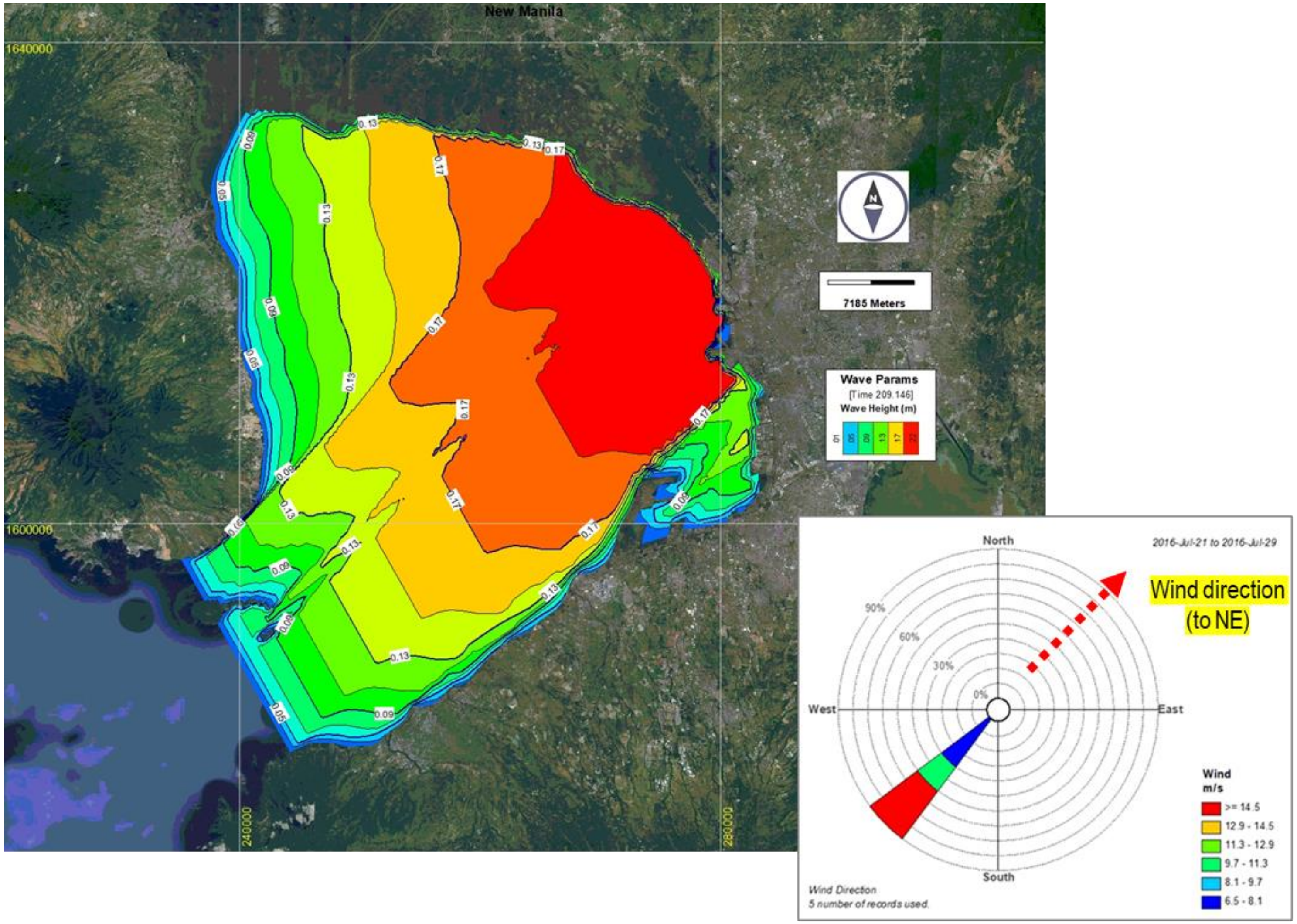
Preliminary simulations of wave heights were performed using the internal wave model of EFDC. The internal wave model used the SMB (Sverdrup, Munk and Bretschneider, see Zhen-Gang Ji, 2008) model wherein the generated wave directions are the same as wind directions, which means that effects of refraction, diffraction and reflection are not taken into consideration (Craig, 2017).

Figure 2-71, **Figure 2-72**, and **Figure 2-73** show the simulated wave heights for the three (3) scenarios with moderate to strong southwest winds. In all simulations or scenarios, wave directions are along the directions of wind flows. Simulated wave heights were also higher at the northeaster part of Manila Bay. Cavite City, which extends northward from the coast of Cavite, partially blocks generation of higher waves at the three (3) reclamation islands located S-E of the proposed project.

For Scenario 1 (without the projects) the simulated wave heights at cell no. 116, 15 (southwest of project site) were higher than with the presence of the proposed project site (**Figure 2-74**). The presence of the other reclamation islands (five islands), however, resulted to substantial reduction of wave heights at the said location. This was due to the blocking effect of the other reclamation islands southwest of the project site.

In terms of wave-induced bed shear stress due to persistent southwest winds, results show that high simulated bed stresses are found at shallow areas in the coastal waters of Navotas and west of Cavite City, and relatively lower at the project site due to its depth (**Figure 2-75**).

Locations of high bed stresses provide indication of areas prone to high sediment mobilization and transport cause by longshore currents and littoral transport of non-cohesive sediments, such as sands and silts. Due to unavailability of updated sediment bed data at the project site and its vicinities, however, this study focused only on simulating cohesive sediment transports.



Wind rose

Figure 2-71. Simulated wave heights with assumed persistent strong southwest winds (Scenario 1 – without project)

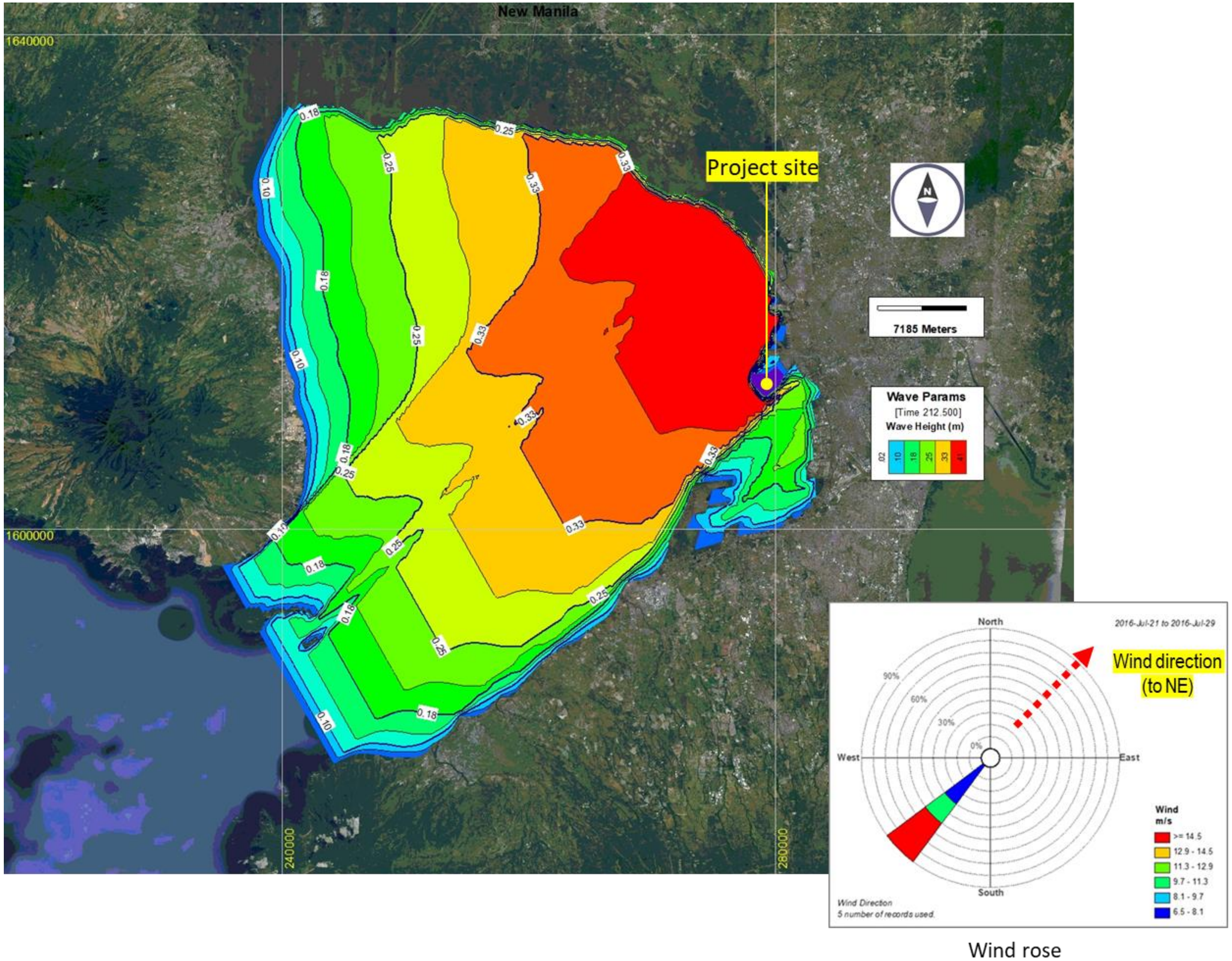
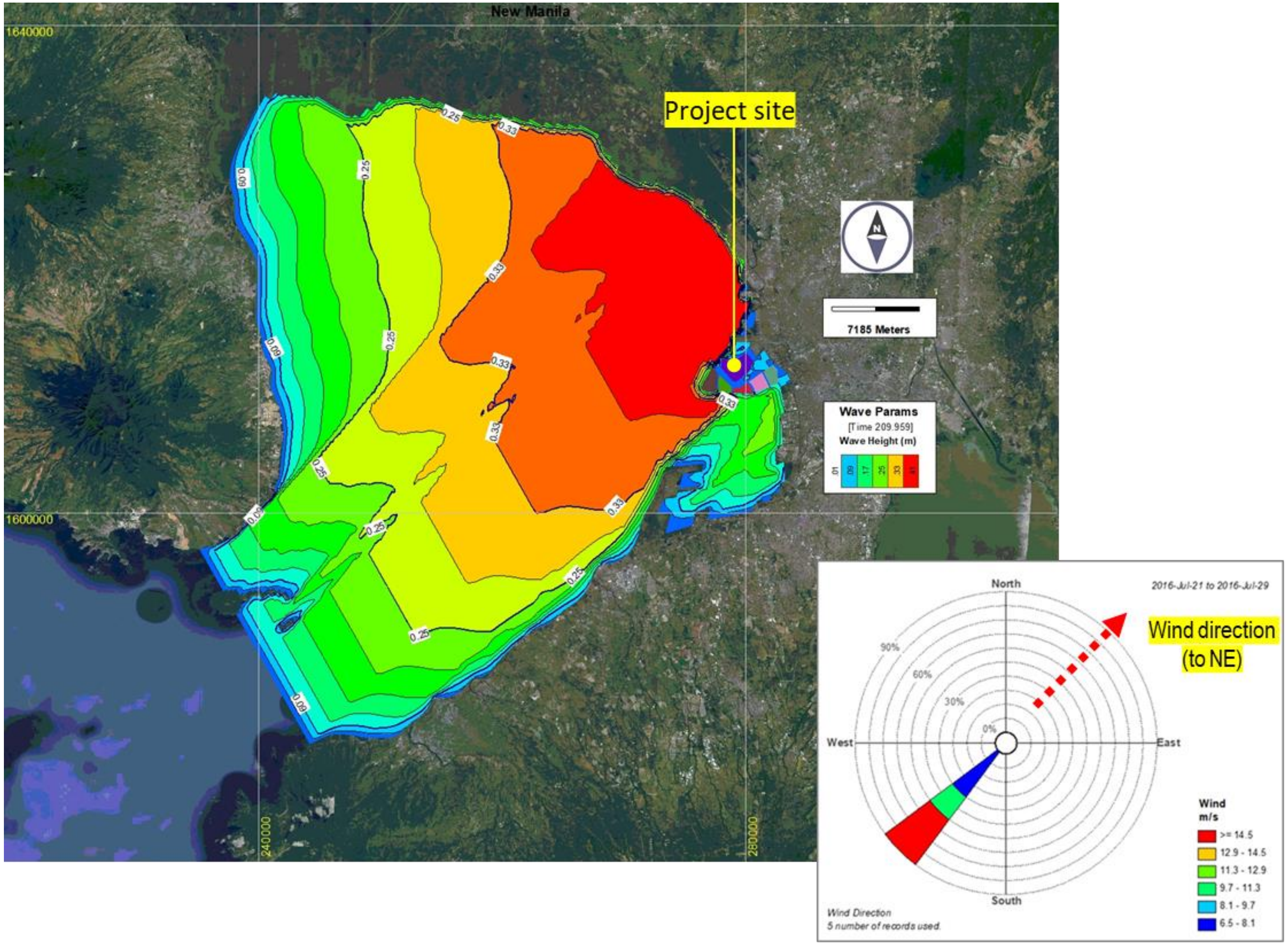


Figure 2-72. Simulated wave heights with assumed persistent strong southwest winds (Scenario 2 – with project – New Manila)



Wind rose

Figure 2-73. Simulated wave heights with assumed persistent strong southwest winds (Scenario 3 – with all projects

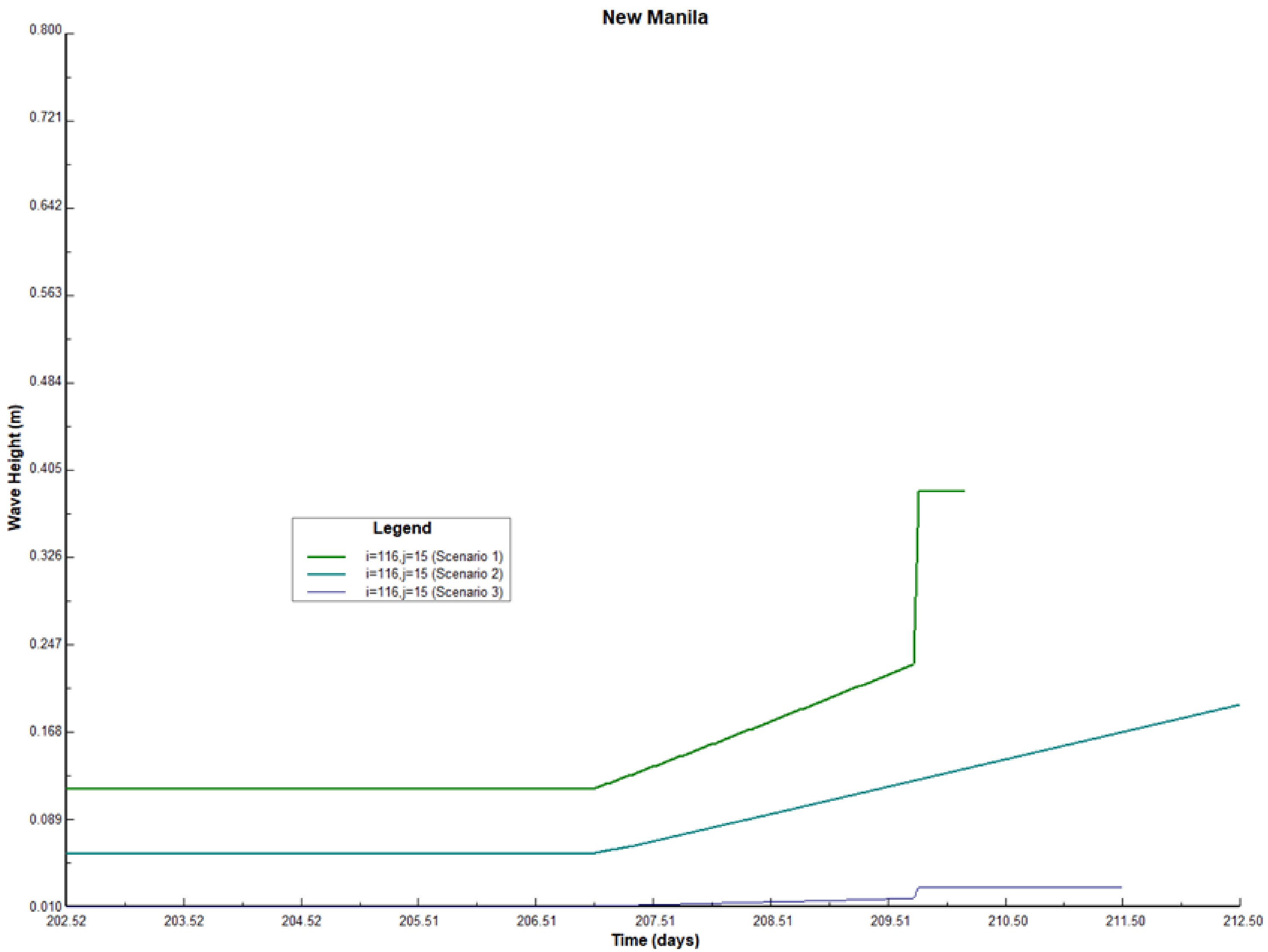
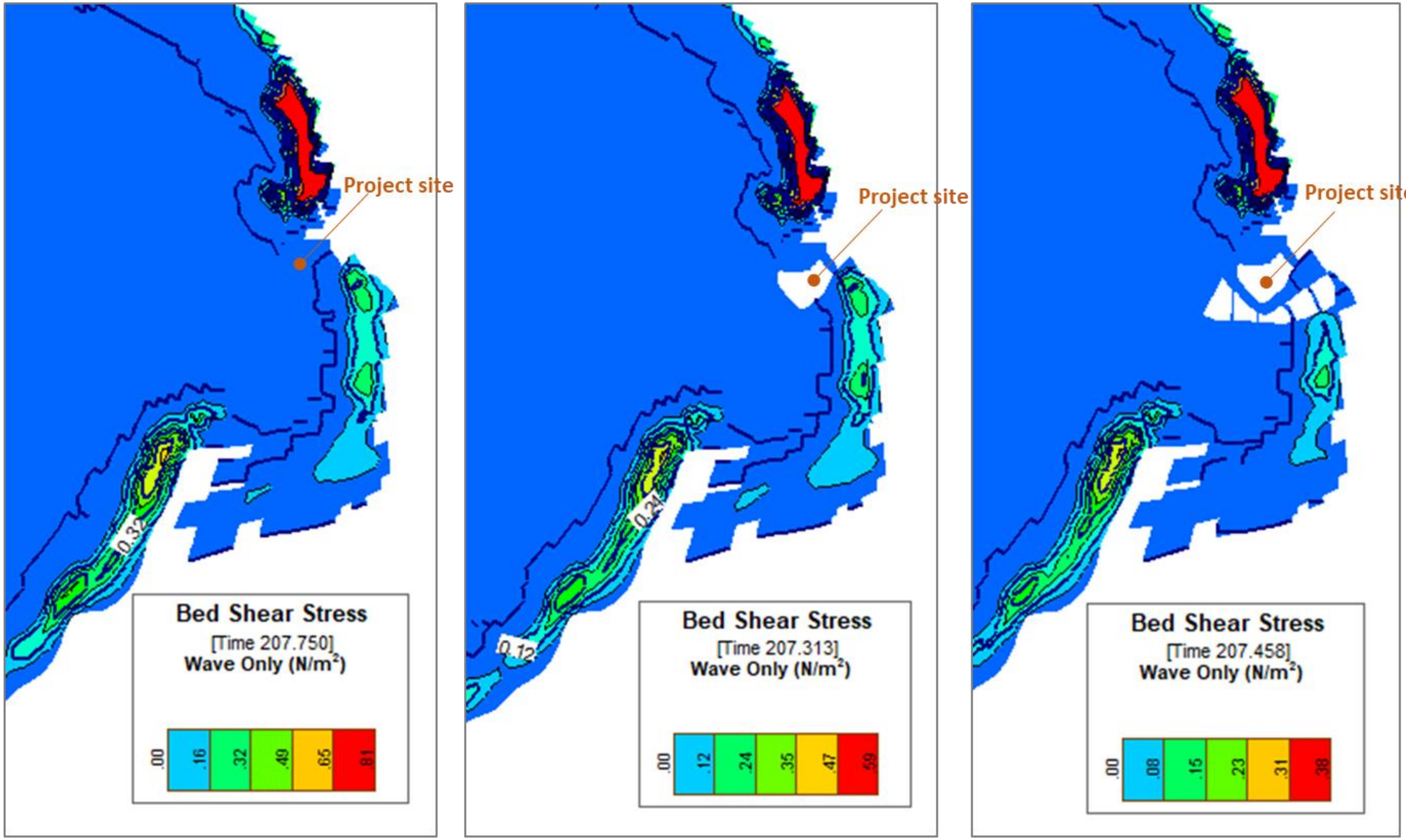


Figure 2-74. Time series of simulated tidal heights d persistent strong southwest winds (– with all projects



Scenario 1-Without project | Scenario 2-With project (New Manila) | Scenario 3-With all reclamation projects

Figure 2-75. Simulated wave-induced bed shear stresses for the three (3) scenarios

2.2.2.3.3.4 Simulated Sedimentation or Dispersion of Sediments

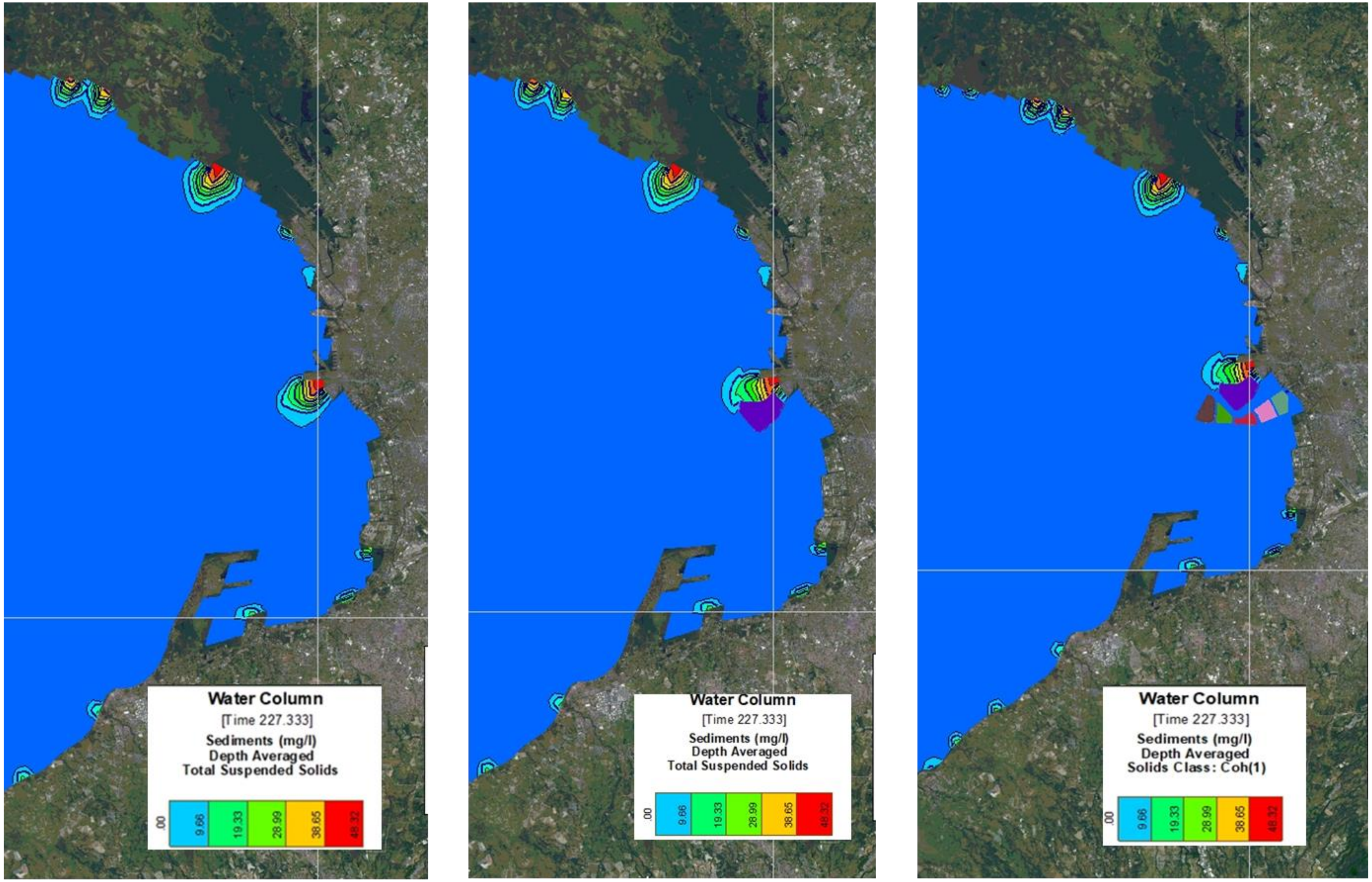
Figure 2-76 shows the estimated sedimentation patterns in August arising from cohesive sediment transports from river inflow. Results show that without the project scenario, sedimentations occur at areas near the mouth of Pasig River and at the project site. With the project scenario, sedimentations are still apparent at areas fronting the Pasig River and between the project site and the coast of Manila Bay (or east side of the project site).

Dispersion of sediments are expected during the reclamation of the project, and if not properly mitigation, would cause an increase of background levels of total suspended solids (TSS) and/or at levels greater than the water quality guidelines prescribed for marine waters.

To estimate the dispersion patterns of non-cohesive sediments during reclamation works at the project site, concentration of a conservative dye (no decay rate) with concentration 500 mg/l was released at the project area. After about 2 days from released, the plume of the dye appears to move about 3 km along the northwest and southeast directions, and extends farther to several kilometers, if no decay rate was assumed (**Figure 2-77**).

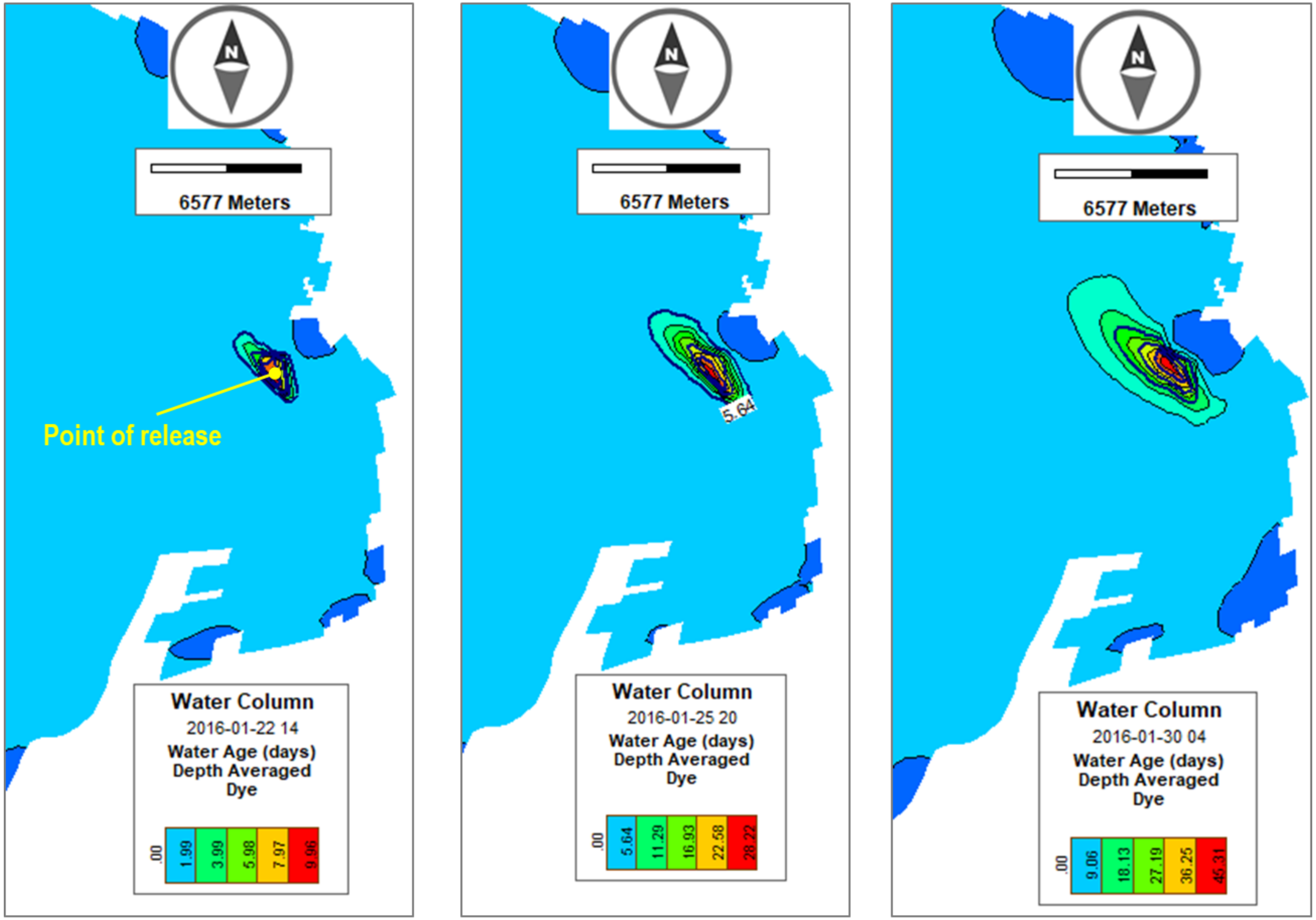
This suggests that mitigation measures should be undertaken to maintain as possible the background levels of sediments or to levels within the water quality criteria prescribed in DAO 2016-08, particularly TSS at 80 g/l. Sand bunds or other types of bund walls or silt curtains or other appropriate mitigation measures should be provided to prevent dispersion of silt or sediments away from the project site during reclamation works.

During project operation, regular dredging works should be conducted adjacent the proposed project site, specifically in vicinities of the mouth of Pasig River where sediment deposition from these highly-silted river inflows would constrict waterways and current flows. Further, dredging works shall regularly be conducted adjacent and at immediate vicinities along the eastern part of project boundaries wherein accretion of sediments is likely due to the presence of the reclaimed project site.



Scenario 1-Without project | Scenario 2-With project (New Manila) | Scenario 3-With all other projects

Figure 2-76. Simulated concentrations of cohesive sediments arising from river inflows



Time from released = approx. 2 days | Time from released = approx. 5 days | Time from released = approx. 10 days

Figure 2-77. Dispersion of an assumed conservative dye (or “sediments”) after released during reclamation works

2.2.2.3.4 Impacts of Storm Surge and Sea Level Rise

Secondary data and studies from PAGASA, Project NOAH, Lapidez et. al (2014) and IPCC (2013) were used to assess the impacts of storm surges and sea level rise in the project area.

2.2.2.3.4.1 Storm Surge

Historical storm surge data from PAGASA showed storm surge of about 0.66 m in the coastal areas located near the project site (**Figure 2-78**). Storm surges of 1.65 to 2.81 were also noted along Cavite coastline with the highest storm surge at Cavite City of 2.81 m.

Table 2-12 shows the storm surge events as compiled in Project Noah. Based on **Table 2-12**, there were twelve (12) storm surge events that were recorded in Manila Bay from 1589 to 2013 with recorded storm surge height ranging from 0.6 to 4 m.

Lapidez et al (2014) conducted storm surge simulations at selected areas in Leyte, Iloilo and Metro Manila. Results of said study using Typhoon Haiyan with track of Typhoon Georgia showed that storm surge heights of 3.01 to 4 m could be generated in the coastal areas in Manila **(Figure 2-79**), and that these coastal areas are susceptible to high level of flooding (**Figure 2-80).**

Based on the above-mentioned data and information, it appears that the project site is also prone to storm surge with heights greater than 4 m and is susceptible to high level of flooding.

Table 2-12. Storm Surges in Manila Bay (Source: Project Noah website)

No.	Source no.	Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
1	5	June 29, 1589	Unnamed typhoon		Manila Bay		
2	5	August 29, 1863	Unnamed typhoon		Manila		Destroyed Bagumbayan drive due to inundation; several houses were unroofed
3	5	September 20 – 26, 1867	Unnamed typhoon		Manila Bay		17 ships were tossed onto Santa Lucia and Tondo shores
4	5	October 25,1873	Unnamed typhoon	0.6	Cavite		
5	5	November 10 – 23, 1923	Unnamed typhoon		Western Carolines, N		16

No.	Source no.	Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
					of Yap, Borongan, Samar, NE of Romblon, E of Manila, Eastern coast of Luzon, Lingayen Gulf, Balintang Channel		
6	1	November 19, 1970	Typhoon Yoling (Patsy)	4	Manila Bay, southeast coast of Luzon		Destroyed $40M property; sank 21 fishing boats near the North Harbor
7	9, 10	June 23 – 25, 1972	Typhoon Konsing (Ora)		Manila Bay and Bicol region	1	Several ships washed ashore
8	1	July 2, 1983	Typhoon Bebeng (Vera)	4	Bataan and least 10 villages on Manila Bay's western banks	182	49,000 houses
9	6, 7	September 26 – 28, 2011	Typhoon Pedring (Nesat)	6	Coastal areas of Manila Bay, Brgys San Rafael 3 and 4, Cavite, Brgy. Pasungol, Santa, Ilocos Sur, and Sta Rita Aplaya, Batangas City	12	Damaged the breakwater and seawall along Roxas Boulevard
10	2	July 30 – 31, 2012	Typhoon Gener (Saola)		Zamboanga del Norte, Ternate, Cavite, Bulan, Sorsogon, and Sitio Tinago, Brgy. Tibpuan, Lebak Sultan Kudarat		214 houses
11	3, 4	August 22, 2013	Typhoon Maring (Trami)		Brgy. Mabolo, Naic, Cavite and Molo District, Iloilo		14 houses
12	8	October 11, 2013	Typhoon Santi (Nari)		Manila Bay		

References

1- Longshore, D., 2008. Encyclopedia of Hurricanes, Typhoons, and Cyclones, New Edition. NewYork: Facts on File, Inc., 280-346. http://books.google.com.ph/books?id=8kXwskQHBLoC&pg=PA461&lpg=PA461&dq=typhoon+kate+storm+surge&source=bl&ots=qDKg_J873Q&sig=xf02S5nehRW97LYv9uRPik3OcF8&hl=en&sa=X&ei=YXj4Uf9vy9-SBZLngNgC&ved=0CF0Q6AEwCQ#v=onepage&q=typhoon%20kate&f=false
2- NDRRMC Update: SitRep No.20 re Effects of Typhoon "GENER" (SAOLA) Enhanced by Southwest Monsoon. August 6, 2012 National Disater Risk Reduction and Management Council http://www.ndrrmc.gov.ph/attachments/article/630/SitRep%20No.%2020%20re%20Effects%20of%20Ty%20GENER%20(SAOLA),%2006Aug2012.pdf
3- Chino Gaston. Ilang bahay,winasak ng storm surge. August 22, 2013. 24 Oras. GMA.video. http://www.gmanetwork.com
4- Jaime Sinapit. Storm surge hurts 3, damages 8 houses in Iloilo City. August 22, 2013. Interaksyon. http://www.interaksyon.com/
5- R. García-Herrera, P. Ribera, E. Hernández, L. Gimeno:'Typhoons in the Philippine Islands 1566-1900'. Submitted to JGR – Atmospheres. http://pendientedemigracion.ucm.es/info/tropical/philippine.html
6- NDRRMC Update: SitRep No.26 re Effects of Typhoon"PEDRING" (NESAT). October 11, 2011. National Disater Risk Reduction and Management Council. http://www.ndrrmc.gov.ph/attachments/article/306/NDRRMC%20Update%20SitRep%20No.26%20re%20Effects%20of%20Typhoon%20PEDRING%20(NESAT)%20as%20of%2011OCT2011,%206AM.pdf
7- Helen Flores. 'Pedring' slams Metro. The Philippine Star. 28 September 2011. http://www.philstar.com/headlines/731323/pedring-slams-metro
8- Mark Balmores. Man Against Nature. Manila Bulletin. 12 October 2013. http://www.mb.com.ph/man-against-nature/
9- Buckmaster, Albert T. and Nishimoto, Hiroshi. 1972 Annual Typhoon Report. U.S. Fleet Weather Central/Joint Typhoon Warning Center. 1 January 1995.
10- Kelvin S. Rodolfo. Why reclamation of nearshore Manila Bay is a very bad idea. The Philippine Star. 3 October 2013. http://www.philstar.com/science-and-technology/2013/10/03/1240670/why-reclamation-nearshore-manila-bay-very-bad-idea

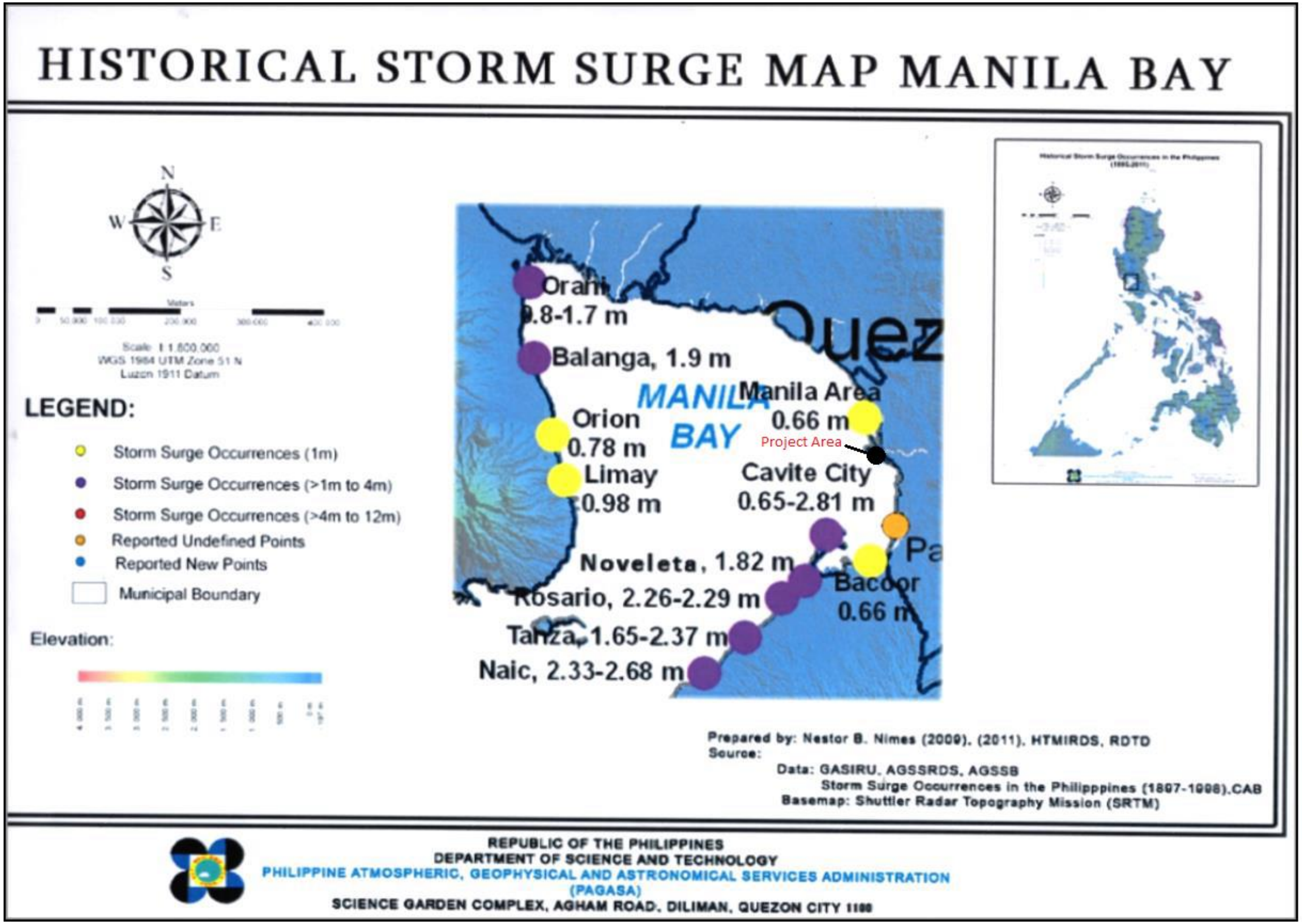


Figure 2-78. Historical Storm Surge Map in Manila Bay

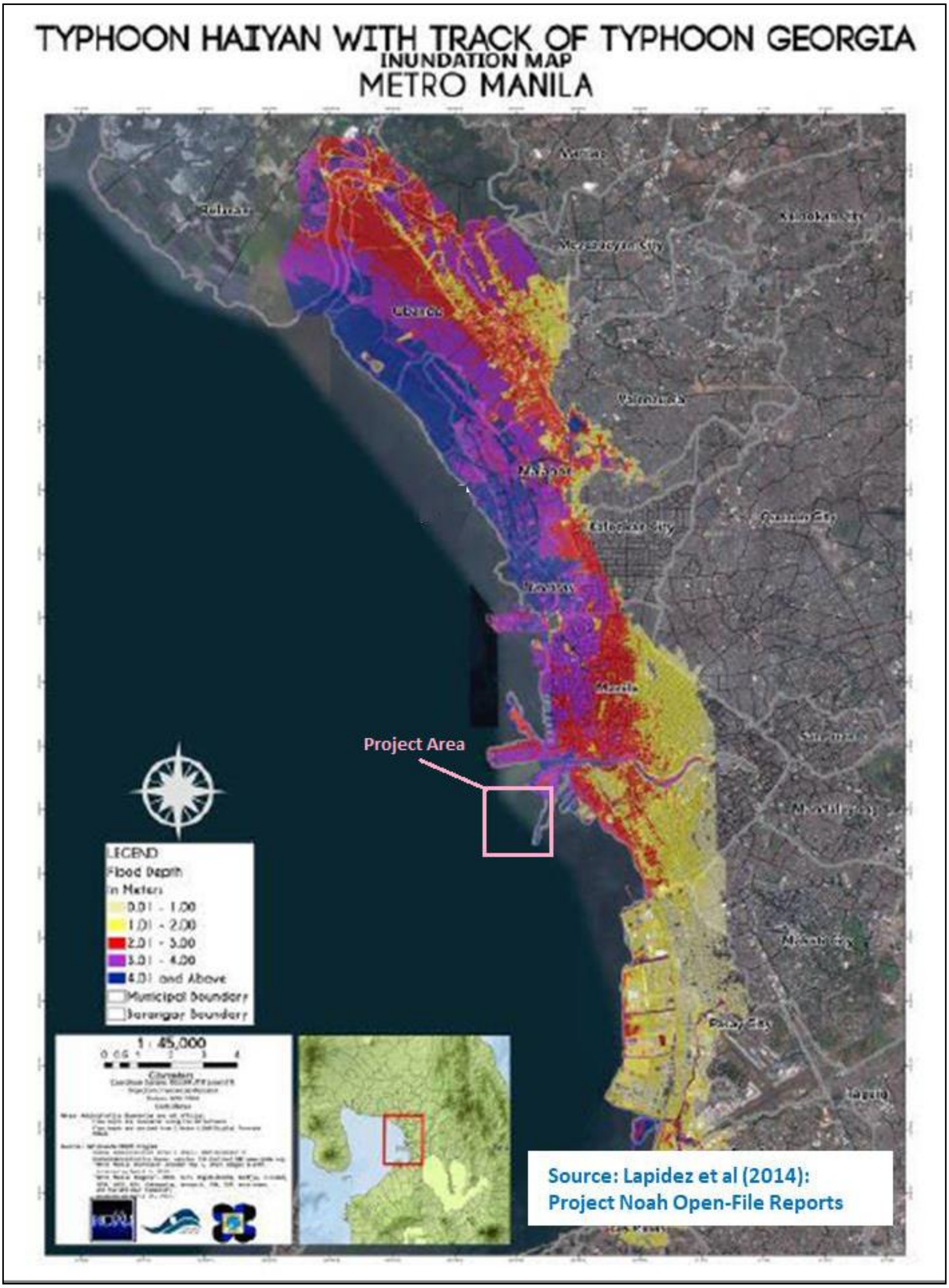


Figure 2-79. Predicted storm surge heights (Source: Lapidez et al, 2014)

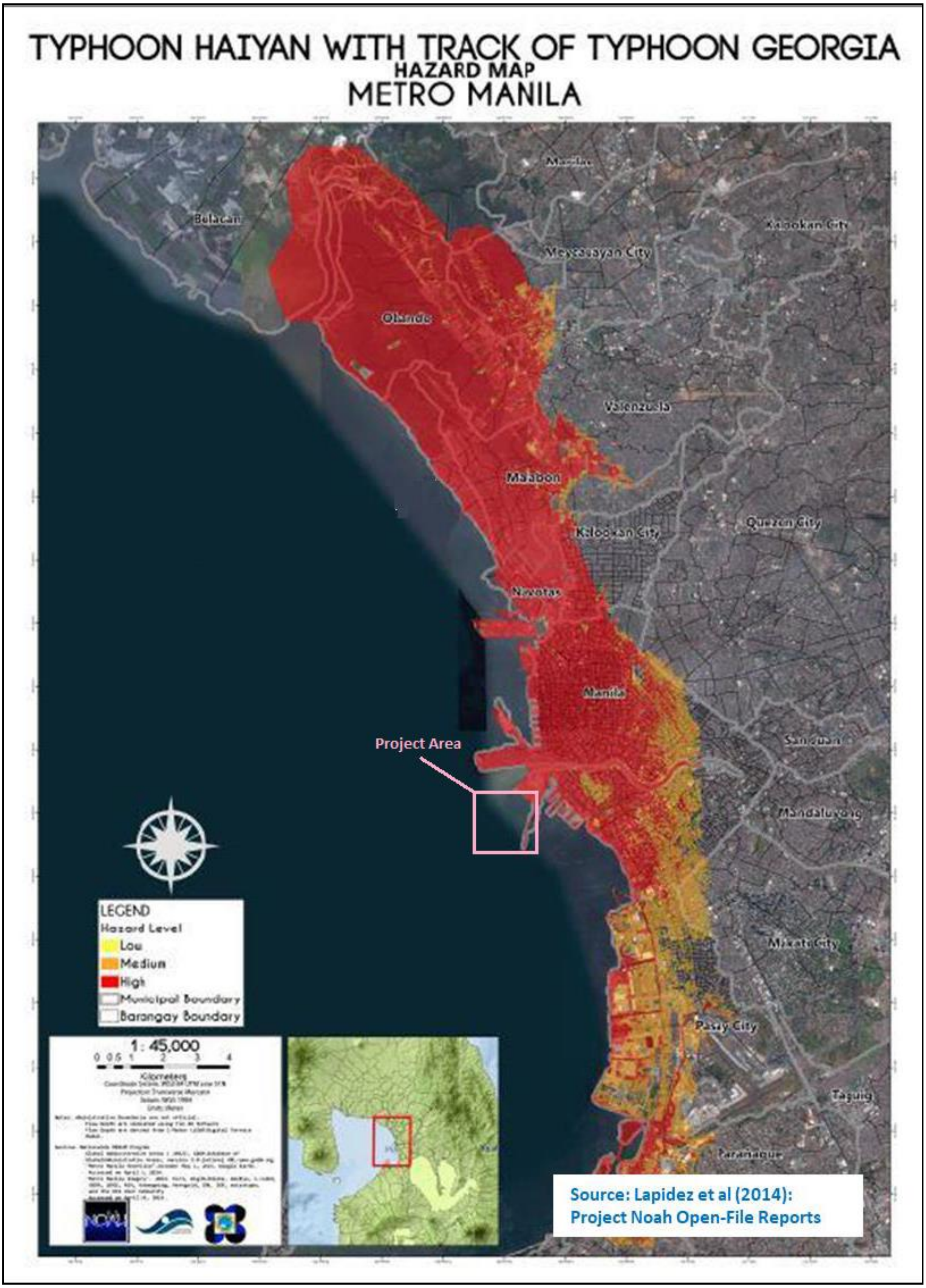


Figure 2-80. Hazard level map (Source: Lapidez et al, 2014)

2.2.2.3.4.2. Sea Level Rise

Sea level rise is expected in Manila bay as noted by studies of Perez et al (199) and MERF (2012). IPCC (2013) also published projections of sea level rise in the world caused by warming of the ocean and loss of land-based ice.

Perez et al (1999) showed that increase of sea levels would inundate about 2090 and 5555 ha of land in the coastal areas of Manila Bay and Cavite City. Further, MERF (2012) noted increase of sea level rise in the coasts of Manila between 0.2 and 0. 4 m in more recent years to the present, which was attributed mainly by climate change effects and other factors, such as land reclamation and ground subsidence.

IPCC studies have shown that sea levels are gradually rising in the 20th century and about 70% of the coastlines in the world will experience sea change within 20% of the sea level. Significant increase of projected sea level is projected in 21st century relative to the 1980 to 1999 mean.

2.2.2.3.4.3 Mitigation Measures

Based on the previous studies on storm surge, flooding, and sea level rise as discussed above in Manila Bay particularly at or in vicinities of the project, it appears that the proposed project site is vulnerable to high storm surges and flooding, including effects of sea level rise (if not properly addressed or included in the reclamation design).

Mitigation measures to address impact of storm surges, i.e., provision of storm surge barriers, due to passage of typhoon, and increasing the height of the reclamation site considering flooding cause by storm surge, are impractical due to cost involved not to mention the uncertainties of modelling storm surges. Ellis and Shermal (2014) recommended adaptation measures to reduce vulnerability to climate change impact (e.g., storm surges and sea level rise).

One of the adaptation measures is for residents to evacuate the area in the event of incoming typhoon. Provision of early warning systems and effective dissemination procedures could effectively avoid casualties in the event of extreme weather events.

Further, the reclamation site should be designed considering the projected sea level rise in Manila Bay, including the heights of the highest astronomical tide and wave effects during southwest monsoon (not storm surges). Revetments should also be provided to prevent erosion due to waves, storm surges and currents.

2.2.3 Water Quality

This section presents the results of the marine water quality baseline study conducted on June 28, 2018. The NAMRIA topographic map was used for initially identifying the possible locations of water sampling stations. The assessment of water quality focused on the marine water within the project area.

2.2.3.1 Methodology

Seven (7) marine surface water samples were taken from strategically located sampling stations within the project area. Parameters tested were: pH, Color, Total Suspended Solids (TSS), Oil and Grease, Hexavalent Chromium (Cr^{6+}), Phosphate, Nitrate as NO_3—N, Sulfate (SO_4^{2-}), Cyanide (CN^-), Arsenic (As), Cadmium (Cd), Lead (Pb), Mercury (Hg), and Fecal Coliform.

2.2.3.2 Results

The guidelines stipulated in DENR Administrative Order No. 2016-08 – Water Quality Guidelines and General Effluent Standards of 2016 were used in the assessment of the current status of surface water quality in the study area. Philippine fresh, coastal and marine waters are classified based on their beneficial use. Based on DENR Memorandum Circular No. 2010-08, Manila Bay is classified as Class SB with the following intended beneficial use:

1. Fishery Water Class II - Waters suitable for commercial propagation of shellfish, and intended spawning areas for milkfish (*Chanos chanos*) and similar species
2. Tourist Zones - for ecotourism and recreational activities
3. Recreational Water Class I - Intended for primary contact recreation (bathing, swimming, skin diving, etc.)

Table 2-13 below presents the results of the water quality sampling conducted for the proposed project as compared to Class SB Water Quality Guideline (WQG), while Figure 2-81 indicates the location of the sampling stations relative to the final landform of the proposed reclamation project.

Recorded pH levels in S3, S4, S5, S6 and S7 are slightly above the pH range for Class SB Water Quality Guideline. Parameters, total suspended solids (TSS), oil and grease, hexavalent chromium, phosphate, nitrate and heavy metals: Arsenic, Cadmium, Lead and mercury are all below the Class SB WQG. Sulfate readings in all stations exceeded the Class SB WQG of 250mg/L. High levels of phosphates in saltwater promotes algae growth and negative effects on coral growth and development. Cyanide levels also exceeded the Class SB WQG of 0.02 mg/L in stations S1, S2, S3 and S4. Fecal coliform reading is very high in S1 with 16 x 10^4 MPN/100mL result.

Table 2-13. Results of Water Quality Analyses for Marine Waters

Parameters	Sampling Station							Water Quality Guideline (Class SB)	Unit	Method
	S1	S2	S3	S4	S5	S6	S7			
pH	7.8	8.1	8.8	8.7	8.7	8.7	8.6	7.0-8.5	-	Electrometric
Color	2	25	25	25	25	50	20	50	ACU	Visual Comparison
Total Suspended Solids (TSS)	4	3	2	3	3	4	3	50	mg/L	Gravimetric, dried at 103-105 °C
Oil and Grease	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2	mg/L	Liquid-Liquid, Partition - Gravimetric
Hexavalent Chromium (Cr^{6+})	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	mg/L	Colorimetric
Phosphate	0.23	0.11	0.04	0.02	0.03	0.03	0.02	0.5	mg/L	Stannous Chloride
Nitrate as NO_3^- N	0.08	0.05	0.01	0.04	0.02	0.09	0.09	10	mg/L	Colorimetric, Brucine
Sulfate ($S0_4^{2}$-)	613	1275	2491	2060	1950	2612	1318	250	mg/L	Turbidimetric
Cyanide (CN^-)	0.05	0.05	0.05	0.05	<0.05	<0.05	<0.05	0.02	mg/L	Cyanide - Selective Electrode (w/o distillation)
Arsenic (As)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	mg/L	Manual Hydride Generation AAS
Cadmium (Cd)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	mg/L	Direct Air-Acetylene Flame
Lead (Pb)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	mg/L	Direct Air-Acetylene Flame
Mercury (Hg)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	mg/L	Cold Vapor AAS
Fecal Coliform	16 x 04	-	23	-	-	7.8	33	100	MPN/ 100mL	Multiple Tube Fermentation Technique-Fecal Coliform Procedure

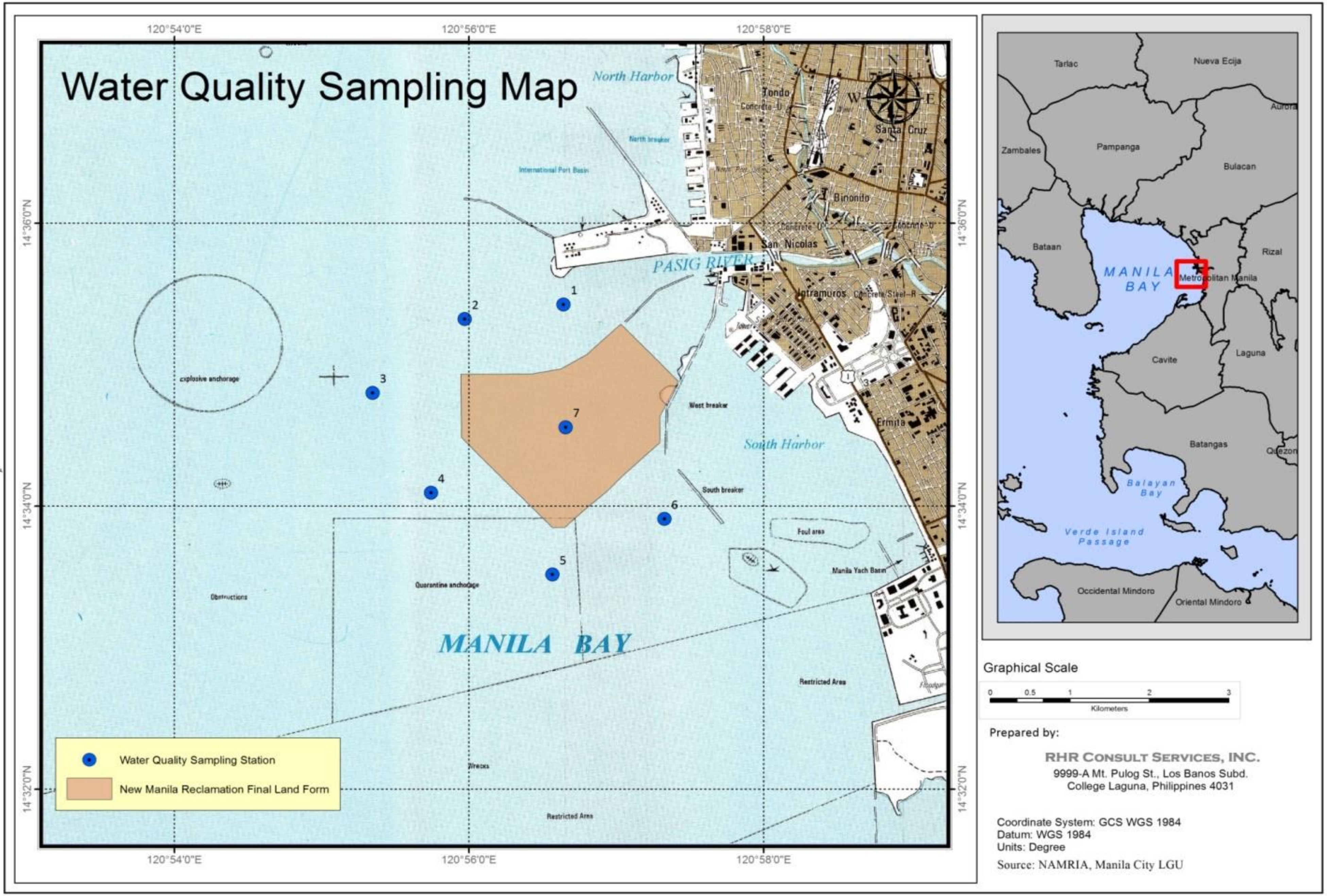


Figure 2-81. Water Quality Sampling Map

2.2.4 Freshwater Ecology

River ecology assessment was conducted in three sampling stations in the Pasig River as part of the EIA baseline assessment for the proposed New Manila Reclamation Project on 24 July 2018. The objective of the aquatic ecology baseline study is to establish baseline parameters of the river system and to determine the presence of important aquatic biota that can be susceptible to anthropogenic issues that can arise during the establishment and operation of the project. The freshwater ecology baseline assessment employed standard survey methodologies to (i) determine fish biota and fishing practices in the river through the conduct of test fishing and documentation of actual fishing operations by fishers, (ii) determine diversity of benthic macro-invertebrates and soft bottom communities, (iii) identification of plankton communities, and (iv) measurement of basic river parameters.

The Pasig River is contiguous to the proposed reclamation area and its estuary lies less than half a kilometer away from the southern boundary of the proposed reclamation. The river, which connects Laguna de Bay and Manila Bay and meanders north-westward through the cities of Taguig, Pasig, Makati, Mandaluyong, Manila, and the municipality of Taytay. It is the main water body in Metro Manila that bisects the Metropolis and its surrounding urban area into northern and southern halves. Its major tributaries are the Marikina River and San Juan River. It is approximately 27 km long with an average width of 91 meters and depth ranging from 0.5 to 5.5 meters. The average depth is 1.3 meters. The deepest portions are located between Guadalupe Bridge and C6 Bridge, while the shallowest portion is at the mouth of Manila Bay. The average water volume is 6.6 million m3. During low flow from March to May, the discharge volume is $12m^3$/sec, while from October to November the discharge volume reaches $275m^3$/sec. It is considered as a tidal estuary because of the interchange of water during low tide from Laguna de Bay and during high tide from Manila Bay. *(Pasig River Rehabilitation Commission, 2006).* The river has become very polluted and is considered biologically dead. Because of this, the Pasig River Rehabilitation Commission (PRRC) was created in 1999 under the Executive Order No. 54 with a mandate to rehabilitate the Pasig River to its previous pristine condition, for recreation, transportation, and tourism. Several small ferryboats use the Baseco area in the river for passenger boarding and unloading.

The position of the Pasig River, particularly its estuary, relative to the proposed reclamation area is shown in **Figure 2-82**. The coordinates of the three stations surveyed for river characteristics are summarized in **Table 2-14** below.

Table 2-14. Coordinates of stations investigated for basic river parameters (RVR) during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay in July 2018

WP Code	LATITUDE	LONGITUDE	REMARKS
RVR1	N 14.596036°	E 120.968133°	Upstream portion east of Delpan Bridge; survey conducted on 1107H 23 July 2018
RVR2	N 14.595635°	E 120.960036°	Midstream portion west of Delpan Bridge across residences; Survey undertaken 1132H 23 July 2018
RVR3	N 14.595486°	E 120.951298°	Downstream portion approaching estuary; Survey undertaken 1155H 23 July 2018

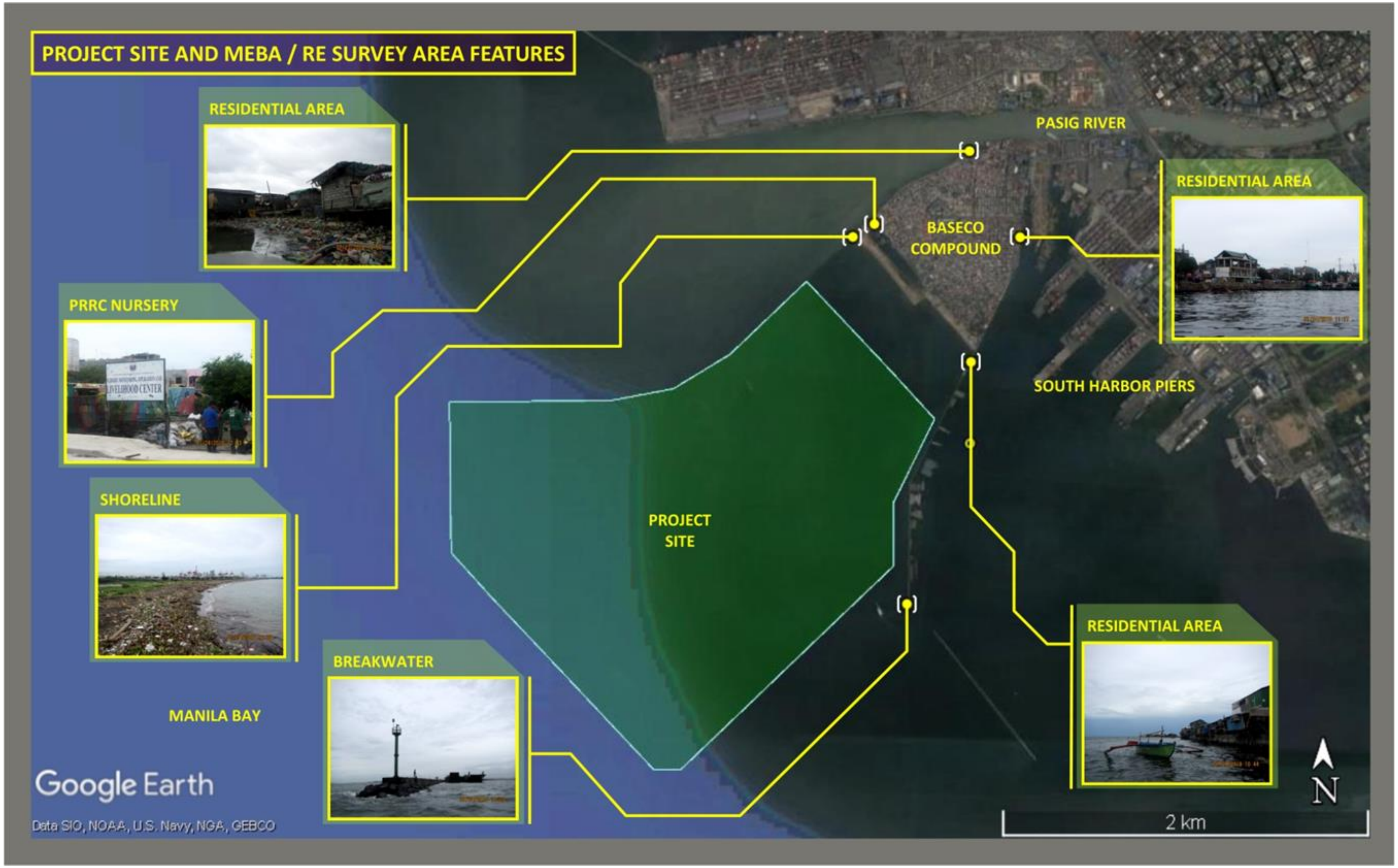


Figure 2-82. Relative position of the Pasig River and its estuary in relation to the proposed New Manila Reclamation Project in Manila Bay;
map prepared by Jose Rene Villegas; July 2018

Figure 2-83. River parameter stations in the Pasig River (stations 4, 5 and 6; shown with marine ecology survey stations 1, 2 and 3) surveyed during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay; July 2018; map prepared by Jose Rene Villegas

2.2.4.1 Sampling Methodology and Stations

Three (3) sampling stations were investigated in the Pasig River. The plankton and benthos stations were distributed in the upstream portion of the river, in midstream portion, and near the river's estuary downstream. At each location, biotic sampling included phytoplankton, zooplankton, macrobenthos and macro-invertebrates, and fish species diversity. Sampling for freshwater fish species was generally conducted through test fishing operations in three locations to document species diversity and catch rates.

Plate 2-2. River parameter survey stations surveyed during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay; July 2018

2.2.4.1.1 River Parameters

Depth in the stations was measured using a HONDEX Portable Handheld Depth Sounder (Ps-7 A423 067); salinity with a standard Atago refractometer, and width with the use of GPS tracking. Substrate composition was collected through scuba diving and stream flow was estimated in three replicates employing modified stream flow measurements. Turbidity was measured with a standard sechhi disc attached to a fiberglass meter tape.

2.2.4.1.2 Plankton

Phyto-and zooplankton were collected at seven sampling sites by filtering 1 liter samples into a composite sample. Phytoplankton samples were filtered through a 20 µm mesh sieve; zooplankton were filtered through a 33 µm mesh sieve. Phytoplankton samples were then fixed using Lugol's solution; zooplankton samples were fixed with 10% buffered formalin. Samples were then sent to a laboratory for counting and identification. Counting and identification of organisms were conducted using a Sedgwick-Rafter plate. For phytoplankton, a compound light microscope was used, while for zooplankton, a dissecting microscope. Phytoplankton were counted and identified to the lowest taxonomic level (genera) possible while zooplankton were identified to major groups using available references. Phytoplankton and zooplankton densities are presented as number of cells or organisms per liter.

The plankton community sampling stations are listed in **Table 2-14** and the locations are shown in **Plate 2-3**.

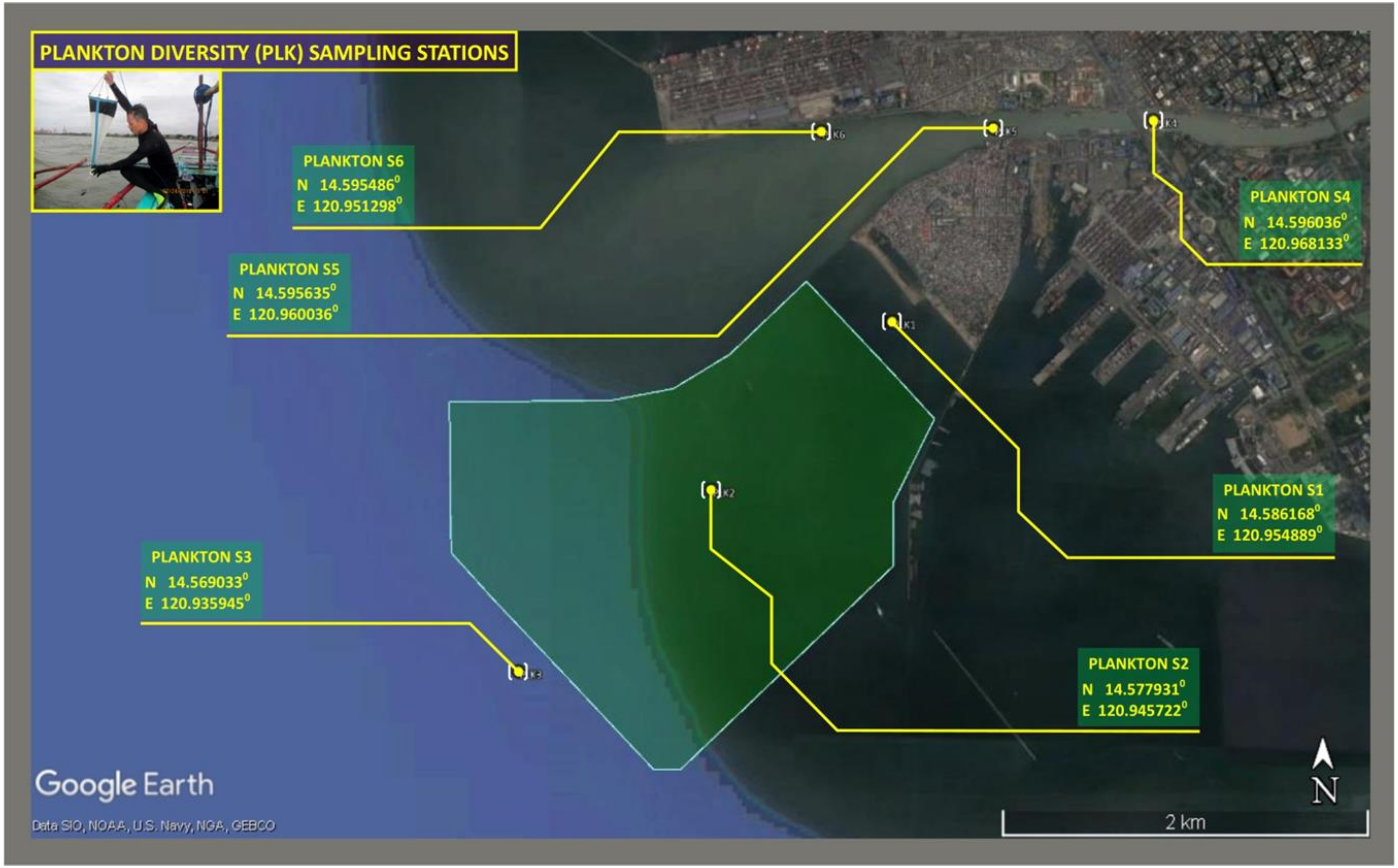


Figure 2-84. Plankton and benthos community sampling stations in the Pasig River surveyed during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay; July 2018

2.2.4.1.3 Macrobenthos / macro-invertebrates

Benthic or bottom dwelling animals constitute a major part of the diet of many benthic and bottom dwelling fishes and crustaceans. Many of the bivalves in riverine and estuarine systems are also normally edible invertebrates collected for food and sustenance trade. Epibenthic fauna (macro-invertebrates or macrobenthos), on the other hand, serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Due to their filter-feeding nature, macro-invertebrates are good indicators of environmental conditions over time and can be used as indicators of water quality and the degradation of the aquatic environment.

Benthic macro-invertebrates re-collected in the same three stations where plankton samples were collected (**Table 2-14**) employing a standard kick net. The net is thrust into productive habitats and substrates (*e.g.*, riffle areas, flooded vegetation, submerged root mats and other woody debris) to collect specimens. Benthos samples were sent to the UP MSI for identification. Opportunistic survey of macro-invertebrates of significant importance for food or trade was also undertaken randomly in order to reinforce data on aquatic animal diversity specifically for bivalves, crustaceans and gastropods in the river. The locations of stations are mapped (same as plankton stations; also see **Plate 2-3**).

Plate 2-3. Plankton, macrobenthos sampling and river parameter measurement during the freshwater ecology baseline assessment in the Pasig River; July 2018.

2.2.4.1.4 Fish Biota

Fish species identification in the river was facilitated through the conduct of test fishing in three (3) locations in the river employing a cast net and hook and line. Fish and crustacean species, as well as macro-invertebrates of significant value as food, were identified *in-situ* through opportunistic observations in the macrobenthos stations. Fisheries data was supplemented by key informant interviews of fishers to document fish catch composition and catch per unit effort.

Coordinates of the sampling sites for freshwater fish diversity are listed in **Table 2-15** below and shown in a map and **Plate 2-4** displays photographs of the actual fishing activity.

Table 2-15. Coordinates of actual fishing (TSF) stations during freshwater ecology baseline assessment in Pasig River; July 2018.

WP Code	LATITUDE	LONGITUDE	Location/Remarks
FSH2	N 14.588869°	E 120.951266°	Test Fishing with 1 fisher using cast net; catch composition consists of 3 pcs tilapia, and 1 goby
FSH3	N 14.594735°	E 120.959307°	Test Fishing with 2 fishers using drag net; catch composition of approximately 5 kilograms of assorted fish fingerlings
FSH4	N 14.595692°	E 120.968666°	Actual Fishing with 1 fisher using hook and line; catch composition consists of tilapia, big-head carp (imelda fish), gourami, and janitor fish

Figure 2-85. Location of test fishing activities to document fish biota in the Pasig River during freshwater ecology baseline assessment in July 2018 (note: Fish Post no. 1 in the map above is a site for actual fishing in the marine ecology survey; freshwater fish sampling stations are Fish Post 2, 3 and 4); map prepared by Jose Rene Villegas

Plate 2-4. Test fishing in the Pasig River using a cast net (left) and fisher with gill net and hook and line (right) during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

2.2.4.2 Results and Discussions

2.2.4.2.1 River Characteristics in sampling stations

All three sampling stations were characterized by murky, turbid waters with heaps of trash streaming through the current. Ferryboats and barges were docked on the left bank where concrete walls were built, while shanties were dense in both flanks (**Plate 2-5**). River width was widest at 580 m in station 3 near the estuary and narrowest in the upstream station, at 6.5 m (**Table 2-16**). Turbidity was measured at 0.38 meters in the upstream station, 0.26 m midstream, and 0.29 m in station 3. Flow rate was swift - between 0.6 m/s in the estuary to 1.1 m/sec in the narrower upstream station. In all stations, substrate was comprised intense silt mixed with garbage, mostly plastic.

Table 2-16. Basic characteristics of river stations surveyed during river ecology baseline assessment in the Pasig River; July 2018; (Measurements taken on 23 July 2018 at 1107 to 1155 h during ebb tide).

Station	Relative Position	Location	Depth	Width	Salinity	Substrate	Color	Flow Rate	Turbidity
RVR1	Upstream	East of Delpan Bridge	6.5m	130m	0 ppt	silt/ garbage	brown	1.1m/s	0.38m
RVR2	Midstream	West of Delpan Bridge across residences	4.6m	170m	3 ppt	silt/ garbage	brown	0.9m/s	0.26m
RVR3	Down-stream	Approaching estuary connecting to Manila Bay	1.6m	580m	4 ppt	silt/ garbage	brown	0.6m/s	0.29m

Plate 2-5. Images of river stations surveyed in the Pasig River during freshwater ecology baseline assessment in the New Manila Reclamation Project; July 2018.

Lower left photo shows diver with substrate sample collected in one of the river stations comprised of blackish mud and silt.

2.2.4.2.2 Plankton

2.2.4.2.2.1 Phytoplankton Diversity

Phytoplankton are microscopic, free-drifting organisms that are found at the base of the food chain. They play a key role in the primary production and global nutrient cycles of the Earth (Daniel 2001) by making up the main producers in any given water body (Biddanda and Benner 1997). Phytoplankton communities are among the first group of organisms that respond to environmental changes and therefore their total abundance, composition and diversity are used as indicators of water quality (Reynolds et al. 2002; Brettum and Andersen 2005). However, planktons are not known to proliferate in fast moving lotic environs and the sampling stations chosen were areas of relatively slow current. Changes in ecological conditions in a stream often lead to changes in the community structure of planktons and benthic animals.

The phytoplankton community diversity, abundance, and relative composition were determined in three sampling stations (designated as PLK4, PLK5, and PLK6; along the Pasig River as a primary impact area for the proposed site of the New Manila Reclamation Project in Manila Bay across the BASECO compound, City of Manila on 23 July 2018. All sampling stations were set at pre-determined locations by GIS along the waters of the target river in order to assess and compare the microscopic biota contained within. These sampling stations are in correlation to the ones set up along Manila Bay labelled PLK1, PLK2, and PLK3 corresponding marine ecology baseline assessment for the same proposed project.

Results of laboratory analysis revealed a total density of 7,920 cells/L belonging to eleven (11) genera that were identified for all sampling stations. The phytoplankton community in the survey area is comprised of organisms from four major phytoplankton taxa: Cyanophytes (blue-green algae) with two genera, Bacillariophytes (diatoms) with five genera, Dinophytes (dinoflagellates) with two genera, and Chlorophytes (green algae) with two genera as shown in **Table 2-17**. Green algae were the most abundant taxonomic group with a total count of 4,760 cells/L accounting for 60% composition. This is followed by diatoms with 2,700 cells/L at 34% composition, next by blue-green algae with 240 cells/L at 3% composition, and then by dinoflagellates with 220 cells/L also at 3% composition (**Table 2-17** and **Figure 2-86**).

The green algae *Pediastrum* spp. was the relatively abundant genera with 4,500 cells/L (57% of the total composition). It is a photoautotrophic, nonmotile coenobial (fixed number of cells) green algae that inhabits freshwater environments. *Pediastrum* colonies are disk-shaped and are characterized by peripheral hornlike projections. The number of cells per colony varies (2–128) depending on the species. This genera along with the other recorded green algae, *Scenedesmus* spp. (at 260 cells/L – 3.28% composition) are almost exclusively restricted to freshwater habitats and are important non-marine paleoecological indicators of the presence of lacustrine environments.

For the diatoms, the centric-forming, *Minidiscus* spp. was the most abundant in this group with a total sampling count of 900 cells/L accounting for 11.36% composition for all recorded organisms. Another centric, chain forming diatom identified was *Chaetoceros* spp. with 700 cells/L at 8.84% composition, and is the most abundant organism in sampling station PLK5. This genera is one of the most widespread and abundant diatom in marine and brackish habitats worldwide. These are usually found at a higher abundance than other species due to opportunistic behaviour and a rapid response to nutrient pulses and water turbulence (Reynolds, 2006). Some studies suggest that colonies of *Chaetoceros* serve as an important food source within the water column and major carbon contributor to the benthic environment.

Other diatoms that contribute to the amassed volume of cells are *Achnantes* spp. with 260 cells/L (3.28% of total composition), *Melosira* spp. with 620 cells/L (7.83% of total composition), and *Skeletonema* spp. with 220 cells/L (2.78% of the total composition). None of these diatoms have been linked with being a toxin carrier. Commonly found in warm tropical waters, these diatoms provide significant influences in the overall primary productivity in such marine environments. Furthermore, these are some of the major food source of filter-feeding shellfish, which are found along the coastal waters conjoining the survey area.

For the blue-green algae, only two genera have been recorded; *Microcystis* spp. with 220 cells/L (2.78% of total composition), and *Oscillatoria* spp. with 20 cells/L (0.25% of total composition). *Microcystis* spp. is a genus of freshwater cyanobacteria which includes the harmful algal bloom *Microcystis aeruginosa*. The cyanobacteria can produce neurotoxins and hepatotoxins, such as microcystin and cyanopeptolin. Blooms of this specific organism can contaminate potable water with microcystin, which are known to cause liver bleeding. However, identification was only at genus level and it is not logically to be concluded that the recorded organism would be the said species. In general, *Microcystis* is capable of producing large surface blooms through a combination of rapid division and buoyancy regulation by production of gas-filled vesicles. Their ability to regulate buoyancy is key to their dominance of eutrophic waters, by optimally positioning themselves within the photic zone in a stable water column; and because they can form large surface blooms, they are capable of out-competing other phytoplankton by essentially monopolizing light in the photic zone.

As for *Oscillatoria* spp., this genera is not known to be pathogenic, but some of its species are capable of secreting anatoxins and microcystins. Anatoxins are known to interfere with neuron signalling, while microcystins as previously described are known to cause liver bleeding.

Cell densities that were observed during the sampling were very relatively low as compared to areas where blooms of these organisms have been reported. However, the presence of these organisms should not be taken for granted and ignored, as their population be constantly monitored systematically during all project phases to prevent negative public health impact brought about by possible blooms of these species.

Dinoflagellates in this survey have been restricted to only two genera; *Ceratium* spp. with 20 cells/L (0.25% of total composition), and *Prorocentrum* spp. with 200 cells/L (2.53% of total composition). There are some species-specific organisms associated with these genera that are also known to be toxin carriers, however as previously stated, identification was only at the genus level and it is not conclusive to speculate that said genera would be the harmful ones. Conversely, these dinoflagellates are of great importance at the base of the food web, as they are sources of nutrients for larger organisms, and act as predators on smaller organisms such as diatoms.

As described, species-level identification of the mentioned genera was not feasible as it requires a more powerful microscope such as the Transmission Electron Microscope (TEM); but for monitoring purposes, the presence of these organisms should not be taken for granted and ignored, and always be considered as potentially harmful. Their population should be systematically monitored on a regular basis during all project phases to prevent negative public health impact brought about by possible blooms of these species.

Photomicrographs of dominant and common phytoplankton found in the survey area are shown in **Plate 2-6**.

Table 2-17. Phytoplankton composition, abundance (cells/L), and diversity in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

TAXA	SAMPLING STATIONS			Grand Total	Rel Abund
	PLK4 (UPSTRM)	PLK5 (MDSTRM)	PLK6 (DNSTRM)		
Blue-green Algae (2)	**220**		**20**	**240**	**3.03**
Microcystis	220			220	2.78
Oscillatoria			20	20	0.25
Diatoms (5)	**300**	**1,700**	**700**	**2,700**	**34.09**
Achnanthes		220	40	260	3.28
Chaetoceros		680	20	700	8.84
Melosira	100	300	220	620	7.83
Minidiscus	200	440	260	900	11.36
Skeletonema		60	160	220	2.78
Dinoflagellates (2)		**180**	**40**	**220**	**2.78**
Ceratium			20	20	0.25
Prorocentrum		180	20	200	2.53
Green Algae (2)	**1,760**	**420**	**2,580**	**4,760**	**60.10**
Pediastrum	1,720	300	2,480	4,500	56.82
Scenedesmus	40	120	100	260	3.28
Total Abundance (N)	**2,280**	**2,300**	**3,340**	**7,920**	**100.00**
Mean Abundance = 2,640					
Total No. of Organisms = 11					
Richness	**5**	**8**	**10**		
Mean Richness = 8					
Diversity (H')	**0.86**	**1.88**	**1.03**		
Evenness (I')	**0.53**	**0.90**	**0.45**		

Note: Genera and associated values highlighted in red characters indicate a potential bio-toxin agent

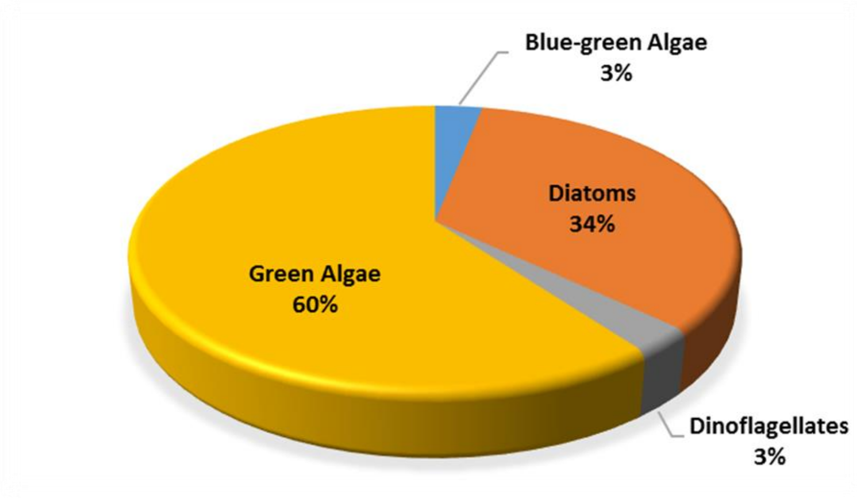


Figure 2-86. Percentage composition of major phytoplankton groups in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

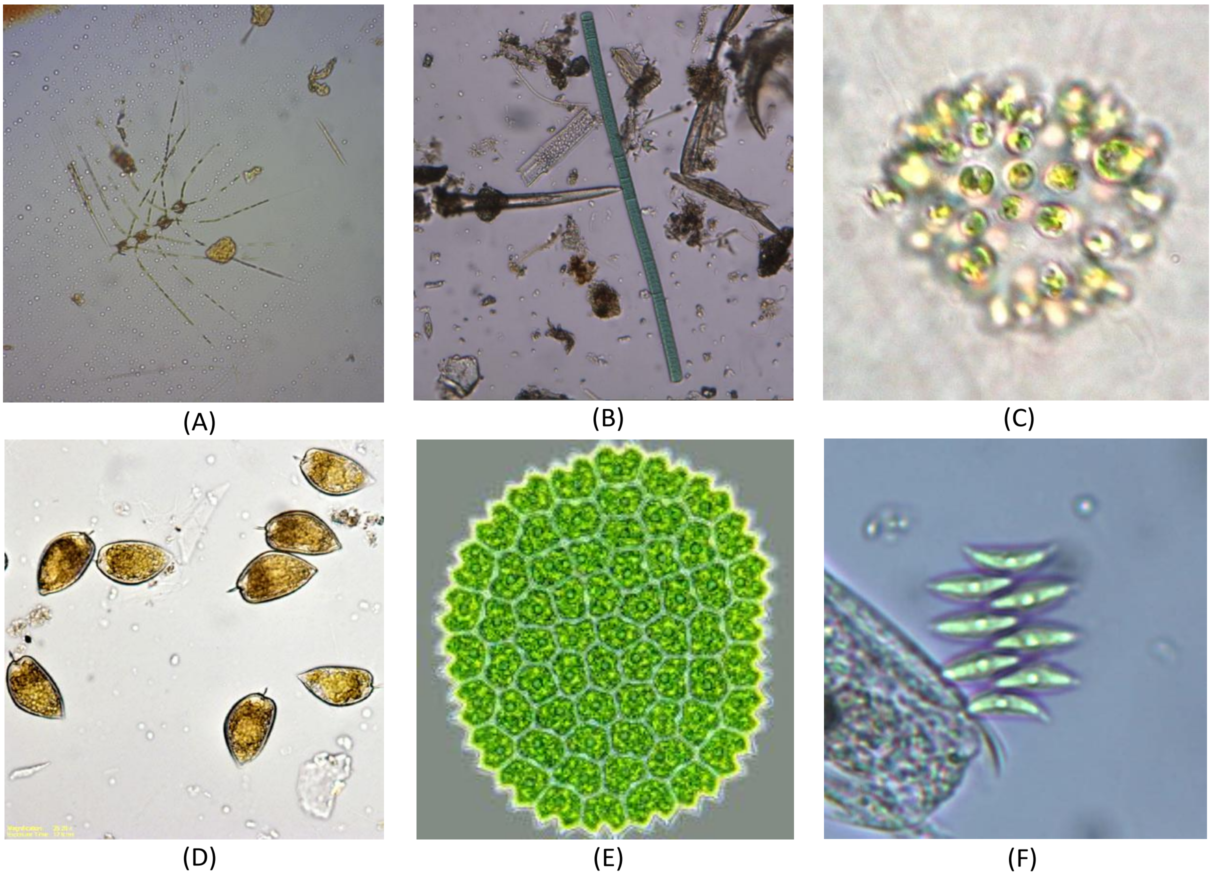


Plate 2-6. Photomicrographs of phytoplankton identified and recorded in three sampling stations along the Pasig River proximal to the BASECO Compound as RE results for the New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

Top: (A) Chaetoceros spp. (B) Oscillatoria spp. (C) Microcystis spp.; Bottom: (D) Prorocentrum spp. (E) Pediastrum spp. (F) Scenedesmus spp.

The mean cell density of all phytoplankton in the three sampling stations during this sampling period was 2,640 cells/L. In terms of spatial distribution, sampling station PLK6 had the relatively highest abundance with 3,340 cells/L, and also with the most taxa representation with 10 genera out of the total 11 documented. In contrast, the relatively lowest phytoplankton density at 2,280 cells/L and the lowest taxa representation with 5 recorded organisms was attributed to sampling station PLK4. (**Table 2-17** and **Figure 2-87**). The green algae, *Pediastrum* spp. was the dominant organism in sampling stations PLK4 with 1,720 cells/L and PLK6 with 2,480 cells/L.

Sampling station PLK6 is located at the downstream position approaching the estuarine area where the Pasig River and Manila Bay connects north of the BASECO Compound, while sampling station PLK5 is at the midstream position approximately 790m west of Delpan Bridge, and sampling station PLK4 is relatively proximal to the said bridge at approximately 67m east of the structure along the upstream position.

During this survey, the concentration for cell abundance as determined in sampling station PLK6 as compared to sampling station PLK4 may be due to the proximity to available nutrients by its distance from the compound where several organic and inorganic matter lay floating on the water surface and/or scattered along the shoreline, as well as the mixing of saline and brackish waters, and the possibility that the waters along sampling station PLK4 are so polluted that only the recorded genera have the resiliency to be tolerant to such conditions.

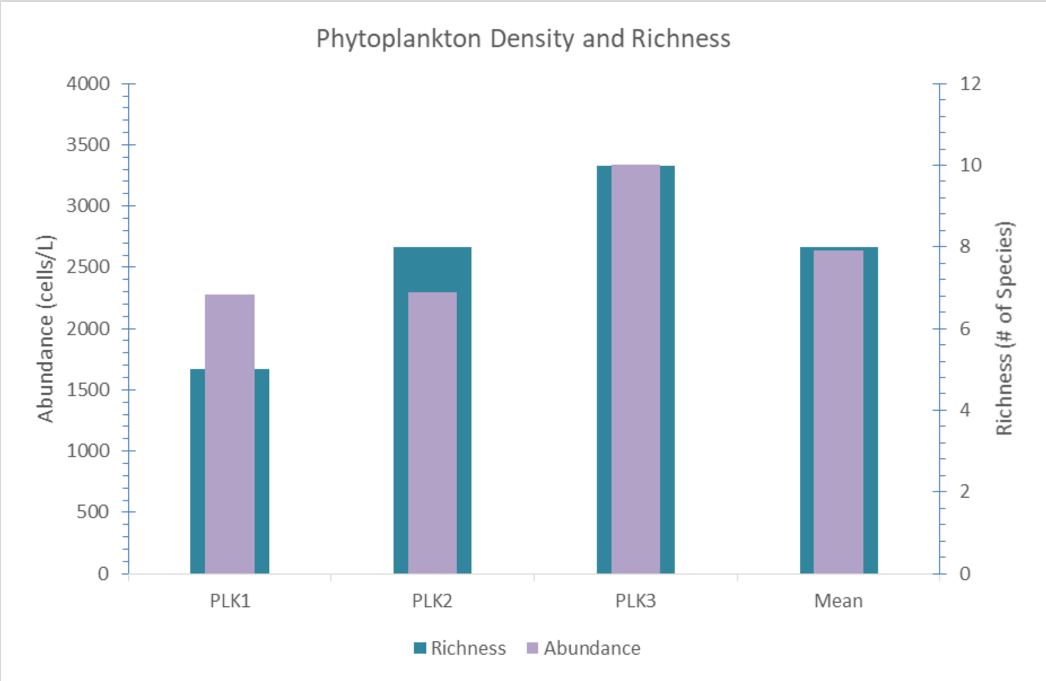


Figure 2-87. Total and mean phytoplankton abundance and richness recorded in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

In reference to **Table 2-17**, the diversity measurement based on the Shannon-Weiner Index is low (<2) in all sampling stations; revealing the relatively highest value of 1.88 attributed to sampling station PLK5, and the lowest diversity value of 0.86 determined to be at sampling station PLK4. In normal conditions for aquatic biota and the associated habitat, the diversity index value is more than 2.0. Values above 3.0 indicate that the habitat structure is stable and balanced, while values midway from 1.0 to 2.0 describe a threatened condition; furthermore, values lower than 1.0 indicates pollution and degradation of habitat structure (Goncalves and Menezes, 2011); the Diversity Index however, very rarely exceeds a 4.5 value.

In terms of evenness, the computed index among the three sampling stations was highly variable ranging with the highest at 0.90 in sampling station PLK5 to the lowest at 0.45 in sampling station PLK6. This indicates that the numbers of the phytoplankton community in sampling station PLK5 are not that relatively numerous to one another, and sampling station PLK6 is not evenly distributed with some genera overwhelmingly dominating as relative to others, which in this case is *Pediastrum* spp. as previously described. It should also be noted that sampling station PLK6 though having the lowest evenness value had the highest density of phytoplankton and the highest number of representative genera.

Phytoplankton abundance is highly variable and seasonal, but the diversity measurements in the two of the three sampling stations is indicative of stressful conditions caused by a disturbance which may possibly result from factors like high turbidity and eutrophication within the waters of the Pasig River along with its exposure to pollutants, which is unfavorable to the proliferation of pollution-tolerant phytoplankton organisms.

The overall impression from the results obtained in the phytoplankton sampling along the survey area is poor, with a low number of genera and cell densities; but should be taken into account - as reflected by the relatively low diversity values, as well as the inclusion of potentially harmful genera as recorded during the sampling period. The presence of these pollution indicator organisms should be considered in a system of periodic monitoring that should be mandatory implemented in all phases of the project.

2.2.4.2.2.2 Zooplankton Diversity

The zooplankton community diversity, abundance, and relative composition were determined in the same three sampling stations of phytoplankton (PLK4, PLK5, and PLK6) along the Pasig River as a primary impact area for the proposed site of the New Manila Reclamation Project in Manila Bay across the BASECO compound, City of Manila on 23 July 2018. As previously described, all sampling stations were set at pre-determined locations by GIS along the waters of the target river in order to assess and compare the microscopic biota contained within. These sampling stations are again in correlation to the ones set up along Manila Bay labelled PLK1, PLK2, and PLK3 corresponding to the same proposed project.

A total of 279,304 ind/m^3 distributed among eight zooplankton groups (in adult and larval forms) were quantified and recorded for all three sampling stations (PLK4-PLK6) featured in **Table 2-18** and as composed of the following:

- Copepods in adult forms; i.e., **calanoid** (2,666 ind/m^3), and **cyclopoid** (21,997 ind/m^3) - with a collective total of 24,663 ind/m^3 at 8.8% composition;
- Other adult forms such as: **arcellidae** = freshwater protozoans (7,999 ind/m^3) at 2.9% composition, **rotifers** (17,332 ind/m^3) at 6.2% composition, and **ciliates**, which is the most abundant group having 170,649 ind/m^3 at 61.1% composition;
- The larval forms of **bivalve veligers** (1,333 ind/m^3) at 0.5% composition, **nauplius**, which is the next most abundant group having 52,662 ind/m^3 at 18.9% composition; and **polychaete trocophores** (4,666 ind/m^3) at 1.7% composition.

Overall, the ciliates were the most dominant followed by nauplius larvae, copepods (collectively) rotifers, arcellidae, polychate trocophores, and other bivalve veligers (**Figure 2-88**).

Ciliates are protozoans (or protists) that are characterized by the presence of hair-like organelles called cilia. The presence of cilia as an organelle for locomotion and feeding was used as a means to classify these organisms from other protozoans, such as flagellates, amoeboids, and sporozoans. Although most ciliates are free-living and aquatic, such as the *Paramecium*, many are ectocommensals, dwelling harmlessly on the gills or integument of invertebrates, and some, such as the dysentery-causing *Balantidium*, are parasitic. These genera are not however exactly determined during the laboratory analysis of the water samples collected.

The nauplius larva is the first, free-swimming, planktonic larva of most marine and some freshwater crustaceans; having no evident segmentation but with only three pairs of appendages, the first and second antennae (used for swimming), and the mandibles; along with a single median eye in front of the head. As the nauplius feeds and grows, it gradually changes into the adult form -the body becomes segmented, or jointed, and additional limbs develop.

Copepods are the dominant members of zooplankton that serve as major food sources for fish and other aquatic life. Because of their smaller size and relatively faster growth rates, and because they are more evenly distributed throughout more of the world's aquatic forms, copepods almost certainly contribute far more to the secondary productivity of the world's oceans, and to the global ocean carbon sink than krill and perhaps more than all other groups of organisms together. As such, copepods have a significant role in grazing pressure on the phytoplankton community due to their very high density (Merrel and Stoeker, 1998).

Rotifers, which are found in many different types of water, including waste water, were mostly confined in sampling stations PLK4 and PLK5. Studies have shown that these organisms are beneficial in stabilizing organic wastes, stimulating microfloral activity and decomposition, enhancing oxygen penetration, and recycling mineral nutrients. Some industrial plants use rotifers and worms as an indicator as to when to increase the waste load since it means the sludge is getting older (http://www.environmentalleverage.com/Rotifer.htm).

Ecologically, these dominant groups serve as important links in marine food webs, serving as major grazers of phytoplankton, as components of the microbial loop, and as prey for ichthyoplankton and other larger pelagic carnivores (Turner, 2004).

Photomicrographs of zooplankton groups recorded in the survey area are shown in **Plate 2-7**.

Table 2-18. Zooplankton composition and abundance (ind/m^3) in three sampling stations along the Pasig River proximal to the BASECO Compound

as RE results for the New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

TAXA	STATIONS			Grand Total	Rel Abund
	PLK4 (UPSTRM)	PLK5 (MDSTRM)	PLK6 (DNSTRM)		
Adult forms (5)	**99,989**	**85,325**	**35,329**	**220,643**	**79.00**
Calanoid Copepod			2,666	2,666	0.95
Cyclopoid Copepod	2,666	16,665	2,666	21,997	7.88
Arcellidae	4,666	3,333		7,999	2.86
Ciliate	82,658	57,994	29,997	170,649	61.10
Rotifer	9,999	7,333		17,332	6.21
Larval forms (3)		**21,998**	**36,663**	**58,661**	**21.00**
Bivalve veliger			1,333	1,333	0.48
Nauplius		21,998	30,664	52,662	18.85
Polychaete trocophore			4,666	4,666	1.67
Total Abundance (N)	**99,989**	**107,323**	**71,992**	**279,304**	**100.00**
Mean Abundance = 93,101					
No. of Rep Groups = 8					
Richness (S)	**4**	**5**	**6**		
Mean Richness = 5					
Diversity (H")	**0.63**	**1.24**	**1.22**		
Evenness (I')	**0.45**	**0.77**	**0.68**		

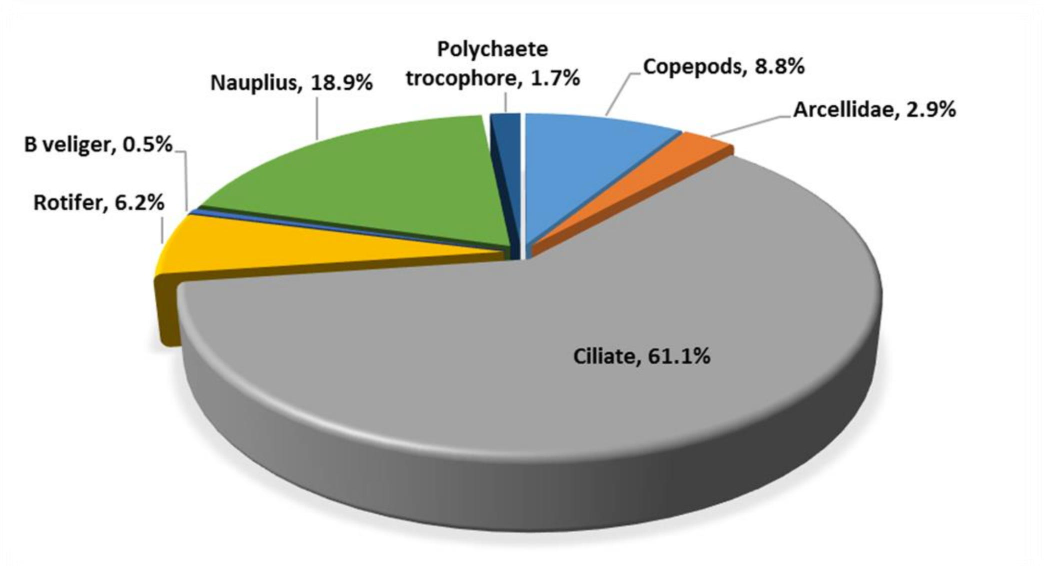


Figure 2-88. Percentage composition of major zooplankton groups in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

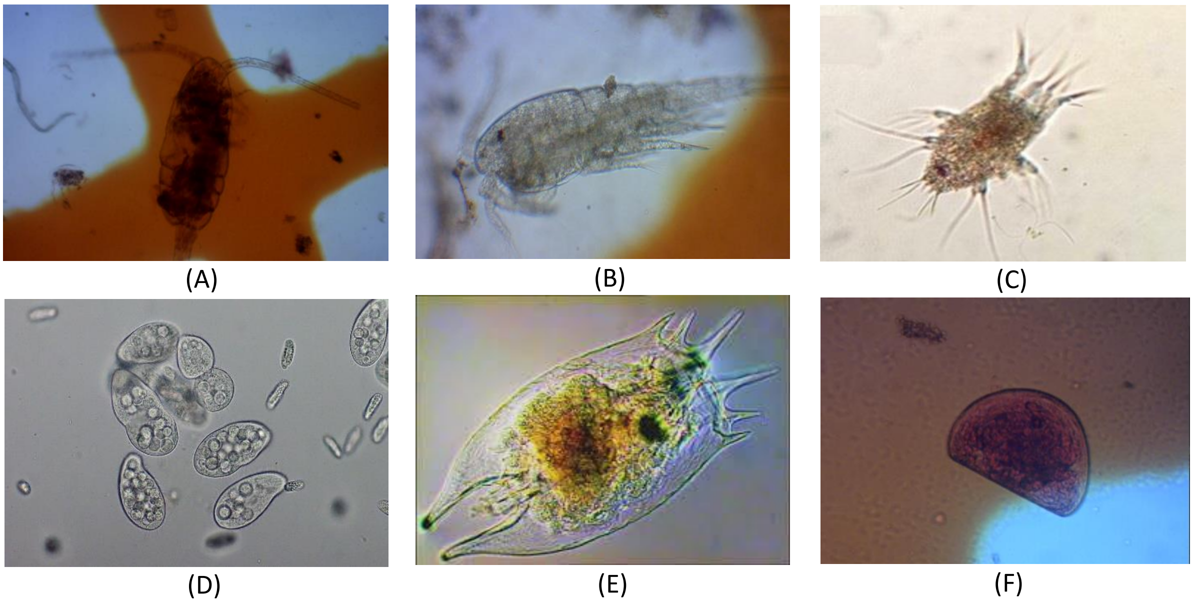


Plate 2-7. Photomicrographs of zooplankton identified and recorded in three sampling stations along the Pasig River proximal to the BASECO Compound as RE results for the New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

Top: (A) Calanoid copepod (B) Cyclopoid copepod (C) Nauplius copepod; Bottom: (D) Ciliates (E) Rotifer (F) Bivalve veliger

The mean estimate of abundance for the zooplankton community was 93,101 ind/m^3 recorded for all three sampling stations during this survey (**Figure 2-89**). In terms of spatial distribution, the most number of population counts is attributed to sampling station PLK5 with a density of 107,323 ind/m^3, as dominated by ciliates (57,994 ind/m^3). In terms of species richness, sampling station PLK6 had the highest record of six representative groups out the eight zooplankton groups identified.

In contrast, the relatively lowest zooplankton abundance at 71,992 ind/m^3 is attributed to sampling station PLK6; while the lesser representation in terms of species richness with four groups is attributed to sampling stations PLK4. In correlation to the results of the phytoplankton sampling, PLK4 also has the least cell density and also the least representative genera. This may be due to the displacement of the plankton communities caused by massive water movement by current and waves in which conditions are influenced by run-offs due to massive rains and floods in the past days before the sampling period, or that the waters along sampling station PLK4 are so polluted that only the recorded genera have the resiliency to be tolerant to such conditions as previously described.

As discussed in the phytoplankton section, sampling station PLK4 is relatively proximal to the Delpan Bridge at approximately 67m east of the structure along the upstream position, while sampling station PLK5 is at the midstream position approximately 790m west of the structure, and sampling station PLK6 is located at the downstream position approaching the estuarine area where the Pasig River and Manila Bay connects north of the BASECO Compound.

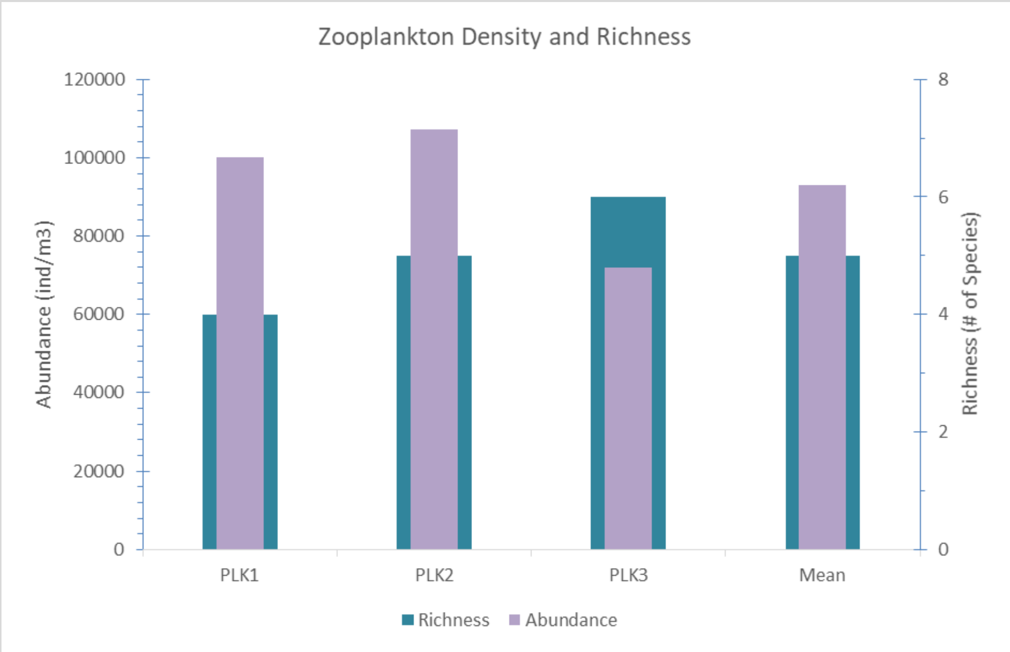


Figure 2-89. Total and mean zooplankton abundance and richness in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 23 July 2018.

In reference to **Table 2-18**, diversity measurements based on the Shannon-Weiner Index were again low (<2.0) in all sampling stations. The relatively highest value of 1.24 is attributed to sampling station PLK5, while the relatively lowest at 0.63 was determined to be at sampling station PLK4. As previously discussed in the phytoplankton section, diversity index values that are greater than 2.0 indicate normal conditions for aquatic biota and the associated habitat. Values above 3.0 indicate that the habitat structure is stable and balanced, while values midway from 1.0 to 2.0 describe a threatened condition; furthermore, values lower than 1.0 indicates pollution and degradation occurring in the habitat structure (Goncalves and Menezes, 2011); the Diversity Index however, very rarely exceeds a 4.5 value.

In terms of evenness, the computed indices for the three sampling stations was quite variable and low ranging with the lowest at 0.45 in sampling station PLK4 to the highest at 0.77 in sampling station PLK5 – which indicates an uneven distribution of the zooplankton community, due to the dominance of a particular group, which in this case are the ciliates present with high individual counts in all sampling stations.

It should also be noted that sampling station PLK4 aside from having the lowest diversity, also has the lowest evenness value, and the lowest number of representative groups. This is attributed to the absence of any larval forms that may have contributed to the amassed number of organisms.

The computed diversity and evenness indices indicate that the zooplankton communities in the area are low based on the Wilhm criteria (1975), classifying the diversity index <3.0 as low community stability. As an overall impression, the zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance during the time of survey.

Zooplankton are one of the most important biotic components influencing all the functional aspects of any aquatic ecosystem, such as food chains, food webs, energy flow and cycling of matter (Supritam pal et al.,2015). As an overall impression, the zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance for some groups during the time of survey. There are however no rare or endangered genera or groups in the sampled zooplankton community, and all are cosmopolitan in distribution worldwide.

The dominant plankton taxa catalogued in the freshwater ecology survey in the Pasig River is featured in **Figure 2-90**.

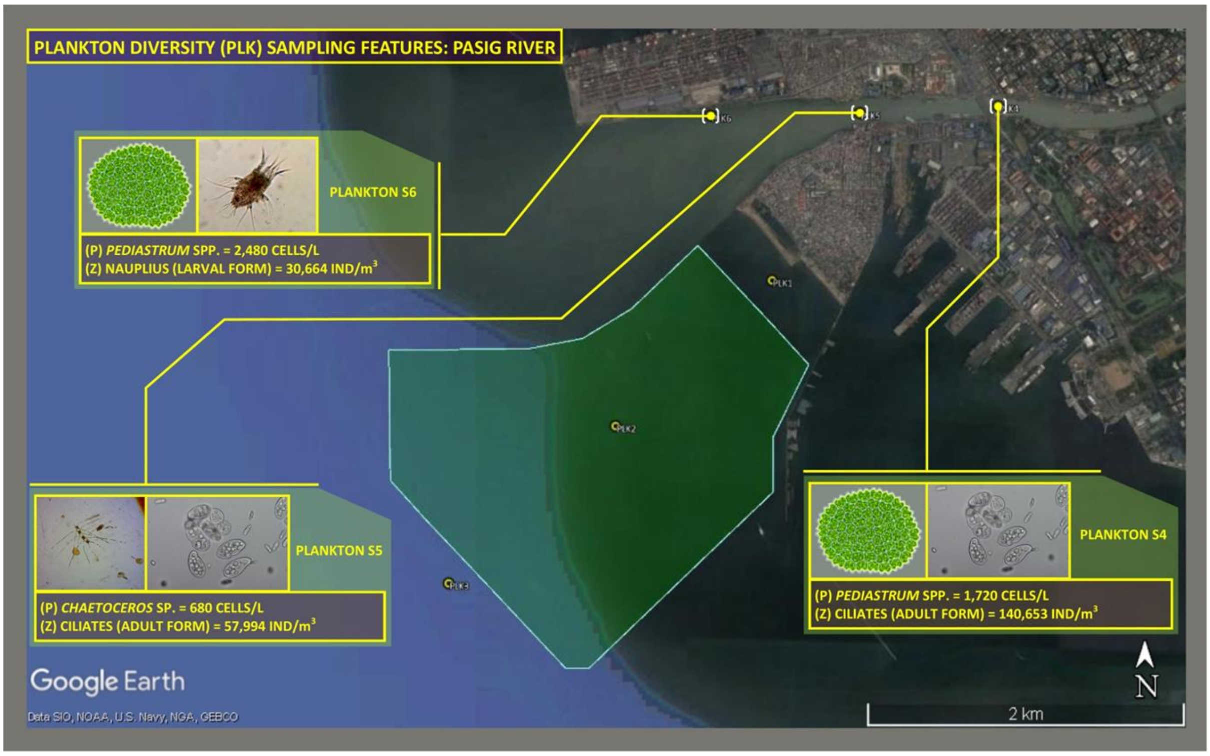


Figure 2-90. Dominant phytoplankton and zooplankton taxa catalogued in three sampling stations along the Pasig River proximal to the BASECO Compound during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 23 July 2018

2.2.4.2.3 Macrobenthos and Macro-invertibrates collected for food and trade

Communities of macrobenthos provide many ecosystem services that help to maintain good water and sediment quality. Filter feeders remove particles from the water column, which may result in enhanced water clarity. Given the importance of light in shallow water estuarine ecosystems, filter feeding may improve shallow water habitat for submerged aquatic plants and benthic microalgae. Accordingly, the changes in benthic species composition and abundances could aid as an alarm system and even allow the quantification of environmental alterations (Hutchinson, et.al, 1993). The macrobenthos survey in the Pasig River was conducted on 23 July 2018 covering three sampling stations in the same locations as the plankton sampling.

A total 727 individuals belonging to six (6) families/classes was identified across all survey stations. The macrobenthos recorded in this survey was represented by only (2) major phyla i.e Annelida and Mollusca. Phylum Annelida totally dominated the macrobenthos community accounting for 81% while phylum Mollusca only constituted for 19% (**Figure 2-91**). The polychaetes were the most family rich phyla which constituted nine (9) families. Among the polychaete families, the family Ciratulidae was the most abundant which accounted for 31%. Mollusks were represented by the family Ceritthiidae and Nassaridae. Oligochaetes also contributed significant number constituting for 25% of the total macrobenthic faunal count. They were collected in three stations within the river with abundance ranging from 45-91 ind/m3. They usually feed on detritus, using bacteria as a source of nutrients (Brinkhurst et al., 1972). Some species of this class are considered useful as sediment quality indicators, owing to their high tolerance of environmental risk factors, especially the toxic effects of metals and allochthonous pollutants (Marchese and Ezcurra de Drago, 1999). There are no edible nor economically important taxa recorded in this survey. The detailed composition, distribution diversity and abundance of microbenthic community for three stations sampled are shown in **Table 2-19**. Images of the most abundant representative macrobenthos taxa are shown in **Plate 2-8**.

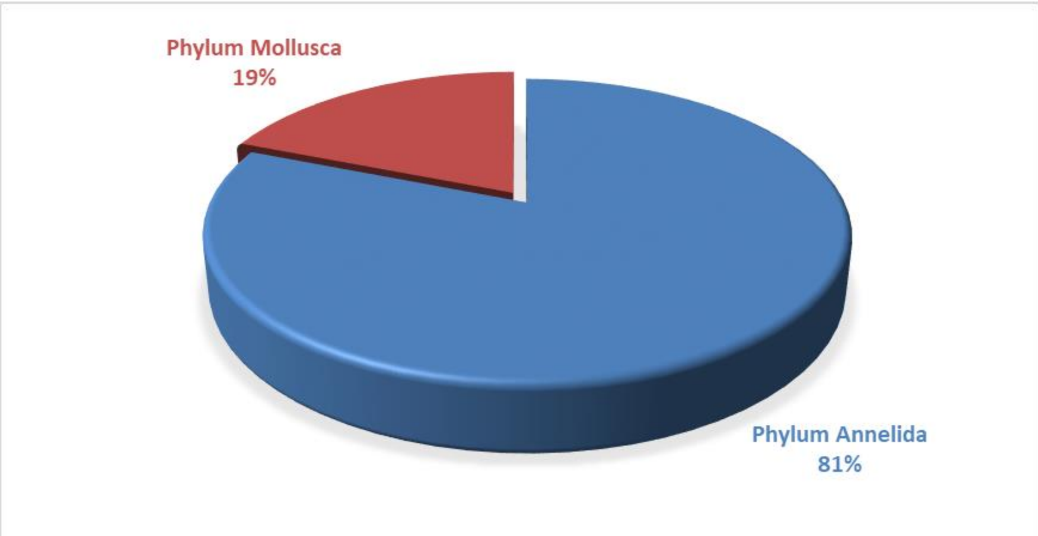


Figure 2-91. Percent composition of major benthic macroinvertebrates in three sampling stations in the Pasig River during freshwater ecology assessment in the proposed New Manila Reclamation Project, 23 July 2018.

Table 2-19. Macrobenthos composition, abundance and distribution in the three sampling stations in Pasig River during freshwater ecology assessment in the proposed New Manila Reclamation Project, 23 July 2018.

TAXA	STATION			Grand Total	Rel. Abund.
	BN4	BN5	BN6		
Phylum Annelida	**136**	**136**	**318**	**591**	**81**
Class Oligochaeta	**45**	**45**	**91**	**182**	**25**
Class Polychaeta	**91**	**91**	**227**	**409**	**56**
Family Ciratullidae			227	227	31
Family Nereididae	91			91	13
Family Phyllocolidae		91		91	13
Phylum Mollusca			**136**	**136**	**19**
Class Gastropoda			**136**	**136**	**19**
Family Cerithiidae			45	45	6
Family Nassaridae			91	91	13
Grand Total	**136**	**136**	**455**	**727**	**100**
Richness	**2**	**2**	**4**	**4**	**4**
Evenness (I')	**0.92**	**0.92**	**0.88**	**0.88**	**0.88**
Diversity (H')	**0.64**	**0.64**	**1.22**	**1.22**	**1.22**

The mean abundance in all survey stations was 1,061 ind/m^2. Spatially, the highest benthos concentration was collected in station BN3, the most offshore station with 2,500. It is also the most taxa rich station with 13. The most depauperate stations was collected in station BN4 and BN5, located in the river. These stations also recorded low abundance with 136 ind/m^2. Diversity based on Shannon-Wiener Index (H’) was low (<3) with the highest computed value in the BN6 with 1.22 while the lowest was computed in BN4 and BN5 with 0.64. The index of evenness based on Pielou’s Index (I’) was not so variable with values ranging from 0.88 to 0.92. The low abundance, diversity and richness in the stations collected in the river is indicative of poor sediments and water quality. Also, there were no edible nor economically important macrobenthos fauna sampled in the three stations during the river survey.

The highlights of dominant macrobenthos taxa catalogued in the freshwater ecology baseline assessment in the Pasig River is displayed.

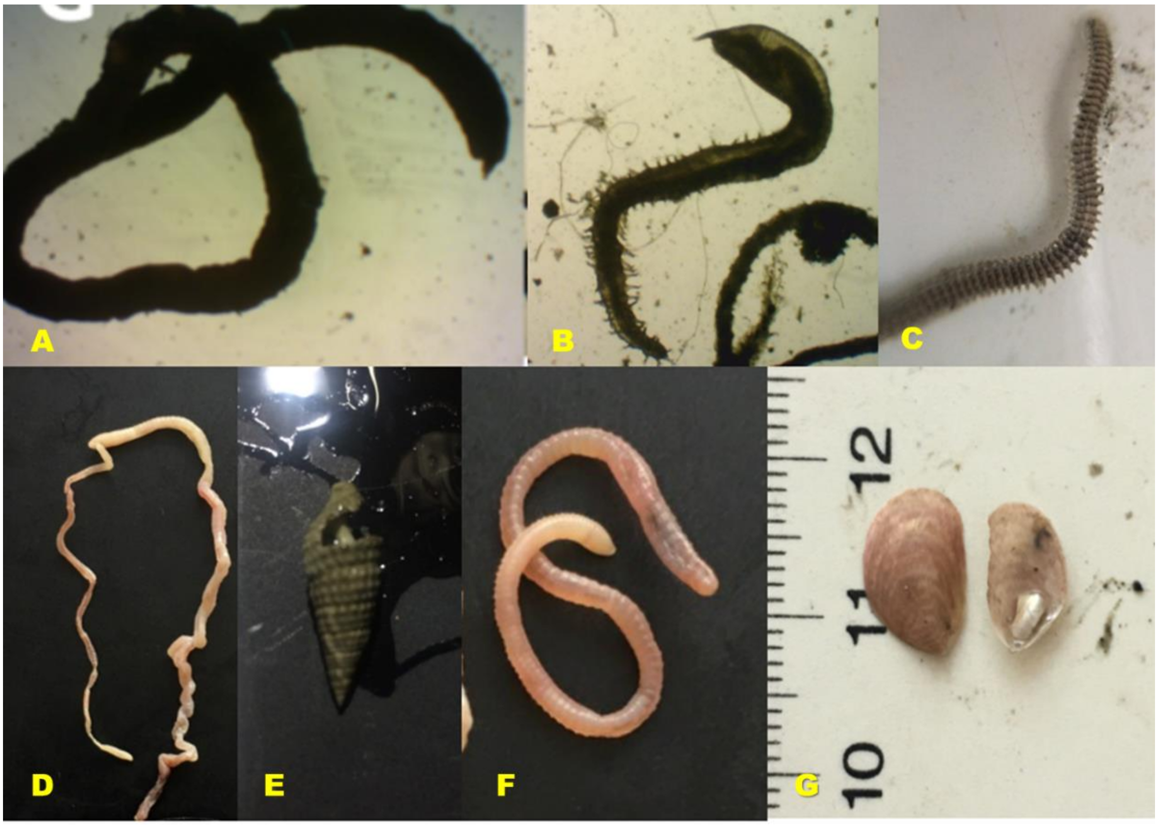


Plate 2-8. Images of some soft-bottom benthos taxa identified during the survey

(A) Capetillidae (polychaete) (B) Glceridae (polychaete) (C) Phyllodicidae (polychaete) (D) Nemertea (E) Cerithiidae (gastropod) (F) Oligochaete (G) Mytillidae (brown bivalve)

2.2.4.2.4 Commercially Important macro-invertebrates in Pasig River

Opportunistic survey for macro-invertebrates of commercial importance for food or trade was undertaken to supplement data on macrobenthos survey but no edible macro-invertebrates were encountered. In the submerged water lilies, the apple snail (*Pomacea canaliculata*) – considered an invasive gastropod – was found in a heap of trash where garbage scavengers were collecting plastic (**Plate 2-9**). In the rocky revetments of the Baseco breakwater, only swamp ceriths (*Tereblralia palustris)* and nerith shells (*Nerita costata)* were seen.

Plate 2-9. The invasive "kuhol" was the only macro-invertebrate found in a patch of water plants mixed with heaps of garbage near one to the river ecology stations.

Figure 2-92. Dominant macrobenthos catalogued in three sampling stations in the Pasig River during freshwater ecology assessment in the proposed New Manila Reclamation Project, 23-24 July 2018.

2.2.4.2.5 Fish Biota

According to key informants, fishing in not being undertaken in the Pasig River because the strong current carrying various solid waste materials oftentimes result to net damage and due to the presence of pest species of fish, particularly the knife fish and janitor fish (**Plate 2-10**). Nevertheless, the three test fishing operations in the Pasig River yielded six (6) species of brackishwater species dominated by the Tilapia (**Table 2-20**; **Plate 2-11**).

The catch per unit effort is modest but included pest species. The drag net in test fishing station 2 caught 5 kg of Tilapia fingerlings mixed with sardines (CPUE = 5 kg/hour), three (3) pcs Tilapia or Tikapia were caught in station 1 after 1 hour of fishing (CPUE: 0.6 kg/hour) and four (4) kg of Tilapia, carp and janitor fish in station 3 in 2 hours of fishing time (CPUE=2kg/hour).

The catch diversity is tabulated in **Table 2-21** and shown in **Plate 2-11**.

Plate 2-10. Pest fish species caught in the Pasig River – knife fish and janitor fish. Both emanates from Laguna Lake.

Table 2-20. Diversity of finfish caught during actual fishing documentation and key informant interviews in the three survey stations in the Pasig River during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

Family	Species Name	Local Name	Common Name	IUCN Red List Status
1. Gobiidae	*Glossogobiussp*	Biya	Goby	Not assessed
2. Anabantidae	*Anabas testudineus*	Puyo/Bakang	Gourami	Data deficient
3. Cichlidae	*Oreochromisnilotica*	Tilapia	Tilapia	Least concern
4. Cyprinidae	*Hypophthalmichthys nobilis*	“Imelda fish”	Bighead carp	Data deficient
5. Sardinella	*Sardinella melanura*	Lupoy	Blacktip sardinella	Least concern
6. Channidae	*Channa striata*	Dalag	Snakehead	Least concern

Plate 2-11. Diversity of finfish caught during actual fishing documentation and key informant interviews in the three survey stations in the Pasig River during freshwater ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018

Table 2-21. Diversity and catch per unit effort (CPUE) of finfish caught during actual fishing documentation in the Pasig River during freshwater ecology baseline assessment; July 2018.

Test Fishing	Gear used	No. of hours	Catch Species Composition	Yield	CPUE
1	Cast net	1	*Tilapia; Goby*	3 pcs ≈ 500 grams	.5 kg/hr
2	Drag net (salap)	1	*Tilapia, sardines, knife fish*	5 kg	5 kg/hour
3	Hook and line	2	*Oreochromis sp, Imelda fish", janitor fish, guorami*	4 kg.	2 kg/hr

2.2.4.3 Impacts and Mitigating Measures

2.2.4.3.1 Threat to existence and or loss of important local species and habitat

There were no rare or endemic zooplankton species recorded in the area and majority of the zooplankton groups are generally common and cosmopolitan in distribution. The invasive and predatory knife fish and janitor fish found in the Pasig River most probably crossed from Laguna Lake where they first appeared. Both species are not endemic to the Philippines but were introduced principally through the aquarium trade. None of the fish species catalogued are reported as threatened. In the same manner, none of the macrobenthos and fish species are listed in the IUCN's Red List, all of which were rated as either *'not assessed'* or *'least concern'.* There are no endemic plankton species catalogued in the three sampling stations.

2.2.4.3.2 Threats to abundance, frequency and distribution of species

2.2.4.3.2.1 Fish and Crustacean Species

The operation of the reclamation project poses no significant threats to the abundance of fish and crustacean stocks in the estuary of the Pasig River. In the first place, the current stocks are already low due to highly silted waters and almost anaerobic condition of the benthic river environment. There are no project impacts that would significantly alter breeding grounds and crustaceans, or impair fish feeding as project operations will not contribute to effluents already extremely present in the river. The anthropogenic issues that can cause a reduction in diversity and standing stock of finfish and crustaceans in the Pasig River estuary where they mostly occur will include wastewater contamination from many point sources, and predation of the highly invasive knife fish. Grazing of fish in the estuary will remain viable as sediments from reclamation activities are unlikely to add considerable silt to the existing silted and impaired condition of the river.

2.2.4.3.2.2 Planktons and macrobenthos

There are no major threats to the existence of plankton communities in the river arising from plant operations. Threats to the plankton community may be caused by the intrusion of fugitive sediments along the estuary of the river during low tide which can contribute to the already turbid conditions of the river. Immense amounts of sediments in the water column can reduce light penetration depth, and thus hampering photosynthetic activities of the phytoplankton and the grazing habits of zooplankton, as well as fish juveniles. However, it is important to note that these effects are relatively short-term once these mechanical activities has been completed, and measures have then been set to prevent further disturbance during regular operations. An increase in turbidity may be also caused by natural processes such as turbulent waves during typhoons and monsoons, regardless of such said activities in the area. In addition, most of the plankton species include toxic and cosmopolitan species. Plankton communities are however resilient, and its population could replenish from the relatively abundant plankton community located offshore or in adjacent areas due to advection as facilitated by water circulation, tidal forcing, and current systems in the water body. There may also be a replacement for niches from displaced plankton with the proliferation of existing tolerant organisms. It is therefore highly recommended to minimize the affected area of any turbid water that may be caused by pollutants or displaced silt/mud and sediments once the reclaimed land is formed. An efficient and periodic monitoring system should also be implemented in all phases of the planned project and its underlying activities.

2.2.4.3.2.3 Macro-invertebrates

There is no threat to mussel populations in the Baseco area as sediments from reclamation activities will be effectively controlled and is unlikely to reach mussel colonies. Moreover, mussels are mostly collected from the hulls of barges docked in the Baseco breakwater.

2.2.4.3.2.4 Presence of pollution indicators species

Plankton blooms are normally indicators of hyper-organic nutrient loading and have been documented to cause harmful algal blooms (HABs) in the Philippines. In many cases, increased nutrient loading through sediment transport has been observed to be a more likely pathway for occurrence of HABs in coastal areas but there are no records of river contamination from algal blooms. Currently, the densities of plankton groups observed in the three river stations investigated for plankton community structure do not indicate proportions that can risk the occurrence of HABs. However, at least three plankton taxa were identified in the samples that are known to be toxin carriers- *Microcystis* spp., *Ceratium* spp. and *Prorocentrum* spp. *Microcystis* spp. is a genus of freshwater cyanobacteria which includes the harmful algal bloom *Microcystis aeruginosa*. The cyanobacteria can produce neurotoxins and hepatotoxins, such as microcystin and cyanopeptolin. Blooms of this species specific organism can contaminate potable water with microcystin, which are known to cause liver bleeding. The latter two dinoflagellate taxa, on the other hand, include some species that are biotoxin carriers.

One pollution-tolerant genera observed in this survey is the blue-green algae *Oscillatoria* spp., that were found to occur in the downstream sampling station albeit in relatively small number. This genera is not known to be pathogenic, but some of its species are capable of secreting anatoxins and microcystins. Cell densities that were observed during the sampling were very relatively low as compared to areas where blooms of these organisms have been reported. However, the presence of these organisms should be constantly monitored

Macrobenthos makes up a large component of benthic community, and mediate the ecosystem processes such as the sediment decomposition (Covich et al 2004). Combined with their relatively sedentary lifestyles such as long life-cycles and poor mobility, macrobenthos respond to environmental changes via community-related variations including species composition, diversity, abundance, and biomass (Koperski 2010). Thus, macrobenthos commonly serve as useful bio-indicators for aquatic environment monitoring and assessment in river, marine and lake ecosystem. Epibenthic fauna (macroinvertebrates or macrobenthos), on the other hand, serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Macro-invertebrates are good integrators of environmental conditions over time and can be used as indicators of heavy metal pollution, especially sessile, filter-feeding macro-invertebrates. Shellfish species such as oysters and epibenthic bivalves can be utilized for biotoxin analysis, including detection of cyanide in bivalve tissue. However, the low diversity of epibenthic and infaunal benthos in the sampling areas already indicate a highly polluted and stressed riverine environment. Moreover, no population of bivalves and gastropods – except for the invasive “kuhol” - have been observed in all the river stations.

In the macrobenthos survey, the presence of nine (9) family taxa of polychaetes indicates an abnormal condition and these annelid worms normally suggest a highly polluted environment.

2.2.5 Marine Ecology

The New Manila Reclamation Project is proposed to be established in a 407.42-hectare inshore portion of Manila Bay southwest of the Baseco compound and about 1.5 kilometers southwest of the mouth of the Pasig River.

A comprehensive baseline assessment of the primary and secondary impact area of the proposed Project was conducted as part of the overall Environmental Impact Assessment (EIA) study associated with the establishment of the project. The survey was conducted in the broader coastal impact area of the proposed reclamation project as well as in the downstream section of the Pasig River in order to identify and describe occurrence of benthic habitats and ecological niches that may be present in the reclamation area, as well as associated ecosystem functions that can be susceptible to anthropogenic disturbances arising from the project. The characterization of susceptible benthic resources, if any are present in the impact area, will enable informed decision-making and provide valuable data from where mitigating measures can be drawn. Moreover, the baseline data set can provide a comparable index from where future monitoring data can be comparatively analyzed in order to distinguish impacts of the project and effectiveness of mitigating measures.

Essentially, the survey aimed to validate presence or absence of coral reef habitats or similar benthic life forms, other fragile ecological habitats and associated marine species of fish in survey pathways distributed across the entire reclamation area in order to identify whether such ecological components can be displaced or damaged by potential issues arising from the project’s activities. The sampling stations and survey pathways were guided withy GPS- referenced coordinates after preliminary analysis of maps showing the location of the reclamation site and its approximate boundaries.

In the last several years, various marine ecology baseline assessments have been conducted for similar reclamation projects, including the Manila Goldcoast reclamation project, the Manila Waterfront Reclamation project west of the proposed New Manila Reclamation Project, and the Navotas reclamation project northwest of the proposed site. Results from these studies, including those located in Pasay and Parañaque revealed the absence of coral reefs in a benthic environment comprised of thick silt, mud and fine grains of sand emanating from the metropolis and Pasig River. Nearshore areas of the Bay, including the proposed reclamation site, has been subjected to heavy deposition of sediments, domestic wastewaters and solid wastes wantonly disposed into Manila Bay or carried through canals from communities and slums in the city. In particular, coastal areas west and northwest of the Pasig River delta are viewed as major sinks for sediments resulting to decreasing depths in portions of near-shore seawater. Pre-survey interviews with local residents in Baseco confirmed that the nearshore areas are largely devoid of significant benthic communities and coastal waters are immensely turbid due to domestic wastewater and heavy sediment loading.

Plate 2-12. The proposed reclamation area taken from its outermost boundary (right); coastal area fronting the proposed reclamation (left).

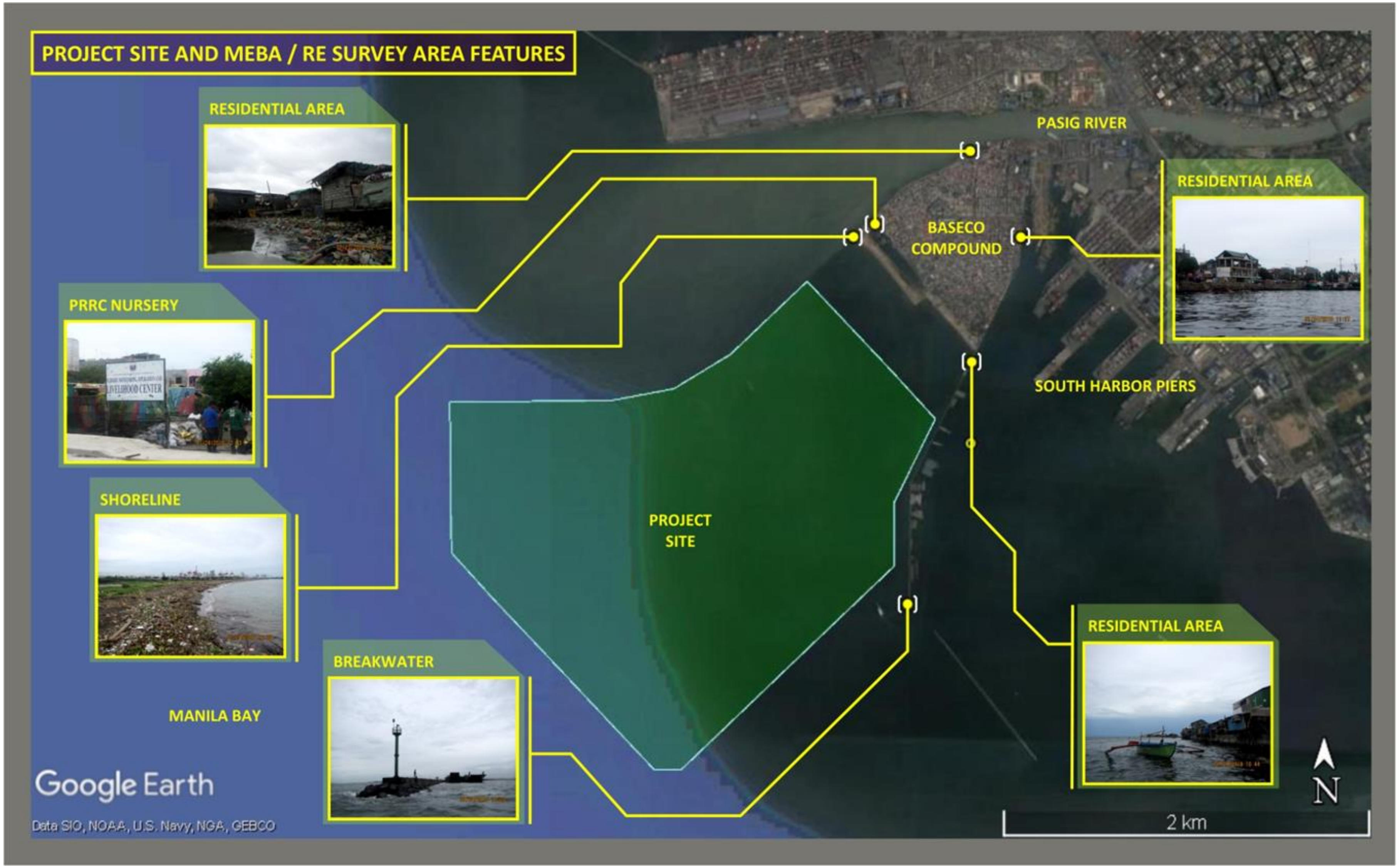


Figure 2-93. The proposed New Manila Reclamation Project in Manila Bay.

2.2.5.1 Methodology

Standard scientific survey methods prescribed in the marine survey manual formulated by *English, et. al*. (1997) was employed, but these modified due to the turbid waters in Manila Bay and the absence of corals and seagrass colonies. The scope of the assessment includes the following:

2.2.5.1.1 Validation of presence or absence of benthic life forms - corals and coral-associated fauna and define the nature of the benthic environment.

Two methods were employed to characterize benthic habitats, characterize the nature of the seabed and substrate, collect sample sediments and validate the presence or absence of coral life forms and associated benthic habitats:

a. *Broad area manta tows with tuck dives aided by underwater torch*

Manta tow surveys enable the observation of the benthic environment and substrate composition through systematic snorkeling over a broad swath of coastal area. Manta tow is the most common method used in describing large areas as it allows the observer to accurately observe and pinpoint diverse habitats and document unique ecological attributes that can be subjected to finer assessments along the tow pathways. Due to turbid waters, modified manta tows with 'tuck dives' using a torpedo buoy and aided by underwater torch was used to discern whether coral reef or its rugosity is present in shallow waters. In deeper waters, validation dives using scuba was employed. To the extent possible the entire stretch of nearshore shallow waters where the reclamation island is proposed to be located was subjected to intensive manta tows with tuck dives and scuba validation dives totaling twenty twenty-five (25) contiguous tows covering a linear distance of 6.4 km (**Table 2-22**). Benthic observations on the seabed during the manta tow observations also aimed to locate seagrass beds and macro algal colonies if they occur in the area, as well as document diversity of demersal fish aggregations if such resources are encountered.

Table 2-22. Manta tow track lengths and total tow distance surveyed during marine ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018

Track	Length (m)	Track	Length (m)
S00-T01	210	T13-T14	248
T01-T02	223	T14-T15	271
T02-T03	223	T15-T16	294
T03-T04	245	T16-T17	255
T04-T05	259	T17-T18	257

Track	Length (m)	Track	Length (m)
T05-T06	257	T18-T19	259
T06-T07	279	T19-T20	272
T07-T08	270	T20-T21	240
T08-T09	253	T21-T22	261
T09-T10	245	T22-T23	260
T10-T11	268	T23-T24	259
T11-T12	258	T24-T25	296
T12-T13	248		
Total Length = 6,410m ~ 6.4km			

b. *Spot Dives*

In as much as coastal waters in Manila Bay are turbid, the survey team undertook periodic validation/spot dives in order to confirm that no benthic fauna occur in the vicinity of the muddy substrates observed in the manta tow pathways. A total of six (6) spot/validation dives were completed (**Plate 2-13**). The spot dives involved the inspection of the benthic condition over a 10-meter diameter radius around the spot dive points. Coordinates of the spot dives are listed in

Table 2-23 below. In the same stations, the nature of sediment and substrate were documented and samples were obtained.

Table 2-23. Coordinates of spot dive stations and sediment collection for benthic substrate characterization in the proposed 407-hectare New Manila Reclamation Project in Manila Bay; July 2018.

WP Code	Latitude	Longitude	Remarks
SPD1	N 14.569322°	E 120.936312°	Survey conducted in a 10m radius from obtained coordinates. Substrate primarily DARK GRAY SILT=100%
SPD2	N 14.579317°	E 120.935661°	Survey conducted in a 10m radius from obtained coordinates. Substrate primarily DARK GRAY SILT=100%
SPD3	N 14.579743°	E 120.944152°	Survey conducted in a 10m radius from obtained coordinates. Substrate primarily DARK GRAY SILT=100%
SPD4	N 14.569200°	E 120.947316°	Survey conducted in a 10m radius from obtained coordinates. Substrate primarily DARK GRAY SILT=100%
SPD5	N 14.576875°	E 120.950039°	Survey conducted in a 10m radius from obtained coordinates. Substrate primarily DARK GRAY SILT=100%
SPD6	N	E	Survey conducted in a 10m radius from

WP Code	Latitude	Longitude	Remarks
	14.587884°	120.951522°	obtained coordinates. Substrate primarily DARK GRAY SILT=100%

Plate 2-13. Manta tows and spot dives being undertaken during marine ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

2.2.5.1.2 Fisheries and Fishing Practices

In the absence of significant demersal fish stocks in the proposed reclamation area due to absence of coral reefs and seagrass meadows, very few fishers, mostly in small 5-HP boats were seen operating in the area, employing small gill nets and spear. Gleaners were also collecting mussels in the 'north breakwater'. Unproductive fisheries has caused fishers with larger boats to fish farther offshore in the mouth of Manila Bay where frigate tuna, teraponids, nemipterids and sardines can still be caught. The fishing grounds are 0.5 to 2 km from the shoreline of the Baseco area locally called 'Gasangan". Fishers were also fishing with the use of handlines and poles in the rocky revetments in 'Gasangan" (please see **Plate 2-14**). Similarly, in the absence of reef-associated fish assemblages, identification of pelagic fish species present in the area at the time of survey was undertaken through boat-based opportunistic observations of species of fish along the survey pathways. Catch rate and catch composition were investigated through observation of actual catch landing of two fishers using bottom set gill net and an actual fishing operation using simple handlines was observed.

The details of actual fishing documentation listed in **Table 2-24**.

Table 2-24. Coordinates of actual fishing (AFS) catch documentation during the marine ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

WP Code	Fishing ground	Remarks
AFS1	Gasangan, (0.5 to 1.0 km from shoreline)	Name of fisher: Bernardino Arogante – age 38; Method of fishing: Bottom-set Gill net – no. 7 mesh x 25 mm monofilament nylon; Length – (15 banata)1,200 meters long; Fishing area:
AFS2	Fishing area: Gasangan / baras (0.5 to 2.0 km from shoreline)	Name of fisher: Ricky Ayade - age 30, married with 4 children – 15 years in fishing; method of fishing: bottom-set gill net no. 7 mesh x 25 mm mono filament nylon; Length – (8 Banata) or 650 meters long;
AFS3	Gasangan breakwater- N 14.573666°, E 120.955679°	Name of fisher: Mario Cahulugan; Hook and line fishing along the break-water dike; Spends 2 -3 hours fishing per day for food consumption; bait- small tahong/ mussel

Figure 2-94. Manta tow pathways surveyed during the marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay on 23-25 July 2018 (map by Jose Rene Villegas).

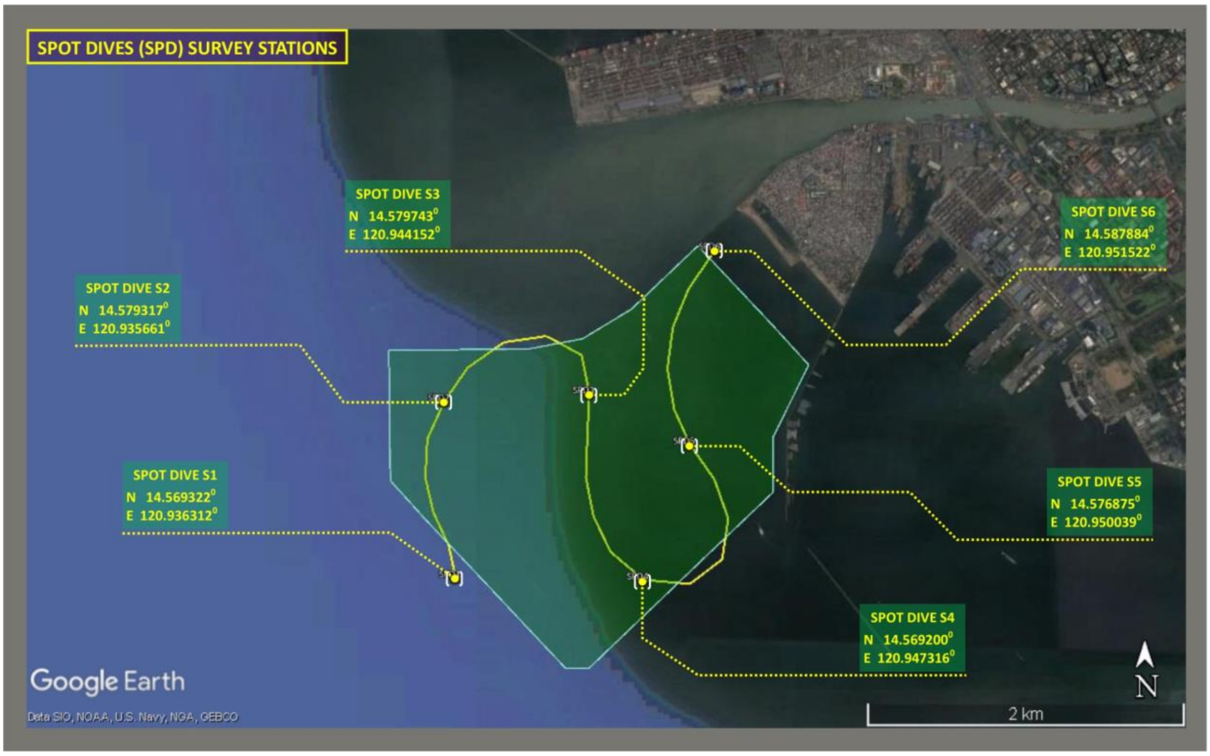


Figure 2-95. Location of spot dive stations surveyed during the marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay; 23-25 July 2018 (map by Jose Rene Villegas).

Figure 2-96. Location of actual fishing documentation during the marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay; 23-25 July 2018 (map by Jose Rene Villegas).

2.2.5.1.3 Plankton Community

Composition, abundance and density of phytoplankton communities was analyzed from water samples taken in three (3) stations spread out across the proposed reclamation area. Three other stations were sampled in the Pasig River which discussed separately in this report. Plankton samples were collected using a-20 μm plankton net with a mouth diameter of 0.3m (**Plate 2-14**). In every station, the plankton net was lowered at 1m and hauled at a rate of about 0.5m/sec. Duplicate samples of zoo- and phytoplankton were collected for each station and placed in properly labeled plastic containers. Phytoplankton samples were preserved with Lugol's solution, while samples of zooplankton were fixed with 10% formalin immediately after collection. For phytoplankton samples, a 1ml aliquot subsample was placed in a Sedgewick-Rafter cell counter and was examined under a Nikon Alphaphot II YS2 microscope. For zooplankton samples, a 1ml aliquot subsample was placed in a Petri dish with grids and examined under a microscope. Phytoplankton will be counted and identified to the lowest taxonomic level (genera) possible using standard taxonomic guide. Zooplankton will be identified to major groups using available references. Analysis of diversity and abundance was undertaken employing the Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics. Identification of harmful algal bloom-causing plankton (HAB) was undertaken in the UP MSI laboratory. The plankton station coordinates are detailed in **Table 2-25** and a map of station location.

Table 2-25. Coordinates of plankton sampling stations surveyed in the proposed New Manila Reclamation Project during marine ecology baseline assessment; July 2018.

WP Code	LATITUDE	LONGITUDE	Remarks
PLK1	N 14.586168°	E 120.954889°	Approx 160m offshore from the outermost shoreline of the BASECO Compound. Dominant phytoplankton *Dinophysis* spp. at 1,640 cells/L, while dominant zooplankton are nauplius larvae at 140,653 indiv/m^3
PLK2	N 14.577931°	E 120.945722°	Approx 1.5m offshore from the outermost shoreline of the BASECO Compound. Dominant phytoplankton *Dinophysis* spp. at 6,900 cells/L, while dominant zooplankton are nauplius larvae at 147,985 indiv/m^3
PLK3	N 14.569033°	E 120.935945°	Approx 2.9km offshore from the outermost shoreline of the BASECO Compound. Dominant phytoplankton *Peridinium* spp. at 600 cells/L, while dominant zooplankton are cyclopoid copepods at 88,658 indiv/m^3

Plate 2-14. Plankton sampling during marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay

Plankton sampling conducted (left); right photo shows a female fisher in the breakwater of Baseco compound 330 meters away from the boundary of the reclamation site.

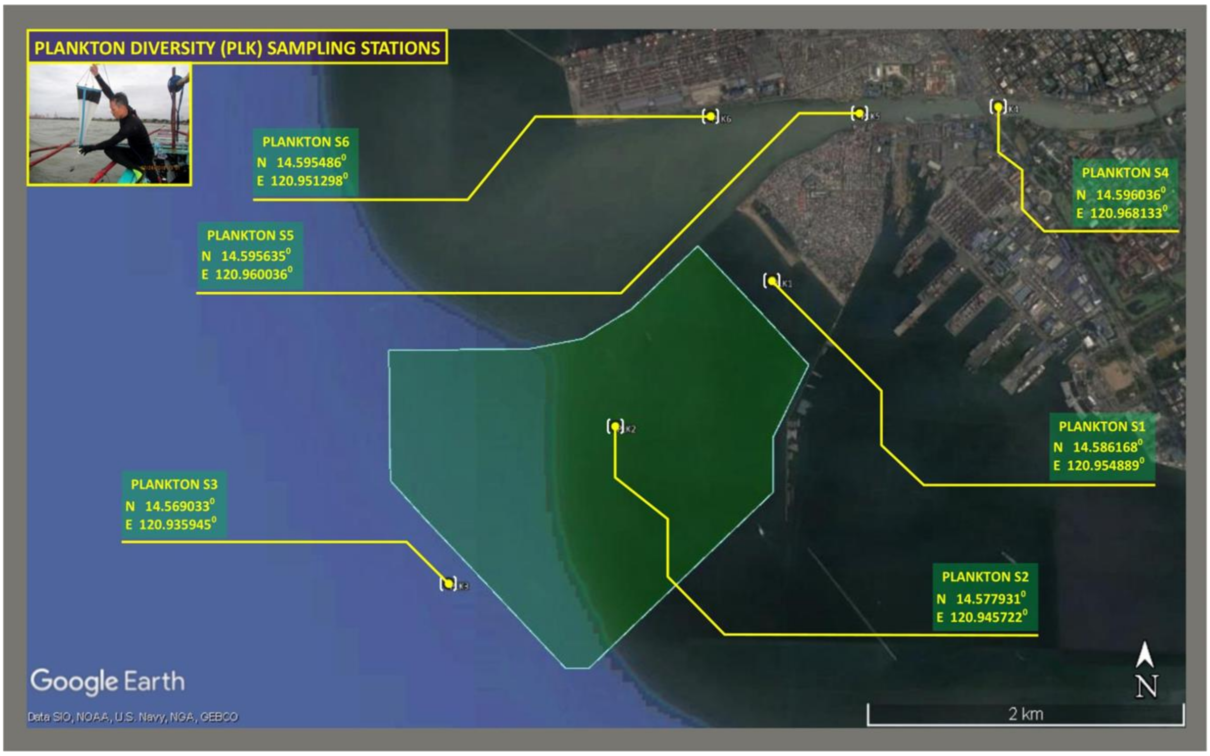


Figure 2-97. Location of plankton sampling stations
(together with river plankton sampling stations- stations 4, 5 and 6) surveyed during marine and river ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018 (map by Jose Rene Villegas).

2.2.5.1.4 Macrobenthos

Three benthos sampling station were investigated. Soft-bottom substrates are rich in dissolved nutrients, plankton, and organic debris, and under normal conditions, usually sustain large communities of in-faunal and benthic invertebrates. In many coastal areas, the bivalves and gastropods that inhabit such tidal flats provide an abundant food source (e.g. ark shells, spider shells) for the community through gleaning during ebb tides. Soft bottom benthos supports a diverse food chain in the demersal marine environment. Identification of benthic and epi-benthic soft bottom benthos was undertaken through grab sampling in four stations around the proposed project site and identification of animals was undertaken through coarse sorting *in-situ*. The location of the six (6) benthos sampling stations is shown in Figure 2-98 Station coordinates are listed in **Table 2-26**.

Table 2-26. Coordinates of sampling stations for macrobenthos communities surveyed in the impact area of the proposed New Manila Reclamation Project; July 2018.

WP Code	LATITUDE	LONGITUDE	Remarks
BNT1	N 14.586168°	E 120.954889°	Same location as PLK1. Total Density = 1,273 individuals with F Capetillidae (polychaete worms) dominant @ 364 individuals

WP Code	LATITUDE	LONGITUDE	Remarks
BNT2	N 14.577931°	E 120.945722°	Same location as PLK2. Total Density = 1,864 individuals with F Glyceridae (blood worms) dominant @ 500 individuals
BNT3	N 14.569033°	E 120.935945°	Same location as PLK3. Total Density = 2,500 individuals with P Nemertea (ribbon worms) dominant @ 500 individuals

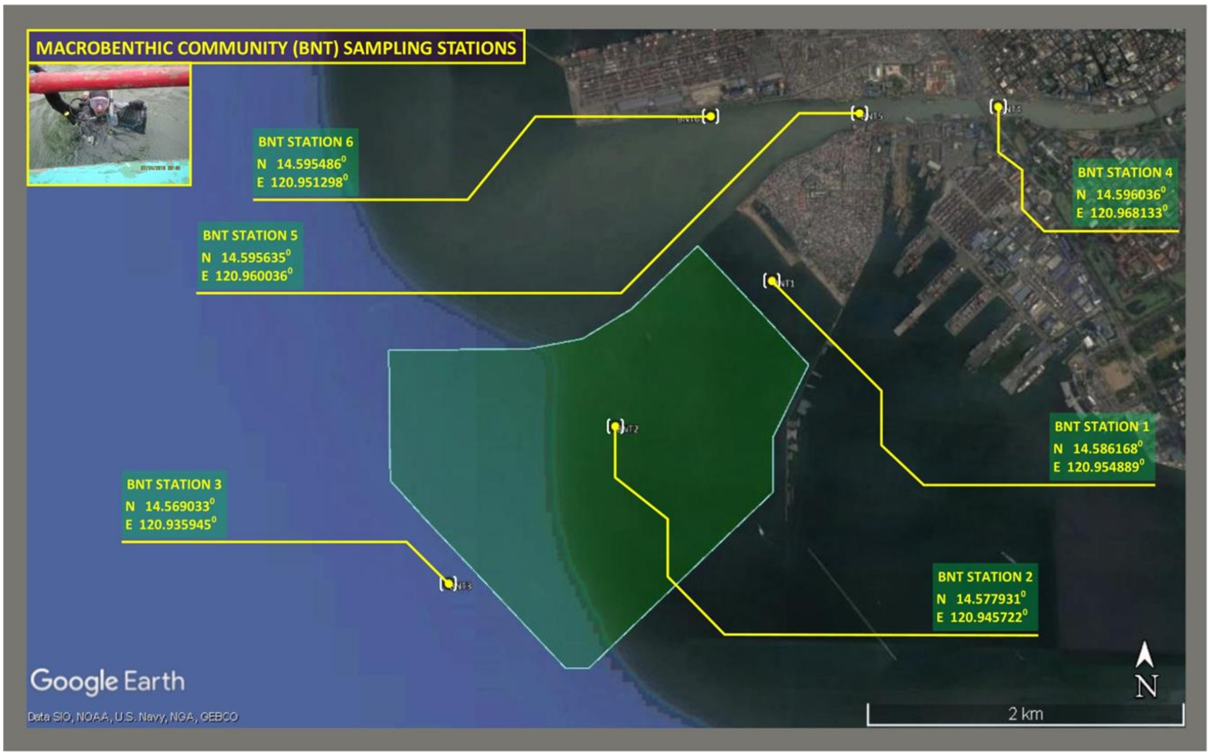


Figure 2-98. Location of benthos community sampling stations surveyed during marine ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

2.2.5.1.5 Macro-Invertebrates of commercial significance

Benthic and in-faunal invertebrates are usually found in inter-tidal flats, seagrass and coral substrates but these habitats do not exist in the nearshore area of Manila Bay close to the proposed reclamation project. However, the survey team encountered gleaners of mussels along the edge of rocky revetments in the western Baseco coastline, 330 meters from the proposed reclamation area. Mussels were the only species being collected. In the project site itself, no macro-invertebrates were encountered.

2.2.5.1.6 Seagrass and Associated Macrobenthic Algae

Manta tows and spot dives revealed absence of seagrass meadows in the muddy shelf in coastal waters inside the proposed reclamation site.

2.2.5.1.7 Mangroves

Two (2) mangrove reforestation areas are located in the coastline of Barangay 649, or what is more popularly known as “Gasangan”. The older site is about 10 meters long by 4 meters wide; the new reforested area is allegedly about 800 square meters. Mangroves are patchy and far between; with surviving trees measuring 1 to 1.5 meters in height. The species planted included *Rhizopora mucronata* and *Candelia candel* (**Plate 2-16**). Planted 2 years ago, it is noticeable that the growth of *Candelia candel* is stunted as it was introduced in the area compared to *Avicennia marina* that is an endemic species and used to be free-growing in the area. The mangrove areas, littered with trash from nearby communities, were too small to require detailed assessment. Both sites are nearly 1 km away from the boundary of the proposed reclamation site.

The location of the mangrove reforestation areas is mapped in **Figure 2-99**.

Plate 2-15. Mangrove reforestation area with sparse trees and stunted Candelia candel species in Barangay 649, Baseco, Manila.

Figure 2-99. Location of mangrove reforestation plots in the Baseco compound near the proposed New Manila Reclamation Project; July 2018 (map by Jose Rene Villegas).

Plate 2-16. Mangrove reforestation area with sparse trees and stunted Candelia candel species in Barangay 649, Baseco, Manila

2.2.5.2 Results and discussion

2.2.5.2.1 Benthic resources and substrate characterization

Corals and seagrass communities, including macro-algae and similar habitats were completely absent in the 6.5 kilometers of benthic observation pathways, spot dives, sediment collection and systematic snorkeling across the proposed reclamation area. The entire benthic environment is composed of thick mud and silt and fine sand mixed with trash (**Table 2-27**, **Plate 2-17**). Other associated benthic life forms that are normally tolerant of polluted conditions – sea pens, sponges and ascidians, have not been encountered in the exhaustive scuba underwater observations undertaken during the survey. Rocks, coralline boulders, or artificial reef structures were also absent in the entire proposed reclamation site. The spot dives and sediment collection in six stations revealed that the bottom substrate in the proposed reclamation site is comprised of loose silt and mud deposits, occurring in all areas investigated with scuba (**Figure 2-102**). Polluted and turbid waters, exacerbated by extensive sediment loading from the Pasig River, are among the causative factors that prevent settlement of corals and similar habitat types. Poor water quality and extremely turbid conditions is unlikely to support coral settlement and growth. In addition, the substrate in the sea bottom is smothered with thick silt and sediment deposits which are not conducive to anchorage of coral planulae and macro-algal communities, including seagrass. In a condition like this, settlement of coral recruits and seagrass cannot possibly occur.

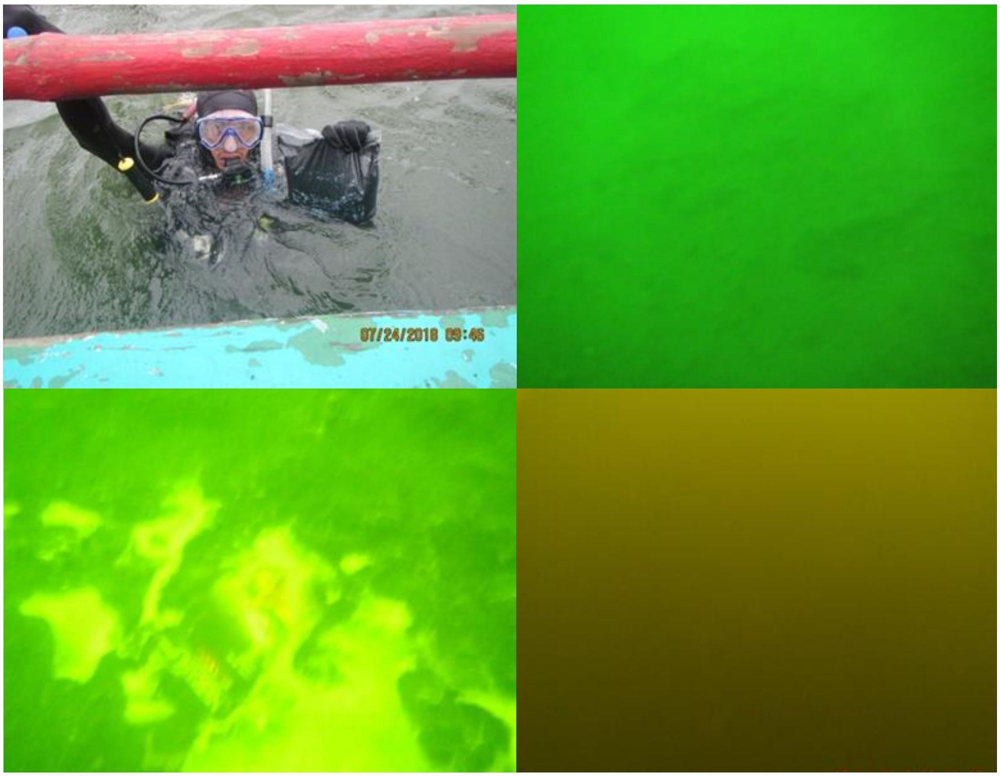


Plate 2-17. Extremely turbid waters blurry underwater photos of the bottom substrate in the proposed New Manila Reclamation Project

Top photo shows diver with “black” sediments collected in one of the spot dives images taken on July 2018 during marine ecology baseline assessment.

Table 2-27. Tabulated results of twenty-five (25) manta tow benthic life form and substrate investigations with spot dives and “tuck dives” undertaken during the marine ecology baseline assessment in the proposed New Manila Reclamation Project; July 2018.

Site name:	Offshore waters of Manila Bay southwest of BASECO Compound, City of Manila NCR	**Observers:**

Time / Date:		0922H-1346H / 24 July 2018					1. Ronald Pocon
Tow Speed:		4.0 kmh (ave)					2. Ernie Fontamillas
Visibility:		Varying from ±30cm					3. Rene Villegas
Weather:		Overcast with cloud layers					
Wave:		Strong rolling crests of approx. ±1.3m					
Current:		Varying from mild to lightly strong					
Tide:		Lowering (1.01m to 0.28m) as ref from Manila, Philippines Tidal Station (WXTIDE32)					
Water Temp:		Approx. ±28°C					
Wind Speed:		Beaufort Scale #2					
Cloud Type(s):		Nimbus Clouds					
Tow Coverage	**Location [DecDeg]**	**LHC**	**SC**	**DC**	**DCA**	**R**	**S**	**Remarks**
S00	N 14.569322° E 120.936312°	-	-	-	-	-	-	Start of Tow
S00-T01	N 14.571177° E 120.935902°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T01-T02	N 14.572998° E 120.935021°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T02-T03	N 14.574975° E 120.934540°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T03-T04	N 14.577185° E 120.934660°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T04-T05	N 14.579317° E 120.935661°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T05-T06	N 14.581216° E 120.937023°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T06-T07	N 14.582650° E 120.939145°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T07-T08	N 14.582999° E 120.941629°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T08-T09	N 14.581914° E	0	0	0	0	0	100	Predominantly dark gray silt and garbage

	120.943711°							
T09-T10	N 14.579743° E 120.944152°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T10-T11	N 14.577340° E 120.944032°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T11-T12	N 14.575014° E 120.943952°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T12-T13	N 14.572805° E 120.944392°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
Tow Coverage	**Location [DecDeg]**	**LHC**	**SC**	**DC**	**DCA**	**R**	**S**	**Remarks**
T13-T14	N 14.570790° E 120.945394°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T14-T15	N 14.569200° E 120.947316°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T15-T16	N 14.568968° E 120.950039°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T16-T17	N 14.570363° E 120.951922°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T17-T18	N 14.572650° E 120.952282°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T18-T19	N 14.574859° E 120.951481°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T19-T20	N 14.576875° E 120.950039°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T20-T21	N 14.578852° E 120.949118°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T21-T22	N 14.581178° E 120.948718°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T22-T23	N 14.583503°	0	0	0	0	0	100	Predominantly dark gray

	E 120.949038°							silt and garbage
T23-T24	N 14.585674° E 120.949959°	0	0	0	0	0	100	Predominantly dark gray silt and garbage
T24-T25	N 14.587884° E 120.951522°	0	0	0	0	0	100	Predominantly dark gray silt and garbage; End of Tow
Average Reef and Substrate Composition		**0**	**0**	**0**	**0**	**0**	**100**	

- *Tow points are expressed in Decimal Degrees WCS notation with reference to WGS84 Map Datum*
- *Reef and Substrate composition are expressed in (%) and described as follows:*

Live Hard Coral (LHC) - coverage of stony or hard corals on the bottom or part of the bottom
Live Soft Coral (SC) - coverage of soft corals attached to the bottom
Dead Coral (DC) - recently dead coral still attached and recognizable at the bottom in original upright position, color usually white with no living tissue
Dead Coral with Algae (DCA) - corallites still visible, skeletal structure can still be seen but algae dominate the structure (often appears greenish to brownish)
Coral Rubble/Rock (CR) - loose broken fragments of stony corals, consolidated hard bottom or large blocks of hard reef materials not attached or easily moved around sand/silt (s)

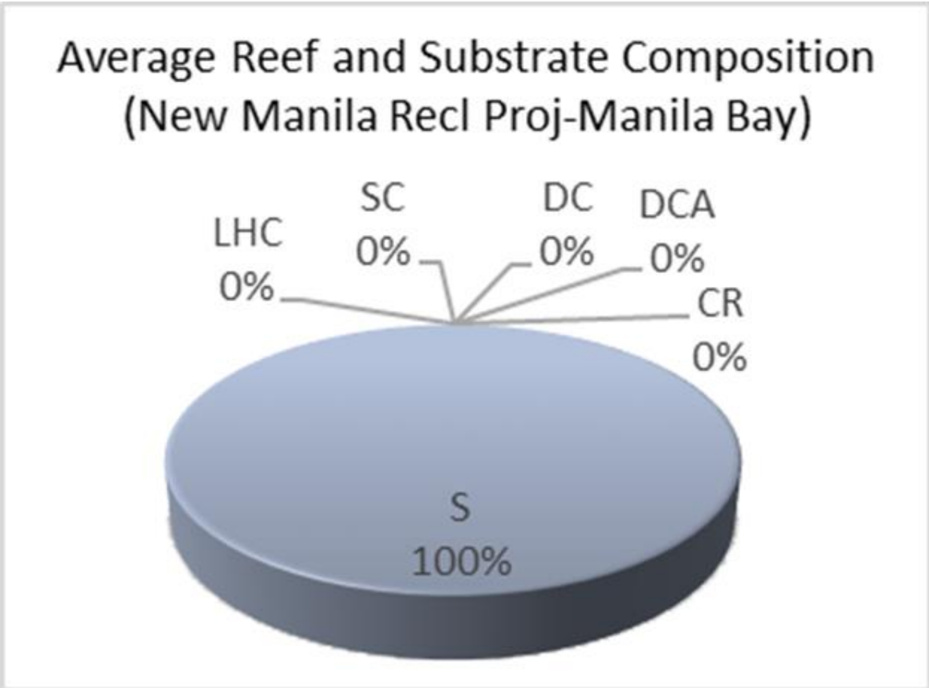


Figure 2-100. Results of twenty five benthic observation tows revealed complete absence of corals or other benthic habitats of similar nature in the proposed New Manila Reclamation Project.

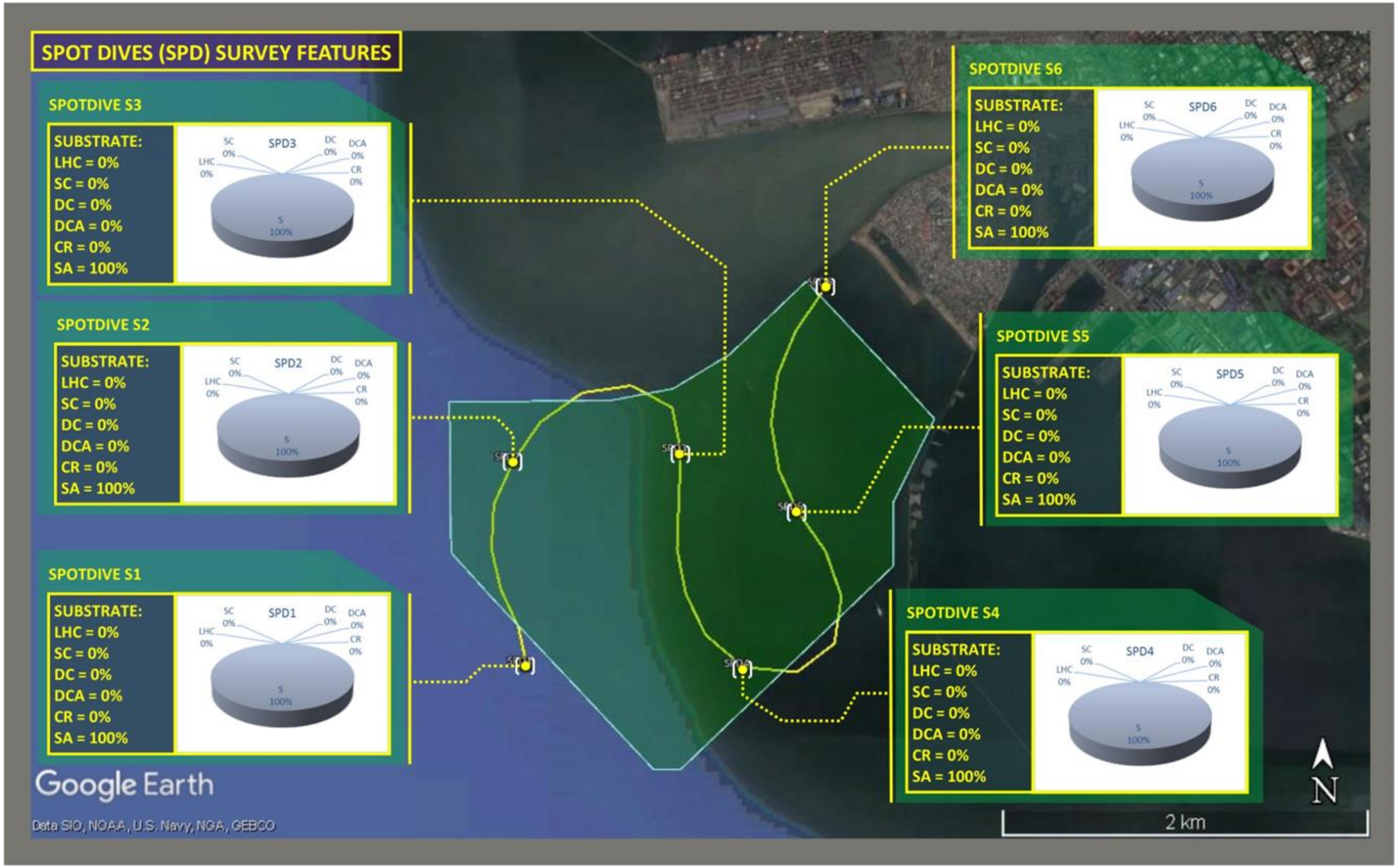


Figure 2-101. Results of spot dives for benthic observations in the proposed New Manila Reclamation Project in Manila Bay surveyed during the marine ecology baseline assessment in July 2018 revealed silt and mud across the entire reclamation project site; (map prepared by Jose Rene Villegas).

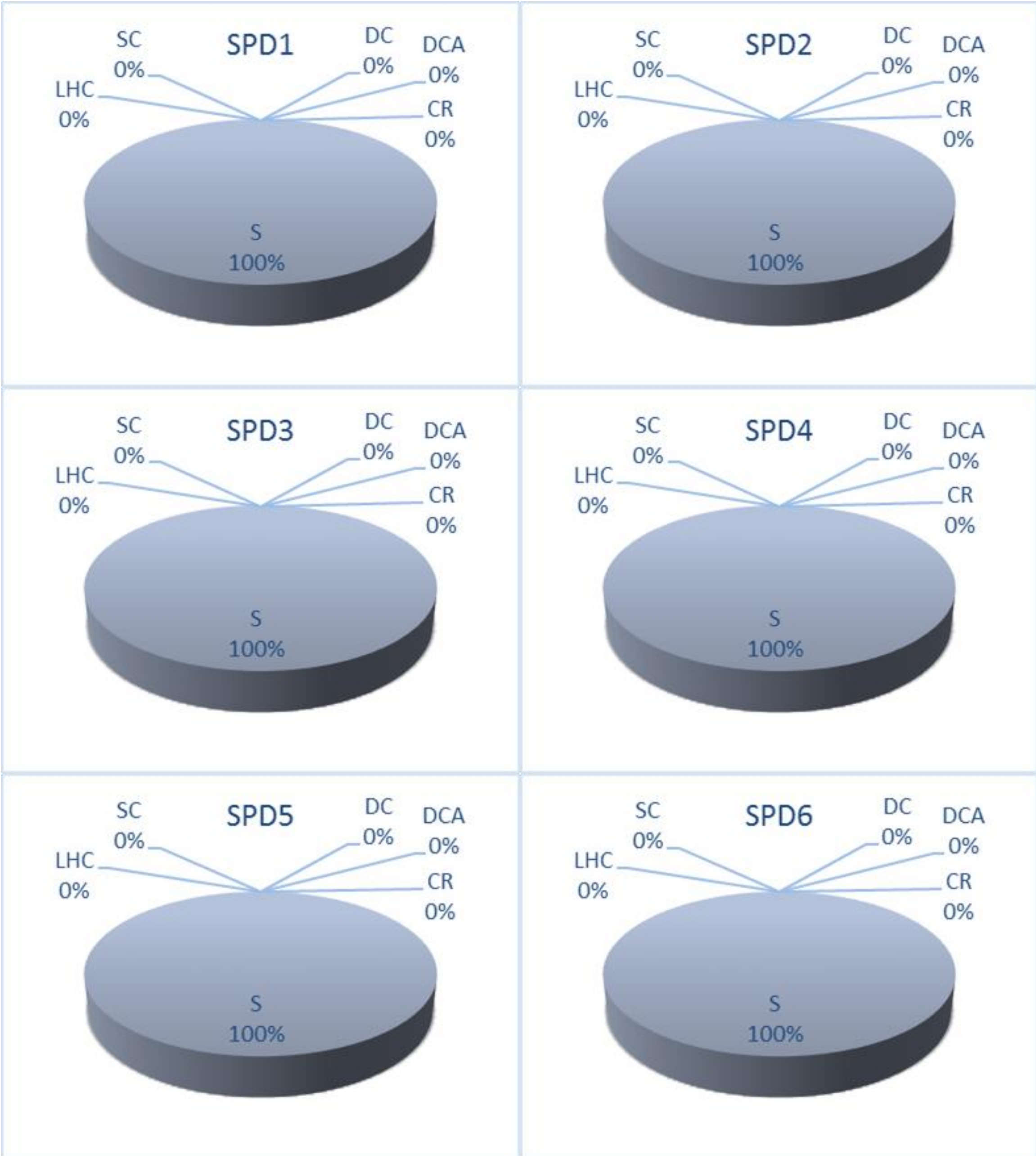


Figure 2-102. Results of spot dives and sediment collection in six stations in the proposed New Manila Reclamation Project in Manila Bay surveyed during the marine ecology baseline assessment on July 2018 show silt and muddy substrate in all stations

The same results were recorded in similar reclamation projects. Mud and silt were catalogued in all survey stations in the proposed New Manila Waterfront Reclamation Project south of the proposed New Manila Reclamation Project surveyed in September 2017) and in the proposed Navotas Reclamation Project surveyed in October 2017 where all manta tow stations exhibited mud and silt in the benthic environment.

Figure 2-103. Results of spot dives surveys in the proposed Manila Waterfront City Reclamation Project in Manila Bay surveyed during the EIA baseline assessment in September 2017.

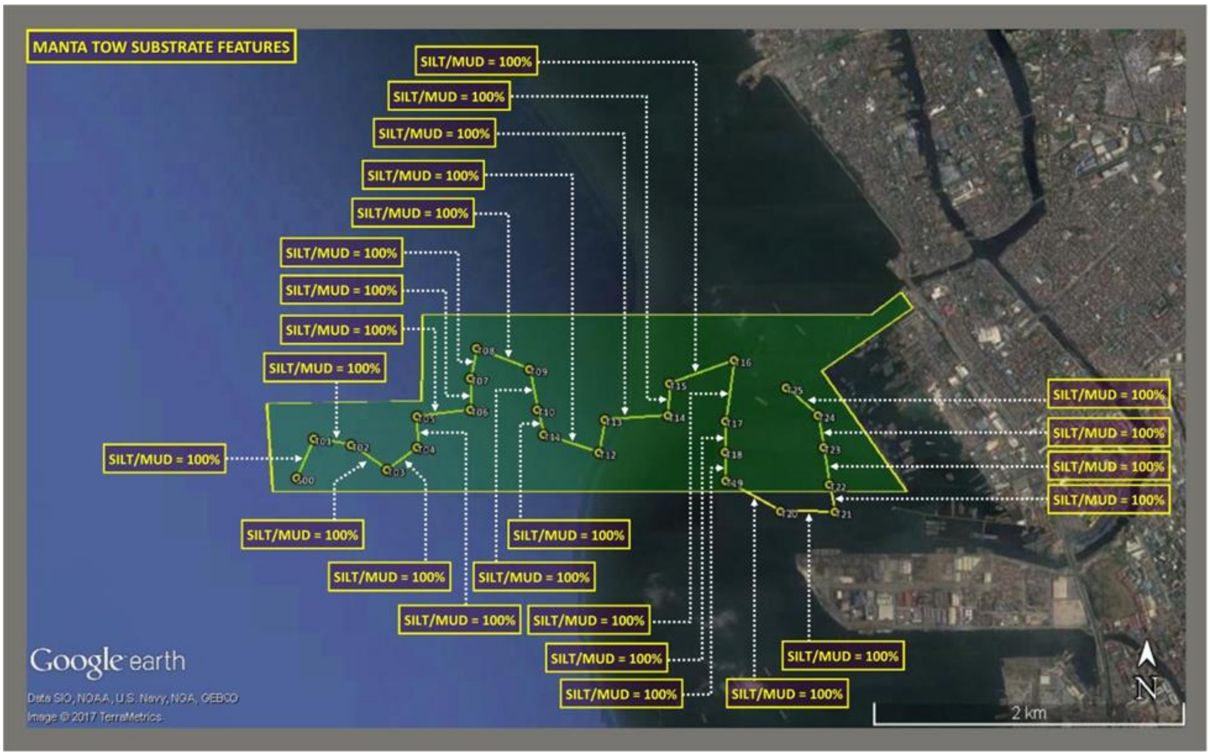


Figure 2-104. Results of manta tow surveys in the proposed Navotas Reclamation Project in Manila Bay surveyed during the EIA baseline assessment on October 2017.

2.2.5.2.2 Fish Communities and Species Richness

In the absence of coral reefs, fish visual census was no longer undertaken as no significant stocks of demersal fish species were encountered in the manta tows and spot dives. The absence of demersal fish species in the reclamation area and contiguous environs is an offshoot of the absence of ecologically important benthic habitats and ecosystem functions that can support a viable level of demersal fish population. However, observations of actual fishing catch landings indicate the presence of resilient target species of at least twelve (12) species of fish such as small trevally (*Carangidae*), teraponids (e.g., *Terapon jarbua*), mojarras (*Gerres filamentous*), and mullet (*Mugil spp*) which are normally found in brackishwater and feeds on detritus, small fish and zoobenthos. Sustenance fishing is also being undertaken in piled rocks in the Gasangan breakwater, 330 meters away from the reclamation site. Boat-based observations also point to the presence of small aggregations of pelagic fish, including sardines (*Sardinella spp*) and gizzard shad (*Anodontostoma chacunda).* Anecdotal accounts of fishers interviewed during the survey claiming declining catch rates are supported by fish production statistics reported by the Bureau of Agricultural Statistics on municipal fisheries production of top species caught in Manila Bay. In the six year period from 2008 to 2013, eight (8) out of fourteen (14) species of fish traditionally caught in the greater Manila Bay exhibit continuous regression. These include demersal species of breams, snappers and goatfish. Production of sardines however, shows a steady increase (*Philippine Statistics Authority (PSA); Fisheries Statistics of the Philippines, Volume 24, 2016*). The list of species commonly caught in fishing grounds allegedly 0.5 to 2 km from the shoreline of Baseco is presented in **Table 2-28** (also please see **Plate 2-18**). *All of the species caught are listed as either "not evaluated" or "least concern" in CITES.*

Table 2-28. Common fish species caught in Bacoor Bay as observed during marine ecology baseline assessment on 03 August 2017.

English name	Local name	Scientific name
Nile Tilapia	Tilapia	*Oreochromis nilotica*
Milkfish	Bangus	*Chanos chanos*
Flathead mullet	Banak	*Mugil cephalos*
Long-arm mullet	Aligasin	*Valamugil cunnessius*
Gizzard shad	Kabansi	*Anodontostoma chacunda*
Spotted mojarras	Latab	*Gerres filamentosus*
Rabbitfish	Danngit	*Siganus sp.*
Trevally	Talakitok	*Carangoides sp*
Spadefish	Kitang	*Scatophagus argus*
Sardines	Tamban	*Sardinella aurita*
Ponyfish	Sap-sap	*Leiognathus spp*
Common whiting	Asohos	*Sillago sihama*

Four (4) gear types are operated in the area, the most common are the spear fishing *(Pana)*, single handline *(Bingwit)*, bottom set encircling gillnet (*Pante palubog')* and fishing with the use of compressor for the collection of mussel (*Boso – an illegal method)*. The small pelagic species sardinella (*Sardinella aurita) or Tamban* and Flathead mullet (*Mugil cephalos) or Banak,* as well as the dominant fish Nile tilapia *(Oreochromis nilotica)* is the most common species occurring near the breakwater of Baseco. Catch rates of three groups of fishers documented as they were landing their catch in the Gasangan area indicate a modest level, shown in **Table 2-29**.

Table 2-29. Catch composition and catch per unit effort of fishers documented during catch landing in the Baseco area; July 2018

WP Code	Fishing gear/fishing ground	Average Catch rate fishing time	Catch Composition	CPUE
AFS1	Fisher KI: *Bernardino Arogante* – age 38; Method of fishing: Bottom-set Gill net length – 15 banata/1,200 meters long; Fishing area: Gasangan, (0.5 to 1.0 km from shoreline)	5 to 10 kg In 12 hours; Up to 25kg in peak season	mojarras, tilapia, mullet, milkfish, ponyfish, snapper, rabbitfish, theraponid, flying fish	0.833 kg/fishing hour/boat (lean season) 1.6 kg/fishing hour/boat (peak season)
AFS2	Name of fisher: *Ricky Ayade* - age 30, married with 4 children – 15 years in fishing; method of fishing: bottom-set gill net no. 7 mesh x 25 mm mono filament nylon; Length – (8 Banata) or 650 meters long; Fishing area: Gasangan / baras (0.5 to 2.0 km from shoreline)	3to 5 kg (lean); 8 to 20 Kg peak/"jackpot" 6 hours fishing time	tilapia, mullet, snapper, rabbitfish, theraponid, shark	0.66kg/fishing hour/boat (lean season) 2.33 kg/hour/boat (peak season)
AFS3	Name of fisher: *Mario Cahulugan*; Hook and line fishing along the breakwater dike; Spends 2 -3 hours fishing per day for food consumption; bait-small tahong/mussel	1 to 3 kg/3 hours	mojarras, tilapia, mullet, rabbitfish, theraponid, asohos	0.33 kg/fishing time in the Gasangan breakwater (no fishing boat)

Plate 2-18. Catch composition of small-scale fishers in the vicinity of the proposed New Manila Reclamation Project

TOP ROW, MULLET, MOJARRAS, PNYFISH; BOTTOM: CAVALLA, THERAPON, COMMON WHITING

2.2.5.2.3 Plankton Diversity

2.2.5.2.3.1 Phytoplankton Diversity

The phytoplankton community diversity, abundance, and relative composition were determined in three sampling stations (PLK1, PLK2, and PLK3) along the proposed site of the New Manila Reclamation Project in Manila Bay across the BASECO compound, City of Manila on 24 July 2018. All sampling stations were set at pre-determined locations by GIS along the marine waters in the said survey area in order to assess and compare the microscopic biota contained within.

Results of laboratory analysis revealed a total density of 20,740 cells/L belonging to 16 genera that were identified for all sampling stations. The phytoplankton community in the survey area is comprised of organisms from two major phytoplankton taxa: Bacillariophytes (diatoms) with 10 genera, and Dinophytes (dinoflagellates) with six genera as shown in **Table 2-30**. Dinoflagellates were the most abundant taxonomic group with a total count of 17,080 cells/L accounting for 82% composition; while the diatoms had 3,660 cells/L at 18% composition (**Table 2-30** and **Figure 2-105**).

The cosmopolitan dinoflagellate, *Dinophysis* spp., was the relatively abundant genera with 9,100 cells/L (44% of the total composition). Species of this genera are known to produce toxins that cause *DSP - Diarrheic Shellfish Poisoning (FAO, 2004)*. It is thus associated with “red tide” phenomena that results to mass mortality of fish in the Gulf of Thailand and Seto Inland Sea in Japan (Okaichi, 1967). In this survey, it was recorded with a relatively high abundance particularly in sampling station PLK2, which determines that its presence is permanently in the area since there were episodes of red tides that have occurred according to narratives from the residents. Fortunately, the highly toxic dinoflagellate, *Pyrodinium bahamense* var. *comppressum*, which is historically associated with Parasitic Shellfish Poisoning (PSP) responsible for cases of human mortality along the coastal area of Manila Bay was not recorded during the time of this survey.

Other dinoflagellates that contributed to the amassed volume of cell densities of this group are: *Ceratium* spp. (3,500 cells/L – 17% composition), *Peridinium* spp. (600 cells/L – 3% composition), *Prorocentrum* spp. (2,100 cells/L – 10% composition), *Protoperidinium* spp. (1,660 cells/L – 8% composition), and *Scrippsiella* spp. with 120 cells/L, having a 0.58% composition from the total population sample (**Table 2-30**). These dinoflagellates are of great importance at the base of the food web, as they are sources of nutrients for larger organisms, and act as predators on smaller organisms such as diatoms.

For the diatoms, the relatively abundant genera was *Pseudonitzschia* spp. with 1,100 cells/L (5.3% of the total composition). This chain-forming organism has some species that are known to produce domoic acid (DA) – a toxin associated with Amnesic Shellfish Poisoning (ASP). Currently, 51 species are known, 26 of which have been shown to produce DA. The direct impacts of species identification on public health make this a serious concern. Toxogenic and nontoxogenic species commonly co-occur; therefore, discrimination between various *Pseudonitzschia* spp. is imperative to determine the potential toxicity of an algal bloom. Optical microscopy identification techniques are inadequate when a large number of samples must be routinely examined, such as is required for a monitoring program for public health. Unlike certain dinoflagellate blooms, domoic acid-producing *Pseudonitzschia* spp. must be present in high concentrations (greater than 100,000 cells L^{-1}) to contaminate shellfish at a level that would cease harvesting. Sediment cores indicate a link between increasing coastal nutrient levels and an increase in *Pseudonitzschia* spp. blooms (ref: https://en.wikipedia.org/wiki/Pseudo-nitzschia).

Another significant diatom identified is another chain-forming genera, *Rhizosolenia* spp. This organism can also be found in marine and brackish water, while some species are also found in sediments. *Rhizosolenia* plays a significant role in the carbon, silica and nitrogen cycles in the oligotrophic seas. The increases of some species of *Rhizosolenia* are responsible for lowering the numbers of good phytoplankton in certain seas due to competition of nutrients. *Rhizosolenia* can also cause fish kills by clogging the gills with their hard silica exterior and from post-bloom anoxia. At the same time, live and dead cells of *Rhizosolenia* are used by bacteria and benthic animals for nutrients. Invertebrates cannot use them directly for nutrients because of the morphological structure of the cells.

Other diatoms that contributed to the amassed volume of cell densities of this group are: *Chaetoceros* spp. (80 cells/L – 0.4% composition), *Coscinodiscus* spp. (300 cells/L – 1.45% composition), *Guinardia* spp. (40 cells/L – 0.2% composition), *Leptocylindrus* spp. (240 cells/L – 1.2% composition), *Melosira* spp. (360 cells/L – 1.8% composition), Navicula spp. (300 cells/L – 1.45% composition), *Skeletonema* spp. (760 cells/L – 3.7% composition), and *Thallasionema* spp. with 180 cells/L, having a 0.9% composition from the total population sample (**Table 2-30**). Commonly found in warm tropical waters, these diatoms provide significant influences in the overall primary productivity in such marine environments. Furthermore, these are some of the major food source of filter-feeding shellfish, which are found along the coastal waters of Paranaque and Cavite, as well as in the 'North breakwater'.

For this survey, species-level identification of the mentioned genera was not feasible as it requires a more powerful microscope such as the Transmission Electron Microscope (TEM); but for monitoring purposes, the presence of these organisms should not be taken for granted and ignored, and always be considered as potentially harmful. Their population should be systematically monitored on a regular basis during all project phases to prevent negative public health impact brought about by possible blooms of these species.

Photomicrographs of dominant and common phytoplankton found in the survey area are shown in **Plate 2-19**.

Table 2-30. Phytoplankton composition, abundance (cells/L), and diversity in three sampling stations in Manila Bay across the BASECO Compound as MEBA results for the New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

TAXA	SAMPLING STATIONS			Grand Total	Rel. Abund.
	PLK1	PLK2	PLK3		
Diatoms (10)	**1,760**	**1,420**	**480**	**3,660**	**17.65**
Chaetoceros	40	40		80	0.39
Coscinodiscus	80	80	140	300	1.45
Guinardia	20	20		40	0.19
Leptocylindrus	120	120		240	1.16
Melosira	180	180		360	1.74
Navicula	260	40		300	1.45
Pseudonitzschia	440	660		1,100	5.30
Rhizosolenia	260	20	20	300	1.45
Skeletonema	260	180	320	760	3.66
Thallasionema	100	80		180	0.87
Dinoflagellates (6)	**4,820**	**10,360**	**1,900**	**17,080**	**82.35**
Ceratium	1,740	1,200	560	3,500	16.88
Dinophysis	1,640	6,900	560	9,100	43.88
Peridinium			600	600	2.89
Prorocentrum	420	1,500	180	2,100	10.13
Protoperidinium	900	760		1,660	8.00

TAXA	SAMPLING STATIONS			Grand Total	Rel. Abund.
	PLK1	PLK2	PLK3		
Scrippsiella	120			120	0.58
Total Abundance (N)	**6,580**	**11,780**	**2,380**	**20,740**	**100.00**
Mean Abundance = 6,913					
Total No. of Organisms = 16					
Richness	**15**	**14**	**7**		
Mean Richness = 12					
Diversity (H')	**2.12**	**1.45**	**1.70**		
Evenness (I')	**0.78**	**0.55**	**0.87**		

Note: Genera and associated values highlighted in red characters indicate a potential bio-toxin agent.

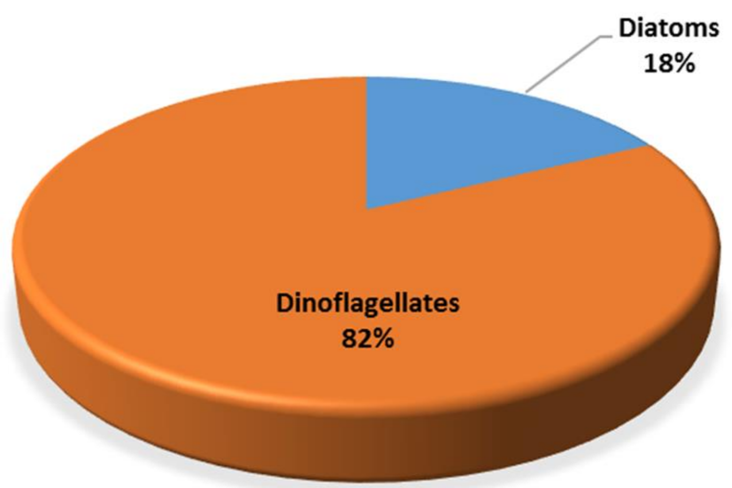
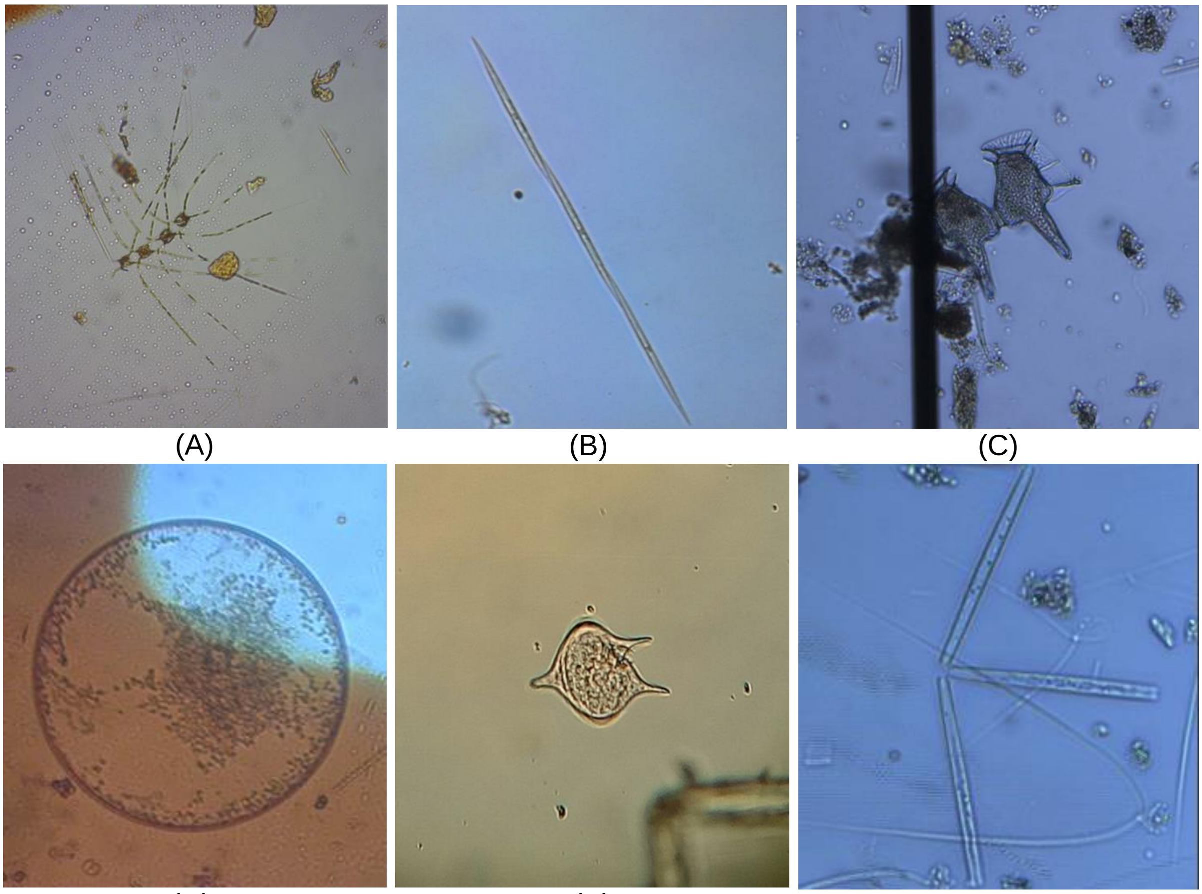


Figure 2-105. Percentage composition of major phytoplankton groups in three sampling stations in Manila Bay across the BASECO Compound as MEBA results for the New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.



(A) (B) (C)

(D) (E) (F)

Plate 2-19. Photomicrographs of phytoplankton identified and recorded in three sampling stations in Manila Bay across the BASECO Compound as MEBA results for the New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

Top: (A) Chaetoceros spp. (B) Pseudonitzschia spp. (C) Dinophysis spp.; Bottom: (D) Coscinodiscus spp. (E) Protoperidinium spp. (F) Thalassionema spp.

The mean cell density of all phytoplankton in the three sampling stations during this sampling period was 6,913 cells/L. In terms of spatial distribution, sampling station PLK2 had the relatively highest abundance with 11,780 cells/L, while the relatively most taxa representation was in sampling station PLK1 with 15 genera out of the total 16 documented. In contrast, the relatively lowest phytoplankton density at 2,380 cells/L and the lowest taxa representation with seven (7) recorded organisms was attributed to sampling station PLK3 (**Table 2-30** and **Figure 2-106**). The dinoflagellate, *Dinophysis* spp. was the dominant organism in sampling stations PLK1 with 1,640 cells/L and PLK2 with 6,900 cells/L.

Sampling station PLK2 is approximately 1.5 km from the outermost shoreline of the BASECO Compound while sampling station PLK1 is more proximal at 160 meters, and sampling station PLK3 is the relatively most offshore at approximately 2.9 km from the same reference point.

During this survey, the concentration for cell abundance as determined in sampling station PLK2 as compared to sampling station PLK3 may be due to the depth of the water and proximity to available nutrients by its distance from the compound where several organic and inorganic matter lay floating on the water surface and/or scattered along the shoreline.

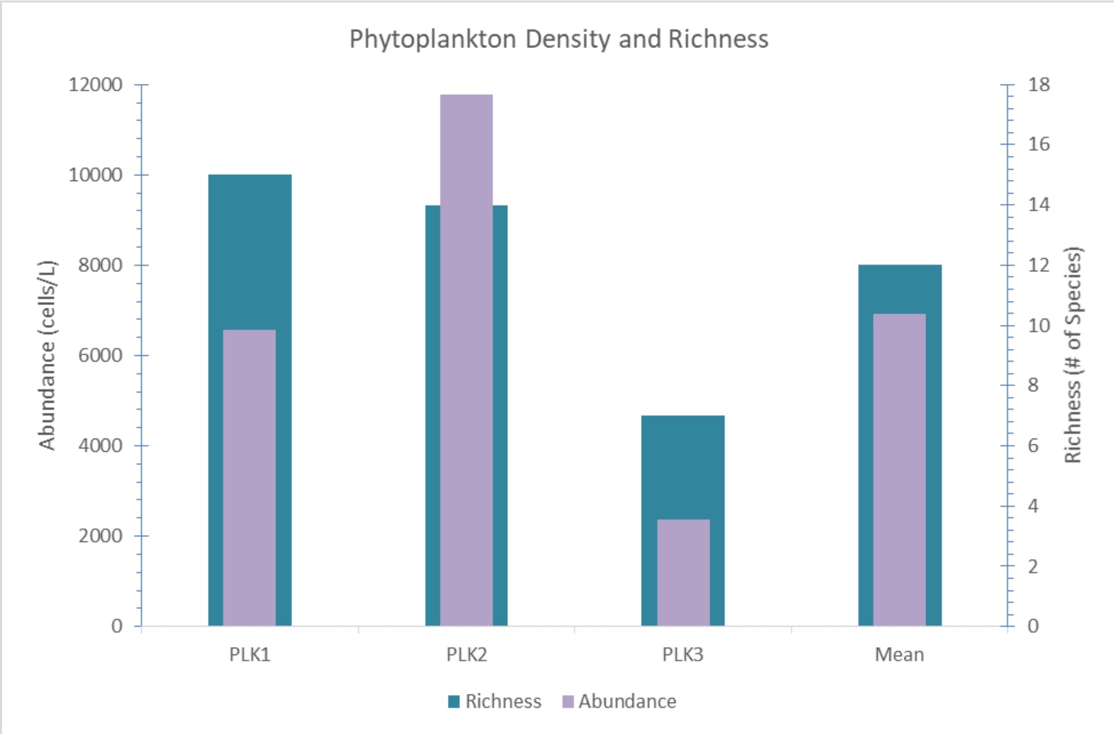


Figure 2-106. Total and mean phytoplankton abundance and richness recorded in three sampling stations in Manila Bay across the BASECO Compound during marine ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

In reference to **Table 2-30**, the diversity measurement based on the Shannon-Weiner Index is impressive (>2) in one sampling station; revealing the relatively highest value of 2.12 attributed to sampling station PLK1, and the lowest diversity value of 1.45 determined to be at sampling station PLK2. In normal conditions for aquatic biota and the associated habitat, the diversity index value is more than 2.0. Values above 3.0 indicate that the habitat structure is stable and balanced, while values midway from 1.0 to 2.0 describe a threatened condition; furthermore, values lower than 1.0 indicates pollution and degradation of habitat structure (Goncalves and Menezes, 2011); the Diversity Index however, very rarely exceeds a 4.5 value.

In terms of evenness, the computed index among the three sampling stations was variable ranging with the highest at 0.87 in sampling station PLK3 to the lowest at 0.55 in sampling station PLK2. This indicates that the numbers of the phytoplankton community in sampling station PLK3 are not that numerous to one another, and sampling station PLK2 is not evenly distributed with some genera overwhelmingly dominating as relative to others, which in this case is *Dinophysis* spp. as previously described. It should also be noted that sampling station PLK3 had the lowest density of phytoplankton and the lowest number of representative genera.

Phytoplankton are microscopic, free-drifting organisms that are found at the base of the food chain. They play a key role in the primary production and global nutrient cycles of the Earth (Daniel 2001) by making up the main producers in any given water body (Biddanda and Benner 1997). Phytoplankton communities are among the first group of organisms that respond to environmental changes and therefore their total abundance, composition and diversity are used as indicators of water quality (Reynolds et al. 2002; Brettum and Andersen 2005).

Phytoplankton abundance is highly variable and seasonal, but the diversity measurements in the two of the three sampling stations is indicative of stressful conditions caused by a disturbance which may possibly result from factors like high turbidity and eutrophication within the waters fronting the BASECO Compound, which is inversely favorable to the proliferation of pollution-tolerant phytoplankton organisms.

The overall impression from the results obtained in the phytoplankton sampling along the survey area is poor, with a low number of genera and cell densities; but should be taken into account - as reflected by the relatively low diversity values, as well as the inclusion of potentially harmful genera as recorded during the sampling period. The presence of these indicator organisms should be considered in a system of periodic monitoring that should be mandatory implemented in all phases of the project.

2.2.5.2.3.2 Zooplankton Diversity

The zooplankton community diversity, abundance, and relative composition were determined in the same three sampling stations of phytoplankton (PLK1, PKK2, and PLK3) along the proposed site of the New Manila Reclamation Project in Manila Bay across the BASECO compound, City of Manila on 24 July 2018. As previously described, all sampling stations were set at pre-determined locations by GIS along the marine waters in the said survey area in order to assess and compare the microscopic biota contained within.

A total of 729,926 ind/m^3 distributed among 13 zooplankton groups (in adult and larval forms) were quantified and recorded for all three sampling stations (PLK1-PLK3) featured in **Table 2-31** and as composed of the following:

- Copepods in adult forms; i.e., **calanoid** (117,988 ind/m^3), and **cyclopoid** (177,982 ind/m^3) - with a collective total of 295,970 ind/m^3 at 40.5% composition;

- Other adult forms such as: chaetognaths = arrow worms (2,666 ind/m^3) at 0.37% composition, **larvacean** tunicates (2,667 ind/m^3) at 0.37% composition, and **polychaetes** = marine worms (667 ind/m^3) at 0.09% composition - with a collective total of 6,000 ind/m^3 at 0.8% composition;
- The larval forms of **bivalve veligers** (15,998 ind/m^3) at 2.2% composition, copepod eggs (8,666 ind/m^3) at 1.2% composition, **gastropod veligers** (17,331 ind/m^3) at 2.4% composition, **medusae** (9,332 ind/m^3) at 1.3% composition, and **nauplius**, which is the most abundant group having 368,630 ind/m^3 at 50.5% composition;
- Other larval forms such as: ***Balanus* sp. (nauplius stage)** (3,333 ind/m^3) at 0.46% composition, **flatworm larvae** (3,333 ind/m^3) at 0.46% composition, and **polychaete trocophores** (1,333 ind/m^3) at 0.18% composition - with a collective total of 7,999 ind/m^3 at 1.1% composition.

Overall, the larval forms of nauplius were the most dominant followed by copepods (collectively) followed by gastropod veligers, bivalve veligers, medusae, copepod eggs, other larval forms, and other adult forms (**Figure 2-107**). No fish larvae were catalogued.

The nauplius larva is the first, free-swimming, planktonic larva of most marine and some freshwater crustaceans; having no evident segmentation but with only three pairs of appendages, the first and second antennae (used for swimming), and the mandibles; along with a single median eye in front of the head. As the nauplius feeds and grows, it gradually changes into the adult form -the body becomes segmented, or jointed, and additional limbs develop.

Copepods are the dominant members of zooplankton that serve as major food sources for fish and other aquatic life. Because of their smaller size and relatively faster growth rates, and because they are more evenly distributed throughout more of the world's aquatic forms, copepods almost certainly contribute far more to the secondary productivity of the world's oceans, and to the global ocean carbon sink than krill and perhaps more than all other groups of organisms together. As such, copepods have a significant role in grazing pressure on the phytoplankton community due to their very high density (Merrel and Stoeker, 1998).

The presence of gastropod and bivalve veligers correlate to the findings of the macrobenthos survey where samples of these mollusks have been recorded.

Ecologically, these dominant groups serve as important links in marine food webs, serving as major grazers of phytoplankton, as components of the microbial loop, and as prey for ichthyoplankton and other larger pelagic carnivores (Turner, 2004).

There were no rare or endemic zooplankton species in the area, and majority of the zooplankton groups are generally common and cosmopolitan in distribution. Likewise, no fish eggs and larvae have been recorded during the sampling period; however, the gastropod and bivalve veligers may be edible genera based on the results of the macroinvertebrate sampling.

Photomicrographs of zooplankton groups recorded in the survey area are shown in **Plate 2-20**.

Table 2-31. Zooplankton composition and abundance (ind/m^3) in three sampling stations in Manila Bay across the BASECO Compound as MEBA results for the New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

TAXA	STATIONS			Grand Total	Rel Abund
	PLK1	PLK2	PLK3		
Adult forms (5)	**102,656**	**75,993**	**123,321**	**301,970**	**41.37**
Calanoid Copepod	57,994	29,997	29,997	117,988	16.16
Cyclopoid Copepod	44,662	44,662	88,658	177,982	24.38
Chaetognath			2,666	2,666	0.37
Larvacean tunicates		667	2,000	2,667	0.37
Polychaete		667		667	0.09
Larval forms (8)	**161,983**	**167,317**	**98,656**	**427,956**	**58.63**
Balanus nauplius	2,666	667		3,333	0.46
Bivalve veliger	5,999	4,666	5,333	15,998	2.19
Copepod egg		8,666		8,666	1.19
Flatworm larvae			3,333	3,333	0.46
Gastropod Veliger	7,999	3,333	5,999	17,331	2.37
Medusae	4,666	2,000	2,666	9,332	1.28
Nauplius	140,653	147,985	79,992	368,630	50.50
Polychaete trocophore			1,333	1,333	0.18
Total Abundance (N)	**264,639**	**243,310**	**221,977**	**729,926**	**100.00**
Mean Abundance = 243,309					
No. of Rep Groups = 13					
Richness (S)	**7**	**10**	**10**		
Mean Richness = 9					
Diversity (H")	**1.28**	**1.21**	**1.43**		
Evenness (I')	**0.66**	**0.53**	**0.62**		

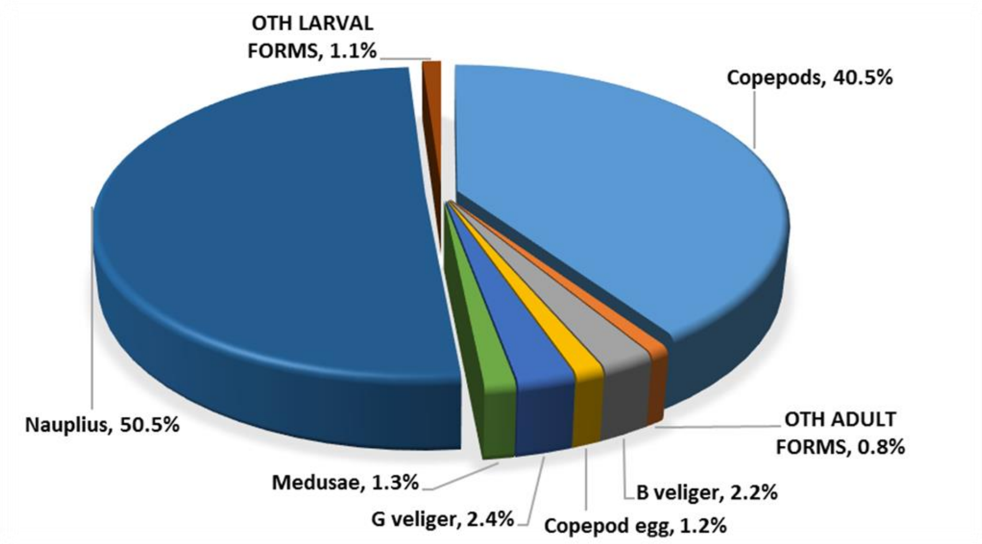


Figure 2-107. Percentage composition of major zooplankton groups catalogued in three sampling stations in Manila Bay across the BASECO Compound during marine ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

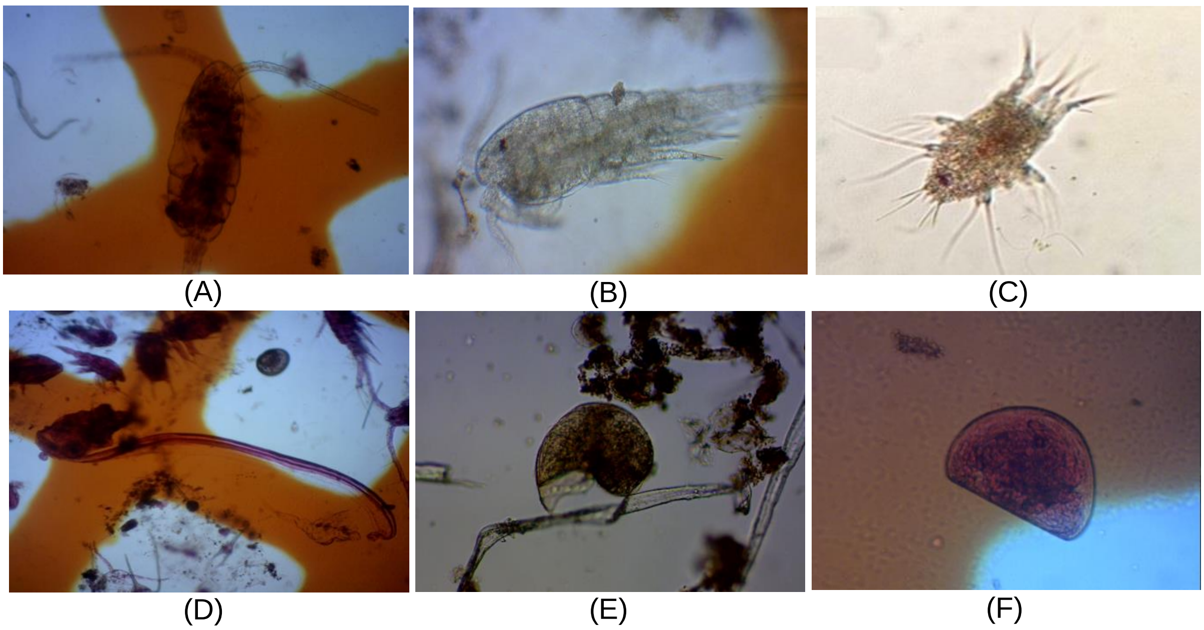


Plate 2-20. Photomicrographs of zooplankton identified and recorded in three sampling stations in Manila Bay across the BASECO Compound as MEBA results for the New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

Top: (A) Calanoid copepod (B) Cyclopoid copepod (C) Nauplius copepod; Bottom: (D) Larvacean (E) Gastropod veliger (F) Bivalve veliger

The mean estimate of abundance for the zooplankton community was 243,639 ind/m^3 recorded for all three sampling stations during this survey (**Figure 2-108**). In terms of spatial distribution, the most number of population counts is attributed to sampling station PLK1 with a density of 264,639 ind/m^3, as dominated by nauplius larvae (140,653 ind/m^3). In terms of species richness, sampling stations PLK2 and PLK3 both had the relatively highest record of 10 representative groups each out the 13 zooplankton groups identified.

In contrast, the relatively lowest zooplankton abundance at 221,977 ind/m^3 is attributed to sampling station PLK3; while the lesser representation in terms of species richness with seven groups is attributed to sampling stations PLK1. In correlation to the results of the phytoplankton sampling, PLK3 also has the least cell density and also the least representative genera. This may be due to the displacement of the plankton communities caused by massive water movement by current and waves in which sea conditions are influenced by winds from a forming low pressure weather disturbance during the sampling period, or that natural concentrations of abundant densities are present in the waters more proximal to the shoreline.

As previously described in the phytoplankton section, sampling station PLK1 is approximately 160 meters from the outermost shoreline of the BASECO Compound, while sampling stations PLK2 and PLK3 are more distal at distances of 1.5 km and 2.9km respectively from the same reference point.

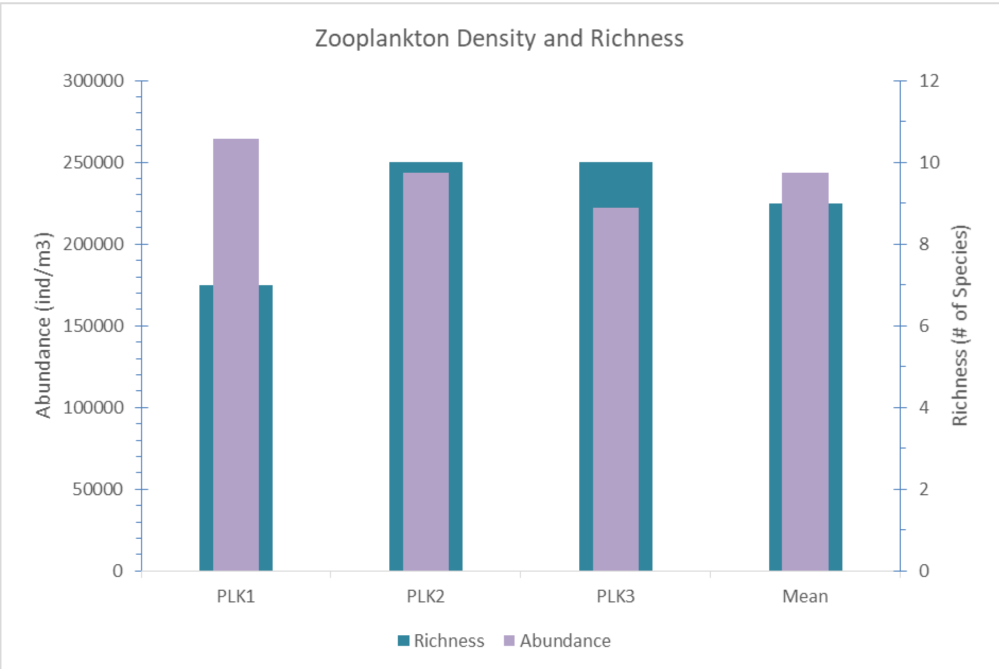


Figure 2-108. Total and mean phytoplankton abundance and richness catalogued in three sampling stations in Manila Bay across the BASECO Compound during marine ecology baseline assessment in the proposed New Manila Reclamation Project, City of Manila, NCR; 24 July 2018.

In reference to **Table 2-31**, diversity measurements based on the Shannon-Weiner Index were low (<2.0) in all sampling stations. The relatively highest value of 1.43 is attributed to sampling station PLK3, while the relatively lowest at 1.21 was determined to be at sampling station PLK2. As previously discussed in the phytoplankton section, diversity index values that are greater than 2.0 indicate normal conditions for aquatic biota and the associated habitat. Values above 3.0 indicate that the habitat structure is stable and balanced, while values midway from 1.0 to 2.0 describe a threatened condition; furthermore, values lower than 1.0 indicates pollution and degradation occurring in the habitat structure (Goncalves and Menezes, 2011); the Diversity Index however, very rarely exceeds a 4.5 value.

In terms of evenness, the computed indices for the three sampling stations was not so variable and low ranging with the lowest at 0.53 in sampling station PLK2 to the highest at 0.66 in sampling station PLK1 – which indicates an uneven distribution of the zooplankton community, due to the dominance of a particular group, which in this case are the nauplius larvae and the copepods present with high individual counts in all sampling stations.

It should also be noted that sampling station PLK2 aside from having the lowest diversity, also has the lowest evenness value, but with a high number of representative groups. This is attributed to the inclusion of the density of copepod eggs and polychaetes that contributed to the amassed number of organisms which is enhanced by nauplius larvae and the two forms of copepods as previously described.

The computed diversity and evenness indices indicate that the zooplankton communities in the area are low based on the Wilhm criteria (1975), classifying the diversity index <3.0 as low community stability. As an overall impression, the zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance during the time of survey.

Zooplankton are one of the most important biotic components influencing all the functional aspects of any aquatic ecosystem, such as food chains, food webs, energy flow and cycling of matter (Supritam pal et al., 2015). As an overall impression, the zooplankton community in the survey area is relatively poor as indicated by a low number of taxa and abundance for some groups during the time of survey. There are however no rare or endangered genera or groups in the sampled zooplankton community, and all are cosmopolitan in distribution worldwide.

The highlights of the plankton community sampling is also featured in a map in **Figure 2-109**.

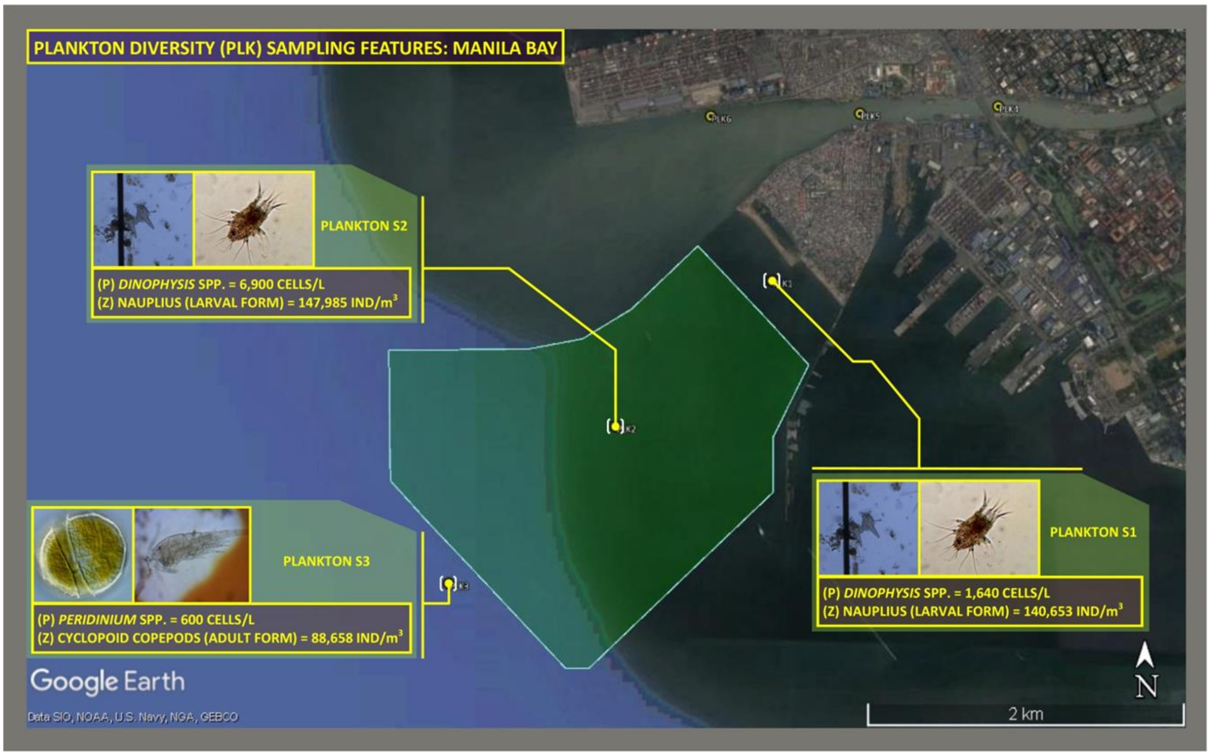


Figure 2-109. Dominant phytoplankton (P) and zooplankton (Z) composition in three sampling stations investigated during marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay, Manila, NCR; July 2018.

2.2.5.2.4 Macrobenthos Diversity

The soft-bottom benthic community or macrobenthos mediate the ecosystem processes such as the sediment decomposition (Covich et al 2004). Combined with their relatively sedentary lifestyles such as long life-cycles and poor mobility, macrobenthos respond to environmental changes via community-related variations including species composition, diversity, abundance, and biomass (Koperski 2010). Thus, macrobenthos commonly serve as useful bioindicators for aquatic environment monitoring and assessment in river, marine and lake ecosystem. Communities of macrobenthos provide many ecosystem services that help to maintain good water and sediment quality. Filter feeders remove particles from the water column, which may result in enhanced water clarity. Accordingly, the changes in benthic species composition and abundances could aid as an alarm system and even allow the quantification of environmental alterations (Hutchinson, et.al, 1993).

A macrobenthos sampling was conducted in three stations (BN1-BN3) within and near the proposed reclamation site on July 24, 2018. A total 5,636 individuals belonging to 16 families/phyla was identified in all survey stations. The macrobenthos recorded in this survey was represented by five major phyla i.e Annelida, Mollusca, Nematoda, Nemertea and Sipunculida. Phylum Annelida was the most abundant phyla accounting for 60%, followed by phylum Mollusca constituting for 15%, phylum Nemertea with 9%, phylum Sipunculida with 9% and phylum Nematoda with 7% (**Figure 2-110**). The polychaetes (≈worms) were the most family rich phyla which constituted for nine (9) families. Among the top three most abundant macrobenthos belongs to polychaete families i.e Capetillidae, Glyceridae and Phyllocolidae. Polychaetes are usually the most abundant taxon in benthic communities and have been most often utilized as indicator species of environmental conditions. They are used as sensitive monitors of water quality especially in terms of the effects of pollutants on life history characteristics. They may also be utilized as general indicators of community diversity but those species indicative of lower diversity may differ geographically and temporally. Their occurrence at high density and wide distribution in the sampling sites during this survey is *indicative of poor sediment and water quality* in the site. Mollusks were represented by two gastropod families (Ceritthiidae and Nassaridae) and one bivalve family (Mytillidae). The identified molluscs, including the brown mussel belonging to family Mytillidae, are not preferred edible species as compared to the more common edible green mussel. The detailed composition, distribution diversity and abundance of macrobenthic community for three stations sampled are shown in **Table 2-32.** Images of the most abundant representative macrobenthos taxa are shown in **Plate 2-21**.

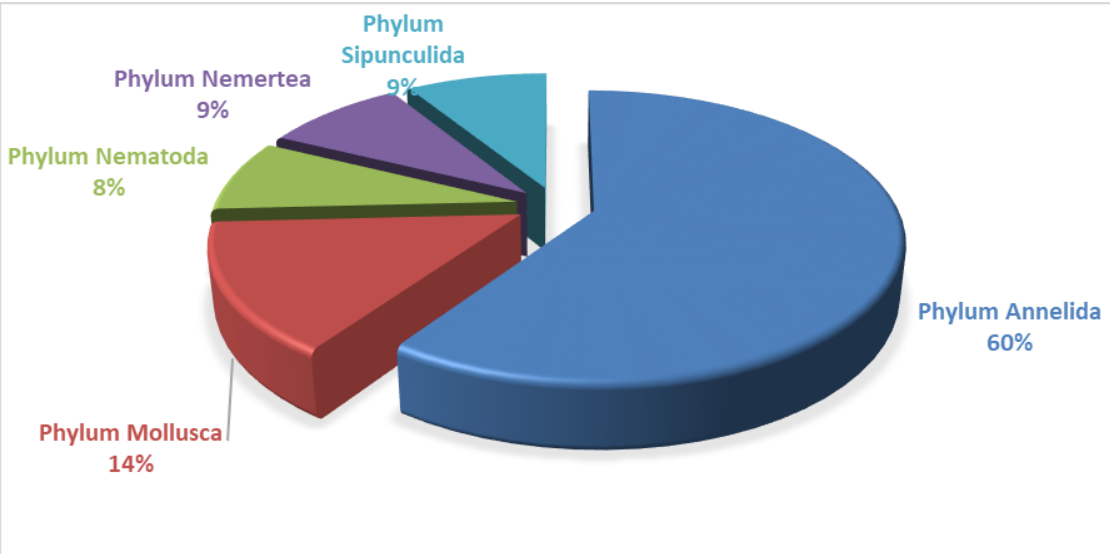


Figure 2-110. Percent composition of major benthic macroinvertebrates in the three sampling stations during the July 24, 2018 marine ecology baseline assessment in the proposed New Manila Reclamation Project.

Table 2-32. Macrobenthos composition, abundance and distribution in the three sampling stations during the July 24, 2018 marine ecology baseline assessment in the proposed New Manila Reclamation Project.

TAXA	STATIONS			Grand Total	Rel. Abund.
	BN1	BN2	BN3		
Phylum Annelida	**727**	**1,227**	**1,409**	**3,364**	**59.68**
Class Polychaeta	**727**	**1,227**	**1,409**	**3,364**	**59.68**
Family Capetillidae	364		364	727	12.90
Family Cirratullidae	91	0	182	273	4.84
Family Cossuridae	91	91	182	364	6.45
Family Glyceridae		500	91	591	10.48
Family Lumbrineridae	91	136	91	318	5.65
Family Nereididae				0	0.00
Family Ophellidae		318		318	5.65
Family Orbiidae	45	91	136	273	4.84
Family Phyllodocidae	45	91	364	500	8.87
Phylum Mollusca	**227**	**227**	**364**	**818**	**14.52**
Class Bivalvia	**45**	**0**	**182**	**227**	**4.03**
Family Veneridae	45	0	182	227	4.03
Class Gastropoda	**182**	**227**	**182**	**591**	**10.48**
Family Cerithiidae	91	91	91	273	4.84
Family Nassaridae	91	136	91	318	5.65
Phylum Nematoda	**182**	**136**	**136**	**455**	**8.06**
Phylum Nemertea			**500**	**500**	**8.87**
Phylum Sipunculida	**136**	**273**	**91**	**500**	**8.87**
Grand Total	**1,273**	**1,864**	**2,500**	**5,636**	**100**
Richness	**11**	**10**	**13**		
Evenness (I')	**0.91**	**0.91**	**0.93**		
Diversity (H')	**2.17**	**2.10**	**2.37**		

The mean abundance in all survey stations was 242 ind/m^2. This is relatively lower to what was quantified in the Pasig river stations. Spatially, the highest benthos concentration was collected in station BN6, which is located in the mouth of the river with 455. It is also the most taxa rich station with four (4). The most depauperate station was collected in station BN1 with six (6) taxa (**Figure 2-111**). This station also had lowest benthos abundance both with 136 ind/m^2. Diversity based on Shannon-Wiener Index (H') was generally low (<2) with the highest computed value in the BN3 with 2.37 while the lowest was computed in BN2 with 2.10. The index of evenness based on Pielou's Index (I') was not so variable with low values ranging from 0.91 to 0.93.

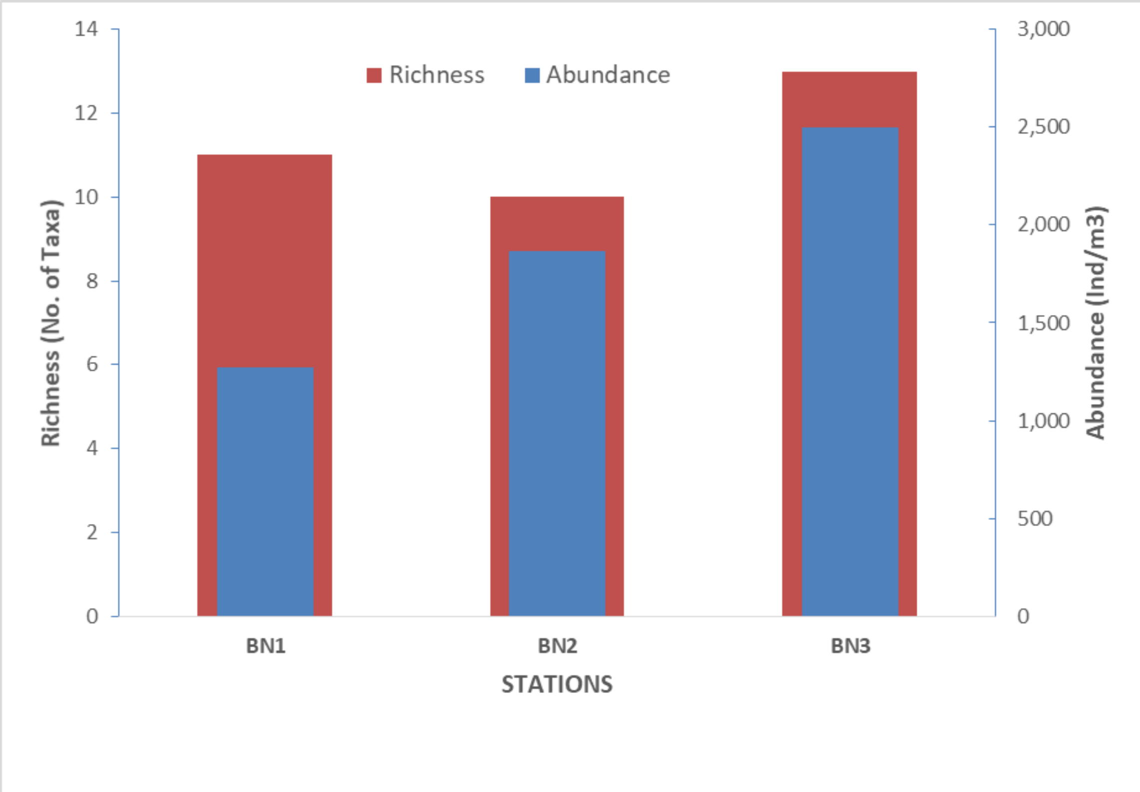


Figure 2-111. Total macrobenthos density and richness in the three sampling stations catalogued during the July 2018 marine ecology baseline assessment in the proposed New Manila Reclamation Project

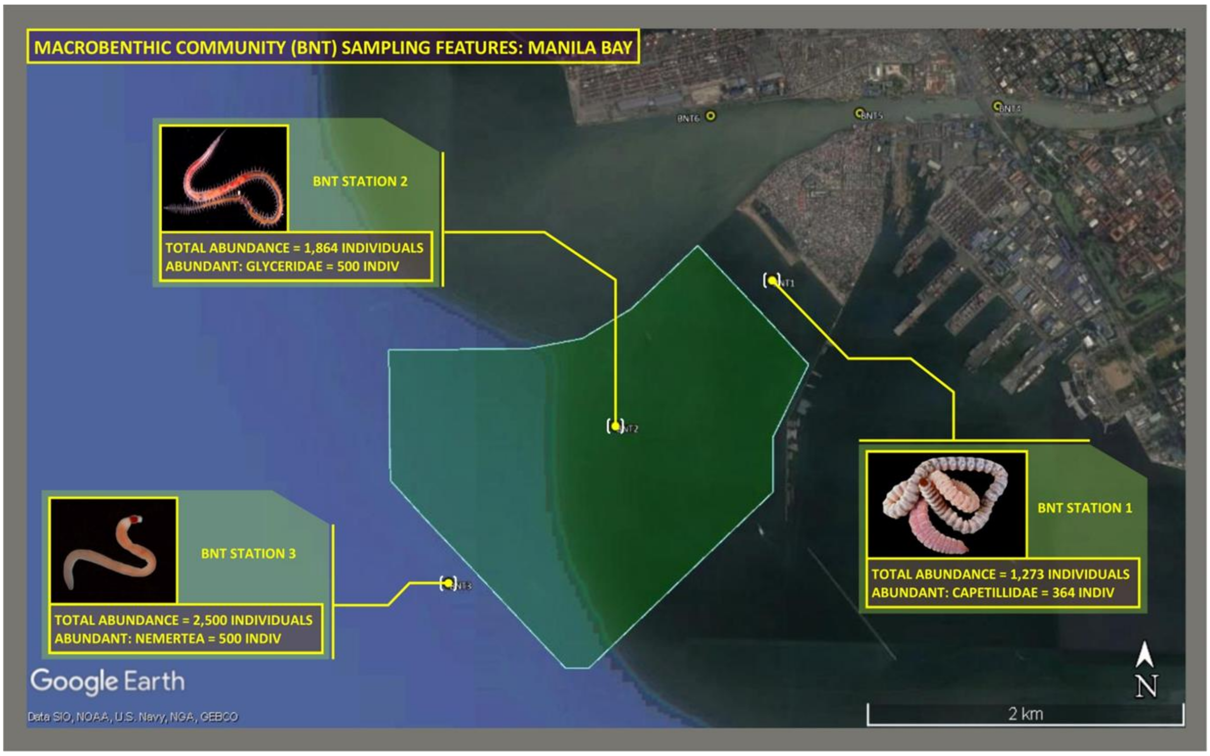


Figure 2-112. Dominant macrobenthos species catalogued in three sampling stations during the marine ecology baseline assessment in the proposed New

Manila Reclamation Project in Manila Bay, Manila, NCR; 09 and 13 September 2017

Plate 2-21. Images of some soft-bottom benthos taxa identified in three sampling stations during the marine ecology baseline assessment in the proposed New Manila Reclamation Project in Manila Bay
Top row - (A) Capetillidae (polychaete) (B) Glceridae (polychaete) (C) Phyllodicidae (polychaete) Bottom row - (D) Nemertea (E) Cerithiidae (gastropod) F. Oligochaete G. Mytillidae (brown bivalve)

2.2.5.2.5 Macro-invertebrates significant to livelihoods

In the proposed reclamation area itself, no macroinvertebrates collected for food were encountered. Collection of oysters and mussels is being undertaken in the "North Breakwater" about 100 meters north of the project site and in the rocky rip-rap in the Gasangan breakwater where barges are docked. Both breakwaters, as well as the hulls of the barges, are the only firm structure in this particular portion of Manila Bay that has evolved as habitat for shellfish, algae and some demersal species of fish. Gleaning for edible bivalves of the Asian green mussel (Mytillus), and various species of the zigzag venus (Manila Clam or *Halaan; Venerupis philippinarum*) is being undertaken regularly (**Plate 2-22**). Only one gleaner was observed in the breakwater during the survey. The oyster and mussels comprises 80% of the harvest followed by 'halaan' or venus clams. About twenty (20) kilograms of the Philippine leaf oyster (*Dendostrea folium)* was collected by three gleaners in three (3) hours of gleaning observed during the survey (**Plate 2-22**). The gleaning area in the breakwater is about 500 meters away from the boundary of the proposed reclamation site.

Plate 2-22. The Baseco breakwater is a favored shellfish gleaning area by fishers harvesting stocks of mostly bivalves in the hulls of barges and rocks.

2.2.5.3 Impacts

2.2.5.3.1 Threat to existence and/or loss of important local species and habitat

There are no corals, seagrass and macro-algae, as well as significant stocks of demersal marine fishes, macro-invertebrates or crustaceans encountered in the survey. Polluted and turbid waters, exacerbated by extensive sediment loading, are among the factors that deter settlement and growth of corals and other benthic life forms. Turbid waters reduce sunlight penetration and depress oxygen production which are essential for survival of corals and associated demersal reef fish species. Spot dives in six points within the proposed reclamation area revealed that the bottom substrate in the proposed reclamation site is comprised of thick silt deposits mixed with trash, occurring in all expanses of the area, with clouds of disturbed silt reducing visibility to less than thirty (30) centimeters. Survey team divers reported that the silt carpet could be as deep as 0.75 meters. The sea bottom is bleak and grimy with thrash and wastes embedded in black mud, exacerbated by largely eutrophic conditions brought about by decaying sediments and constant invasion of silt.

2.2.5.3.2 Threat to abundance, frequency and distribution of local species and habitats

Substrate disturbance will be minimized by the use of steel sheet pile wall and sloping revetment during reclamation filling and compacting. Silt plumes arising from reclamation area filling are expected to have short term impacts on ecosystem modification in an area where the coastal environment is already heavily impaired by pollution, eutrophic episodes, and absence of benthic ecological structures and functions.

Possible Threats to the Plankton Community and their Adaptability

Threats to the plankton community may be caused by the displacement of the water column resulting from the settling and piling of earth materials along with the structural enhancements from the bottom to the surface of the marine waters. This movement of the said materials would result to sand, silt, mud, and various loads of sediments and suspended solids infiltrating into seawater column that can contribute to turbidity and subsequently reduce light penetration depth, thus hampering photosynthetic activities of the phytoplankton, the grazing habits of zooplankton and the entire primary productivity of the area.

Another would be unforeseen spillage of petroleum-oil-lubricants (POLs) and ballasts, aside from liquid and solid biological and chemical waste materials from sea vessels that are involved in the reclamation process that would pollute the immediate waters and may spread to adjacent areas. These wastes may increase the loads of oil-contaminated suspended solids that will be absorbed by seawater, reducing light penetration depth, which again in turn, affect photosynthetic activity by the phytoplankton and reduce the grazing success of zooplankton as previously described.

However, it is important to note that these effects are relatively short-term once structural and mechanical reclamation reinforcements are completed, and measures have then been set to prevent further disturbance during compacting – such as immediate planting of vegetation. An increase in turbidity may be also caused by natural processes such as turbulent waves during typhoons and monsoons, regardless of such said activities in the area. In addition, most of the plankton species include toxic and cosmopolitan species. Plankton communities are however resilient, and its population could replenish from the relatively abundant plankton community located offshore or in adjacent areas due to advection as facilitated by water circulation, tidal forcing, and current systems in the water body. There may also be a replacement for niches from displaced plankton with the proliferation of existing tolerant organisms. It is therefore highly recommended to minimize the affected area of any turbid water that may be caused by pollutants or displaced silt/mud and sediments once the reclaimed land is formed. Furthermore, ships and boats that are involved in the reclamation process should be aware not do dispose of any waste water, ballasts, or POL-based liquids in to the seawater. An efficient and periodic monitoring system should also be implemented in all phases of the planned project and its underlying activities.

Threats to abundance of fish species

Reclamation activities will further contribute to turbidity and dispersal of silt plumes will further impair photosynthesis in the water column but this will be temporary and would not have far reaching impacts on benthic life forms or fishing practices in areas further from the reclamation site. The negative impacts will have little effect on fish reproductive functions as there are no significant fish populations of maturing size in the area owing to the absence of suitable settlement and habitats for reproduction and recruitment. Pelagic fish species, including Tilapia mostly proliferate in the Pasig River estuary while trevallies and ponyfishes occur farther offshore and reclamation activities will have little impact on standing stocks as the constant flow of seawater and currents that carry nutrients for fish feeding will not be disrupted significantly. Since there are no significant fisheries resources and resource use practices present in the project site itself, the project will have very insignificant effects on capture fisheries as fishers will simply move farther past the boundary of the reclamation project. There will be no significant impact on catch rates and fisheries operation in fishing grounds offshore of the reclamation as fishers will move to new fishing grounds past the reclaimed area where seawater will probably be less polluted in the long term. In other nearshore areas, the provision of seawater channels should ensure that plankton communities will continue to enrich inshore fishing grounds where sardines and other small pelagic fishes graze, as well as sustain the few macro-invertebrate species. Pelagic species of sardines will continue to move to areas close to the shore and their seasonal movement into the coastal seas surrounding the reclamation project will be sustained.

Finally, it is noted that there are no permanent or stationary fishing gears within the proposed reclamation site; mussel farms and stationary lift nets (“sapra”) are absent. It is also unlikely that coral reefs in Cavite and Bataan, more than 32 kilometers away, will be affected.

Potential enhancement of harmful algal blooms

Episodes of HAB-causing phytoplankton blooms are already a periodic consequence of hyper-nutrient loading in the area and the project operation will not have an incremental effect to this phenomenon. The reclamation project therefore, would not be a primary enhancement trigger for HAB episodes that are already occurring in the area due to uncontrolled contributing factors.

Threats to macrobenthos

The poor diversity of macrobenthos as revealed in the survey indicates that there will be no significant population of macroinvertebrates that can be dislocated in the reclamation site itself. Populations of oysters and mussels are too far from the project site and no alteration of their habitats is anticipated.

Oil and Grease Contamination

The risk of oil and grease contamination in seawater around the reclamation site can occur if disposal of marine vessel bilge water and if accidental spillage from refueling at sea is experienced. While the issue is not anticipated to be severe, oil slicks from inadvertent spillage may remain sequestered in the water column or carried to the shoreline in blotches. Areas with inter-tidal corals in Bataan and mussel colonies in Cavite can be considered at risk from exposure to such slicks, leading to immediate coral and shellfish mortality. In open waters of Manila Bay, the chain reaction can be far-reaching, affecting not only benthic communities but stocks of fish that are dependent on plankton and zooplankton as their primary diet.

Increase in domestic waste water around the reclamation site
Compacting, configuring and development structuring of the reclaimed area will result to increased human activity in the project site due to the influx of workers and this is expected to generate a significant amount of solid wastes and domestic wastewater that could find its way to the coastal and marine environment if waste disposal and management systems are not sufficient. However, the risk of waste contamination of benthic resources is insignificant due to the absence of significant benthic habitats. The predicted impact of this threat to epi-benthic soft bottom communities in the seabed could be more pronounced. The outflow of domestic wastewaters from project facilities if such waste streams are not properly treated and managed can lead to hyper-nutrient loading which in turn can cause algal blooms. In the project area where seawater flushing is moderate and water turbidity is already intense, such phenomenon can lead to problems on paralytic shellfish poisoning (PSP).

2.2.5.4 Mitigating Measures

2.2.5.4.1 Potential Impacts arising from Climate Change scenarios

The reclamation will not contribute to enhancement of impacts arising from climate change, notably rise in surface sea water temperature. However, if hyper-nutrient loading in warm waters become intensified – either from domestic wastewaters or from point sources in the project, the risk of oxygen depletion and fish kills over a broad area can be possible. Immediate extensive vegetation planting around the reclaimed site will in fact contribute to sequestration of greenhouse gasses in the future.

2.2.5.4.2 Mitigation of potential sediment fluxes

Minimizing sediment influx from the project site to the coastal waters is a critical and underpinning strategy. Sedimentation is predicted to be high while sheet piles are being installed as well as during reclamation area filling and compacting. Impacts on turbidity are predicted to range from moderate to high depending on the implementation of mitigating measures during project operations. Best practices and modern sediment-sequestration structures – such as use of steel sheet piles installation of a series of silt curtains and sediment recovery weirs will be implemented around the reclamation site. The main intention is to prevent the possibility of sediment fluxes reaching fishing grounds offshore, areas with set nets and bivalve farms. During soil compacting, a series of diverse sediment mitigation measures and facilities will be established in strategic locations, with silt and sediment diversion canals placed inside reclaimed area to ensure loose soil are captured in weirs and screens before seawater-laden sludge flows out to sea. An additional measure is the early planting of extensive vegetative cover in order to increase sediment amalgamation capacity and soil compacting aided by stabilization of areas where earth moving has been completed.

2.2.5.4.3 Wastewater management

Modern and sufficient sanitation facilities and disposal systems will be installed. Modern latrines with chambered septic tanks will be installed and sludge will be periodically collected. The objective is to ensure that pollution-causing effluents that can be potentially carried into the sea are controlled and collected at the source.

2.2.5.4.4 Solid Waste Management

Waste minimization, retrieval and recycling will be practiced in all aspects of reclamation activities. A rigid waste management and retrieval system will be enforced in all aspects of reclamation activity. There will no disposal of wastes at sea.

2.2.5.4.5 Oil and Grease

Potential risks of small oil spills will be controlled through strict fuel and oil dispersal protocols backed-up by an oil/fuel spill contingency plan. An oil and grease recovery system will be adopted employing the best facilities. The project will enforce strict policies against indiscriminate disposal of oily waste and marine vessel bilge into the sea.

2.2.5.4.6 Fisheries and Fishing gears

Any set fishing gear that will be dislocated by reclamation filling and operations will be compensated through the provision of new fishing gear paraphernalia and technical assistance. Supplemental livelihood projects, through mariculture of full cycle aquaculture species will be promoted through collaboration with the Bureau of Fisheries and Aquatic Resources.

2.2.5.5 Presence of Pollution Indicator Gears

Plankton – Some plankton and macrobenthos species identified in the samples collected during the marine ecology baseline assessment are pollution indicator species and normally imply eutrophic and polluted environments. The cosmopolitan dinoflagellate, *Dinophysis* spp., was the relatively abundant genera with 9,100 cells/L (44% of the total composition). Species of this genera are known to produce toxins that cause DSP - Diarrheic Shellfish Poisoning (FAO, 2004). It is thus associated with the one of the “red tide” phenomena. The relatively abundant diatom found in the survey - *Pseudonitzschia* genera - with 1,100 cells/L (5.3% of the total composition sampled) is a chain-forming organism known to produce domoic acid (DA) – a toxin associated with Amnesic Shellfish Poisoning (ASP). The direct impacts of this species identification on public health make this a serious concern. Toxogenic and nontoxogenic species commonly co-occur; therefore, discrimination between various *Pseudonitzschia* spp. is imperative to determine the potential toxicity of an algal bloom. Another significant diatom identified is a similar chain-forming genera, *Rhizosolenia* spp which are known to cause fish kills during blooming of the species.

On the other hand, the polychaetes (≈worms -i.e Capetillidae, Glyceridae and Phyllocolidae.) catalogued in the macrobenthos survey – in fact dominant in the station near the Pasig River - are used as sensitive monitors of degraded water quality especially in terms of the effects of high pollution level and poor sediment and water quality in the site.

Filter-feeding bivalves – Algal blooms are natural phenomenon and can be influenced by a number of factors. These include cultural eutrophication, unusual climatological conditions and transport of dinoflagellates through ballast waters, and transfer of shellfish stocks. Mussels and oysters are standard biotoxin monitoring medium and the BFAR implements a periodic monitoring system of plankton levels and toxicity analysis through bioassay in mussel and oysters in Manila Bay. While the reclamation project would not be a primary trigger for HAB episode enhancement, bivalves gathered by gleaners near the project area should be placed under a strict biotoxin level monitoring system through engagement of BFAR personnel. Moreover, the Project will support the conduct information, education and communication (IEC) campaigns to promote red tide awareness and to pinpoint sources of nutrient loading into the sea.

2.3 Air and Noise

2.3.1 Meteorology / Climatology

This section presents the climatological normal and extreme values of rainfall, temperature, and prevailing winds recorded at PAGASA's synoptic stations in the vicinity of the New Manila Reclamation Project, the potential impact of the Project in local climate and the impact of medium to long term climate change projects in the region. The projected greenhouse gas (GHG) emissions of the project and corresponding mitigation and/or sequestration measures were also discussed in this section.

2.3.1.1 Methodology

2.3.1.1.1 Assessment of Baseline Condition

The climate at the proposed Project site was described using the Climate Map of the Philippines while the meteorological condition at the Project site was described using the meteorological data from Port Area (MCO), Manila located approximately at 14°35'13.10" N and 121°58'43.33" E in Manila City, Metro Manila, approximately 3 km away from the Project site.

2.3.1.1.2 Impact Assessment

Climate Change

The projected changes in rainfall, air temperature, and extreme weather events from 2006 to 2035 (centered in 2020) and from 2036 to 2065 (centered in 2050) was determined using projected climate data in NCR (PAGASA, 2011).

Greenhouse Gas Emissions (GHG).

Majority of greenhouse gas (GHG) emissions that may be generated by the proposed Project are expected to come from activities associated with the construction (fuel/electricity use for the operation of construction vehicles and equipment). The GHGs that are typically generated from fuel/electricity use for the operation of construction vehicles and equipment are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Of these gases, the major gas emitted is CO_2. Methane and nitrous oxide emissions have a very low share in terms of emissions. Hence, this report only focused on CO2 emissions.

The CO_2 were calculated using emission factor-based estimation method. The methodology estimates the CO_2 emissions by multiplying a level of activity data (AD) by an emission factor (EF). Activity data is a quantified measure of activity resulting in emissions during a given period of time (e.g. data on fuel consumption (liters/km) and purchased electricity (kWh) while the emission factor is the average emission rate of a given GHG for a given source, relative to units of activity. The general equation is shown below. This is based on The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report.

Equation: GHG Emissions = AD x EF

2.3.1.2 Baseline Condition

2.3.1.2.1 Climatology and Meteorology

2.3.1.2.1.1 Local Climate

Based on the Modified Coronas Climate Classification System, the proposed Project site falls under Type 1 climate classification as shown in the Climate Map of the Philippines in **Figure 2-113**. This type of climate is characterized by two (2) pronounced seasons, which are dry from November to April and wet during the rest of the year (PAGASA 2015). High rainfall is expected during the southwest monsoon season that normally occurs in the Philippines from June to September.

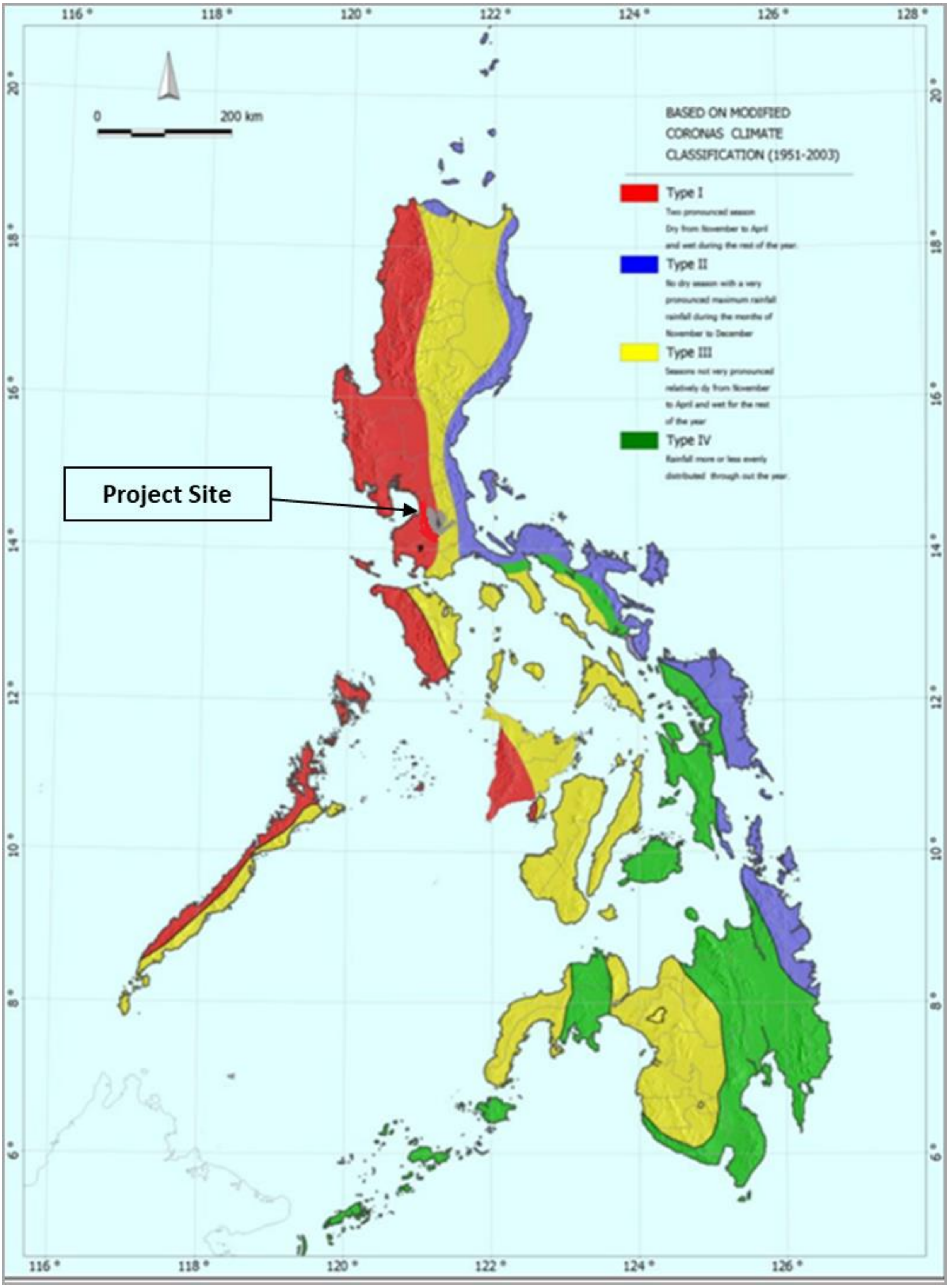


Figure 2-113. Climate map of the Philippines showing the Project Location

2.3.1.2.1.2 Rainfall

The proposed project area falls under Type 1 climate classification wherein high rainfall is expected during wet season or southwest monsoon season, which occurred from June to September. Based on the climatological normal values (1981-2010) recorded at Port Area Synoptic Station of PAGASA, August has the highest monthly average rainfall at 432.4 mm followed by July and September at 420.5 mm and 355.1 mm, respectively. During these months (i.e. July, August and September), there are more number of rainy days. During the months of July and August, the average number of rainy days 21 and 20 rainy days during the month of September. Months with less rainfall are January, February and March with recorded rainfall of less than 20 mm. During these months, lesser number of rainy days (i.e. 3 - 4 rainy days) is experienced. These months are within the northeast monsoon season which is characterized by colder and less humid air. **Table 2-33** presents the climatological normal values at recorded at PAGASA Port Area Synoptic Station. The rainfall pattern at the Project area is shown in (**Figure 2-114**).

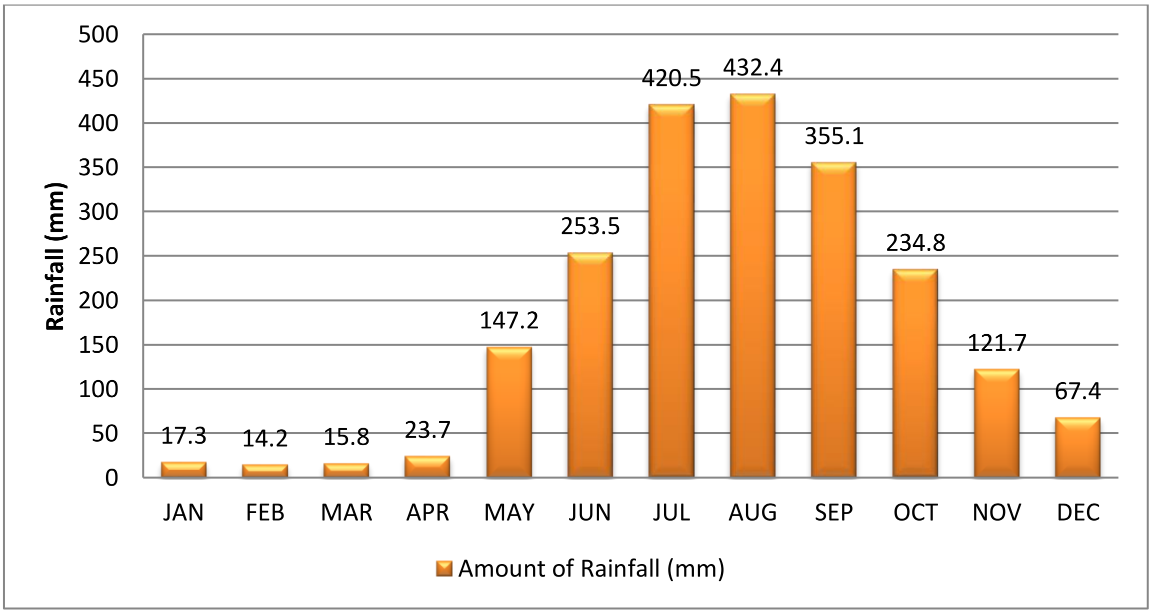


Figure 2-114. Monthly average rainfall at PAGASA Port Area Synoptic Station (1981-2010)

<u>Extreme Recorded Rainfall Events</u>

As of 2016, the highest recorded daily rainfall at Port Area Synoptic Station of PAGASA was 403.1 mm on September 1, 1970. **Table 2-34** and **Figure 2-115** show highest recorded daily rainfall at PAGASA Port Area Synoptic Station.

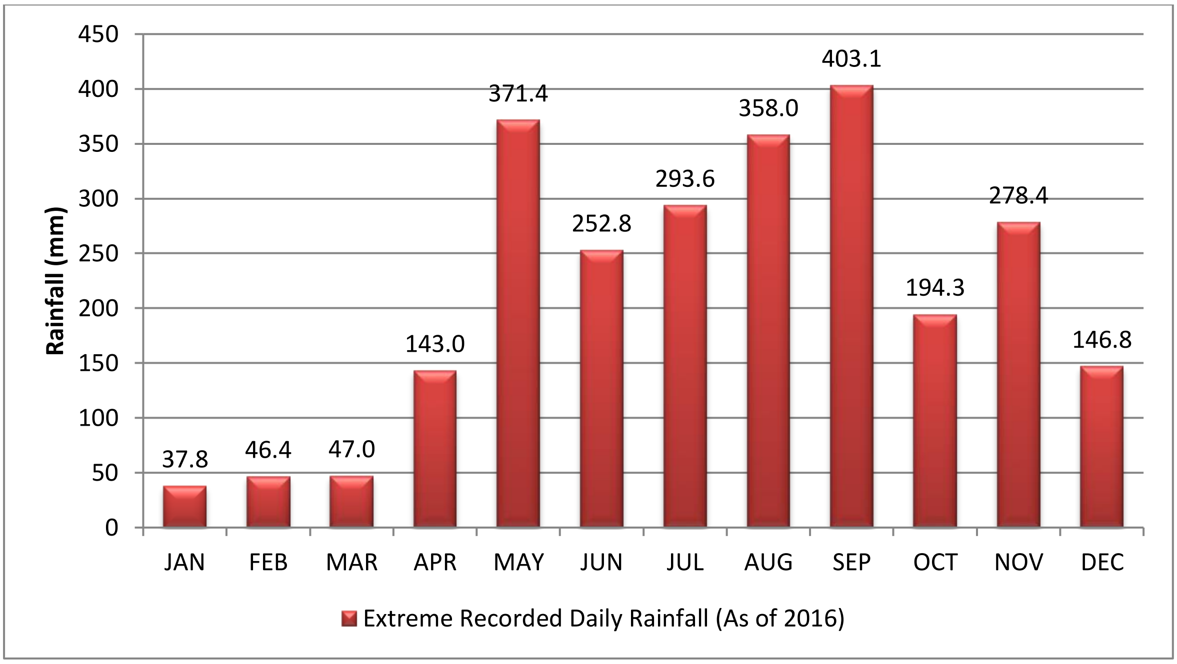


Figure 2-115. Plot of Extreme Recorded Daily Rainfall in Each Month (As of 2016)

Table 2-33. Climatological Normals of PAGASA-Port Area, Manila (1981-2010)

MONTH	RAINFALL		TEMPERATURE						VAPOR PRESS. (mbs)	RH (%)	MSLP (mbs)	WIND		CLOUD AMT. (okta)	NO. OF DAYS W/	
	AMOUNT (mm)	NO. OF RD	MAX (°C)	MIN (°C)	MEAN (°C)	DRY BULB (°C)	WET BULB (°C)	DEW POINT (°C)				DIR (16pt)	SPD (mps)		TSTM	LTNG
JAN	17.3	4	29.6	23.8	26.7	26.7	22.9	21.4	25.3	72	1013	N	2	7	0	0
FEB	14.2	3	30.6	24.2	27.4	27.3	22.9	21.2	24.9	69	1012	E	3	6	0	0
MAR	15.8	3	32.1	25.3	28.7	28.5	23.7	21.9	26	67	1012	SE	3	6	0	1
APR	23.7	4	33.5	26.6	30.1	30	24.9	23.1	28	66	1010	SE	3	6	2	2
MAY	147.2	10	33.2	26.9	30	30	25.7	24.3	30	71	1009	SW	3	6	9	9
JUN	253.5	17	32.2	26.4	29.3	29.3	25.8	24.6	30.8	76	1008	SW	3	7	11	9
JUL	420.5	21	31.2	25.9	28.5	28.5	25.6	24.6	30.8	79	1008	SW	3	7	12	9
AUG	432.4	21	30.8	25.8	28.3	28.2	25.6	24.7	31	81	1007	SW	4	7	11	7
SEP	355.1	20	31	25.7	28.4	28.3	25.5	24.6	30.7	80	1008	SW	3	7	12	8
OCT	234.8	17	31.1	25.7	28.4	28.3	25.2	24.1	29.9	78	1009	SW	3	7	7	6
NOV	121.7	12	30.9	25.1	28	28	24.5	23.2	28.3	75	1010	N	3	7	3	1
DEC	67.4	7	29.8	24.2	27	27	23.4	22	26.3	74	1012	N	2	7	1	0
ANNUAL	**2103.6**	**139**	**31.3**	**25.5**	**28.4**	**28.4**	**24.6**	**23.3**	**28.5**	**74**	**1010**	**SW**	**3**	**7**	**68**	**52**

Source: Climate and Agrometeorology Division, PAGASA

Latitude: 14°35’13.10” N

Longitude: 120°58’43.44” E

Elevation: 15.0 m

Notes:

VP – Vapor Pressure
mbs – millibar
MSLP – mean sea level pressure
Dir – direction
TSTM – thunderstorm
LTNG – lightning

Table 2-34. Climatological Extremes of PAGASA-Port Area, Manila (As of 2016)

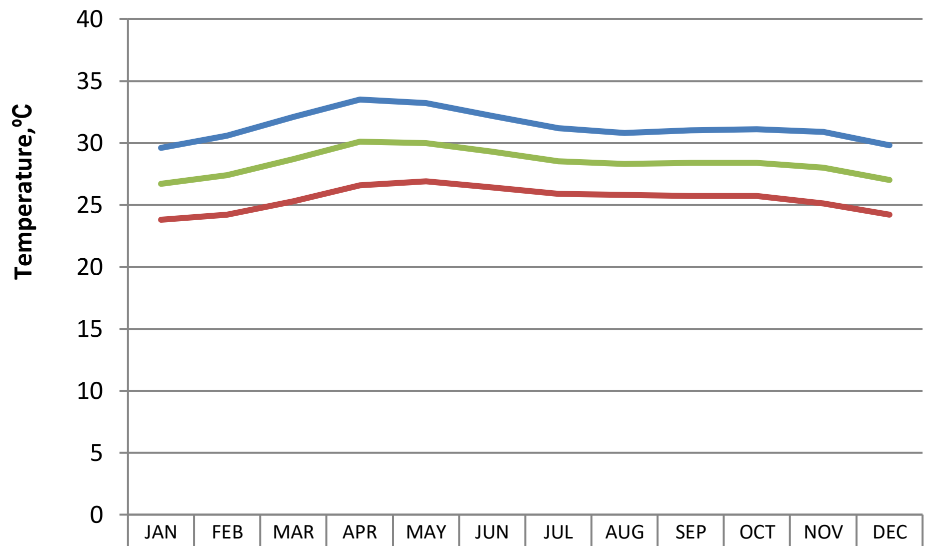
MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		STRONGEST WINDS (mps)			SEA LEVEL PRESSURES (mbs)			
	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	36.5	01-30-1984	14.5	01-11-1914	37.8	01-08-1955	18	E	01-15-1987	1022.4	01-09-1914	1003.3	01-05-1999
FEB	35.6	02-25-1906	15.6	02-18-1920	46.4	02-03-1986	25	SE	02-26-1962	1021.4	12-01-1962	1002.7	02-18-1998
MAR	36.8	03-23-1966	16.2	03-10-1911	47.0	03-25-2009	27	SSE	03-16-1962	1020.5	03-30-1958	997.3	03-27-1991
APR	38.0	04-30-1915	17.2	04-02-1923	143.0	04-29-1905	24	WSW	04-18-1962	1018.8	04-01-1958	998.1	04-29-1905
MAY	38.6	05-17-1915	20.0	05-01-1921	371.4	05-19-1976	35	E	05-17-1989	1015.9	05-09-1937	987.4	05-23-1922
JUNE	37.6	06-04-1912	20.1	06-04-1973	252.8	06-27-1985	47	SW	06-29-1964	1021.6	06-28-1993	974.6	06-29-1964
JULY	36.5	07-02-1973	19.4	07-14-1970	293.6	07-29-1919	31	WSW	07-24-1968	1014.9	07-29-1987	990.7	07-16-2014
AUG	35.6	08-09-1964	18.0	08-14-1974	358.0	08-07-2012	34	S	08-04-1989	1015.2	08-12-1958	990.8	08-31-1920
SEP	35.3	09-18-1903	20.2	09-02-1970	403.1	09-01-1970	34	SW	09-13-1961	1015.2	09-20-1965	986.7	09-27-1906
OCT	35.8	10-01-1968	19.5	10-26-1913	194.3	10-15-1918	41	W	10-26-1978	1017.0	10-28-1960	977.9	10-14-1970
NOV	35.6	11-04-1966	16.8	11-03-1911	278.4	11-18-1923	56	WNW	11-19-1970	1019.0	11-29-1985	966.5	11-19-1970
DEC	34.6	12-14-1947	15.7	12-03-1992	146.8	12-15-2015	41	W	12-14-1964	1020.9	12-08-1960	971.1	12-26-1947
ANNUAL	**38.6**	**05-17-1915**	**14.5**	**01-11-1914**	**403.1**	**09-01-1970**	**56**	**WNW**	**11-19-1970**	**1022.4**	**01-09-1914**	**966.5**	**11-19-1970**
Period of Record	**1885-2016**				**1865-2016**		**1948-2016**			**1885-2016**			

Source: Climate and Agrometeorology Division, PAGASA

2.3.1.2.1.3 Ambient Air Temperature

High temperatures are expected in dry season in April and May. The highest monthly mean temperature recorded at PAGASA Port Area is 30.1 °C during the month of April and this was followed by 30.0 °C during the month of May. On the contrary, December and January are the coldest months when northeast winds brought colder and less humid air from higher latitudes. The lowest monthly mean temperature is 26.7 °C during the month of January and 27.0 °C during the month of December.

The monthly average maximum temperature was recorded during the month of May at 33.2 °C while the monthly average minimum temperature was recorded during the month of January at at 23.8 °C. **Figure 2-116** shows the plot of the monthly average maximum and minimum and mean temperatures at PAGASA-Port Area Stations.



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly Ave Max Temp.	29.6	30.6	32.1	33.5	33.2	32.2	31.2	30.8	31	31.1	30.9	29.8
Monthly Ave MinTemp.	23.8	24.2	25.3	26.6	26.9	26.4	25.9	25.8	25.7	25.7	25.1	24.2
Monthly Mean Temperature	26.7	27.4	28.7	30.1	30	29.3	28.5	28.3	28.4	28.4	28	27

Figure 2-116. Maximum, Minimum and Mean Ambient Temperatures at PAGASA-Port Area, Manila (1981-2010)

Extreme Temperature Events

As of 2016, the highest recorded temperature at PAGASA Port Area was 38.6 ºC on May 17, 1915 followed by 38 ºC on April 30, 1915. In terms of lowest recorded ambient air temperatures, PAGASA-Port Area Station recorded the lowest at 14.5 ºC on January 11, 1914 (**Table 2-34**). **Figure 2-117** shows the monthly highest and lowest recorded temperature at PAGASA Port Area.

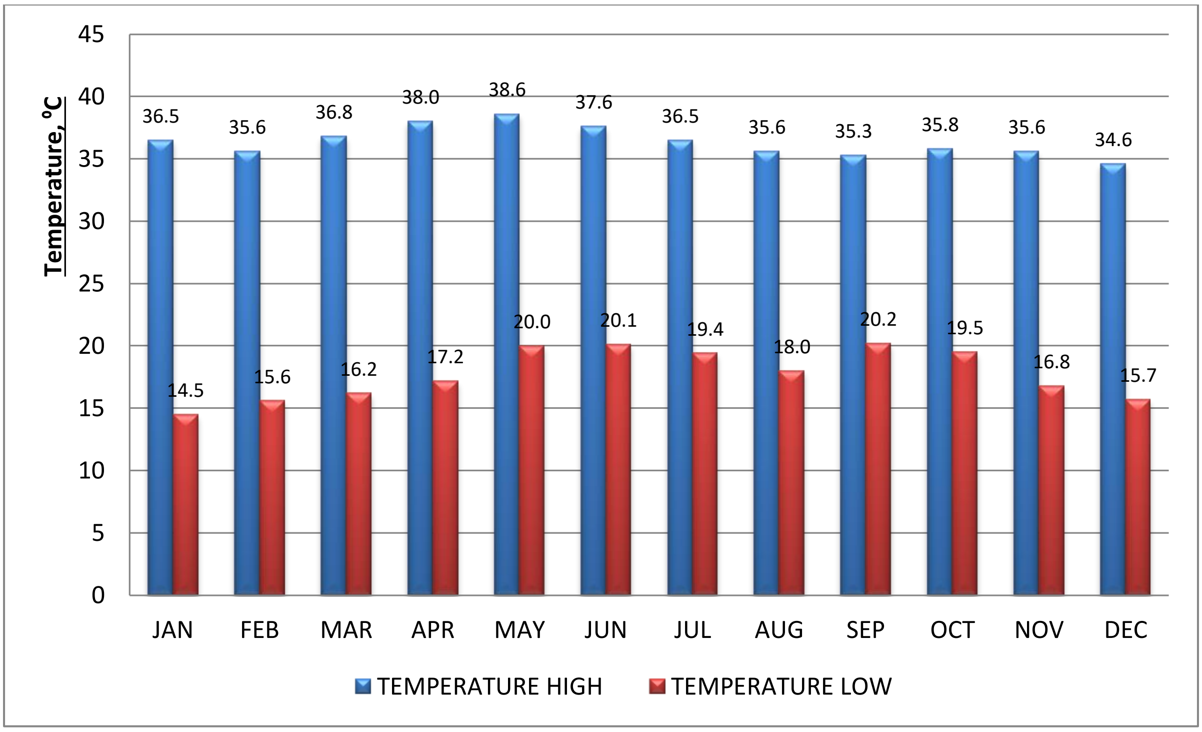


Figure 2-117. Monthly Highest and Lowest Recorded Temperatures at PAGASA Port Area, Manila (As of 2016)

2.3.1.2.1.4 Wind Speeds and Wind Directions

The meteorological data recorded at PAGASA Port Area, Manila from 1981 to 2010 show that the prevailing wind at the Project site is from southwest and east directions, each comprise 15% of the events. The average annual wind speed is 2.9 meters per second (m/s). **Figure 2-118** shows the annual wind rose for PAGASA Port Area (1981-2010).

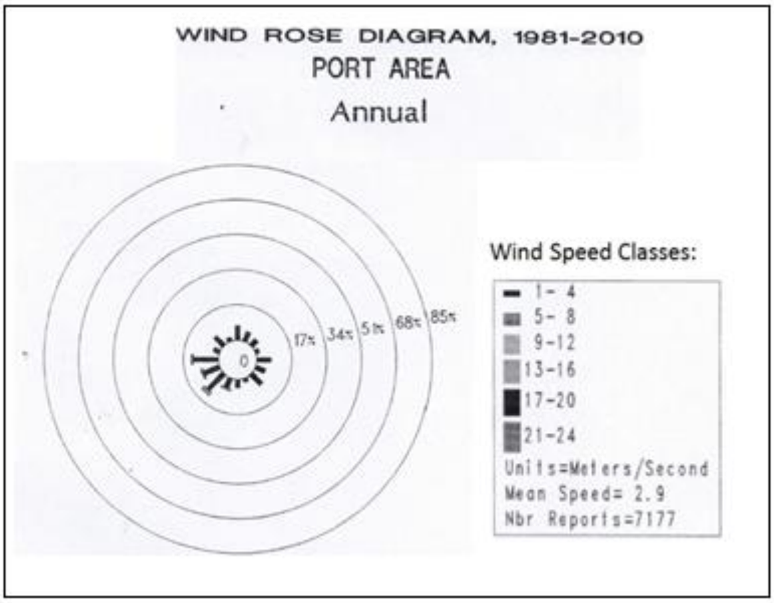


Figure 2-118 Annual Windrose Diagram (PAGASA Port Area, Manila, 1981-2010)

The monthly wind roses when monsoon winds are its peak; that is, January and February for the northeast monsoon and August to September for the southwest monsoon are also shown in **Figure 2-119**. It can be noted that during January and February, when the northeast monsoon is usually at its peak, prevailing winds at PAGASA Port Area Station are from the north, east and west directions. On the other hand, during the southwest monsoon, winds coming from the southwest and west directions prevail. During transition from southwest to northeast monsoon in November, the prevailing winds are from the north direction.

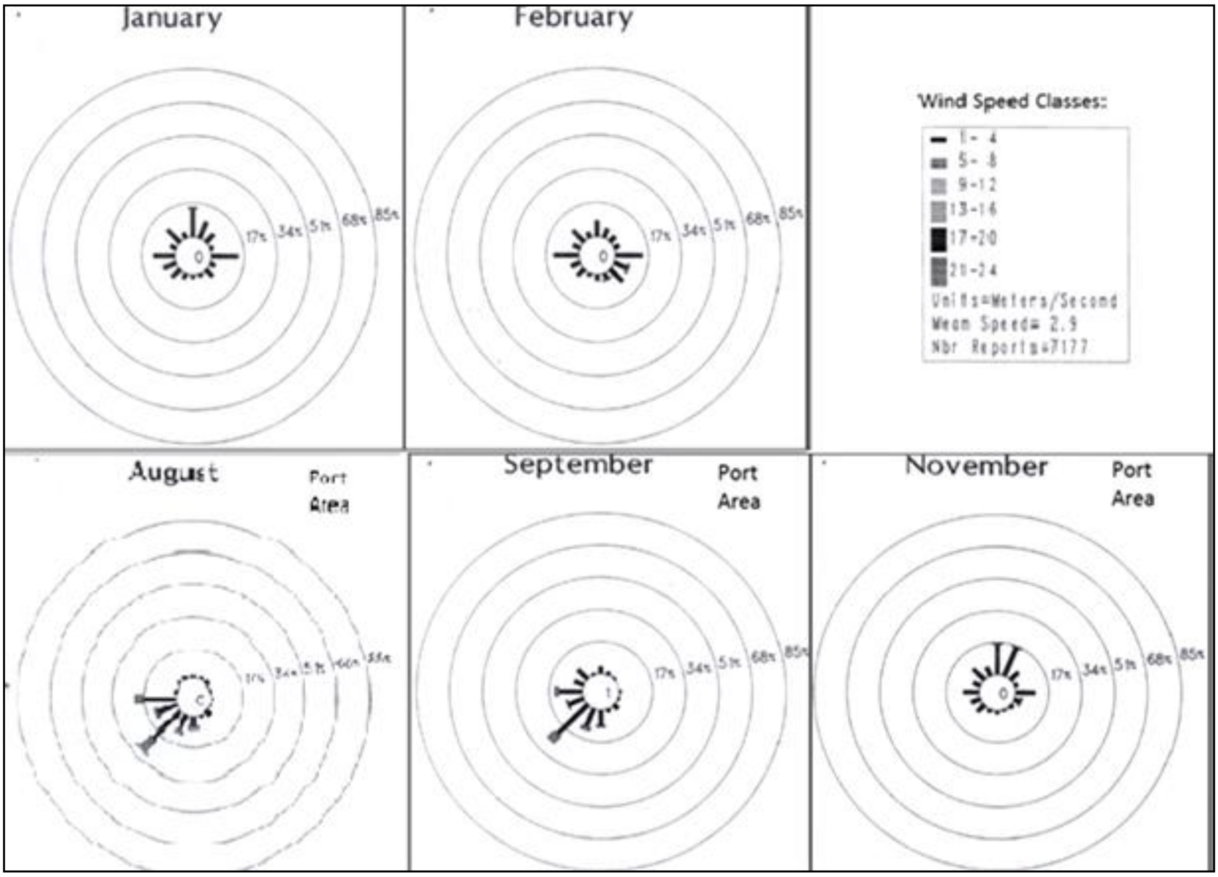


Figure 2-119. January, February, August, September and November Wind Roses (PAGASA Port Area, Manila)

<u>Extreme Recorded Winds</u>:

The highest monthly recorded wind speeds at PAGASA-Port vary from 18 to 56 m/s and 15 to 56 m/s, respectively. The greatest wind speed was recorded at 56 m/s (201.6 km/h) on November 19, 1970. The greatest recorded wind speed was due to passage Typhoon Yoling in November 19, 1970. Based on the new tropical cyclone category of PAGASA, the foregoing greatest recorded wind speeds are within category, Typhoon, with maximum wind speed of 188 to 220 km/h. Maximum wind speeds exceeding 220 km/h are categorized under Super Typhoon.

2.3.1.2.1.5 Cyclone Frequency

The proposed project site is located in a zone wherein about five (5) tropical cyclones pass over the area in 3 years (**Figure 2-120**). From 1948-2016 (period of 68 years) PAGASA determined an annual average of 20 tropical cyclones in the Philippine Area of Responsibility (PAR) with nine of these passing through the Philippine landmasses. Overall, PAGASA tracked 17 tropical cyclones that crossed in Metro Manila from 1948 to 2016 (**Figure 2-121**).

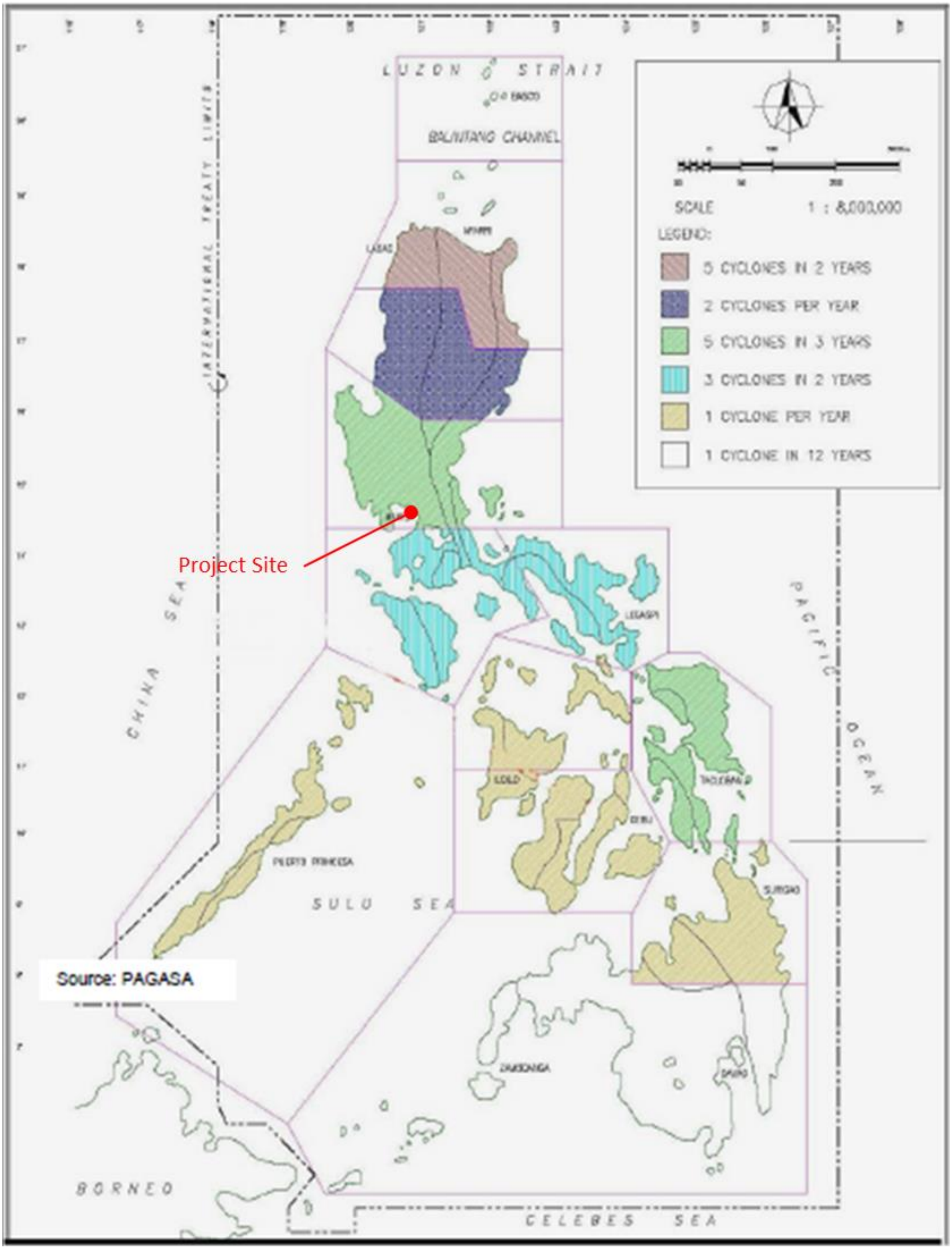


Figure 2-120. Typhoon frequency map

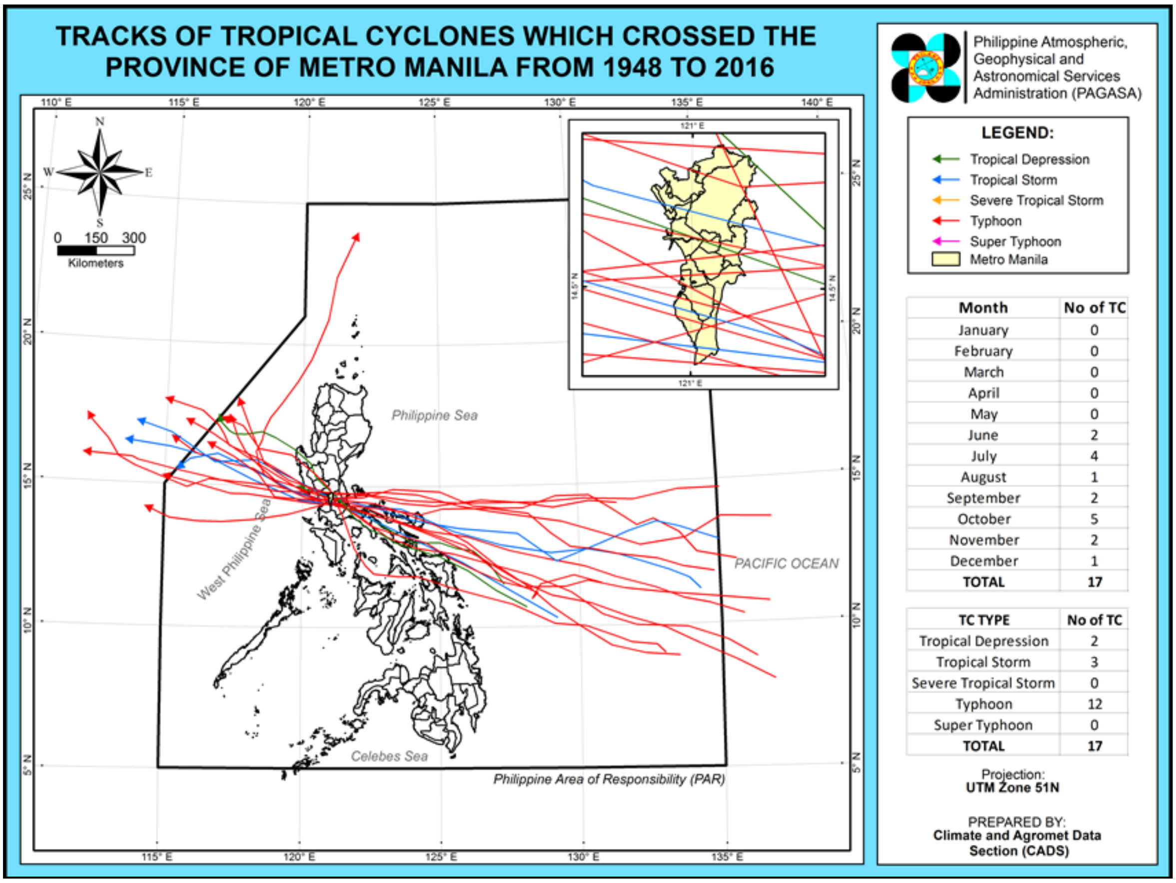


Figure 2-121. Tracks of Tropical Cyclones which Crossed the Province of Metro Manila and from 1948 to 2016

2.3.1.2.2 Greenhouse Gases

Greenhouse gases (GHGs) are gaseous constituents of the atmosphere, either natural or anthropogenic (as a result of human activity), that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. These gases surround the planet preventing the loss of heat into outer space. By trapping the heat, they contribute to the warming of the earth's surface causing changes in weather condition, sea levels, and land use patterns, commonly referred to as "climate change" (IPCC, 2007).

As early as 1991, the Philippines has been proactive in responding to the impact of climate change, which include the reduction of GHG emissions in the atmosphere. As of 2000, the Philippine GHG emission is approximately 32,936.45 Gg of CO_2, 1,968.56 Gg of CH_4 and 43.11 Gg of N_2O as shown in **Table 2-35**.

Table 2-35. Philippine GHG Emissions in Gg (2000)

Sector	CO2, Gg	CH4, Gg	N2O, Gg	*CO2 Emission, Gg
Energy	62,499.10	304.14	2.52	69,667.24
Industrial	8,604.74	0.24	-	8,609.78

Sector	CO2, Gg	CH4, Gg	N2O, Gg	*CO2 Emission, Gg
Processes				
Agriculture	-	1,209.79	37.41	37,002.69
LUFC	(104,040.29)	(46.28)	(0.32)	(105,111.37)
Waste	-	500.67	3.50	11,599.07
Totals	**(32,936.45)**	**1,968.56**	**43.11**	**21,767.41**

Note: CH4 GW Potential – 21; N2O GW Potential-310; * - CO2 + (CH4*21) + (N2O*310)

2.3.1.3 Impact Assessment and Mitigation Measures

2.3.1.3.1 Change in Local Climate

PAGASA projected the medium and long term effect of climate change on the rainfall and temperature of the country. Changes in rainfall pattern and significant changes in local temperature, if not properly incorporated in design, may significantly affect the project such flooding due to under designed drainages. The projected changes in rainfall and temperature pattern in the Project area are discussed below.

2.3.1.3.2 Projected rainfall in 2020 to 2050

The projected decrease and increase of rainfall in the National Capital Region (NCR), during dry and wet seasons, respectively, resembled with the projected trends in the Philippines in 2020 and 2050. In 2020 projection, rainfall appears to decrease during the dry months by 12.8% for months of December to February and 33.3% for months of March to May, but tend to 8.5% increase during the southwest monsoon (June to August). Similarly, the 2050 projection shows a decrease in rainfall by 17.3% to 38.5% for the months of December to May and an increase of 3.7% to 21.3% for the months of July to November and. **Figure 2-122** shows the projected amount of rainfall in the NCR in 2020 and 2050.

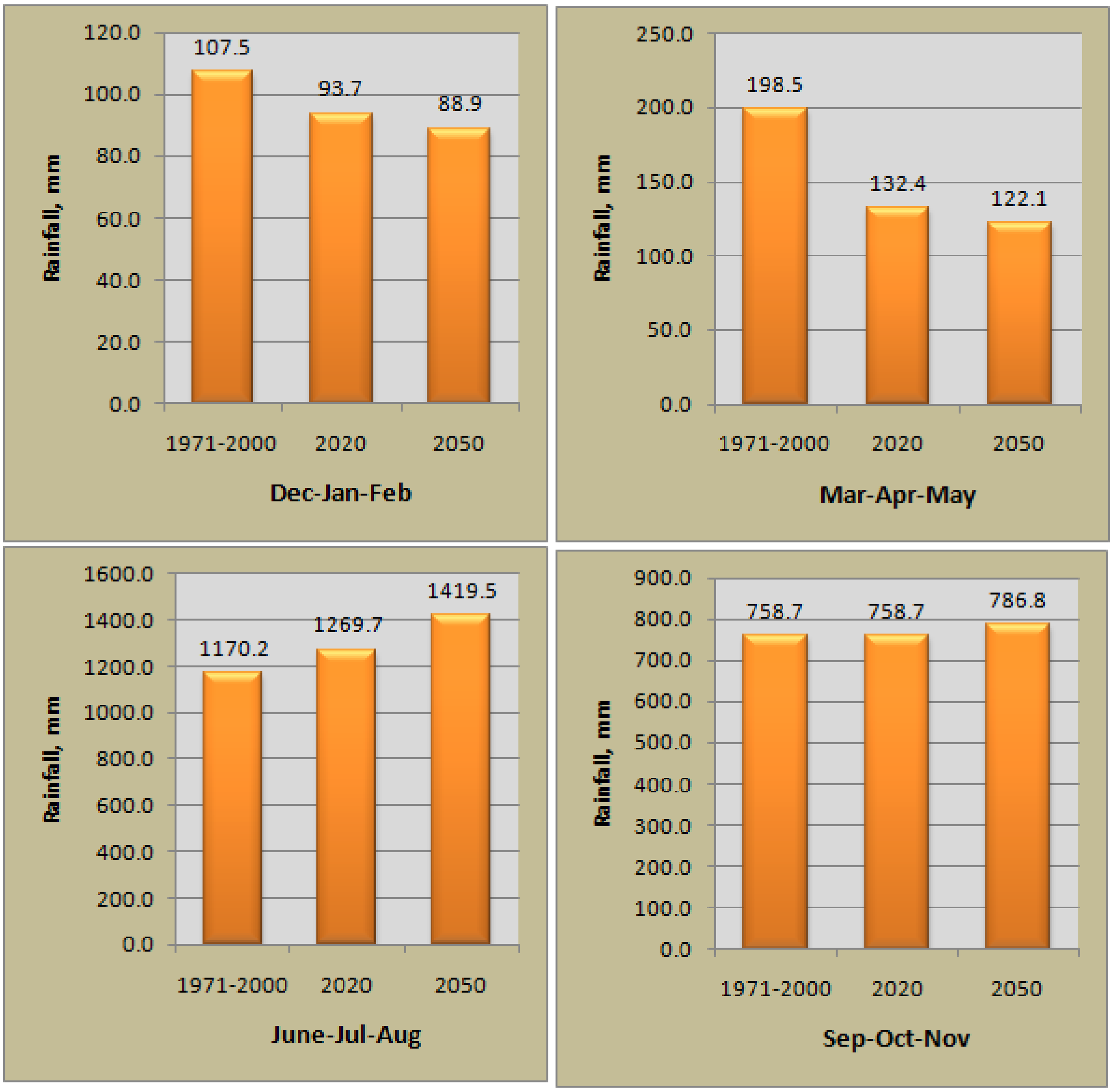


Figure 2-122. Projected change of rainfall in the National Capital Region (NCR) in 2020 and 2050

Projected Extreme Rainfall Events

The projected extreme weather events in 2020 and 2050 were simulated by PAGASA (2011) based on a) increase or decrease of the number of dry days, which is defined as days with rainfall equal or less than 2.5 mm/day, and b) increase or decrease of days with rainfall greater than 200 mm.

In NCR, where the proposed project site is located, there would be decreased of dry days from the baseline years (1971 to 2000) of 7380 days to 6455 days (2006 to 2036) and 6382 days (2036 to 2065) in 2020 and 2050, respectively. In terms of rainfall greater than 200 mm, there would be slight increased of rainfall from 2036 to 2065 (centered at 2050). From 2006 to 2035 (centered in 2020), it appears that there would be no increased on days with rainfall greater than 200 m as compared to the baseline year (1971 to 2000).

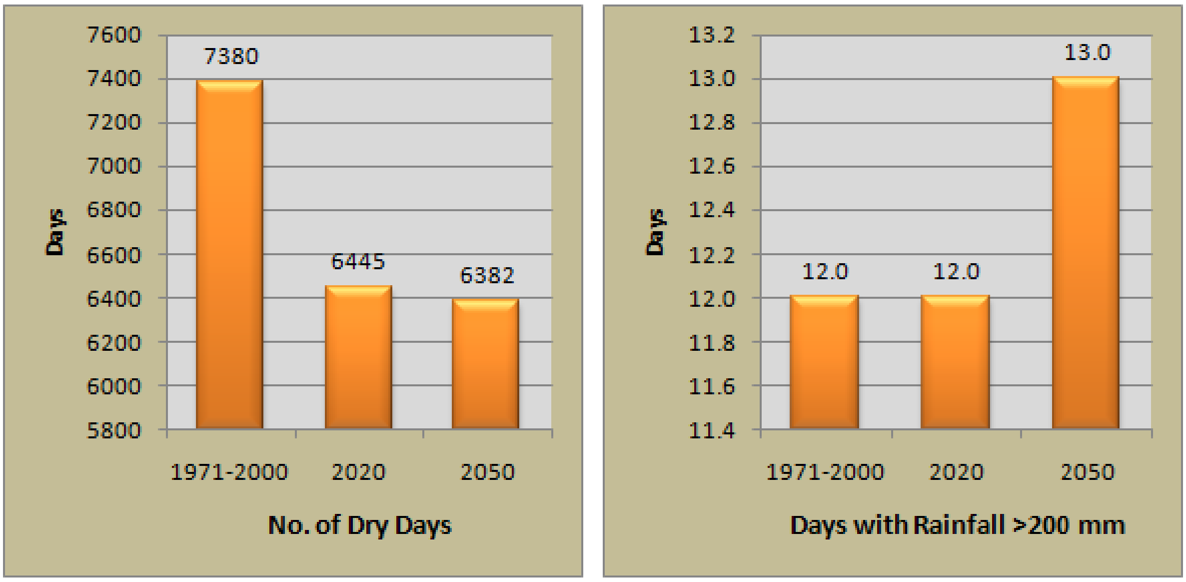


Figure 2-123. Projected number of dry days with rainfall greater than 200 mm in the NCR

<u>Projected Temperature in 2020 and 2050</u>

The climate change scenario for the Philippines published by PAGASA in February 2011 indicated that NCR will have an increase in temperature in 2020 and 2050. The highest increase on ambient air temperature would be during the dry season (about 1 to 1.1 ºC) and from 0.9 to 1.0 ºC in the wet season. PAGASA (2011) noted that increase of ambient air temperature in 2020 and 2050 in the Philippines was generally due to increase of GHG emissions as modelled using increase of GHG at medium-case scenario. **Figure 2-124** shows the projected air temperatures in the NCR in 2020 and 2050.

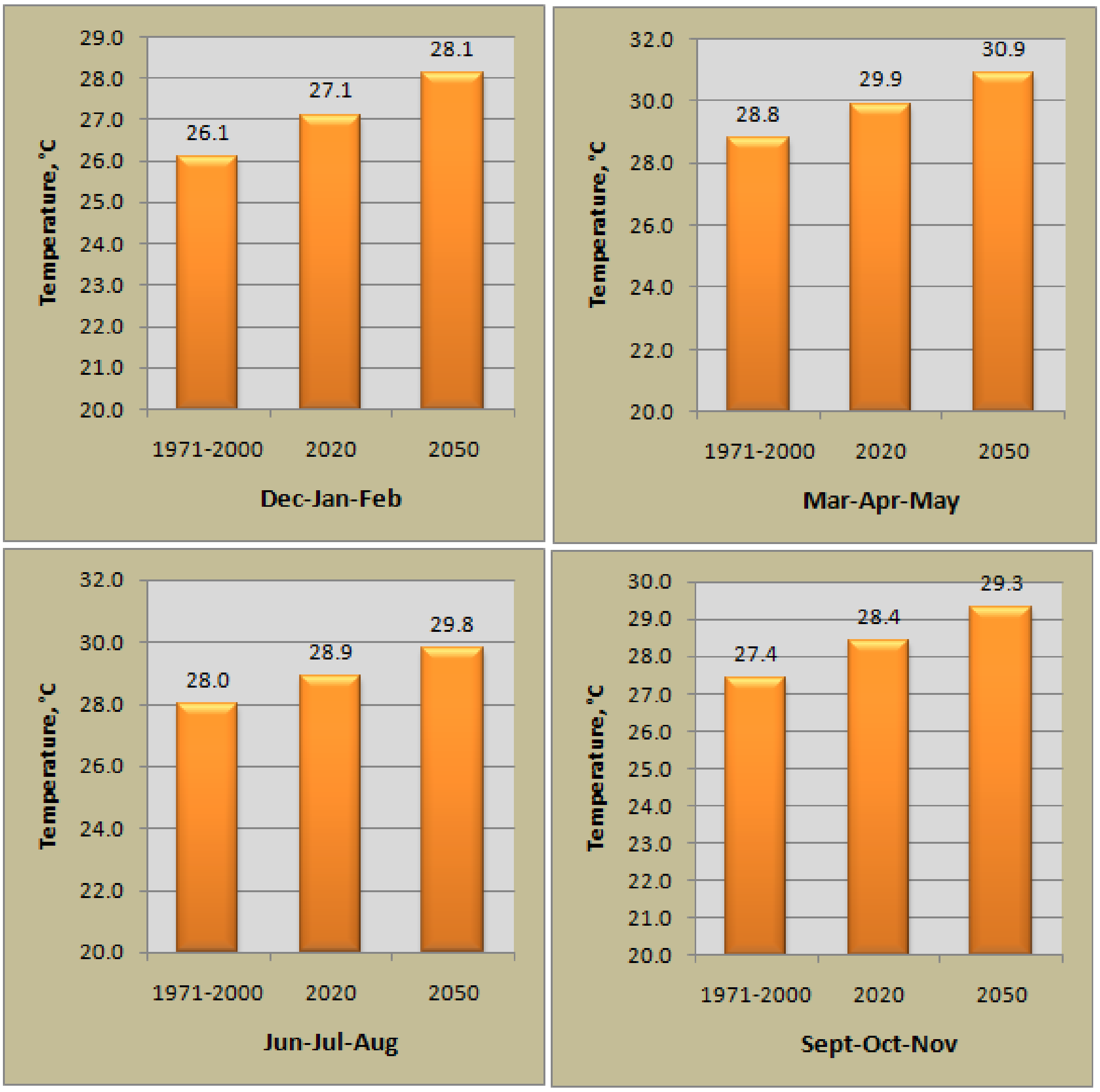


Figure 2-124. Projected change in temperatures in 2020 and 2050 in the NCR

Projected Extreme Temperature Events

It is projected that in NCR, days with air temperatures greater than 35 ºC are will increase by 1,176 and 2,118 days from 2006 to 2035 (centered in 2020) and from 2036 to 2065 (centered in 2050) as compared to the baseline years (1971 to 2000). The projected increase of extreme temperature events was associated with the increase of air temperatures due to increase in GHG emissions under medium-case scenario. **Figure 2-125** shows the projected number of days in NCR with temperature of >35 °C.

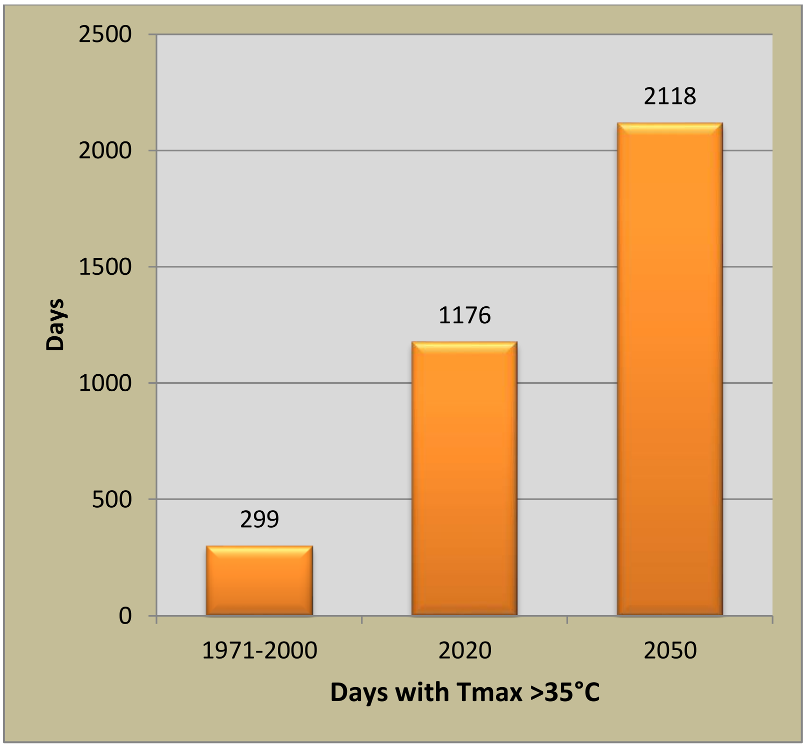


Figure 2-125. Projected Number of Days > 35 ºC in NCR

To mitigate the impacts of climate change in the project, changes in rainfall pattern and significant local temperature changes shall be included in the design criteria of the Project. Material selection and technologies to be used in the Project will take into consideration the effects of micro-climate variations and the effects of extreme temperature changes to the project components.

2.3.1.4 Contribution in Terms of Greenhouse Gas Emissions

The sources of carbon dioxide emission in the project are the fuels used in the operation of heavy machinery and equipment such as dredgers, pile drivers and the barges during its construction. The table below presents the CO_2 emission by source:

Table 2-36. CO_2 Emission by Sources

Equipment	No of Units	Fuel Type	Fuel Consumption per Unit	Capacity per Unit	Duration of Operation per Unit, (hr)	Emission Factor (kg CO_2/L)[2]	Total Calculated CO_2 Emission (MT CO_2) for 100 Million m^3 Fill	Total Calculated CO2 Emission (MT CO_2/yr)[3]
Cutter Suction Dredger (CSD) at Borrow Area[1]	2	Diesel	68,000 L/100 running hours	7,000 m^3/hr	7,143	2.7	26,229.1	7,494
Cutter Suction Dredger (CSD) at Reclamation Site[1]	2	Diesel	68,000 L/100 running hours	7,000 m^3/hr	7,143	2.7	26,229.1	7,494
Split Hopper Barge (SHB) with tugboat[2]	14	Diesel	19,987 L/ 46,000 m^3	46,000 m^3 with cycle time of 4 hrs	622	2.7	117,481.6	33,566
Equipment	**No of Units**	**Fuel Type**	**Fuel Consumption (L/100 km)**	**Assumed Distance Travelled (km/yr)**	**Fuel Consumption (L/yr)**	**Emission Factor (kg CO_2/L)[2]**	**Total Calculated CO2 Emission (MT CO_2/yr)**	
Excavator	4	Diesel	31.6	5,000	1580	2.7	17	
Bulldozer	4	Diesel	31.6	5,000	1580	2.7	17	
Wheel Loader (as front end loader)	4	Diesel	31.6	5,000	1580	2.7	17	
Vibratory Roller (as roller)	4	Diesel	31.6	5,000	1580	2.7	17	
Total Calculated CO2 Emission (MT CO_2/yr)							48,622	

Notes: 1 Specification were taken from Damen Cutter Suction Dredger

2 Specification used were adopted from EIS Report for the 360 Hectares Reclamation Project in City of Pasay

3 Total calculated CO2 emission/year = (total calculated CO2 Emission for 1000 Million m^3 fill) / (3.5 years construction period) (Baseco Feasibility Study Report)

4 Source: Emission Factors for Greenhouse Gas Inventories (last modified: 9 March 2018), US EPA

The construction of the Project is expected to contribute an approximately 0.14 % of the total CO_2 emission based on the 2000 GHG emission data of the Philippines, which is a small contribution to the total anthropogenic CO_2 load. Moreover, this will only be temporary since the construction project will only be 3.5 years. In order to minimize unnecessary CO_2 generation from construction activities, the following measures will be implemented:

- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR standards on vehicular emissions; and
- Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible.

2.3.2 Ambient Air and Noise Quality

2.3.2.1 Ambient Air Quality

This section presents the methodology and results of baseline ambient air quality monitoring conducted in the vicinities of the proposed project, the assessment of the anticipated impacts arising from the construction of the project, and the proposed mitigation measures and monitoring program.

2.3.2.1.1 Methodology

2.3.2.1.1.1 Sampling and Analysis

RHR Consult Services, Inc. (RHR) commissioned the services of Aces Distribution & Consulting Services Inc. (ACES-DCSI) to conduct baseline ambient air quality monitoring within the vicinity of the proposed New Manila Reclamation Project. The ambient air quality monitoring was conducted on August 2, 2018 to measure the 1-hour ambient concentrations of Total Suspended Particulates (TSP), Particulate Matter less than 10 µm (PM_{10}), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2) at five (5) pre-established sampling stations. The table below presents the location and coordinates of the air sampling stations including the date and time of the monitoring. **Figure 2-126** shows location of the air sampling stations with reference to the Project site.

Table 2-37. Location of Air Sampling Stations and Date and Time of Monitoring

Station ID	Location	Coordinates*	Date and Time of Sampling
AQ1	MICT, Brgy. 20, Tondo, Manila	14°36'30.25" N; 120°57'0.69" E	August 2, 2018 1002H – 1102H
AQ2	MICT Access Road, Brgy. 20, Tondo, Manila	14°35'46.16" N; 120°57'13.65" E	August 2, 2018 1133H – 1233H
AQ3	Brgy. Hall, Brgy. 20, Tondo, Manila	14°35'58.34" N; 120°57'51.69" E	August 2, 2018 1304H – 1404H
AQ4	Baseco Brgy Hall, Brgy. 649,	14°35'28.49" N;	August 2, 2018

Station ID	Location	Coordinates*	Date and Time of Sampling
	Tondo, Manila	120°57'40.23" E	1440H – 1540H
AQ5	Luneta Park, Brgy. 653, Manila	14°34'49.12" N; 120°58'27.94" E	August 2, 2018 1603H – 1703H

The ambient air quality monitoring was conducted in accordance to the standard methods of the DENR as prescribed in its AO No. 2000-81, the Implementing Rules and Regulations (IRR) of the Philippine Clean Act of 1999 and the Presidential Decree No. 984 (National Pollution Control Decree of 1976), as amended by NPCC MC No. 1980-002. The collected samples were brought to CRL Environmental Corporation., a DENR recognized laboratory. **Table 2-38** presents the air pollutants and the corresponding methods of sampling and analysis.

Table 2-38. Sampling and analytical procedures used on baseline ambient air sampling

Pollutant	Method of Sampling and Analysis
Total Suspended Particulates (TSP)	High Volume-Gravimetric Method
Suspended Particulates less than 10 µm (PM_{10})	High Volume-Gravimetric Method
Sulfur Dioxide (SO_2)	Impinger-Pararosaniline Method
Nitrogen Dioxide (NO_2)	Impinger -Griess Saltzman Reaction

Wind speed and direction, cloud cover, rainfall and other relevant parameters which describe the weather condition in the area were also recorded at each station during sampling. The wind direction was reported in cardinal directions while wind speed was described using the Beaufort Wind Scale. The system used to describe the sky condition and rainfall was adopted from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA).

Figure 2-126. Location Map of Ambient Air Sampling Stations

Criteria for Assessment of Ambient Air Quality:

The results of ambient air quality monitoring for the proposed Project were compared to the National Ambient Air Quality Standards (NAAQS) set forth in the Philippine Clean Air Act of 1999. The NAAQS for TSP, PM_{10}, SO_2, and NO_2 are presented in **Table 2-39**.

Table 2-39. National Ambient Air Quality Standards (NAAQS) for SO_2, NO_2, TSP, and PM_{10}

Pollutant	Averaging Time (min)	NAAQS[(1)] ($\mu g/Nm^3$)
Sulfur Dioxide (SO_2)	60	340
Nitrogen Dioxide (NO_2)	60	260
Total Suspended Particulates (TSP)	60	300
Particulate Matter less than 10 microns (PM_{10})	60	200

Notes: $\mu g/Nm^3$ – microgram per normal cubic meter
Source: (1) National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999 (DAO 2000-81)

2.3.2.1.1.2 Impact Assessment

As this proposed project will mainly involve reclamation works and that there is no significant stationary source of emissions (e.g., such as power plants), impact assessment involved qualitative description of the expected impacts to the air environment. To mitigate or lessen the anticipated impacts related to air quality, proposed mitigation measures including proposed air monitoring are presented in the succeeding section.

2.3.2.1.2 Baseline Air Quality

The results of sampling for ambient air quality showed that ambient concentration levels of TSP, PM_{10}, SO_2, and NO_2, except for the ambient concentration level of TSP measured at 1,274.6 $\mu g/Nm^3$ in Station AQ3 (Brgy. Hall, Brgy. 20, Tondo, Manila), were within the ambient standards of 300, 200, 340, and 260 $\mu g/Nm^3$, respectively. **Table 2-40** shows the results of baseline ambient air quality monitoring.

The highest concentration level of TSP was recorded in Station AQ3 at 1,274.6 $\mu g/Nm^3$ while the lowest concentration was recorded at Station AQ5 (Luneta Park, Brgy. 653, Manila) at 25.5 $\mu g/Nm^3$. The highest concentration of PM_{10} was also recorded at Station AQ3 at 2.0 $\mu g/Nm^3$ while the lowest concentration was recorded at Station AQ5 at 0.9 $\mu g/Nm^3$. ACES-DCSI noted that high level of particulates at Station AQ3 was due to the fugitive emissions from the continuous vehicular traffic at the intersection MICT access road. Figure 2-127 shows the graphical presentation of the ambient TSP and PM_{10} concentration levels recorded at each sampling station.

The highest concentration of SO_2 and NO_2 was recorded at Station AQ3 at 15.42 µg/Nm^3 and 19.1 µg/Nm^3, respectively. SO_2 was not detected (i.e. <8.58 µg/Nm^3) at Stations AQ1 (MICT, Brgy. 20, Tondo, Manila), Station AQ2 (MICT Access Road, Brgy. 20, Tondo, Manila) and Station AQ5 (Luneta Park, Brgy. 653, Manila). Meanwhile the lowest concentration level of NO_2 was recorded at Station AQ5 at 6.4 µg/Nm^3. Figure 2-128 shows the graphical presentation of the ambient SO_2 and NO_2 concentration levels recorded at each sampling station.

During the sampling, it was noted that the prevailing wind was observed to be from the Southwest with a Beaufort Force of 2 to 3 or equivalent speed of 3 m/s to 4.5 m/s. The ambient temperature ranged from 31.1 ºC to 35.8 ºC. The sky was partly cloudy and no rainfall was recorded.

The ambient air quality monitoring report of ACES-DSCI is presented in **Annex H**.

Table 2-40. Results of Baseline Ambient Air Quality Monitoring (in µg/Nm³)

Station ID	Location	Date /Time of Sampling	Ambient Concentration (µg/Nm³)				Observed Meteorological Conditions				Observations
			TSP	PM_{10}	SO_2	NO_2	Wind Direction	Wind Speed[1]	Cloud Cover	Rainfall	
AQ1	MICT, Brgy. 20, Tondo, Manila	August 2, 2018 1002H – 1102H	56.0	1.4	<8.58	8.4	SW	BF2	Partly Cloudy	None	Passing heavy vehicles were observed during the sampling period
AQ2	MICT Access Road, Brgy. 20, Tondo, Manila	August 2, 2018 1133H – 1233H	80.8	1.3	<8.72	10.6	SW	BF2	Partly Cloudy	None	Passing light and heavy vehicles were observed during the monitoring
AQ3	Brgy. Hall, Brgy. 20, Tondo, Manila	August 2, 2018 1304H – 1404H	1,274.6	2.0	15.42	19.1	SW	BF2	Partly Cloudy	None	The sampling station is located at the middle of MICT access road intersection. Continuous passing of light and heavy vehicles were noted during the monitoring
AQ4	Baseco Brgy Hall, Brgy. 649, Tondo, Manila	August 2, 2018 1440H – 1540H	130.1	1.3	12.88	10.6	SW	BF2	Partly Cloudy	None	Light vehicles and motorcycles were noted to have passed by near the station
AQ5	Luneta Park, Brgy. 653, Manila	August 2, 2018 1603H – 1703H	25.5	0.9	<8.66	6.4	SW	BF3	Cloudy	None	The sampling station is located at the Quirino Grandstand open field. Light vehicles were noted to have passed by from a distant
NAAQS for Specific Air Poutants (60min averaging time) [2]			**300**	**200**	**340**	**260**					

Note:
(1) Buaufort Wind Scale
BF2 – Equivalent speed is 3 m/s; Light Breeze; Wind felt on exposed skin. Leaves rustle, vanes begin to move.
BF3 – Equivalent speed is 4.5 m/s; Gentle Breeze; Leaves and small twigs constantly moving, light flags extend.
Source:
(2) National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999 (DAO 2000-81)

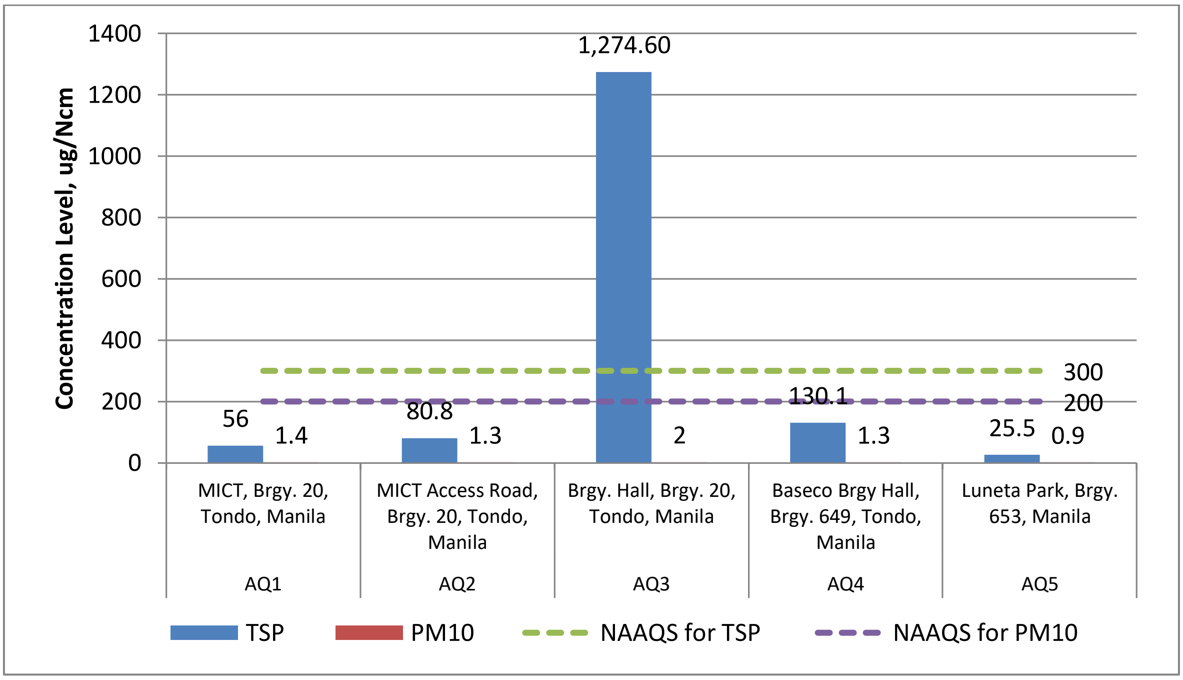


Figure 2-127. TSP and PM_{10} Concentration Levels Recorded at Each Sampling Station

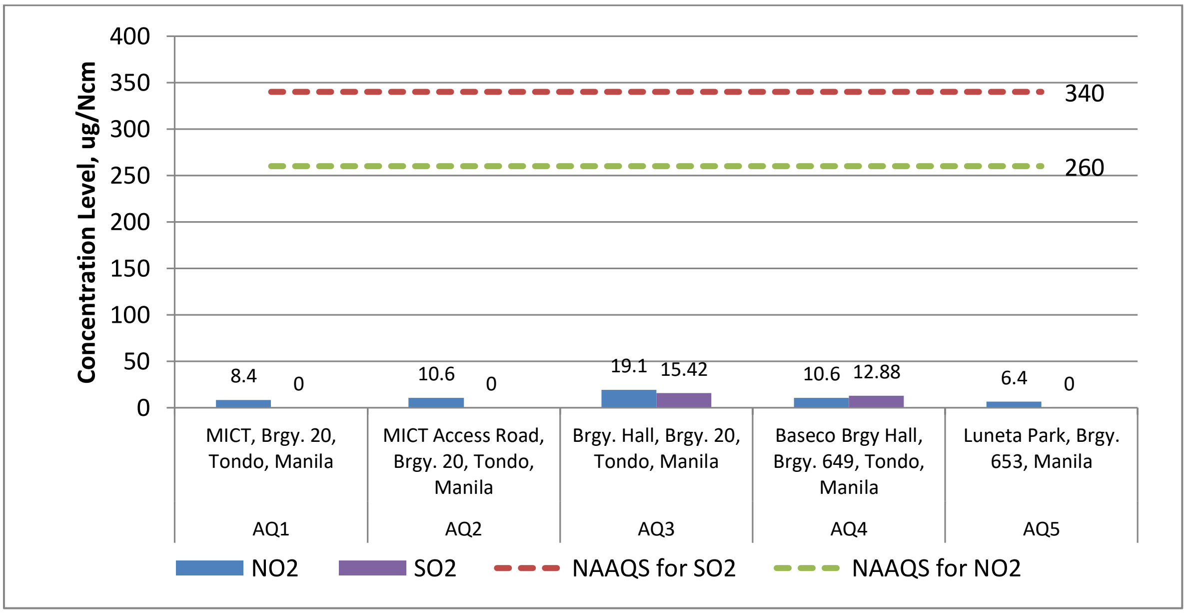


Figure 2-128. SO_2 and NO_2 Concentration Levels Recorded at Each Sampling Station

2.3.2.1.3 Impact Assessment and Mitigation Measures

2.3.2.1.3.1 Pre-Construction and Construction Phase

The construction of the proposed Project will involve dredging of fill materials from the proposed borrow area in San Nicholas Shoal, located within 30 km radius from the project site, filling of the reclamation site, soil improvement and civil works. Such as activities will utilize marine and heavy equipment such as Trailing Suction Hopper Dredger, Backhoe Dredger, Hopper Barge, Tugboat which are expected to generate air pollutants such particulate matter, nitrogen dioxide and carbon monoxide. Vehicles extensively used at construction site will also generate air pollutants, primarily nitrogen dioxide. Air pollutants from these equipment and vehicles can potentially reduce the air quality of the surrounding areas of active construction site. In order to reduce the volume of the air pollutant that will be generated, the use of electrically-powered equipment will be maximized. Also, regular preventive maintenance of heavy equipment, machineries and service vehicles shall be undertaken to keep these equipment, machineries and service vehicles in good working condition for lower emission rate of air pollutants.

Earth works, soil improvement and civil works, and vehicular traffic at the Project area will generate dust which can cause deterioration of air quality at the surrounding areas of active construction sites, especially during windy and dry periods. This impact, however, will only be temporary (i.e. during construction phase only) and can be minimized by the implementation of the following mitigation measures.

a) Frequent water spraying at dry and unpaved reclaimed sites near ASRs, especially during dry periods where fugitive dusts are potentially dispersed by winds;

b) Reduction of wind speeds by installing temporary wind barriers at the area, if necessary. These wind barriers could be strategically located at areas close to the ASRs;

c) Provide wheel washing facilities for vehicles leaving the project site. This wheel washing facility is intended to remove muds from the tires of the heavy equipment and other vehicles, which are potential sources of dust if detached from vehicles traveling outside the project site (e.g., paved or unpaved roads);

d) Impose speed limits within the project site and along access roads. Reduction of vehicular speed will significantly reduce generation of fugitive emissions;

e) If possible, re-route vehicles at considerable distances from the ASRs. This measure (re-routing) is effective means of decreasing release of fugitive emissions to nearby ASRs, especially during very dry conditions where wetting of dry surfaces would be effective for short duration; and

f) Conduct regular visual inspection at the project site (including monthly sampling of TSP, PM_{10}, SO_2, and NO_2) to determine areas with high fugitive emissions, and to implement mitigation measures as necessary.

2.3.2.1.3.2 Operation Phase

During operation phase, it is expected that various locators will invest in the Project. Buildings and other infrastructures will be constructed by different locators within the Project site. Potential pollution at construction sites is typically associated with engine exhausts and dust generation. To avoid adverse environmental impacts, potential locators will be required with ECC and other necessary permits prior to construction and compliance with the conditions of its ECC and permits will be also monitored.

2.3.2.2 Ambient Noise Quality

This section presents a) applicable noise standards and methodology utilized in this study, b) characterization of ambient noise level using DENR standard methods and procedures for sampling and measurement; and c) identification and assessment of the expected impact of the project to existing or background noise levels.

2.3.2.2.1 Methodology

2.3.2.2.1.1 Assessment of Existing Conditions

Sampling and Analysis

RHR Consult Services, Inc. (RHR) commissioned the services of Aces Distribution & Consulting Services Inc. (ACES-DCSI) to conduct baseline noise level monitoring within the vicinity of the proposed New Manila Reclamation Project. The noise level monitoring was conducted on August 2, 2018 to measure the noise levels during daytime at five (5) sampling stations established for ambient air quality monitoring. **Table 2-41** presents the location and coordinates of the noise level monitoring stations including the date and time of the monitoring. **Figure 2-129** shows location of the noise level monitoring stations with reference to the Project site.

Table 2-41. Location of Noise Sampling Stations and Date and Time of Monitoring

Station ID	Location	Coordinates*	Date and Time of Sampling
N1	MICT, Brgy. 20, Tondo, Manila	14°36'30.25" N; 120°57'0.69" E	August 2, 2018 1002H – 1102H
N2	MICT Access Road, Brgy. 20, Tondo, Manila	14°35'46.16" N; 120°57'13.65" E	August 2, 2018 1133H – 1233H
N3	Brgy. Hall, Brgy. 20, Tondo,	14°35'58.34" N;	August 2, 2018

Station ID	Location	Coordinates*	Date and Time of Sampling
	Manila	120°57'51.69" E	1304H – 1404H
N4	Baseco Brgy Hall, Brgy. 649, Tondo, Manila	14°35'28.49" N; 120°57'40.23" E	August 2, 2018 1440H – 1540H
N5	Luneta Park, Brgy. 653, Manila	14°34'49.12" N; 120°58'27.94" E	August 2, 2018 1603H – 1703H

Noise levels were measured using a direct-reading sound level meter (in A-weighing mode). A total of at least fifty (50) readings were recorded in each monitoring station. The arithmetic median of seven (7) maximum-recorded noise levels were determined and compared with the standard.

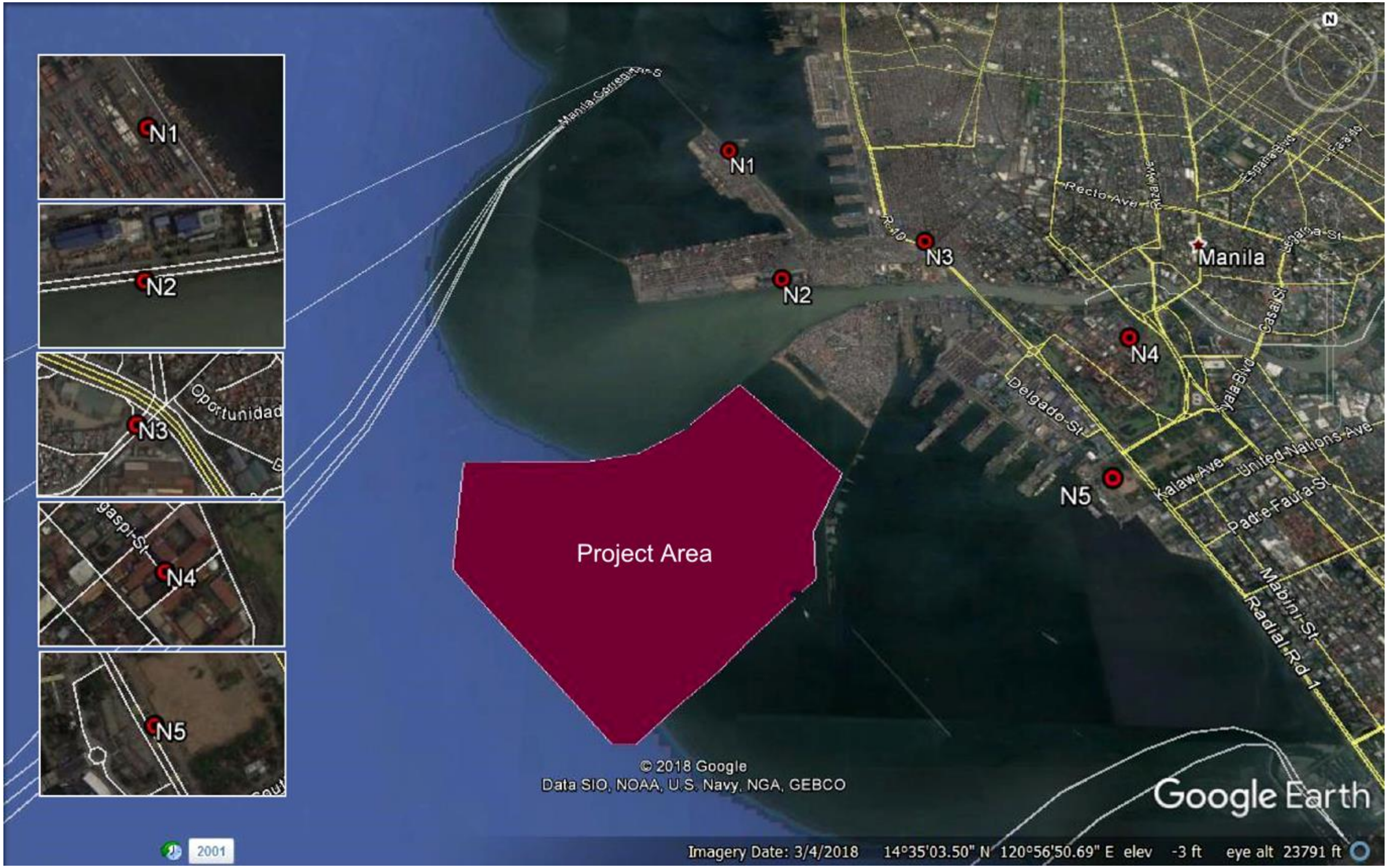


Figure 2-129. Locations Map of Ambient Noise Level Monitoring Stations

Criteria for Assessment of Ambient Noise:

The results of the noise level monitoring were compared with the ambient noise standards established by the then National Pollution Control Commission (NPCC) (now DENR) in 1978 and 1980. **Table 2-42** presents the Environmental Quality Standards for Noise in General Areas as specified in Table 1 of NPCC Memorandum Circular No. 002 series of 1980 (NPCC MC 1980-002).

For the purpose of establishing ambient noise quality standards, areas within any city, region or center of urban living were classified as Class AA, A, B, C and D which are defined below.

Table 2-42. Environmental Quality Standards for Noise in General Areas (NPCC MC 1980-002)

Category of Area	Maximum Allowable Noise (dBA) by time periods		
	Daytime (9:00 A.M. to 6:00 P.M).	Morning/Evening (5:00 A.M. to 9:00 AM/ 6:00 P.M. to 10:00 P.M.	Nighttime (10:00 P.M. to 5:00 A.M).
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

- Class AA- a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged
- Class A - a section of contiguous area which is primarily used for residential area
- Class B - a section of contiguous area which is primarily a commercial area
- Class C - a section of contiguous area reserved as light industrial area
- Class D-a section which is primarily reserved as heavy industrial area

For areas directly facing a public transportation route or an urban traffic artery, the foregoing standards plus a correction factor equivalent to the following were applied:

i – Areas directly fronting or facing a two-lane road …………………….. + 5 dBA
ii – Areas directly fronting or facing a four-lane or wider road ………….. + 10 dBA

Applicable noise standards for construction activities were also specified in NPCC MC 1980-002. These standards specify a maximum noise level that shall be allowed from specific construction activities at a distance of 30 m, as shown in **Table 2-43**.

Table 2-43. Noise Standards for Construction Activities

Classification	Particulars	Maximum Noise Level at 30 meters*
Class 1	Work which requires pile drivers (excluding manual type), pile extractors, reveting hammers or combination thereof. The classification does not include work in which pile drivers are used in combination with earth auger	90
Class 2	Work which requires rock drills, or similar equipment like jack hammers or pavement breakers	85
Class 3	Work which requires air compressor (limited to those compressors which use power other than electric motors with rated with rated output of 15 kW or more). Air compressors power rock drills, jack hammers, pavement breakers are excluded	75
Class 4	Operation involving batching plant (limited to those with a mixer capacity of 0.5 or more cubic meters) and /or asphalt plants (limited to those with mixer capacity of 200 kg or more). Batching plants for the making of mortar are excluded	75

Source: NPCC MC 1980-002

2.3.2.2.1.2 Impact Assessment

A CUSTIC v3.2 noise pollution modeling software was used to assess the expected noise emissions from reclamation and other heavy equipment to be used during reclamation works. Noise input data were estimated based on a) the type and number of equipment to be utilized during reclamation works, b) sound power level of each of the equipment, and c) assumed locations of the equipment in the proposed site. Sound power levels were estimated from the Road Construction Noise Model (RCNM of the U.S. Federal Highway Administration (FHWA) and from related EIA reports that utilized the same type of reclamation equipment.

2.3.2.2.2 Baseline Ambient Noise Levels

The result of ambient noise level monitoring showed that noise level (median of 7 highest readings) in Station N1 (MICT, Brgy. 20, Tondo, Manila) was lower than the NPCC maximum allowable noise level of 75 dBA set for heavy industrial areas during daytime period. Similarly, the noise level at Station N2 (MICT Access Road, Brgy. 20, Tondo, Manila) was lower than the NPCC maximum allowable noise level of 70 dBA set for light industrial areas during daytime period. However, noise level at Station N3 (Brgy. Hall, Brgy. 20, Tondo, Manila), an area classified as light industrial, exceeded the NPCC maximum allowable noise level by 12 dBA. The noted sources of noise in this station were the continuous passing of light and heavy vehicles at the nearby access road and the pedestrians passing nearby.

The noise levels at Station N4 (Baseco Brgy Hall, Brgy. 649, Tondo, Manila) and Station N5 (Luneta Park, Brgy. 653, Manila) exceeded the NPCC maximum allowable noise level of 55 dBA and 50 dBA, respectively, during daytime period. Station was located in a residential area (Class A) while Station N5 was located in an area which requires quietness (Class AA). The noted sources of noise in these stations were the vehicles passing nearby. **Table 2-44** shows the results of baseline noise level monitoring.

The highest noise level was recorded at Station N3 at 82 dBA. This was followed by followed by Station N1 at 75 dBA. The lowest noise level was recorded at Station N5 at 62 dBA. **Figure 2-130** shows the observed noise levels in each monitoring station.

Table 2-44. Results of Noise Level Monitoring

Station ID	Location	Date & Time of Measurement	Noise Level* (dBA)	NPCC Standard			Sources of Noise
				Category of Area	Monitoring Period	NPCC Standard	
N1	MICT, Brgy. 20, Tondo, Manila	August 2, 2018 1002H – 1102H	71	D	Daytime	75	Operational Rubber Time Gantry (RTG) and heavy vehicles passing
N2	MICT Access Road, Brgy. 20, Tondo, Manila	August 2, 2018 1133H – 1233H	65	C	Daytime	70	Passing light and heavy vehicles; pedestrians passing by
N3	Brgy. Hall, Brgy. 20, Tondo, Manila	August 2, 2018 1304H – 1404H	82	C	Daytime	70	Continuous passing of light and heavy vehicles; pedestrians passing by
N4	Baseco Brgy Hall, Brgy. 649, Tondo, Manila	August 2, 2018 1440H – 1540H	68	A	Daytime	55	Frequent passing of light vehicles and moorcycles; children playing near the monitoring station
N5	Luneta Park, Brgy. 653, Manila	August 2, 2018 1603H – 1703H	62	AA	Daytime	50	Passing light vehicles from a distance; passing/jogging pedestrians; rustling of leaves and grass due to wind

Note: Median of 7 Highest Readings (dBA)

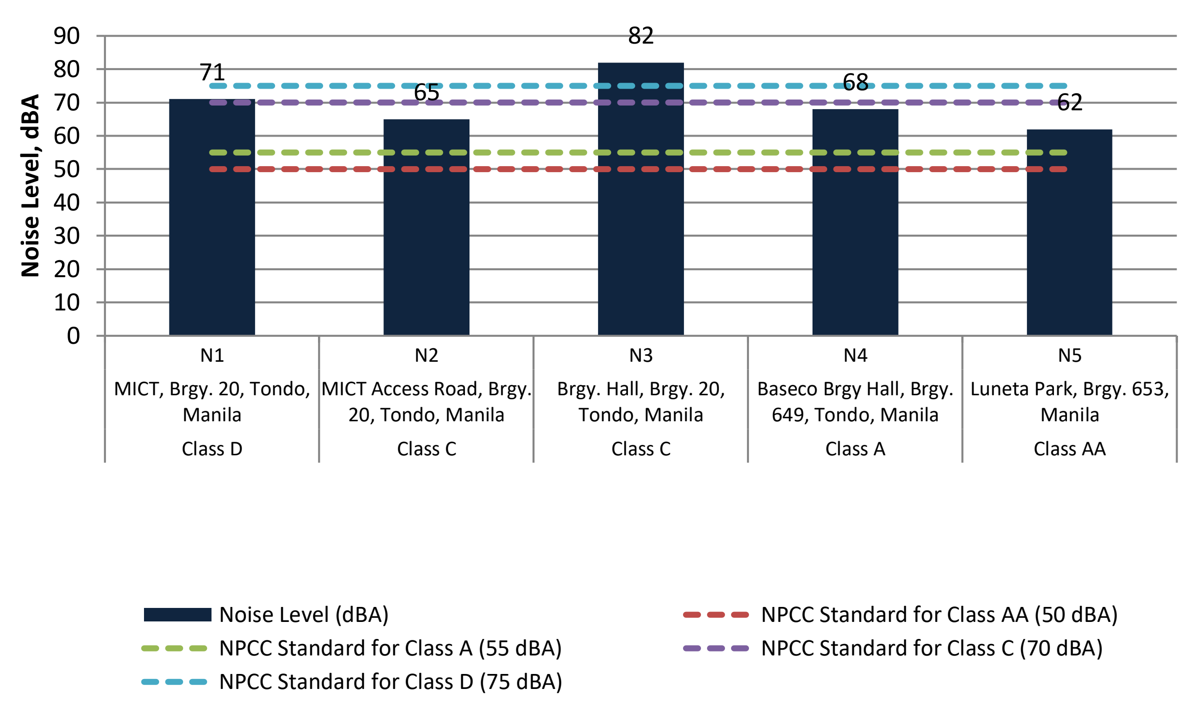


Figure 2-130. Plot of Noise Levels at the Monitoring Stations

2.3.2.2.3 Impact Assessment and Mitigation Measures

Noise from the operation of heavy equipment at the reclamation area may cause disturbance to the local community. To assess the impact significance of noise on the adjoining population, a noise modeling using CUSTIC v3.2 was conducted. The evaluation of impacts based on the noise modeling is presented below.

<u>Input Parameters</u>

The input data used and the assumptions made to execute the simulation of noise propagation during the construction phase of the proposed Project are as follows:

a) Type, number and sound power level of equipment to be utilized during reclamation works

The reclamation equipment to be used during construction phase of the proposed Project and the estimated sound power level and sound level at 50 ft (or 15.24 m) are shown in **Table 2-45**. Sound level data from U.S. FHWA (2006) (**Table 2-45**) were used to compute the sound power level using the following formula.

$$Lw = Lp + 10log(4\pi r^2)$$

where:

Lw = sound power level (in re dBA re 1 PW);

Lp = sound level at distance, r, from the equipment; and

r = distance from the noise source (or 15.24 m)

As there is no available sound level data at various octave band center frequencies (e.g., 16 Hz to 8000 Hz), sound power data were assumed at frequency centered at 1000 Hz. **Annex H-3** shows the noise modeling input data.

Table 2-45. Reclamation equipment and estimated sound pressure and/or power levels

Equipment	No of Units	Spec Lmax (dBA)	Source of Information
Cutter Suction Dredger (CSD) at Reclamation Site	2	(103)	EIA Tai) Sheltered Boat Anchorage (2000)
Split Hopper Barge (SHB) with tugboat	7	(104) 110	EIA Tai) Sheltered Boat Anchorage (2000)
Backhoe Dredger	2	80.0	U.S. FHWA (2006)
Excavator	4	85.0	U.S. FHWA (2006)
Bulldozer	4	85.0	U.S. FHWA (2006)
Wheel Loader (as front end loader)	4	80.0	U.S. FHWA (2006)
Vibratory Roller (as roller)	4	85.0 (108)	U.S. FHWA (2006)

Notes:

1) Sound level (in dBA) at 50 feet (or 15.24 m) unless otherwise specified.
2) Values in parenthesis under column Spec Lmax are sound power level (in dBA re 1PW)

b) Barriers and Foliage

Noise attenuation or reduction due to barriers and foliage such as the existing houses or structures were not included as this case assumed screening modeling. More detailed noise assessment using numerous barriers and foliage may be including later depending on the preliminary noise screening results. Thus, modeling results in this case are expected higher than those considering existing structures as barriers.

Modeling Results and Discussion

Figure 2-131 shows results of the simulation of the propagation of noise from the operation of reclamation equipment. The predicted noise level from equipment was added to the background noise levels to determine the cumulative noise level at the two (2) closest receptors or noise stations (MICT Access Road, Brgy. 20, Tondo, Manila and Brgy. Hall, Brgy. 20, Tondo, Manila) (**Table 2-46**). The results showed a <5 dBA increase in the baseline noise levels. According to the impact categories by Wilson (1986) shown in **Table 2-47**, an increase of <5 dBA in the noise level data have none to minor effects.

Table 2-46. Cumulative noise impact (Predicted plus Background and Median Noise Levels)

Location	Baseline Noise Level, Median of 7 Highest Readings (dBA)	Predicted Noise Level from the Operation of Reclamation Equipment (dBA)	Cumulative Noise Level (dBA)
MICT Access Road, Brgy. 20, Tondo, Manila	65	30.83	65.001
Brgy. Hall, Brgy. 20, Tondo, Manila	82	20.55	82.000

Table 2-47. Noise Level Increases and Corresponding Impact Categories (Source: Wilson, 1986)

Category	Increase (dBA)	Effect
I	< 5	None to Minor
II	5 to 10	Moderate
III	> 10	Significant to Severe

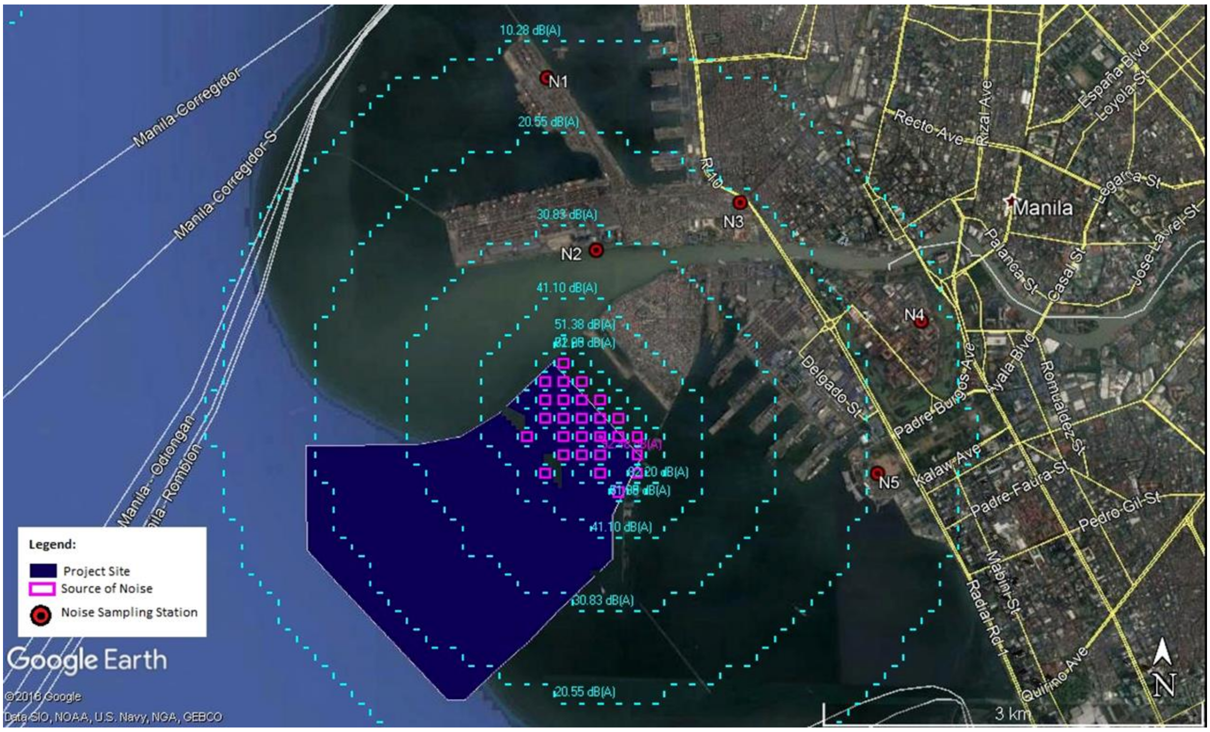


Figure 2-131. Predicted Noise Levels (in dBA)

Mitigation measures in the form of good site practices will be taken to reduce noise levels generated by the construction activities, such as:

- All machinery will be maintained in accordance with the original manufacturer's specifications and manuals to avoid excessive noise, vibration and vehicle exhaust pollution. Regular maintenance of equipment and engines as per manufacturers requirements will be carried out

- Conduct reclamation works during nighttime at the project area relatively far from the Barangay Baseco.
- Reduce the number of equipment to be operated at nighttime and inform the residents and barangay officials prior to the conduct of reclamation works, especially if equipment need to be operated near residential areas.

Monitor noise levels especially at nighttime periods (10:00 P.M. to 5:00 P.M) at residences closest reclamation works

2.4 People

The study focuses on the impact areas of the proposed project. Manila City is considered the indirect impact area based on the social impacts the project may induce. On the other hand, Barangay 649 is deemed as direct impact areas where the project components are to be located near. The following sections present the demographic and socio-economic profile of the impact areas as well as the issues/concerns/possible impacts regarding the project and corresponding proposed mitigation/enhancement measures.

2.4.1 Methods

Various methods were employed in gathering information on the socio-economic conditions and perceptions of the impact community. The summary and details of these activities/methods presented in the following table and sections, respectively:

Table 2-48. Public Participation Activities conducted for the Project

Activity	Date	Location / Venue	Participants
1. Requirements Prior to the Public Scoping:			
a. Focus Group Discussion	May 9-11	Barangay 286 Barangay 649	23
b. IEC Activity	May 9-11, June 1, 4, & 6, 2018	City of Manila: 1. Brgy 20 2. Brgy 275 3. Brgy 286 4. Brgy 653 5. Brgy 649 6. Government Agencies 7. Business Establishments 8. Religious Institutions 9. Educational Institutions	1. Barangay 20, 275, 286, 653, 649 LGUs; 2. Intramuros Administration 3. National Parks Development Committee (NPDC) – Luneta Admin 4. Philippine Coast Guard HQ 5. Philippine Coast Guard NCR 6. Philippine Coast Guard Marine Environmental Protection Unit 7. Pasig River Rehabilitation Commission – Baseco Field Office 8. Samahang Magkakapitbahay ng

Activity	Date	Location / Venue	Participants
			Valderama– Brgy 286 9. Manila Ocean Park 10. Hotel H20 11. Pres. Corazon C. Aquino High School 12. Herminigildo J. Atienza Elementary School
c. Initial Perception Survey	May 10-11, 2018	City of Manila: 1. Barangay 286 2. Barangay 653 3. Barangay 649	 33 12 55
2. Public Scoping	July 2, 2018	Tamayo Restaurant, General Luna cor. Anda St., Intramuros, Manila	80 participants 27 stakeholder groups / sectors
3. Perception Survey			
4. Public Hearing			

2.4.1.1 Requirements Prior to the Public Scoping

In compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System, Focus Group Discussion (FGD), Information and Education Campaign (IEC) and Initial Perception Survey were conducted as part of the requirements for the Public Scoping.

2.4.1.1.1 Focus Group Discussion

Focus Group Discussion (FGD) Activities on the New Manila Reclamation Project were conducted on May 9-11, 2018 (Wednesday-Friday) in several Impact Barangays that were initially identified.

The participants for the FGDs were from the Informal Settlers sector, who, as per initial data gathering are the foremost sector in the Impact Areas in terms of number. Two barangays were selected for the FGD. These are Barangays 286 and 649 which were initially identified as being among the nearest to the proposed project's site.

The number of participants were 15 and 8, respectively, totaling to 23 overall. Four (4) Personnel were engaged in conducting the FGD proper.

Figure 2-132. Photo documentation during FGD

Comments, Issues and Concerns, and Suggestions Raised during the IEC are presented in this EIA Report.

2.4.1.1.2 IEC Activity

In compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System, Information and Education Campaign (IEC) Activities on the New Manila Reclamation Project were conducted on May 9-11, 2018 (Wednesday-Friday), and June 1, 4, and 6, 2018 (Friday, Monday, Wednesday) in several Impact Barangays that were initially identified, as well as concerned Government Agencies, Business Establishments, and Institutions that were initially identified.

The IEC Activities conducted were the following:
1. Courtesy Calls and Consultations;
2. Discussions with Key Stakeholders and Stakeholder Representatives;
3. Distribution of Brochures; and
4. Placements of Posters in Strategic Areas

These were held in barangay halls, residences, stores and work areas in the following five (5) Barangays:
1. Barangay 20
2. Barangay 275
3. Barangay 286
4. Barangay 653
5. Barangay 649

as well as with the following concerned Government Agencies and Interest Groups, Business Establishments, and Institutions and Interest Groups within and near the Impact Areas:
1. Intramuros Administration
2. National Parks Development Committee (NPDC) – Luneta Admin
3. Philippine Coast Guard (PCG) HQ
4. Philippine Coast Guard (PCG) NCR
5. Philippine Coast Guard (PCG) Marine Environmental Protection Unit (MEPU)

6. Pasig River Rehabilitation Commission (PRRC) – Baseco Field Office
7. Samahang Magkakapitbahay ng Valderama (SMV) – Brgy 286
8. Manila Ocean Park
9. Hotel H20
10. Pres. Corazon C. Aquino High School
11. Herminigildo J. Atienza Elementary School

The content of the IEC Discussions and material were on the following:

1. Project Information
2. Information on the EIA Process

There were eight (8) Personnel involved in conducting the IEC activities.

As these were just the initial IEC Activities held, more in-depth and broad activities are lined up in the following days and months up to until, during, and even following the completion of the project.

Alongside and prior to the aforementioned activities, a series of consultations, meetings, and communications with regards to the project were conducted with several concerned Government Agencies by the proponent which yielded a Memorandum of Understanding (MOU) with and Letter of No Objections from the following:

1. Philippine Reclamation Authority (PRA)
2. Philippine Ports Authority (PPA)
3. Department of Tourism (DoT)
4. Bureau of Fisheries and Aquatic Resources (BFAR)
5. Department of Health (DoH)
6. Department of Public Works and Highways (DPWH)

Comments, Issues and Concerns, and Suggestions Raised during the IEC are presented in this Chapter.

2.4.1.1.3 Initial Perception Survey

An Initial Perception Survey on the New Manila Reclamation Project was conducted in Compliance to DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System.

This activity was conducted on May 10-11, 2018, Thursday to Friday, for a duration of 2 Days.

The venues of the Survey are in the barangay hall and residences, stores and work areas in the impact Barangays in the Project. There were three (3) Barangays overall selected for Sampling of the Perception Survey, namely Brgy. 286, Brgy. 653, and Brgy. 649.

The number of enumerators who facilitated the Perception Survey were five (5) personnel.

The Survey Methodology used was Purposive Sampling, wherein the selection of the respondents was based on their representation of the different Sectors in their community. The other respondents randomly selected are residents, albeit ensuring that only one per household is selected, of different genders, and that ages, although limited to adults (18 years old and up) are not of a narrow range.

In case of Brgy. 649, seven (7) sections were sampled, namely: 1. Seawall, 2. Block 1 Aplaya, 3. Block 1 Gasangan, 4. Block 1 Dubai, 5. Block 15, 6. Gawad Kalinga Site, 7. Habitat/Site.

An assigned number of 100 Total Number of Persons (Pax) was designated to serve as the 100% of the Respondents. The assigned Distribution are as follows:

The Distribution of Pax per Barangay is different per barangay depending on the household density based on ocular inspection

- Brgy. 286 = 33 Pax
- Brgy. 653 = 12 Pax
- Brgy. 649 = 55 Pax
  - Seawall = 13 Pax
  - Block 1 Aplaya = 16 Pax
  - Block 1 Gasangan = 7 Pax
  - Block 1 Dubai = 5 Pax
  - Block 15 = 4 Pax
  - Gawad Kalinga Site = 4 Pax
  - Habitat Site = 6 Pax

Comments, Issues and Concerns, and Suggestions Raised during the IEC are presented in his Chapter.

2.4.1.2 Public Scoping

The Public Scoping of the proposed New Manila Reclamation Project was held on the 2nd of July 2018 (Monday) Tamayo Restaurant, General Luna cor. Anda St., Intramuros, Manila. The program proper started at 9:00 am and finished at 10:50 am. In attendance were at least 80 representatives of 27 stakeholder organizations and/or sectors.

The issues and concerns during public scoping were summarized in this Report.

2.4.1.3 Review of Secondary Data

Socio-demographic and economic data were procured from pertinent documents from respective government institutions such as City and Provincial LGUs, as well as online sources for background information. All sources were exhausted in the study. The latest available documents provided by LGUs and agencies are listed in **Table 2-49**.

Table 2-49. List of References Used in the Study

Document	Date	Source	Impact Area Covered	
			Manila City	Barangay 649
Manila Comprehensive Land Use Plan and Zoning Ordinance (2005-2020)	2005-2020	Manila City	✓	
Barangay 649 State of Barangay Governance (2016)	2016	Barangay 649	✓	✓
Census of Population and Housing (2015)	2015	National Statistics Office	✓	
Marine Vessel Traffic Report of Manila Bay	January-July 2018	Philippine Ports Authority	✓	

RHR CONSULT SERVICES, INC.
9999-A Mt. Pulog Street, Los Baños Subd.
College, Laguna, Philippines 4031
Tel/Fax (049) 536-7480

OFFICE OF THE SECRETARY
RECEIVED
BY:
TIME: 10:10
DATE: 05-09-18
MANILA CITY HALL

08 May 2018

Hon. Joseph Marcelo Ejercito Estrada
Manila City Mayor
Padre Burgos Ave, Ermita, Manila

Attention : City Planning and Development Office

Subject : Request for Comprehensive Land Use Plan, Ecological Profile, Socio-economic Profile and other pertinent documents

Dear **Mayor Estrada:**

Greetings!

We are currently gathering baseline for the sociological and bio-physical study of the City of Manila for the Environmental Impact Assessment (EIA) Study of the proposed **407-Hectare Reclamation/Restoration Project in the City of Manila**. In line with this, we would like to request/purchase a copy of the **Comprehensive Land Use Plan, Ecological Profile, Socio-economic Profile and other pertinent documents** that you may find helpful in our study.

E-copy may be more convenient for both our offices and will be very much appreciated.

Looking forward for your favorable response.

Respectfully,

Ryan Filiberto P. Botengan
Managing Director
RHR CONSULT SERVICES, INC.

CPDO
RECEIVED
10:12

Figure 2-133. Letter request for CLUP, Socio Economix Profile and other Pertinent Documents to the City Planning and Development Office of Manila City

Figure 2-134. Document covers / pages obtained from LGUs for the review of secondary data: Left – Comprehensive Land Use Plan of Manila City (2005-2020), Right – Barangay Profile of Barangay 649 (2016)

2.4.1.4 Perception Survey

Section 2.4.2.4 presents the summary of Perception Survey conducted for the proposed project.

The venues of the Survey are in the barangay hall and residences, stores and work areas in the impact Barangays in the Project. Barangay 649 in Baseco, Manila the impact barangay of the Project, was selected for the sampling of the Perception Survey.

The number of enumerators who facilitated the Perception Survey were 5 personnel. The Survey Methodology used was Purposive Sampling, wherein the selection of the respondents was based on their representation of the different Sectors in their community. The other respondents randomly selected are residents, albeit ensuring that only one per household is selected, of different genders, and that ages, although limited to adults (18 years old and up) are not of a narrow range.

Seven (7) sections were sampled in Barangay 649, namely: 1. Seawall, 2. Block 1 Aplaya, 3. Block 1 Gasangan, 4. Block 1 Dubai, 5. Block 15, 6. Gawad Kalinga Site, 7. Habitat/Site.

An assigned number of 119 Total Number of Persons (Pax) was designated to serve as the 100% of the Respondents. The assigned Distribution are as follows:

- Brgy. 649 = 119 Pax
- Seawall = 28 Pax
- Block 1 Aplaya = 35 Pax
- Block 1 Gasangan = 15 Pax
- Block 1 Dubai = 11 Pax
- Block 15 = 9 Pax
- Gawad Kalinga Site = 9 Pax
- Habitat Site = 13 Pax

Figure 2-135. Photo Documentation of Perception Survey

2.4.1.5 Focus Group Discussion

The participants for the FGDs were from the Informal Settlers sector, who, as per initial data gathering are the foremost sector in the Impact Areas in terms of number. Two barangays were selected for the FGD. These are Barangay 649 which were initially identified as being among the nearest to the proposed project's site.

Figure 2-136. Photo Documentation of Focus Group Discussion

2.4.1.6 Key Informant Interviews

Key Informant Interview (KII) was also used primarily to provide an in-depth discussion on the condition of the community and to determine the perceptions and interests of several groups in the host barangays. This was administered to the knowledgeable and influential people in the locale. Among those interviewed were Barangay Officials of the Direct Impact Barangay.

2.4.2 Results

2.4.2.1 Requirements Prior to the Public Scoping

In compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System, Focus Group Discussion (FGD), Information and Education Campaign (IEC) and Initial Perception Survey were conducted as part of the requirements for the Public Scoping. The following table summarizes the results of the FGD, IEC and Initial Perception Survey:

Table 2-50 Results of the FGD, IEC and Initial Perception Survey

	FGD	IEC	Initial Perception Survey
Biggest Problem the Barangay is currently facing	-	-	1. Cleanliness / Sanitation 2. Peace and Order 3. Livelihood 4. Health 5. Education 6. Water supply 7. Corruption 8. Vices of youth
Respondents fear in the establishment/ running of the project	-	-	1. Displacement of residents 2. Loss of livelihood 3. Accidents/disasters 4. Increase in crime
Perceived Positive Impacts of the Project	1. Housing projects 2. Livelihood 3. Development of Surroundings	-	-
Perceived Negative Impacts of the Project	1. Environmental degradation 2. Water pollution 3. Soil erosion 4. Dislocation/Demolition 5. Traffic 6. Change in lifestyle 7. Increase of crime	1. Dislocation of residences 2. Lack of prospect for concrete and meaningful benefits to community residents as Stakeholders 3. Lack of Information on the project 4. Access to channels and routes	-

	FGD	IEC	Initial Perception Survey
		5. Resource Access and Preservation 6. Provision of Facilities 7. Compliance with Law and other Requirements	
Suggestions about the Project	1. Provide employment 2. Provide Relocation 3. Stop the project 4. Choose another location for the project 5. Do not construct on the sea 6. Consultation with the community 7. Develop the barangay		1. Public Consultation 2. Information Dissemination on Activities regarding the Project 3. Do not continue the project 4. Develop/ improve the surroundings

2.4.2.2 Public Scoping

The Public Scoping of the proposed New Manila Reclamation Project was held on the 2nd of July 2018 (Monday) Tamayo Restaurant, General Luna cor. Anda St., Intramuros, Manila. The program proper started at 9:00 am and finished at 10:50 am. In attendance were at least 80 representatives of 27 stakeholder organizations and/or sectors.

At 9:00 am, the program commenced with an announcement from the facilitator Carl Louie Santiago, followed by a prayer and the singing of the Philippine National Anthem. After which, Diana Espinosa, Chairwoman of Brgy. 649, gave her welcome remarks and was followed by a brief introduction of participants. Engr. Carlo Vic Arida of DENR-EMB then provided the Overview, Objectives and Procedures of the Public Scoping, and also presented the Environmental Impact Assessment (EIA) Process to the body.

EIA Preparer, Jess Addawe, presented and discussed the proposed New Manila Reclamation Project on behalf of the Proponent. After the project presentation, the floor was opened for the Open Forum, during which a total of 36 issues and concerns were raised by 15 participants, with Manuel Quijada of the Proponent's Design Consultant, Jess Addawe of the Proponent's EIA Preparer, Engr. Cristina L. Echon of Manila City's LGU and Engr. Arida of DENR-EMB taking turns in responding to each of the raised issues and concerns.

Engr. Arida closed the Open Forum acknowledging the body's participation and summarizing the issues and concerns raised. Engr. Echon addressed the same with a closing remark which formally ended the activity.

Filipino was the primary language used during the activity, and complementing this was English as the secondary language used. Visual presentations were utilized, and pamphlets detailing the project were distributed to the participants during the registration, to aid in the presentations and discussions. Snacks and Drinks were distributed to the participants. There were no negative incidences and the general atmosphere throughout the course of the activity was cordial and warm.

The table below summarizes the issues and concerns raised during the Open Forum:

Table 2-51. Issues and Concerns Raised during Public Scoping

Name	Issues raised	Response
PROJECT DESCRIPTION		
Edgardo B. Alvinez (The Manila Hotel)	• Timeline of ECC; Start of reclamation?	• Application (timeline) depended on the proponent

Name	Issues raised	Response
	• Impact on power supply	• Have individual source of power supply • Project will have its own substation
Mark Evidente (Heritage Conservation Society)	• Vertical development to be included in the EIA • Systemic problems from the projects	• Another ECC application for the vertical development • 5 reclamation presently considered before the ECC application
Joven Pajora (Bgy 275)	• Access road; projects not indicated that could affect Farola? • only one egress and ingress based on the presentation	• 3 access points for exit and entrance to prevent traffic congestion
Baseco PO - Kabalikat - Jeorgue Tenolete	• Manila Mandamus	• Will be included in the study
Captain Rogelio P. Taruc - Manila Pilot	• Source of filling materials?	• One of the potential sources is San Nicolas Shoal; borrow fill is through barge directly into the reclamation site
Mirna Rodriguez, DPWH-NCR	• 3 proposals for the accessibility of the area? Where?	• Noted.
Mirna Rodriguez, DPWH-NCR	• Why is Manila Bay Coordinating Council and the representative of the Senate not invited?	• Manila Bay Coordinating Council was not able to attend. • Representative of the Senate is present.
LAND		
Edgardo B. Alvinez (The Manila Hotel)	• No impact on traffic along Roxas Blvd.? • Impact on flooding, near Manila Hotel	• All logistics will come/be transported on the seawater • Open ditch; catchment and drainage; sewage treatment plant
Baseco PO - Kabalikat - Jeorgue Tenolete	• Include in the study the earthquake •	• Will be included in the study
Atty Levy Ordonez,	• Is the reclaimed area	• Joint venture with the city of

Name	Issues raised	Response
Director III Rep. of Senate	Alienable and Disposal?	manila. Still in discussion between the two.
Brgy. 649 – Kagawad Markdolph J. Navalta	• Waste disposal impacts on Manila Bay (aquatic life) and the community	• Most of the establishment have no permit • The project has centralized sewage treatment plant; guaranteed discharge within the standards
Mirna Rodriguez, DPWH-NCR	• Reclamation will block all drainage that could cause flooding in Las Pinas	• Not knowledgeable of the opposition of Sen. Villar on the project • MBCO as resource person of DENR
WATER		
Edgardo B. Alvinez (The Manila Hotel)	• Waste impact on aquatic life	• Wastes from sewerage harm the environment; the project will discharge water within the standards of DENR
Mark Evidente of the Heritage Conservation Society	• Impacts upstream of the rivers	
Atty Levy Ordonez, Director III Rep. of Senate	• Effect on the navigable waters?	• 100% guaranteed no effect on navigation and channel based on hydraulic study
Jane Galleto – PPA PMO NCR South	• Existing breakwater to be part of the project? • Consider international ports	• Considered
	• Hazardous equipment impacts on the water quality and historic / aesthetic value of the area	• Will replicate what's done in Singapore where water is clean and maintained.
Chairman of Barangay 286 Alberto B. Loresto	• Is project size part of the study on water displacement as the project is near the mouth of Pasig River	• Considered in the hydraulic study modeling EIA Study • Under hydrogeology module which includes modeling; will be the basis of EMB in the issuance of ECC

Name	Issues raised	Response
Mark Evidente of the Heritage Conservation Society	• Flow analysis of bay / study on impact of drainage to the community to be included in the EIA • Laguna Bay and Pasig river	• Direct and indirect impact areas (Laguna Bay and Pasig River)
PEOPLE		
Chairwoman Diana Espinosa (Brgy. 649)	• Job opportunity • Displacement of barangay residents	• More than 2000 employees needed for the project • No effect on the barangay, operations on the seawater; all equipment will pass through the seawater
Kagawad Rey Campanera (brgy. 649 Baseco)	• Threat of hazards in the community • Mitigation measures to be conducted?	• Included in the EIA Study, including hazards
Mark Evidente of the Heritage Conservation Society	• Improvement of the Baseco Community • Cleared and open Manila bay to preserve historical value of the area	• Historic – under People Module of the EIA Study
Baseco PO - Kabalikat - Jeorgue Tenolete	• Social preparation for the community; • Include in the development of the community	• Noted
AAM GM Henry P. Guntinos	• Fishing grounds affected by the equipment, ex. Compactor • Aid for the fisherfolk?	• Part of the EIA Study
Elmen Garcia – Baseco resident	• Plan for aplaya residents	• No effect on aplaya

2.4.2.3 Review of Secondary Data

2.4.2.3.1 Demographic Profile

2.4.2.3.1.1 Manila City2

Based on the 2015 Census of Population and Housing (CPH), the City of Manila, a highly urbanized city in the National Capital Region, posted a total population of 1,780,148 persons as of August 1, 2015. This is larger by 127,977 persons compared to its total population of 1,652,171 persons counted in the 2010 CPH. The increase in the population count from 2015 to 2000 translated to an average annual population growth rate (PGR) of 0.78%.

The total population of the City of Manila from 1903 to 2015 is shown in **Figure 2-137**.

Table 2-52. Total Population of Manila City, 2000-2015

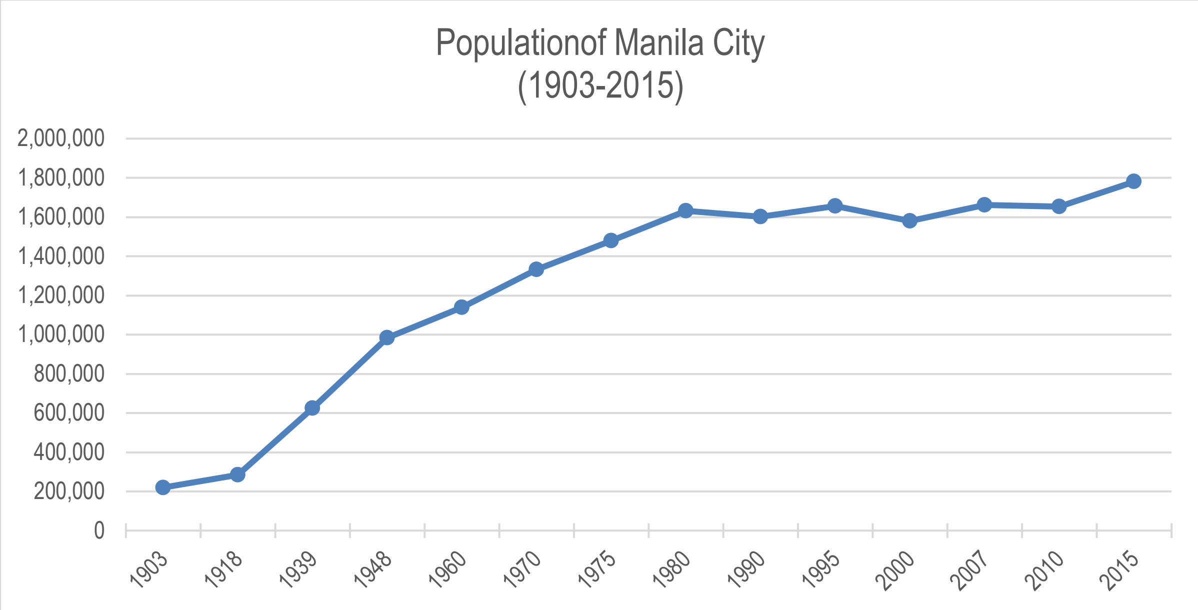
Total Population	2000	2010	2015
Philippines	76,506,928	92,337,852	100,981,437
National Capital Region	9,932,560	11,855,975	12,877,253
Manila City	1,581,082	1,652,171	1,780,148

Source: Philippine Statistics Authority, 2015 Census of Population

Population Growth	2000-2010	2010-2015	2000-2015
Philippines	1.90	1.72	1.84
National Capital Region	1.78	1.58	1.72
Manila City	0.44	1.43	0.78

Source: Philippine Statistics Authority, 2015 Census of Population

2 Philippine Statistics Office (2010)



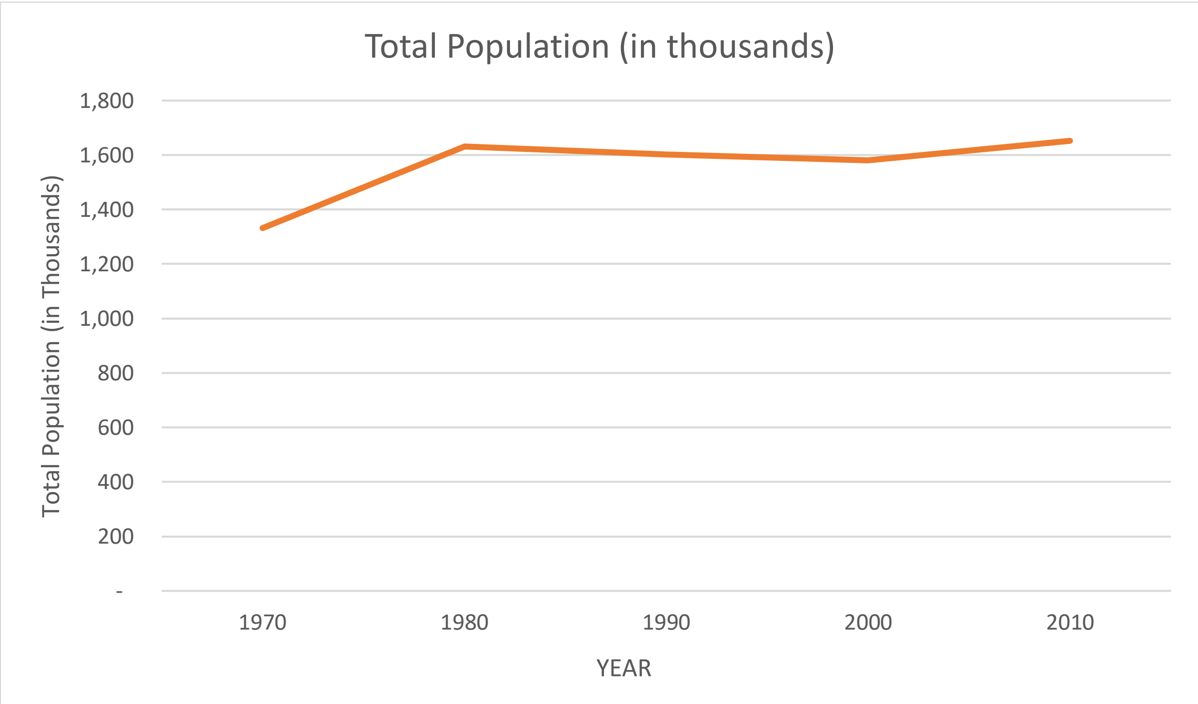


Figure 2-137. Total Population of City of Manila, 1903-2015
Source: NSO, 2015

Out of the 1,780,148 total population of Manila City, females accounted for 50.75% while males comprise 49.45% as shown in the table below. While the young dependents (0 to 14) comprised 28.55% of the total population, the working-age population (15 to 64 years) accounted for 67.43% and the old dependents (65 years and over) posted a share of 4.02%.

Table 2-53. Population by Age Group of the City of Manila, 2015

Age	Both Sexes	Male	Female
Under 1	36,266	18,697	17,569
1-4	150,390	77,165	73,225

Age	Both Sexes	Male	Female
5-9	164,283	84,888	79,395
10-14	157,333	80,534	76,799
15 - 19	177,571	85,167	92,404
20 - 24	191,512	93,206	98,306
25 - 29	170,895	84,763	86,132
30 - 34	144,641	73,118	71,523
35 - 39	123,318	62,401	60,917
40 - 44	106,882	52,770	54,112
45 - 49	94,891	46,460	48,431
50 - 54	80,114	38,341	41,773
55 - 59	63,388	30,062	33,326
60 - 64	47,169	21,581	25,588
65 - 69	31,013	13,574	17,439
70 - 74	17,942	6,851	11,091
75 - 79	11,890	4,079	7,811
80 years & over	10,650	3,030	7,620
All Ages	**1,780,148**	**876,687**	**903,461**

Source: 2015 NSO Census of Population and Housing

The literacy of the City of Manila household population of 1,412,632 (10 years and over) is 99.83% or 1,410,170, 51.54% of literate were female while 48.46% are male.

Table 2-54. Literacy of Household Population 10 yrs. and Over

Age Group	10 yrs. and Older Household Population Both Sexes	LITERATE		
		Both Sexes	Male	Female
10 - 14	157,333	156,784	80,208	76,576
15 - 19	177,571	174,514	83,892	90,622
20 - 24	191,512	186,751	90,331	96,420
25 - 29	170,895	168,242	82,781	85,461
30 - 34	144,641	142,522	71,400	71,122
35 - 39	123,318	121,506	60,899	60,607
40 - 44	106,882	105,585	51,743	53,842
45 – 49	94,891	93,912	45,700	48,212
50 - 54	80,114	79,516	37,921	41,595
55 - 59	63,388	62,983	29,778	33,205
60 - 64	47,169	46,871	21,405	25,466
65 and over	71,495	70,984	7,369	43,615
TOTAL	**1,412,632**	**1,410,170**	**683,427**	**726,743**

Source: 2015 NSO Census of Population and Housing

2.4.2.3.1.2 Barangay 649[3]

As of 2013, the total population of Barangay 649 is 56,380. On the other hand **Table 2-55** presents the total population of Barangay 649. Majority of the population belong to 12 and below age bracket (21%) followed by 15-17 age bracket (18%).

Table 2-55. Total Population of Barangay 649 by Age, 2013

Age	Population
Below 12	11,780
13 – 14	8,710
15 – 17	10,088
18 – 24	8,316
25 – 39	6,448
40 – 49	4,982
50 – 59	4,714
60 and above	1,342

Source: Barangay 649 State of Barangay Governance (2016)

2.4.2.3.2 In-migration

2.4.2.3.2.1 Manila City

The City of Manila number of households in 2015 was 435,237 with an average household size of 4.1 persons. Tondo has the biggest household population and total number of 148,152 household with 4.3 average household size, Intramuros has the smallest household population with only 1,509 and average household size of 3.7 as presented in **Table 2-56**.

Table 2-56. Household Profile of City of Manila, 2015

Geographic District	Population	No. of Households	Ave. Household Size
Binondo	18,040	5,167	3.5
Ermita	10,523	3,338	3.0
Intramuros	5,935	1,509	3.7
Malate	86,196	22,189	3.9
Paco	82,466	20,038	4.1
Pandacan	87,405	21,948	4.0
Port Area	66,742	15,903	4.2
Quiapo	28,478	7,210	3.8
Sampaloc	375,119	94,912	3.9
San Miguel	17,464	4,330	4.0
San Nicolas	43,069	10,912	3.9
Santa Ana	195,155	46,932	4.2

[3] Barangay 649 State of Barangay Governance (2016)

Geographic District	Population	No. of Households	Ave. Household Size
Santa Cruz	132,193	32,697	3.8
Tondo	631,363	148,152	4.3
TOTAL	**1,780,148**	**435,237**	**4.1**

Source: 2015 NSO Census of Population and Housing

A total of 409,987 occupied housing units were recorded in the City of Manila in 2015. This translates to a ratio of 106 households for every 100 occupied housing units, with 4.3 persons per occupied housing unit. In 2000, there were 109 households per 100 occupied housing units and 5.1 persons per occupied housing unit.

Table 2-57. Number of Occupied Housing Units, Number of Households, Household Population, and Ratio of Households and Household Population to Occupied, 2015

City of Manila	Occupied Housing Units*	Number of Households*	Household Population *	Average Household Size	Ratio of Households to Occupied Housing Units	Ratio of Household Population to Occupied Housing Units
Single house	108,277	118,203	538,084	4.55	1.09	4.97
Duplex	57,101	60,966	248,820	4.08	1.07	4.36
Multi-unit residential	238,997	250,012	953,978	3.82	1.05	3.99
Commercial/ industrial/ agricultural	2,427	2,668	9,526	3.57	1.10	3.93
Institutional living quarter	95	104	367	3.53	1.09	3.86
Others	1,632	1,651	6,200	3.76	1.01	3.80
Not Reported	1,458	1,550	6,034	3.89	1.06	4.14
Total	**409,987**	**435,154**	**1,763,009**	**4.05**	**1.06**	**4.30**

*excludes households in relocation area
Source: Philippine Statistics Authority, 2015 Census of Population

In 2015, about 51% of the total occupied housing units have galvanized iron/aluminum for roof and 84% have concrete/brick/stone for outer walls as presented in **Table 2-58**. On the other hand, the 43% of the total occupied housing units are rented house/room including lot while 57% have multi-unit residential as the type of building (**Table 2-59**).

Table 2-58. Occupied Housing Units by Construction Materials of the Roof and Outer Walls: City of Manila, 2015

Construction Materials of the Outer Walls and City/Municipality	Total Occupied Housing Units*	Construction Materials of the Roof								
		Galvanized iron /aluminum	Tile/ concrete /clay tile	Half galvanized iron and half concrete	Bamboo/ cogon/ nipa/ anahaw	Asbestos	Makeshift/ salvaged/ improvised materials	Trapal	Others	Not Reported
Concrete/brick/stone	210,893	186,250	21,164	3,284	4	55	19	42	75	-
Wood	63,024	55,117	1,168	5,510	66	62	222	682	197	-
Half concrete/brick/stone and half wood	129,409	101,680	2,239	25,298	4	26	34	60	68	-
Galvanized iron/aluminum	1,343	1,065	62	199	-	-	9	6	2	-
Bamboo/sawali/cogon/nipa	197	61	-	1	10	-	16	108	1	-
Asbestos	355	355	-	-	-	-	-	-	-	-
Glass	25	25	-	-	-	-	-	-	-	-
Makeshift/salvaged/improvised materials	2,144	206	-	20	3	-	1,391	512	12	-
Trapal	1,749	84	-	-	5	-	101	1,555	4	-
Others	128	61	-	-	-	-	2	7	58	-
No walls	233	25	1	-	-	-	63	108	36	-
Not Reported	487	357	6	103	5	3	1	4	-	8
Total	409,987	345,286	24,640	34,415	97	146	1,858	3,084	453	8

*excludes households in relocation area

Source: Philippine Statistics Authority, 2015 Census of Population

Table 2-59. Number of Households by Tenure Status of the Lot: City of Manila, 2015

Tenure Status of the Housing Unit and Lot and City/Municipality	Number of Households*	Type of Building						
		Single house	Duplex	Multi-unit residential	Commercial/ industrial/ agricultural	Institutional living quarter	Others	Not Reported
Own or owner like possession of house and lot	164,404	57,658	27,215	78,569	426	24	158	354
Rent house/room including lot	188,052	34,840	21,217	130,042	1,625	34	57	237

Tenure Status of the Housing Unit and Lot and City/Municipality	Number of Households*	Type of Building						
		Single house	Duplex	Multi-unit residential	Commercial/ industrial/ agricultural	Institutional living quarter	Others	Not Reported
Own house rent lot	7,319	2,818	1,328	3,145	24	-	-	4
Own house rent-free lot with consent of owner	26,930	7,907	3,831	14,951	47	2	29	163
Own house rent-free lot without consent of owner	14,555	6,205	2,498	5,455	15	3	131	248
Rent-free house and lot with consent of owner	26,324	6,531	3,836	15,044	482	36	113	282
Rent-free house and lot without consent of owner	6,553	2,189	1,027	2,609	48	5	413	262
Not Applicable	750	-	-	-	-	-	750	-
Not Reported	267	55	14	197	1	-	-	-
Total	435,154	118,203	60,966	250,012	2,668	104	1,651	1,550

*excludes households in relocation area

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.2.3.2.2 Barangay 649

The total number of families in the barangay as of 2013 is 13,276.

The Barangay 649 State of Barangay Governance (2016) reported the number of formal and informal housing units constructed in the barangay (**Table 2-60**). A total of 8,983 families reside in the shanties.

Table 2-60. Formal and Informal Housing Units constructed in the Barangay

Housing Project	Villages / Blocks per Housing Project	Number of Units / Structures Constructed
Formal Housing Project		
Gawad Kalinga Housing	20 Villages	1,000 units
Habitat Housing	8 Blocks	1,000 units
New site Housing	18 Blocks	Not reported
Informal Housing Project		
Shanties	16 blocks	7,011

Source: Barangay 649 State of Barangay Governance (2016)

2.4.2.3.3 Culture and Lifestyle

2.4.2.3.3.1 History[4]

Manila began as a small tribal settlement on the banks of the Pasig River near the mouth of Manila Bay. It took its name from a white-flowered mangrove plant, known as the Nilad, that grew in abundance in the area. Maynilad, "where the nilad grows", was a fairly prosperous Islamic community ruled by Rajah Sulayman, a descendant of a royal Malay family. On May 24, 1570, almost 50 years after Ferdinand Magellan, a Portuguese explorer under the service of the King of Spain, first set foot on these islands, a Spanish expedition under Marshal Martin de Goiti reached Sulayman's settlement. Encountering resistance from the Muslim king, de Goiti retaliated by burning down villages and capturing the artillery. The following year, Spanish conquistador Miguel Lopez de Legazpi arrived at the mouth of the Pasig River and claimed the islands in the name of the King of Spain. He established the "distinguished and ever loyal city" of Manila, proclaiming it as the capital. Thus began the Spanish colonization of the Philippines of almost 333 years.

The new city was encircled by double walls, the Intramuros, and guarded by a fort, the Fort Santiago. The Spanish kept to their enclave and sent out their missionaries and armies to conquer the countryside. In the suburbs or arabales like Tondo, Santa Cruz, Quiapo, Sampaloc and Malate, the indios, as the natives were called, lived and worked together with the mestizos (of mixed Filipino and foreign descent). The

[4] Comprehensive Land Use Plan (2005-2020)

sangleys or Chinese merchants lived in the parian, a district which became part of the present Binondo.

In the 19th century, Spain's colonies were racked by corrupt administration and internal disorder. Liberal ideologies fired the spirits of enlightened Manilenos like Philippine national hero Jose Rizal who studied abroad and Filipino rebel leader Andres Bonifacio who read books on revolutionaries and philosophers. The seeds of revolution were thus sown in Philippine soil, and insurrection sprouted all over the countryside. By the late 1800s, Spain had lost control over the Philippines, and with her major defeat by the American fleet in the Battle of Manila Bay, totally relinquished her hold on the colony.

But freedom would not come so easily, for the Filipinos eventually found themselves under their erstwhile ally, the Americans. Under the new conquerors, Manila spread outwards, roads and bridges were built, and schools taught the Filipinos Western culture and proficiency in a new language, English. Democratic processes were introduced; and neo-classical government edifices rose around the old city. The outbreak of World War II soon halted all that.

For three years, the country chafed under the Japanese occupation. The end of the Pacific War left Manila in ruins but it also brought liberation and independence. In July of 1946, the Commonwealth government under Manuel L. Quezon declared independence.

The post-war years saw the reconstruction of Manila and its growth in area and population. Land was developed in areas now covered by the Municipality of San Juan. Subdivisions and residential villages flourished as well in Quezon City, Pasig, Pasay and Parañaque. Factories and industrial areas burgeoned in Caloocan, Malabon and Valenzuela. Adjoining municipalities of Las Piñas, Muntinlupa, Taguig, Pateros and Marikina were developed and annexed. In 1976, a conglomeration of four cities - Manila, Pasay, Caloocan and Quezon City - and 13 municipalities was officially designated as "Metro Manila".

Today, Metro Manila is also known as the National Capital Region, a thriving, ever enlarging urban sprawl covering about 630 square kilometers and harboring a population of approximately ten million.

On the other hand, Barangay 649 is situated along the reclaimed area, Port Area, Manila under the jurisdiction of Philippine Ports Authority, classified as URBAN POOR. It was during the incumbency of Fortner President Ferdinand Marcos that the place was known as ENGINEERING ISLAND OF NASCO. Former First Lady Imelda Marcos, then Governor of Metro Manila, ordered the dredging an island thus formed adjacent to NASCO Compound and employees of it where the first inhabitants of the island.

In 1998, the former Congressman Amado S. Bagatsing donated to the barangay, materials and financial assistance for the construction of public faucets, which was then managed by the Barangay Water Association of barangay 649 and electrification program thru Depressed Area Electrification Program (DAEP) was also realized in 1988, followed by the constriction of school building.

Important events came in the area, last August 21, 2001, the community was declared as one of the KALAHI area - (Kapit-Bisig Laban sa Kahirapan) by the Department of Social Welfare and Development. Hence, census survey was conducted last September 2001 thru the creation of Task Force Baseco with four departments involved, the MDSW, USO, City Planning Office, and Engineering Office of City of Manila. The survey was successfully undertaken January 2002. Furthermore, Barangay 649 was proclaimed by President Gloria Macapagal Arroyo. Presidential Proclamation 145, declaring BASECO open for disposition to actual residents of the community of January 18. 2002, Ordinance 7931 declaring 52 hectares land be awarded to actual BASECO residents.

2.4.2.3.3.2 Culture

Based on the map showing the differentiation and distribution based on linguistic, cultural and racial criteria provided by the National Commission for Culture and Arts (**Figure 2-138**), Manila City is Spanish-influenced contact languages or Chabakano; Caviteño, Ermiteño, and Ternateño in Luzon. The same map also indicated the City as composed of Christian groups.

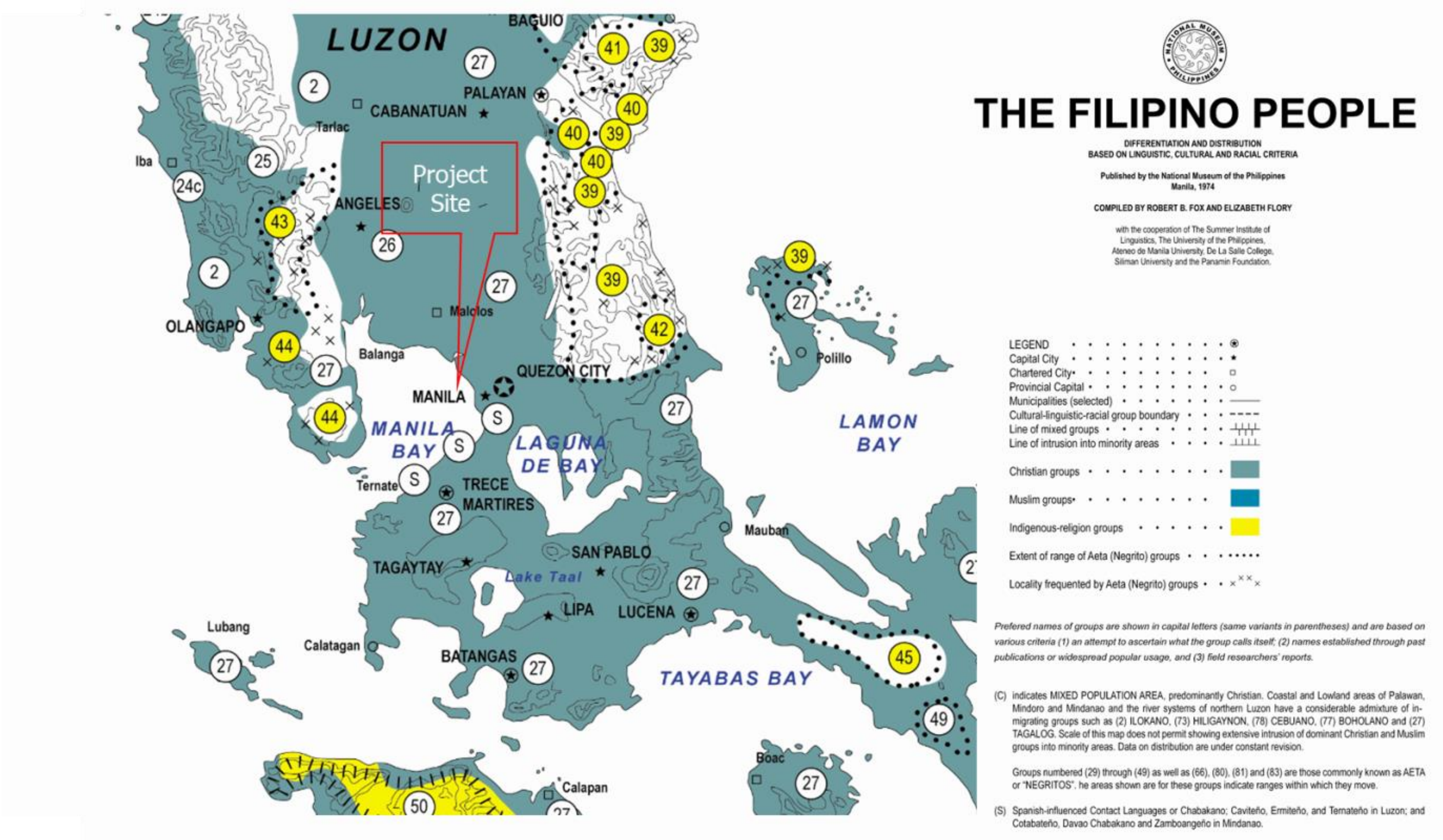


Figure 2-138. Differentiation and Distribution based on Linguistic, Cultural and Racial Criteria

Source: National Commission for Culture and Arts

2.4.2.3.4 Physical Cultural Resources

2.4.2.3.4.1 Archaeological Finds

The following information on archaeological finds in Manila City are lifted from *The Philippine Journal of Science, Outline Review of Philippine Archaeology by Islands and Provinces, 1947*:

North of the Pasig (12 separate individual sites or areas explored)

Site 1: A Chinese building at corner of Pinpin and Dasmariñas
Site 2: Cosmopolitan building site, near Sta. Cruz Bridge
Site 3: Great Eastern Hotel Site, Calle Echague
Site 4: Heacock building, corner David and Escolta
Site 5: Insular Life Building, Plaza Cervantes
Site 6: Reyes (now Soriano) building site, Plaza Cervantes
Site 7: Uy Yet building (China Bank Area), Calle Dasmariñas
Site 8: Cu Unjieng building site, Escolta and Pinpin
Site 9: Ideal Theater building site, Rizal Avenue
Site 10: Trade and Commerce building, Calle Juan Luna
Site 11: (Miscellaneous street excavations)
Site 12: Santo Tomas University Campus (“Bill’s Site”), España

Excavations for building sites proved very interesting and informative regarding the history of Manila. Accurate chronology worked out for downtown area, showing regular subsistence of around 14 inches per century. Good series of datable Chinese and European porcelains obtained in great quantity; also contemporary native and southeastern Asia wares. Some whole pieces found as well as fragments and shreds.)

South of Pasig (14 individual sites or areas explored to some degree, and a few of them excavated extensively):

Site 1: Ermita School Garden (Agriculture and Commerce Building), Wallace Field
Site 2: Laong Laan Tennis Court Area, Wallace Field
Site 3: “Luis Dato” area, east of Tennis Court, Wallace Field
Site 4: Wallace Field, in general
Site 5: Calle Isaac Peral area (Taft to M. H. del Pillar)
Site 6: University of the Philippines Campus; especially area near Florida
Site 7: Weather Bureau and Ateneo Grounds
Site 8: Bureau of Science grounds (and fishpond area)
Site 9: Manila Walls and Moat area
Site 10: Various excavations inside Walled City

Site 11: Post-office building site
Site 12: Metropolitan Theater Building site
Site 13: Colgante Bridge Area (south approach, Quezon Bridge)
Site 14: New City Hall site

Sites 12-14 were very deeply excavated, and produced enormous collections of interesting ceramic and other material from the old Chinese Parian of the late 16th and early 17th centuries. Little modern material, except in upper soil layers.

The Ermita School Garden and most of the various Wallace Field areas lie on the site of old Bagumbayan – the “New Town” built in the last third of the 16th century by the Manila natives ejected from the pre-Spanish town by Goiti and Legaspi. Many interesting types of native pottery, “Manila-ware” clay-pipes, coins, beads, native jewelry, and other articles have been found.

The Ermita area was probably made up largely of sand dunes of various sizes, in pre-Spanish and early Spanish times. Some excavations show the remains of such dunes, and occasionally they contain interesting old objects, particularly on Isaac Peral, Florida, near the Weather Bureau (Ateneo), and the Bureau of Science. Deep borings for setting up telephone and electric-light poles have also often brought up interesting objects – along several streets in this area.

Results of the exploration indicate that downtown Manila was inhabited only from about 1,480 to 1,500 onwards.

2.4.2.3.4.2 Tourism

Based on the Manila City CLUP (2005-2023), Manila has the densest concentration of old buildings and heritage sites in the country. These include the Cathedral and various colonial churches, government buildings, commercial buildings, office buildings, theaters and cinema houses, educational establishments, fortifications of Intramuros and San Antonio Abad, and residential districts such as San Miguel, Quiapo, San Nicolas and Sta Ana. It hosts the seat of government, and contains some of the most impressive civic architecture in the country. Major pilgrimage centers are located here, among them are the churches of Quiapo, Sta. Cruz, Binondo, Tondo, Pandacan, Sta Ana, Ermita, Malate, San Miguel, Sampaloc, St. Jude, the Chinese temples in Binondo, and the mosque in Quiapo. The City of Manila also has the longest waterfront along Manila Bay and the Pasig River. And as already mentioned, Manila is also the largest retail and wholesale center for Metro Manila. Data from the Department of Tourism show that twelve (12) out of sixteen (16) museums and seven (7) out often (10) performing arts theaters are located in the City of Manila.

Manila therefore has the potential for multiple-focus tourism, such as heritage, shopping, leisure, pilgrimage and education. These will attract a large number of foreign and local tourists. Because of the variety of available tourism activities and the fact that these attract large numbers of locals (specially shopping, pilgrimage and leisure), tourism is effectively a stable and major industry of the City that has yet to be fully utilized.

Moreover, these tourism activities are concentrated in the same areas of agglomeration for shopping and small- and medium-scale light industry and of transport nodes. Many of these activities are therefore accessible even to pedestrian traffic.

Manila has twenty-five (25) hotels (out of 36 in Metro Manila) classified as De Luxe, First Class, Standard and Economy. These tend to cater to high-income foreign tourists and high-income local families for short weekend stays. Available data show occupancy rates to range from 32% to 80% in 2001 with wide variation and growth rates.

The rate is somewhat mixed. Attention might also need to be focused on the budget and mid-range accommodations, such as pensionnes, small hotels, and lodging places for a clearer picture of the City's tourism potential. The Tourism Development Plan also needs to encourage more locals to come to Manila for shopping and enjoyment of the city's landmarks, districts with distinct character (e.g., Chinatown, Quiapo, San Nicolas), pilgrimage sites, parks, government structures and the like. Thus, more investment in inexpensive restaurants and eating places, pensionnes and lodging houses, and souvenir shops might need to be encouraged.

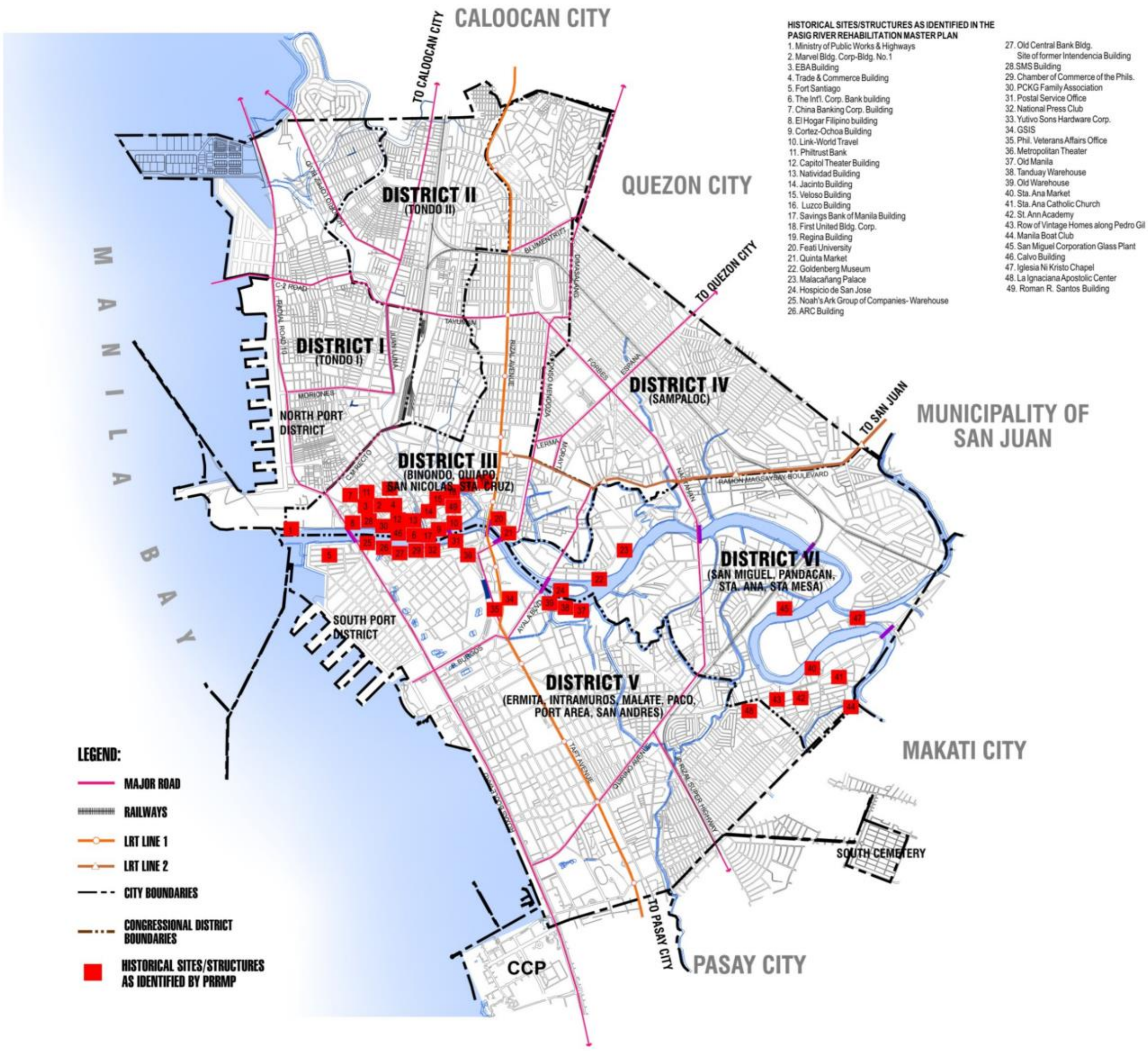


Figure 2-139. Historical Sites/Structures in Manila City

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

2.4.2.3.5 Delivery of Basic Services / Resources

2.4.2.3.5.1Water Supply

Forty-three percent (43%) of the total number of households in Manila as of 2015 use own faucet community water system and 41% use bottled water for drinking. On the other hand, 80% of the total number of households also use own faucet community water system for cooking.

Table 2-61. Number of Households by Main Source of Water Supply for Drinking and Cooking, Manila City: 2015

Purpose	Number of Households*	Source of Water Supply for Drinking												
		Own use faucet community water system	Shared faucet community water system	Own use tubed/piped deep well	Shared tubed/piped deep well	Tubed/piped shallow well	Dug well	Protected spring	Unprotected spring	Lake, river, rain and others	Peddler	Bottled water	Others	Not Reported
Drinking	435,154	188,513	52,760	883	834	91	50	622	6	29	11,449	179,153	764	-
Cooking		347,935	69,597	1,181	1,488	100	48	233	9	13	9,313	5,068	169	-

*excludes households in relocation area

Source: Philippine Statistics Authority, 2015 Census of Population

Table 2-62. Number and Percentage Distribution of Households with Access to Improved Safe Water Supply by Level in Manila City, 2016

Total Household (HH)	HH' with access to improved Safe Water Supply		Level I		Level II		Level III	
	No.	%	No.	%	No.	%	No.	%
337,324	300,218	89	0	0	0	0	300,218	100

Source: DOH Field Health Service Information System: 2016 Annual Report

As a result of the privatization of the Metro Manila Waterworks & Sewerage System (MWSS, the City of Manila is being served by two concessionaires in the distribution of its water supply namely: Maynilad Water Services, Inc. (MWSI) and Manila Water Company (MWC) The coverage service areas of MWSI are Tondo, Sta. Cruz, Quiapo, Sampaloc, Sta. Mesa, Pandacan, Binondo, San Miguel, Ermita, Malate, Intramuros and part of Singalong, while MWC serves Sta. Ana and part of Singalong. Listed in the table below are the reservoir and pump facilites located in the City of Manila. At present, updated information is being sourced from the Maynilad Water Services, Inc.

Table 2-63. Operating Conditions of Reservoirs and Pump Stations, 1998

District	Reservoir Capacity M^3/D)	Pump Number (Ml/D x M)	Motor Number (HP)	Remarks
Tondo District 1	19,000	(22 x42) 2 (34 x 30)	3 (225)	Not Operating Repair works needed for reservoir to pump station
Ermita	19,000	3(23 x 46)	3 (225)	Operating Pump station and reservoir require
District 5		2 (34 x 30)	2 (200)	rehabilitation works

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

2.4.2.3.5.2 Power Supply

As of 2015, the total number of households that uses electricity for lighting is 428,934 (99% of the total number of households in Manila. Other source of fuel for lighting are kerosene, LPG, Oil, solar panel, solar lamp and other.

Table 2-64. Number of Households by Kind of Fuel for Lighting, Manila City: 2015

City/ Municipality	Number of Households*	Fuel for Lighting								
		Electricity	Kerosene (Gas)	Liquefied Petroleum Gas (LPG)	Oil (vegetable animal and others)	Solar panel	Solar lamp	Others	None	Not Reported
City of Manila	435,154	428,934	2,365	1,369	34	66	98	1,018	1,012	258

*excludes households in relocation area

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.2.3.5.3 Peace and Order

Theft and robbery are the two most common crimes in the City of Manila which both accountable for 39 percent each of the recorded cases of crime. This is followed by physical injury (10 percent).

Murder cases almost doubled in number from 65 cases in 2000 to 124 cases in 2001. Index crimes increased from 47 percent in 1999 to 56 percent in 2001. In 2001, there were slightly more index crimes (56 percent) than non-index crimes (44 percent). Crime is often an outcome of contributing factors such as poverty and drug addiction, and hence these factors need to be addressed as well while enforcing protective regulations.

Table 2-65. Crime Statistics, 1999-2001

Offense / Category	1999	2000	2001	Percent share for 2001
Physical Injury	267	281	174	10.03
Homicide	92	72	76	4.38
Murder	80	65	124	7.15
Rape	52	27	15	0.86
Theft	712	759	669	38.56
Robbery	664	769	677	39.02
				100
Total Index Crimes	1867	1973	1735	56.42
NR of Crimes Solved	1703	1944	1638	
Crime Solution Eff (%)	91.22	98.53	94.41	
Total Non- Index Crimes	2082	1856	1340	43.58
NR of Crimes Solved	1924	1702	2000	
Crime Solution Eff (%)	91.85	95.22	92.29	
Average Monthly Index Crime Rate	8.25	8.72	7.66	
Average Monthly Crime Rate	17.45	16.91	13.58	
Based on 4,000,000 population				
AMICR	3.89	4.11	3.61	
AMCR	8.23	7.98	6.41	

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The City has eleven (11) Police Stations and forty (40) Police Community Precints with 2,984 uniformed personnel of which 441 accounts for the traffic police of the 170 outposts. These stations are all strategically located at different areas to facilitate immediate enforcement of law.

In the City of Manila, there is one policeman per 622 of the population. An additional 619 policemen are needed to meet the PNP manning level standard of 1 policeman per 500 population. Also, there is one traffic police per 3,585 population and an additional 86 traffic police personnel are needed to meet the standard of 1 traffic police per 3000 population.

2.4.2.3.5.4 Education Facilities

Among the congressional districts, District I (Tondo I), with its huge school-going population, has the highest elementary enrollment, although it only has 12 of the 71 public elementary schools in Manila. In addition, District I has the highest secondary level enrolment, followed by District II. District I alone accounts for almost a quarter of the students enrolled in public elementary and secondary schools in the City of Manila.

Table 2-66. Status of Educational Institutions by District, 1999

District	Land Area (ha)	Private Schools		DCS-Manila		Universities/Colleges/Institute		
		Primary Schools	Secondary Schools	Primary Schools	Secondary Schools	City Owned	National Gov't	Private
I	624.11	2	2	12	6	-	-	1
II	375	5	4	13	5	-	-	2
III	613.67	5	3	10	5	1	-	22
IV	523.12	6	3	14	5	-	-	17
V	1125.38	12	8	8	5	1	3	16
VI	784.52	11	9	11	6	1	1	9
TOTAL	**4045.8**	**41**	**29**	**68**	**32**	**3**	**4**	**67**
Source	Official Map	DCS	DCS	DCS	DCS	PLM	OED	OED
Year	2002	1999	1999	1999	1999	1999	1999	1999

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Table 2-67. Number of Private Preschools, Elementary and Secondary Schools (2001-2002)

Type	Number	%
Elementary level only	4	4.1
Secondary level only	10	10.3
Preschool and elementary	20	20.6
Preschool and secondary	1	1
Elementary and secondary	9	9.3

Type	Number	%
Preschool, elementary, and secondary	53	54.6
TOTAL	**97**	**100**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Table 2-68. Number of Public Elementary and Secondary Schools, By District

District	No. of Public Elementary Schools	Total Elementary Enrollment, SY 2001-2002	No. of Public Secondary Schools	Total Secondary Enrollment, SY 2001-2002
I	12	47,799	6	18,797
II	14	27,561	5	16,437
III	12	27,259	5	14,778
IV	14	27,465	5	12,608
V	8	24,889	5	17,507
VI	11	25,129	6	13,755
TOTAL	**71**	**180,102**	**32**	**93,882**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The huge demand for public sector education is manifested in the latest enrollment figures. For school year 2001-2002, the private sector accounts for 43,828 elementary students, which is only one-fourth the public school enrollment of 180,102. In the secondary level, private sector enrollment (46,397 students) is only half the public sector enrollment (93,882).

The private sector, however, appears to offer more levels of education. Of the 97 private preschools, elementary and secondary schools in the city, 75 percent have at least a preschool and an elementary school. More than half of the private schools offer complete preschool, elementary and secondary education.

Table 2-69. Gross Teacher- Pupil Ratio and Classroom-Pupil Ratio by District, Elementary Schools

District	Elementary Enrollment	Teachers	Classrooms	Teacher-Pupil Ratio	Classroom-Pupil Ratio	Additional Classrooms Needed
I	49,208	1,442	607	1:34	1:81	377
II	29,344	995	449	1:29	1:65	138
III	28,646	930	397	1:31	1:72	176
IV	58,925	1,009	432	1:29	1:67	149
V	26,192	820	430	1:32	1:61	94
VI	26,452	915	426	1:39	1:62	103
Total	**188,767**	**6,111**	**2,741**	**1:31**	**1:69**	**1,034**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The teacher-pupil ratio in the elementary schools in the City of Manila is 1:31, which more than fulfills the HLURB standard of 1 teacher per 50 pupils. The present classroom-pupil ratio of 1 classroom per 69 students, however, indicates a need for an additional 1,034 classrooms to meet the minimum standard of 1 classroom per 50 pupils.

Table 2-70. Gross Teacher-Pupil Ratio and Classroom- Pupil Ratio by District, Secondary Schools

District	Secondary Enrolment	Teachers	Classrooms	Teacher-Pupil Ratio	Classroom-Pupil Ratio	Additional Classrooms Needed
I	18,797.00	832	243	1:23	1:78	133
II	16,437.00	833	236	1:20	1:70	93
III	14,778.00	722	182	1:21	1:82	114
IV	12,608.00	666	210	1:19	1:61	43
V	17,507.00	831	282	1:22	1:63	69
VI	13,755.00	728	308	1:19	1:45	(-33)
Total	**93,882.00**	**4612**	**1461**	**1:21**	**1:65**	**418**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The teacher-pupil ratio in the secondary schools in the City of Manila is 1:21, which is within the HLURB standard of 1 teacher per 50 pupils. The present classroom-pupil ratio of 1 classroom per 65 students, however, indicates a need for an additional 418 classrooms to meet the minimum standardof1classroomper 50 pupils. The young population of Manila translates to a sizable demand for education at all levels. The schools in Manila respond to this need, and with their various locations, are fairly accessible to most residents.

For schoolyear 2001-2002, there are 71 public elementary schools in the City of Manila, accounting for 180,102 enrolled students. This translates to a school participation rate of about 68 percent, which means that 32 percent of children aged 7-12 are not in school, that is, they are doing other things such as helping earn for the family or staying at home. At the national level, the participation rate for elementary education is much higher at 96 percent.

In Manila, there is a huge demand for public education, particularly elementary education, as indicated by the enrollment figures. There are twice as many students in public elementary schools than there are students in public high schools. District I has the highest enrollment in both public elementary and secondary schools.

The city has 32 public secondary schools where 93,882 students are enrolled. The participation rate for students in the Philippines as well as in the City of Manila declines when they reach secondary education. As students proceed to the higher levels of education, some tend to drop out because they can no longer afford schooling or prefer working instead. The participation rate for public secondary schools in the City of Manila is 55 percent, which is lower than the national participation rate of 72 percent.

While there are more males than females at the start of schooling, more males tend to drop out of school later. At grade VI and 4th year, females already outnumber males. Moreover, Manila has a higher drop-out rate compared to NCR.

2.4.2.3.5.5 Recreation / Sports Facilities

As of year 2000, there are 53 public plazas in the City of Manila maintained by the Parks Development Office, occupying a total land area of 119,120 square meters. This translates to a plaza-population ratio of 75 square meters per 1000 population, which is inadequate, reflecting the scarcity of open space in the City. Following the HLURB standard of at least 500 sq.m, of parks and plazas per 1000 population, Manila needs 671,380 sq.m, of additional parks and plazas.

The other places of recreation are the public playgrounds and sports centers, which are under the supervision of the Public Recreation Bureau. There are 80 public playgrounds and recreation centers in Manila, occupying a total land area of 96,632 square meters (or less than one percent of the Manila land area). District III has the largest total area for playgrounds. The HLURB requires at least 0.5 hectare of public playground per 1000 population, and hence the City of Manila also needs more space for public playgrounds, particularly in Districts II and IV.

Table 2-71. Number and Land Area of Public Playgrounds and Recreation Centers

District	No. of Public Playgrounds and Recreation Centers	Land Area (sq m)	% Share	No. of Public Plazas	Land Area (sq m)	% Share
I	18	10733.00	11.11	6	9,650.00	8.10
II	18	773100	8.00	-	-	0.00
III	11	34,916.00	36.13	11	37,160.00	31.20
IV	11	8,051.00	8.33	4	5,680.00	4.77
V	12	24,532.00	25.39	24	51,677.50	43,38
VI	10	10,669 00	11,04	8	14,952.50	12.55
Total	80	96,632.00	100.00	53	119,120.00	100.00

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

1.4.1.1.1 Public Health and Safety

2.4.2.3.5.6 Health Profile

The City of Manila has twenty three (23) private hospitals, six (6) national government hospitals, and four (4) city government hospitals. The hospitals operated by the City of Manila are the Ospital ng Maynila, Ospital ng Tondo II, Ospital ng Sampaloc, and Gat Andres Bonifacio Hospital. The distribution of health facilities shows that District IV has eight of the 23 private hospitals in Manila, while District II has one private hospital. District III has three national hospitals.

The health center-population ratio is 1:32,267. The Department of Health (DOH) minimum standard is 1:20,000, which means that 30 additional health centers are needed in the city. The Manila Health Department reports that 22 new health centers will be constructed under the World Bank-funded Urban Health and Nutrition Project of the Department of Health. While the detailed architectural and engineering plans have been prepared and approved, sites in Manila have yet to be identified for such new health centers. A major criterion in the site identification is the accessibility of the health centers to their urban poor clients.

RA 6972 mandates that there should be one day care center for each barangay. The HLURB cites this law as a basis for its standard on the number of day care centers in a city or municipality. Not all the 896 barangays in the City of Manila have a day care center. The need for such centers is quite considerable in Districts IV, V, and VI. In all, 616 additional day care centers are needed to complement the existing 280 day care centers in Manila.

Table 2-72. Health and Other Social Infrastructures, 1999

District	Land Area (ha.)	Population	Licensed Private Hospitals	Licensed		Other Health and	
				National Hospitals	City Hospital	Health Centers	Day Care Centers
I	624.11	378,697	2	1	1	9	71
II	375	211,610	1	-	1	7	35
III	613.67	184,905	5	3	0	7	40
IV	523.12	251,352	8	-	1	9	46
V	1125.36	290,378	5	1	1	7	43
VI	784.52	264,140	2	1	0	10	45
TOTAL	4045.8	1,581,082	23	6	4	49	280
Source	Official Map	NSO	DOH	DOH	MHD	MHD	MDSW
Year	2002	2000	1999	1999	1999	1999	2002

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Table 2-73. Number of Existing and Additional Day Care Centers by District

Congressional District	No Of Barangays	No. of Existing Day Care Centers	No. Additional Day Care Centers Needed

Congressional District	No Of Barangays	No. of Existing Day Care Centers	No. Additional Day Care Centers Needed
I	136	71	65
II	122	35	87
III	123	40	83
IV	192	46	146
V	184	43	141
VI	139	45	94
Total	896	280	616

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

While there are more private hospitals than public hospitals, the total bed capacity of public hospitals is greater (3,769 beds compared to 3,438). Thus, the hospital bed population ratio is more favorable in the public sector (one bed per 419 population) than in the private sector (one bed per 460 population).

All hospitals, whether secondary or tertiary, fulfill the requirement on the number of beds according to their service category.

Table 2-74. HLURB Hospital Standard

Hospital Category	No. of Beds	Lot Area
Primary	5-10	
Secondary	25-75	1.5 hectares
Tertiary	100-250	1.5 - 3.0 hectares

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

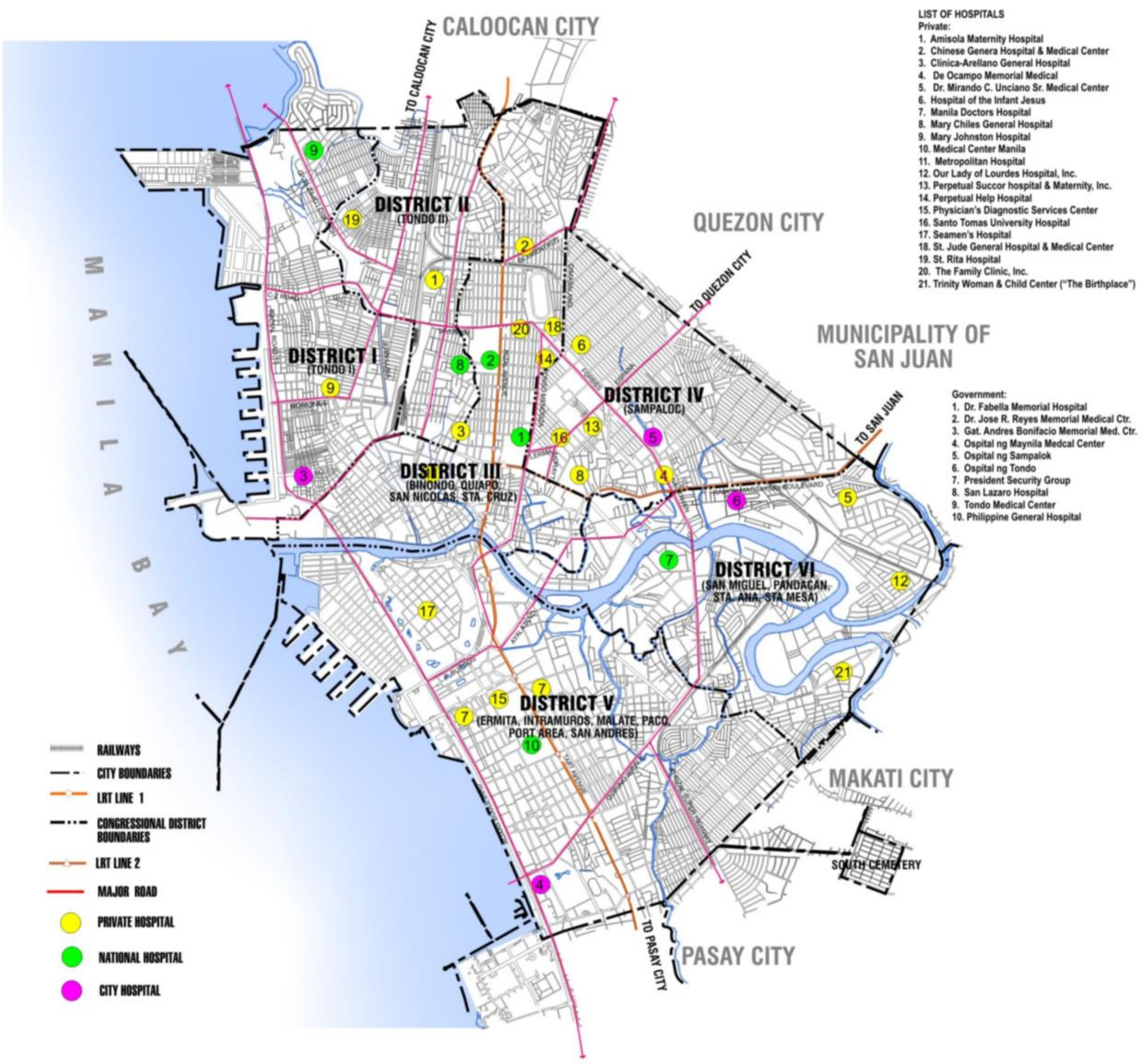


Figure 2-140. Government and Private Hospitals

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Medical Personnel Ratio to Patients

The Manila Health Department is adequately staffed. Its physician-population ratio and nurse-population ratio meet the DOH and HLURB standards for the public health sector, which are 1 physician per 20,000 population and 1 nurse per 20,000 population. The number of midwives employed by the city, however, is not enough to meet the DOH and HLURB standard of 1 midwife per 5,000 population. In this regard, an additional 179 new midwives need to be hired by the Manila Health Department to support its primary health care program and to increase the number of births attended to by trained birth attendants.

General Health Indicators

In the latest record of the City of Manila year 2012 a total of 40,248 live births were recorded, while there are 12,699 total number of death. In the same year, there were 814 numbers of infant death, 356 fatal; death and 27 Maternal death. The leading Cause of Infant Mortality as per 2000 record of Manila Health Department were Pneumonia, Prematurity, Sepsis, Congenital heart diseases, Disseminated intravascular coagulation, Measles, Congenital anomalies, Asphyxia neonatorum, Acute gastroenteritis and Respiratory Distress Syndrome.

Table 2-75. Live births and deaths in Manila City, 2012

Health Indicator	Number
Total Live Birth	40,248
Total Death	12,699
Infant Death	841
Fatal Death	356
Maternal Death	27

Source: Manila Waterfront City Reclamation Project EIS Report,

Leading Cause of Morbidity:

Respiratory tract infection ranked first followed by the ALRTI and Pneumonia, Bronchitis/Bronchiolitis, Acute Watery Diarrheal, Urinary Tract Infection, Hypertension, TB all forms, wounds, Parasitism and Influenza. National Capital Region was adopted since no records for City of Manila are available. While record from the City Health Department as of 2000 listed the following as the leading cause of morbidity Diarrhea, Bronchitis, Pneumonia, TB respiratory, Influenza, Diseases of the heart, Measles, Dengue fever, Mumps and Chickenpox.

Table 2-76. Leading Cause of Morbidity, NCR 2015

Causes	National Capital Region	
	Number	Rate
Acute Respiratory Infection	571,377	4,946.1
ALRTI and Pneumonia	97,950	847.9
Bronchitis	56,677	490.6
Acute Water Diarrhea	48,527	420.1
Urinary Tract Infection	42,834	370.8
Hypertension	32,178	278.5
TB in all Forms	23,181	200.7
Wounds	22,767	197.1
Parasitism	13,205	114.3
Influenza	9,338	80.8

Source: DOH 2015

Hypertension/Hypertensive Heart Disease has become the leading cause of mortality in 2015 at the record of 254 cases. Pneumonia became the number two as Celibro Vascular Disease is the number three leading cause of mortality for adults. Other causes of death are Chronic Lower Respiratory Disease, TB All forms, Condition originating from perinal pd, Assault, Nephritis, Nephritic Syndrome & Nephritis, Trachea, Bronchus and Lung, Malignant Neoplasm of Breast, as shown in **Table 2-77**.

Table 2-77. Deaths, Infant Deaths and Maternal Deaths by Sex, Manila City: 2016

Population	Livebirths	Deaths				Infant Deaths				Maternal Deaths	
		Male	Female	Total	Rate	Male	Female	Total	Rate	No.	Rate
1,686,621	60,239	9,742	7,384	17,126	10.15	590	441	1,031	17.12	25	41.50

Source: DOH Field Health Service Information System: 2016 Annual Report

2.4.2.3.5.7 Environmental Sanitation

As per DOH report in 2016, 72% of the total households of 337,324 has access to sanitary toilets, satisfactory disposal of solid waste, and with complete basic sanitation facilities.

Table 2-78. Number and Percentage Distribution of Households with Sanitary Toilet, Satisfactory Disposal of Solid Waste and Complete Basic Sanitation Facilities in Manila City, 2016

Total Household (HH)	HHs with Sanitary Toilet		HHs with satisfactory disposal of solid waste		HH's w/ complete basic sanitation facilities	
	No.	%	No.	%	No.	%
337,324	242,873	72.00	242,873	72.00	242,873	72.00

Source: DOH Field Health Service Information System: 2016 Annual Report

2.4.2.3.5.8 Waste Water and Sewerage System

The Manila Sewerage System was constructed in 1909 with the original overload capacity to serve 450,000 people. The system covers 1,850 hectares, serving 530,000 people with the total length of 240 Km.

Sewage is collected by lateral interceptor pipes of 15 cm. to 150 cm. in diameter from the various districts of the City. It is then conveyed to the Tondo main sewage pumping station through seven pumping stations. Sta. Ana, a sub-district of Manila, has a separate system and has its wastes discharging directly to the Pasig River. However, the construction of a sewer main line is presently ongoing to interconnect the system in Sta. Ana to the Paco Sewage station.

Not all areas of the City of Manila are connected to the system of sewers and lift stations. In these areas, the sewerage system is a combined one. In residential areas and in light commercial districts, the septic vault is used to pre-treat wastewater. In newer building constructions housing bigger populations, the use of package-type wastewater treatment plants is being pursued.

Among the problems in sanitation and sewage in Manila is the heavy pollution from the effluent of domestic septic tanks. According to the Manila Second Sewerage Project (World Bank-JGATF 2252-3PH), the estimated number of septic tanks in the year 2000 is about 125,279 with a population septic tank ratio of 13:6. The number of septic tanks is expected to increase slightly with new constructions and rehabilitation. There are no records of desludging of tank nor of the in use of packaged type waste water treatment plants but their use may be seen in high-rise commercial-residential buildings in Central Manila.

With the Manila Sewerage System serving roughly 30% of the City, other households discharge wastewater either into a storm drain, septic tank or directly into esteros. The untreated water in this case carries with it fecal matter and other debris which finds its way in catch basins or ultimately to nearby bodies of water. Records of desludging are unavailable, but adequately sized septic tanks normally are desludged once in two or three years.

Regulatory measures for wastewater disposal practices can limit the degradation of the water quality of the City’s riverine system.

2.4.2.3.6 Socio-economic Profile

2.4.2.3.6.1 Employment

Manila is predominantly a service-oriented city. It is one of the most densely populated cities in the country, next to Navotas, and it is fully built-up. Thus very little agriculture, forestry, mining and quarrying are undertaken. The leading industries, namely -- textile/garments, food, personal products, chemical/pharmaceutical, and rubber/plastic products, are generally light, labor-intensive activities. They take advantage of the city's substantial labor and the labor supply from the rest of the metropolis. Service sector employment has steadily dominated the share in total employment, to average about 80% from 1994-99. The rest are employed in industry sector with a minuscule number in agriculture, possibly backyard vegetable growing and small-scale fishing.

Like major global cities, Manila has become less of a center of manufacturing but more of a center for services, amenities and leisure. Given the centrality of the city in the National Capital Region, it provides employment, services, amenities and facilities for a large floating population that does not reside in the city. Further, Manila is a renowned center of education and technical training. Some of the largest universities and technical institutes are located in the City and they cater to students who are by and large from outside the City from overseas. One can conjecture that it has a substantial pool of highly skilled and technical labor force. The city can therefore absorb the expansion of any labor-intensive, high technology industry like software development, product development for specialty products, design establishments and the like. Also the city can develop among the students a lifelong patronage for the city's amenities and services.

2.4.2.3.6.2 Income

The households are dominantly middle income with an increase in the number of high income households and a decrease in the numbers of low-income households from 1994 to 1997.

Table 2-79. Income Bracket /Class Percentage Distribution 1994 and 1997

Year	Low Income	Middle Income	High Income
1994	10.19	78.42	11.39
1997	4.73	70.6	24.67

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

It can be gathered from the table below that the total number of households has grown steadily from 1985 to 1997 as well as the average income, average expenditure and average saving. On the other hand, the number of low-income household have decreased from 1994-1997 and likewise for their income and expenditure.

Table 2-80. Number of Families, Average Income and Expenditures 1985-1997

Item	1985	1988	1991	1994	1997
Total Number of Families	325,541	343,744	370,668	382,028	418,043
Growth Rate	-	5.59	7.83	3.06	9.43
Average Income	53,539	60,394	123,615	146,638	194,455
Growth Rate	-	12.8	104.68	18.62	32.61
Average Expenditure	44,817	43,447	99,904	125,271	163,896
Growth Rate	-	3.06	129.94	25.39	30.83
Average Saving	8,722	16,947	23,711	21,367	30,559
Growth Rate	-	94.3	39.91	-9.88	43.02

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Table 2-81. Number of Families, Income and Expenditure Growth Rate: 1994 and 1997

Income Bracket	Total No. of Families	Average Income	Average Expenditure

Income Bracket	Total No. of Families	Average Income	Average Expenditure
Low Income	(-49.14)	(-5.52)	(-9.65)
Middle Income	(-1.49)	10.51	11.24
High Income	136.92	3.58	8.54
Total	**9.43**	**32.61**	**30.83**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

There was a slight decrease in the number of middle-income households and a huge increase in the number of high-income households. At the same time, the growth rate of income and expenditures of the middle and upper income classes have increased. Even low-income households by 1997 managed to generate a certain portion of their income as savings and this suggests that they are earning a reasonable level of income.

Table 2-82. Number of Families, Income and Expenditure, 1994 and 1997

Income Bracket	Total No. of Families	Income (1,000)	Income Average	Expenditure (1,000)	Expenditure Average
Low Income					
1994	36,920	1.930,495	49.602	1.934,451	49,703
1997	19.793	927,566	46.863	918,366	46.398
Middle Income					
1994	299,579	38.367.650	128.039	34,231.886	114.267
1997	295,116	41,756,763	141,491	37.514.734	127,117
High Income					
1994	43.529	15,731.285	361.402	11.690.706	268.576
1997	103.132	38.606.175	374.337	30.079.654	291.661
Total					
1994	362,028	56.019.430	146.637	47.857.043	125,271
1997	416.043	81.290.506	194.455	68.515.755	163,696

In fact, the sources of income of low-income households are nearly evenly distributed among wages and salaries (38%), entrepreneurial activities (26%) and others (35%). This suggests that the low-income households are engaged in small-scale informal sector enterprises or low-paid, temporary, wage-paying jobs. The middle- and high-income households are in established jobs that also allow for the build-up of family assets, namely the employer's certification that make for ease in opening bank deposits, credit for housing and other consumer needs, and social security and insurance. The average annual employment rate is lower than the national average. The relative stability of the employment rate suggests a dynamic market for jobs.

Table 2-83. Employment Rate Quarterly Report 1989-2000

Period	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1st Qrt	81.7	80.7	84	80.7	84.7	81.2	83.5	86	86.5	86.4	82.8	84.4
2nd Qrt	84.8	*80.7	81.2	72.5	82.2	83.3	80	80.6	86.1	84	76.9	
3rd Qrt	78.2	78.1	79.5	82.2	83.2	80.3	81.4	88	85 1	81.6	93.7	
4th Qrt	83.3	85.1	84.7	82.2	84.9	81.2	82	86.6	84.9	83.6	82.8	
Average Rate	82	81.15	82.35	79.4	83.75	81.5	81.72	85.15	85.65	83.9	84.05	
Growth Rate (%)	-	(-1.05)	1,46	(-3.71)	5.19	(-2.76)	0.269	4.028	0.58	(-2.08)	0.178	

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The residents of Manila are actually of a higher income class than the rest of the country. This is a potential resource for substantial tax revenue, civic participation and market for various goods and services. Also given the income profile and the average unemployment rate, these suggest that the unemployment may well be concentrated among the newly arrived migrants who eventually move elsewhere. One can also conjecture that their initial source of income is the informal sector and their initial entry point will be the port area.

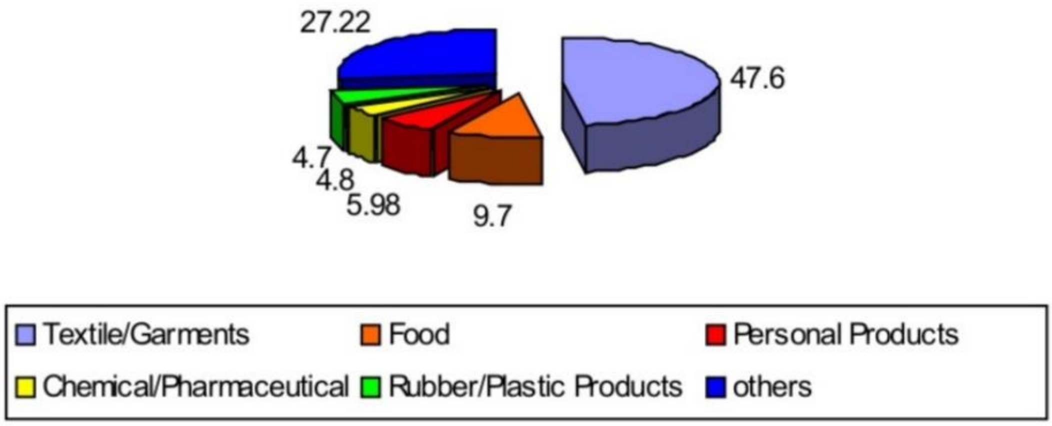


Figure 2-141. Five Leading Industries, 1994

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

2.4.2.3.6.3 Industry

The types of manufacturing establishments that locate in the city are mainly labor-intensive, light activities that need not cause substantial pollution if located in multi-use and residential districts.

These are the textiles/garments, food, personal products, chemical/pharmaceutical, and rubber/plastic products. They also need not take up substantial space and thus can continue to be encouraged in the city. Nearly half (47.6%) of all manufacturing establishments are textile/garment firms and the other four leading industries altogether comprise about 25%. These establishments are reasonably well-dispersed among the six congressional districts with the biggest concentration in the contiguous Districts I and III (34% and 22% respectively). The smallest proportion of 4.8% is located in District VI which is mostly residential. These suggest a reasonably diversified industrial sector that caters largely to domestic or local market demand rather than to exports.

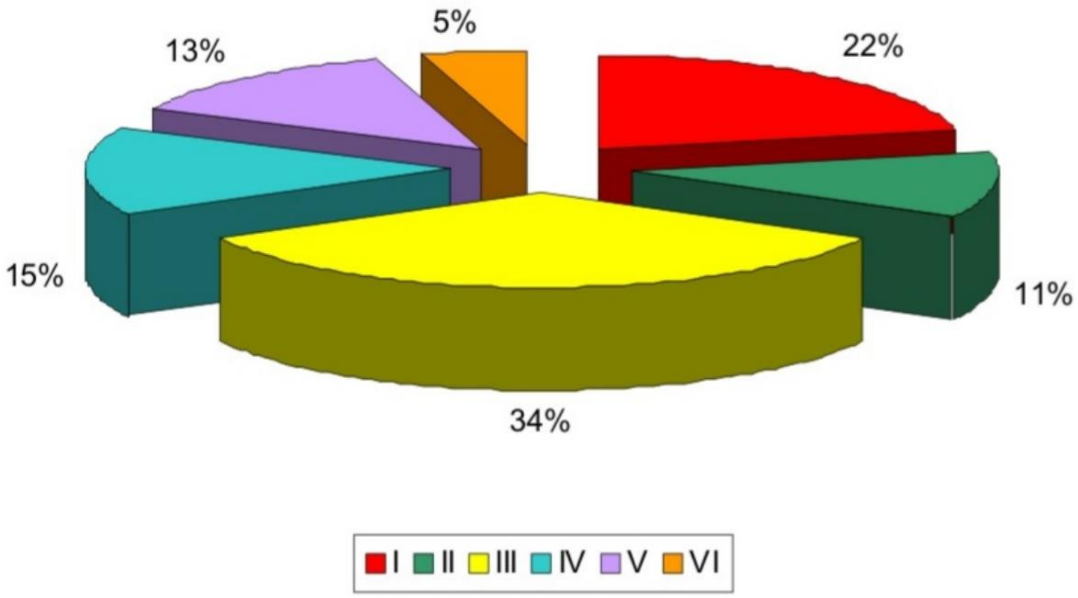


Figure 2-142. Manufacturing Establishments Per District
Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

2.4.2.3.6.4 Commerce and Trade Shipping

Manila is the premier international port in the country and one of the major domestic ports for inter-island shipping. As a major center of water transport and storage, it has experienced a steady increase in shipping, cargo and container traffic from 1994 to 1997. The shipping, cargo and container traffic generate substantial revenues to the City, reaching PHP 2.227 billion in 1997. The port will remain the major international and domestic port for the country in the future. It will continue as one of the main entry points for passengers, immigrants from the island provinces, imported goods and products from various parts of the country. It will also remain as a major exit point for the country's exports.

Agglomeration of products and services occur in well-defined and identified areas, on the street-level. These sites also coincide with designated tourist districts and the location of retail-wholesale commercial establishments, and informal sector establishments. The areas of substantial agglomeration are: Northern Tondo (in the Juan Luna-Tambunting Dimasalang-Tayuman quadrant, mainly District I), Divisoria-

Binondo-Sta Cruz- Quiapo P. Casal zone (District III), and the Ermita-Malate zone (District V). A further evidence of the lively commerce and trade and the vibrant informal sector is that the City has granted dozens of hawkers permits, largely concentrated in Binondo, Quiapo, Sta Cruz, Sampaloc, Ermita and Malate. These provide employment for informal settlers and consumers with inexpensive goods and services.

The economic base is functionally diversified and suggests the basic strength of the city's economy. These districts are effectively multiple-use zones. For example, areas with small-scale, labor-intensive, light manufacturing (e.g., electrical, electronics and home appliances along Puyat; meat products in Velazquez and Vitas) and handicraft (e.g., gold and jewelry along Ongpin; artifacts, artworks and antiques along M.H. del Pilar) are located along tourist- and service-oriented establishments (e.g., restaurants, eating places, souvenir and curio shops, inexpensive lodging houses). Informal settlements are also located nearby. Some areas (e.g. Ermita, Malate, Sta. Cruz specially around Avenida Rizal) already function as 24-hour districts with commercial (e.g. shopping) and other light manufacturing establishments open in the daytime, and flea markets, a number of restaurants and, other leisure establishments open at nighttime.

2.4.2.3.7 Traffic

2.4.2.3.7.1 Road Network and Transport

Roads and Bridges

Inter-city movement is facilitated by the system of circumferential and radial roads connecting many urban areas in the entire Metro Manila.

While the City of Manila experiences traffic problems like any highly urbanized area in the country, it has an extensive network of well-paved roads and bridges crossing its rivers and waterways. Established built-up areas are located along major routes which can provide them easier access and mobility. Circulation within and movement in and out of the City of Manila, however, are becoming increasingly difficult as traffic builds-up along already congested routes.

Table 2-84. Circumferential and Radial Roads, 2000

Circumferential Roads	Radial Roads
1. C-1 C.M. Recto Avenue/ Ayala Boulevard/P. Burgos	1. R-1 Roxas Boulevard / Coastal Road 2. R-2 Taft Avenue / Quirino Avenue 3. R-3 South Superhighway 4. R-6 R. Magsaysay Boulevard/Aurora Boulevard

Circumferential Roads	Radial Roads
2. C-2 Quirino Avenue/Nagtahan/ A. Mendoza/ Gil Puyat Avenue	5. R-7 España / Quezon Avenue/Commonwealth Avenue (Don Mariano Marcos) 6. R-8 Andalucia / A. Bonifacio / Quirino Avenue 7. R-9 J.A. Santos/Rizal Avenue Ext. / McArthur Highway 8. R-10 Marcos Road

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The entire road network in the city is composed of about 770 kms of roads, less than three percent of which remains to be unpaved. With a road density of about 20 kilometers per square kilometer, many of the areas are well connected.

Roads and street are administratively classified as national and local. Road development and maintenance are undertaken by the national government for the national roads and the local government for the city roads. The total number of city streets in Manila is 1,580 occupying a total area of 3,644,000 square meters while the total number of national roads is 258 occupying a total area of 3,162,000 square meters.

Table 2-85. Road Classification, 2000

Road Classification	Total Number	Total Area (sq. m.)	Percent of Total
City Streets	1,580	3,644,000	53.54
National Roads	258	3,162,000	46.46
Total	1,838	6,806,000	100

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

National roads total about 240.5 kilometers in length, 30.31% of the City's total. These roads link the City to its neighboring cities/municipalities namely: Navotas, Caloocan, Quezon City, San Juan, Mandaluyong, Makati and Pasay. The city streets cover a total length of approximately 553.07 kilometers in length, 69.69% of the City's total (CPDO, CEO 2000).

Table 2-86. Classification & Road Length by District (km), As of May 2000

Location	Concrete	% Share	Asphalt	% Share	Unpaved	% Share	Total (km)	% Share
NATIONAL	171.46	32.04	69.08	32.55	-	-	240.54	30.31
CITY	363.72	67.96	143.16	67.45	26.19	100	553.07	69.69
1. District 1	73.17	13.67	19.90	9.38	4.28	16.33	97.35	12.58
2. District II	57.67	10.78	10.23	4.82	0.32	1.22	68.22	8.82
3. District III	54.67	10.22	19.70	9.28	0.86	3.28	75.23	9.72

Location	Concrete	% Share	Asphalt	% Share	Unpaved	% Share	Total (km)	% Share
4. District IV	96.71	18.07	23.14	10.90	9.38	35.80	129.23	16.70
5. District V	45.03	8.41	37.92	17.87	4.34	16.58	87.29	11.28
6. District VI	36.46	6.81	32.28	15.21	7.02	26.80	75.76	9.79
Total (km)	535.18	100.00	212.24	100.00	26.19	100.02	773.61	100.00

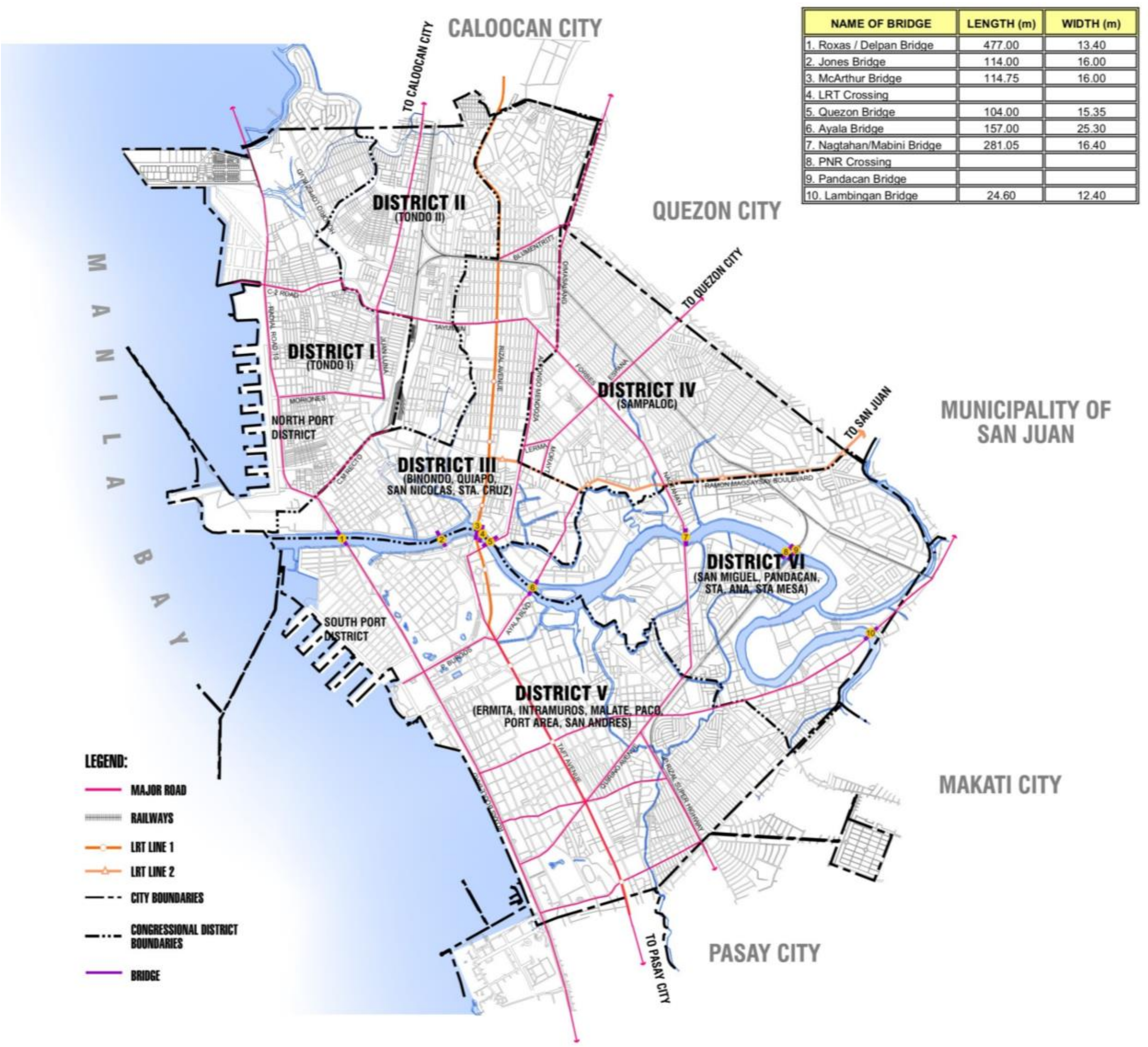
Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The City bridges have a total length of 556.70 linear meters. Bridges made of concrete/masonry accounts for a total of 335.66 linear meters. Wooden/timber bridges have a total length of 162.63 linear meters while bridges made of steel/coco have a total length of 50.41 linear meters.

Table 2-87. Summary of Existing Bridges/Structures, 2000

Description	Concrete/Masonry	Wooden/Timber	Steel/Coco	Total Length
City Bridges/ Structures linear meters	335.66	162.63	50.41	556.7

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020



NAME OF BRIDGE	LENGTH (m)	WIDTH (m)
1. Roxas / Delpan Bridge	477.00	13.40
2. Jones Bridge	114.00	16.00
3. McArthur Bridge	114.75	16.00
4. LRT Crossing		
5. Quezon Bridge	104.00	15.35
6. Ayala Bridge	157.00	25.30
7. Nagtahan/Mabini Bridge	281.05	16.40
8. PNR Crossing		
9. Pandacan Bridge		
10. Lambingan Bridge	24.60	12.40

Figure 2-143. Road Access Map of Manila City

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Traffic Characteristics

The pattern of movement of public trip-makers in Metro Manila and surrounding areas is shown in the Origin Destination Matrix (O-D). According to the O-D Matrix, Manila ranks second to the top generators of trips, accounting for about 11 percent of the total Trip Origins and about 12 percent of Trip Destinations within the 16 zones considered. The more active trip desire lines are seen to be directed along the North-South direction across the Pasig River. The longitudinal directions connecting Manila with Mandaluyong/Pasig, Marikina/Pasig, and Makati-Pateros account for less than three percent of the total trips generated.

An examination at longer-distance trips reveals that there is a possible market for long distance service, possibly via Manila through the Pasig River. Trips destined for and coming from the southern part of Metro Manila, such as Muntinlupa/Las Pinas, Las Pinas/Paranaque, Bacoor/lmus, Cavite/Kawit and Cabuyao/Calamba account for about 22 percent of the total trips produced in the area. The potential for riverside development could help promote local tourism and boost recreational fishing and commercial trading in the area. With the infusion of additional resources, the river system can thus generate income that could be well spent for its regular dredging and maintenance.

Table 2-88. Origin-Destination Matrix for Public Trips on Selected Areas

	Origin / Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1	Manila	1,074	68	90	66	279	196	81	65	71	54	32	37	15	45	13	31	2,217
1	Pasay/Parañaque	81	376	58	29	85	46	30	30	30	27	11	14	5	18	5	12	857
3	Makati/Pateros	140	71	541	65	175	87	67	60	60	44	24	29	11	34	9	24	1,441
4	Mandaluyong/ Pasig	95	32	60	365	169	73	67	36	38	29	18	24	8	24	7	17	1,062
5	Quezon City	323	76	139	136	2.526	264	174	84	94	70	50	64	25	61	29	55	4,170
4	Calookan / Malabon	226	37	63	55	241	1.300	59	36	40	33	20	25	10	26	11	22	2,204
7	Marikina / Pasig	95	26	53	54	171	64	74T	27	30	23	16	22	7	18	a	17	1,372
8	Taguig	80	26	48	29	86	40	29	505	36	23	10	13	5	15	7	17	971
9	Munlinlupa/Las Piñas	78	24	46	29	88	42	29	34	762	42	11	14	6	16	a	27	1,256
10	Las Piñas/ Paranaque	46	19	28	18	50	26	16	15	29	422	6	7	3	13	5	11	716
11	Antipolo	48	11	22	17	65	28	20	12	14	12	454	15	13	12	9	13	765
12	Taytay / Cainta	45	12	26	22	59	26	21	10	12	10	9	597	6	8	6	9	881
13	Angono / Binangonan	21	5	9	T	31	13	9	6	7	6	13	10	219	7	5	7	375
14	Bacoor / Imus	93	27	41	29	109	48	32	24	30	39	18	19	10	719	33	23	1,293
15	Cavite / Kawit	21	6	9	7	42	17	13	11	13	10	11	9	6	30	189	14	408
16	Cabuyao / Calamba	48	13	22	16	79	34	24	24	41	23	16	15	9	21	13	476	873
	Total	**2.519**	**829**	**1,255**	**943**	**4,254**	**2.304**	**1,412**	**979**	**1,309**	**867**	**719**	**914**	**358**	**1,067**	**357**	**775**	**20,861**

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-202

In terms of modal preference for the various trip purposes made in Metro Manila, the modes of transport used are summarized in **Table 2-89**.

Table 2-89. Mode Choices for Various Trip Purposes

Mode	To Home	To School	To Work	Business	Private
Jeepney	39%	46%	34%	24%	42%
Tricycle	14%	21%	6%	13%	12%
Bus	16%	8%	24%	5%	13%
Taxi	6%	2%	5%	14%	7%
Car/ Jeep	16%	10%	20%	25%	21%
LRT/PNR	3%	3%	3%	1%	2%
Others	6%	10%	8%	18%	3%

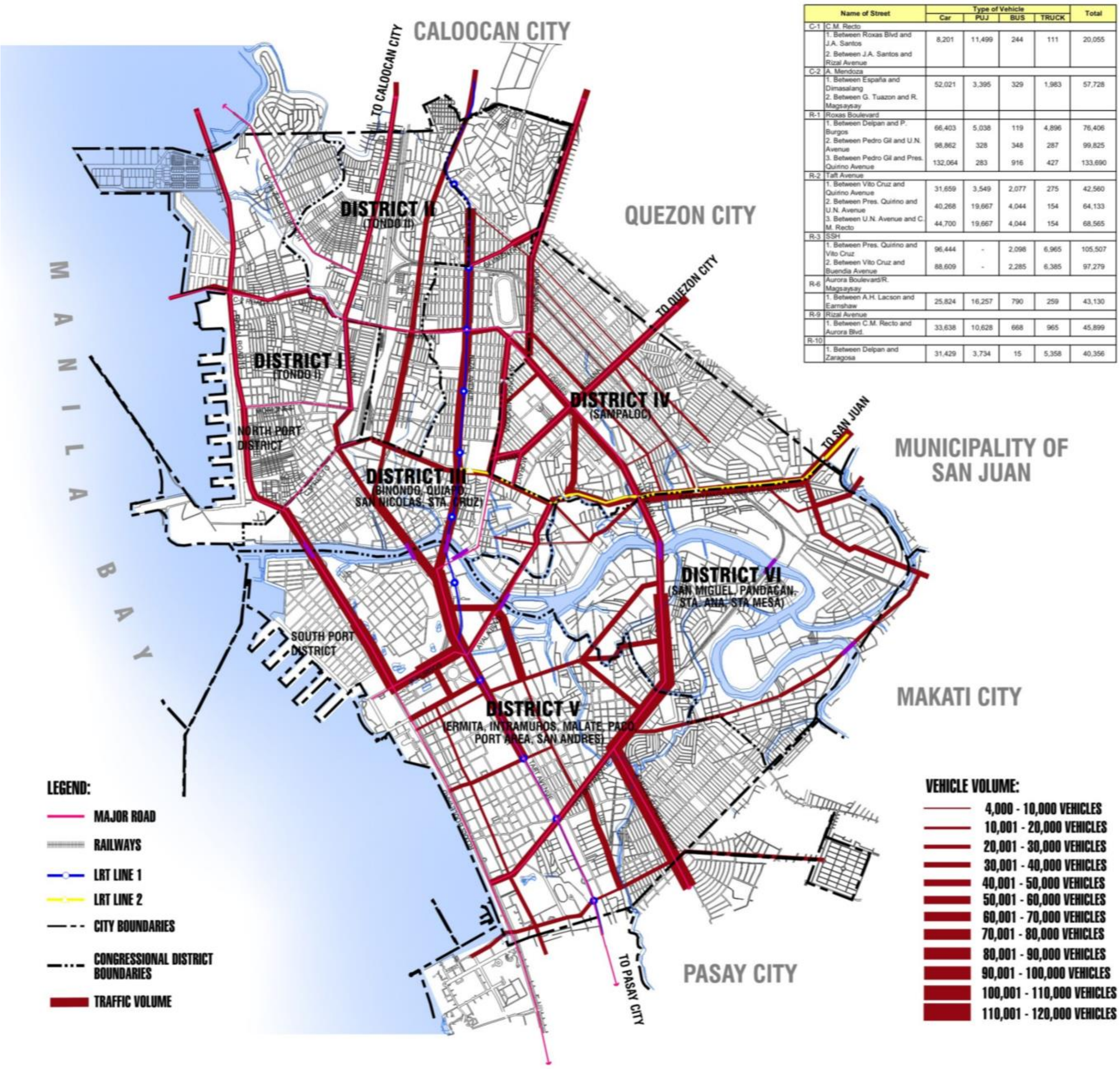
Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Jeepney is the most preferred mode of transport, while buses appear to be not as popular. In all cases, private cars and jeeps are very strong competitors of rail transport and other land transportation modes.

Traffic problems, such as traffic congestion is brought about by the uncontrolled growth and urban sprawl in the metropolis, which led to the deterioration of the urban environment and poor level of service (LOS) of the public transportation system have worsened.

Despite the extensive coverage of the road network of the City of Manila, it serves a heavy volume of vehicles under limited road capacity. With arterial roads serving both through and local traffic, congestion in major intersections has continuously wasted a lot of man hours and fuel energy, and worsened air quality.

The traffic data from the Traffic Engineering Center (2000) on classified vehicle trips along major roads and bridges are summarized in **Figure 2-144**.



Name of Street		Type of Vehicle				Total
		Car	PUJ	BUS	TRUCK	
C-1	C.M. Recto					
	1. Between Roxas Blvd and J.A. Santos 2. Between J.A. Santos and Rizal Avenue	8,201	11,499	244	111	20,055
C-2	A. Mendoza					
	1. Between España and Dimasalang 2. Between G. Tuazon and R. Magsaysay	52,021	3,395	329	1,983	57,728
R-1	Roxas Boulevard					
	1. Between Delpan and P. Burgos	66,403	5,038	119	4,896	76,406
	2. Between Pedro Gil and U.N. Avenue	98,862	328	348	287	99,825
	3. Between Pedro Gil and Pres. Quirino Avenue	132,064	283	916	427	133,690
R-2	Taft Avenue					
	1. Between Vito Cruz and Quirino Avenue	31,659	3,549	2,077	275	42,560
	2. Between Pres. Quirino and U.N. Avenue	40,268	19,667	4,044	154	64,133
	3. Between U.N. Avenue and C. M. Recto	44,700	19,667	4,044	154	68,565
R-3	SSH					
	1. Between Pres. Quirino and Vito Cruz	96,444	-	2,098	6,965	105,507
	2. Between Vito Cruz and Buendia Avenue	88,609	-	2,285	6,385	97,279
R-6	Aurora Boulevard/R. Magsaysay					
	1. Between A.H. Lacson and Earnshaw	25,824	16,257	790	259	43,130
R-9	Rizal Avenue					
	1. Between C.M. Recto and Aurora Blvd.	33,638	10,628	668	965	45,899
R-10						
	1. Between Delpan and Zaragosa	31,429	3,734	15	5,358	40,356

Figure 2-144. Annual Average Traffic Flow Map, 2000

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

The total vehicular traffic across selected Bridge Crossings are shown in **Table 2-90** wherein some of these are vital crossing area experiencing congestion and excessive delay.

Table 2-90. Vehicle Trips across Selected Bridge Crossings, 2002

Bridge Crossing	Cars & Jeep	Jeepney	Bus	Total
Del Pan	43,913	2,384	37	46,334
Jones	27,954	5,078	18	32,690
McArthur	17,726	10,298	914	28,938
Ayala	31,192	436	566	32,194
Quezon	33,445	13,526	1,194	48,165

Source: Manila Comprehensive Land Use Plan and Zoning Ordinance 2005-2020

Given the state of traffic congestion, there is a need to promote traffic alleviation measures in the city. There is a need for an effective traffic management plan that incorporates rules and regulations, safety, a stronger manpower base of enforcers, tries charges and lecture education for pedestrians and commuters. Increasing traffic signage will help improve the flow of traffic in the area.

With the existing demand for transportation, the major infrastructure systems that are required are the construction of roads and railways. With the wide coverage of the existing roads, what is actually needed now is to increase their capacity to accommodate the increasing volume of traffic. This may be done through road widening and removal of obstructions that have encroached upon the road right of way. This need is being addressed by the construction of the Light Rail Transit and the circumferential road networks.

Railway

The railway system that pass through the city and being operated by the Philippine National Railways (PNR) and the Light Railway Transit Authority (LRTA). There are two major PNR stations in the City, one in Tutuban, Tondo and one in Paco, which transport people to the southern part of the archipelago. Manila's LRT compares favorably with similar rail transit systems in other parts of the world when it comes to patronage (3rd largest in the world on a per route-kilometer basis) and fare box ratio (one of the highest despite one of the lowest fares), but suffers unfavorably in terms of staffing and fleet availability.

The LRT system services an average of 386,963 commuters daily using 64 coaches as of September 1995. Out of the 18 stations, 12 are located in the City of Manila (R. Papa, J. Abad Santos, Blumentritt, Tayuman, Bambang, Doroteo Jose, Carriedo, United Nations, Pedro Gil, Quirino Avenue and Vito Cruz).

There are about 9.9 kilometers of elevated tracks which run along Taft Avenue and Rizal Avenue from R. Papa Station up to G. Puyat Station. LRT 1 started commercial service on December 1, 1984 (half line) and full service line in 1995 utilizing 64 cars on a 2-car train basis. Daily passengers averaged 115,000 in 1984, increased to about 402,000 in 1994 and levelled off to 377,000 in 1995. The decline was attributed to a decrease in the number of available trains due to poor maintenance and overloading.

The maximum speed the LRT could attain is 60 kms per hour and the average commercial speed is about 30 kilometer, per hour. Each train has a capacity of 748 passengers. As of August 2000, LRTA has a total of twenty six (26) 2-car trains and four (4) 3-car trains with ordinary coaches, while there are seven (7) 4-car trains with air conditioned coaches operating in Line 1 (LRT 1). LRT 1 recorded the highest total number of passengers served in 1996 with a total of 143,230,000 or a daily average of 395,765 since the start of its operation in 1984.

The system is about to be connected to a second elevated line upon the commissioning of LRT Line 2 running along Magsaysay Boulevard. In the future, Line 1 and Line 2 are planned to be connected to the proposed Line 4, which will run along España Avenue.

Table 2-91. LRT 1 Monthly Ridership, 1995-1999 (In Millions)

Month	1995	1996	1997	1998	1999
JAN	12.76	11.64	11.19	11.72	10.58
FEB	11.74	10.53	10.52	11.05	9.84
MAR	11.19	11.2	9.82	11.53	10.51
APR	9.63	9.32	9.92	7.52	8.65
MAY	10.94	11.36	9.86	9.57	10.03
JUN	9.37	11.46	10.85	10.53	10.48
JUL	11.5	12.51	12.3	11.69	11.69
AUG	11.76	13.42	11.62	11.48	11.36
SEP	11.49	12.87	12	11.15	11.34
OCT	11.39	13.17	11.95	10.59	11.47
NOV	11.17	12.11	11.81	10.66	11.25
DEC	12.96	13.54	12.6	10.38	12.06
TOTAL	135.9	143.23	134.44	127.87	129.26

(Aggregate Figures)

Daily Ave.	**377,490**	**395,765**	**372,430**	**358,160**	**357,101**
Highest	501,389	542,605	529,242	495,563	502,020
	Feb. 1 (Wed.)	Dec 16 (Mon.)	Dec. 17 Wed)	Jan. 9 (Fri.)	Dec. 1 (Wed.)
No. of Days	360	362	361	357	362

2.4.2.3.7.2 Land Traffic Survey

The following traffic survey report was lifted from the New Manila Reclamation Feasibility Study Report prepared by Surbana Jurong Consultants Pte Ltd issued 25 Oct 2016:

Schedule and Locations of Traffic Surveys

Traffic surveys were conducted in the locations shown in **Figure 2-145** below to have a better understanding of the existing traffic conditions. The locations of the traffic counts were chosen based on the connections with the proposed site accesses. Traffic counts were conducted at the 4 junctions indicated at 15-minute intervals for AM (7:30am-9:30am) and PM (5pm-7pm) peak hours on a weekday. The counts cannot be conducted on school holidays, public holidays, and one day before or after a public holiday as the traffic volume would not be representative of usual conditions.

The vehicles are classified into the following 6 classifications.

- Passenger cars/AUV
- Buses/Jeepneys
- Delivery Trucks (Light Goods Vehicles)Rigid Trucks (Medium Goods Vehicles)
- Articulated Trucks (Heavy Goods Vehicles)
- Motorcycles/Tricycles

The counts were conducted by recording videos at the junctions followed by off-site counts.

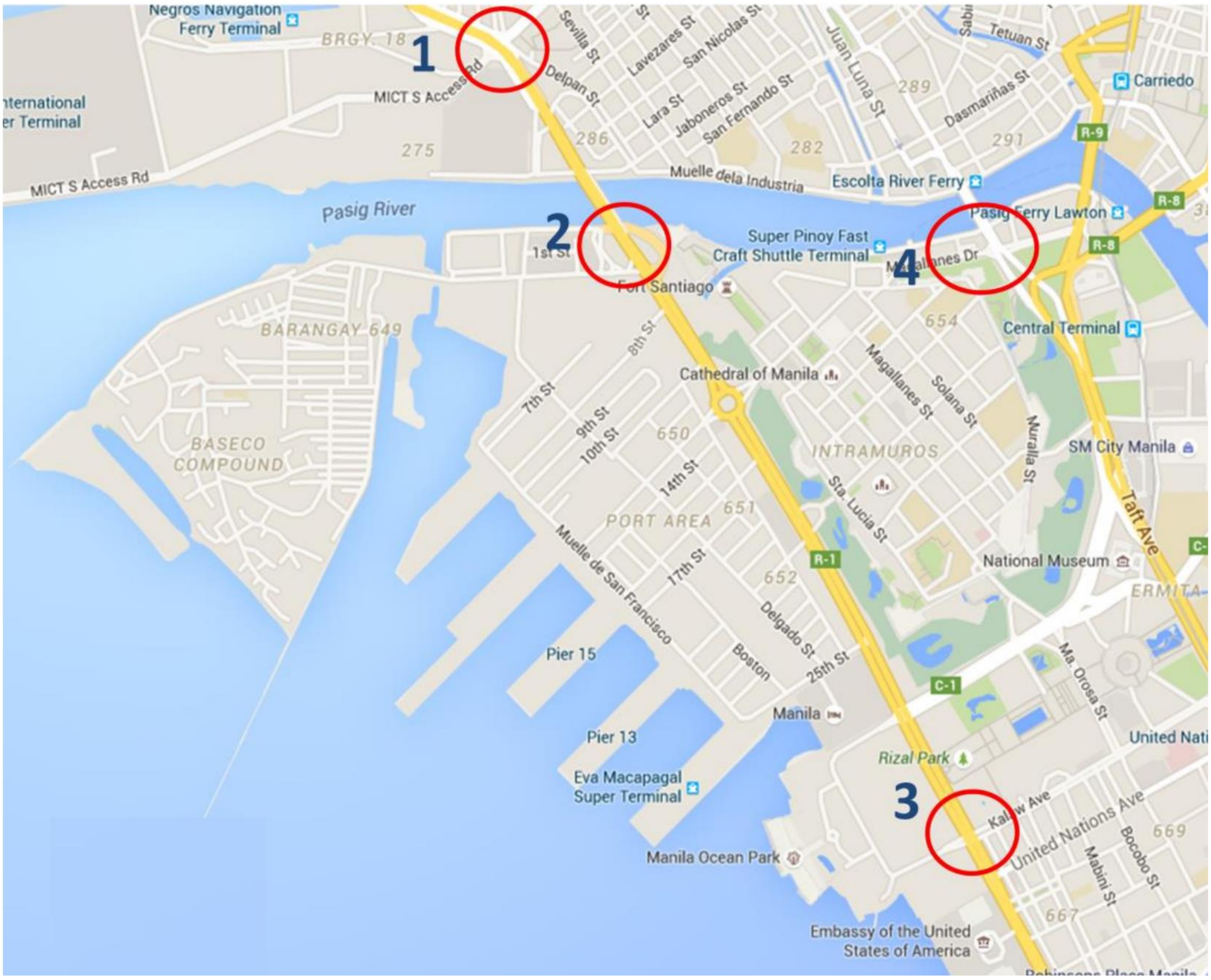


Figure 2-145. Locations of Traffic Surveys

Source: Feasibility Study for the New Manila Reclamation, 2016

The first location surveyed is at the intersection between Recto Avenue and Radial Road 10. The movements surveyed include vehicles entering and leaving Radial Road 10 from Recto Avenue and through traffic.

The second location is at the interchange of Bonifacio Drive and 2nd Street. The movements surveyed were the exits to and from Bonifacio Drive in both directions and the through traffic on Bonifacio Drive.

The third location is at the intersection between Roxas Boulevard and South Road. All traffic movements at the intersection were surveyed.
The fourth and final location is the intersection of P. Burgos Road (South bound) and Magallanes Drive. All vehicles entering and exiting P. Burgos Road from Magallanes Drive were counted.

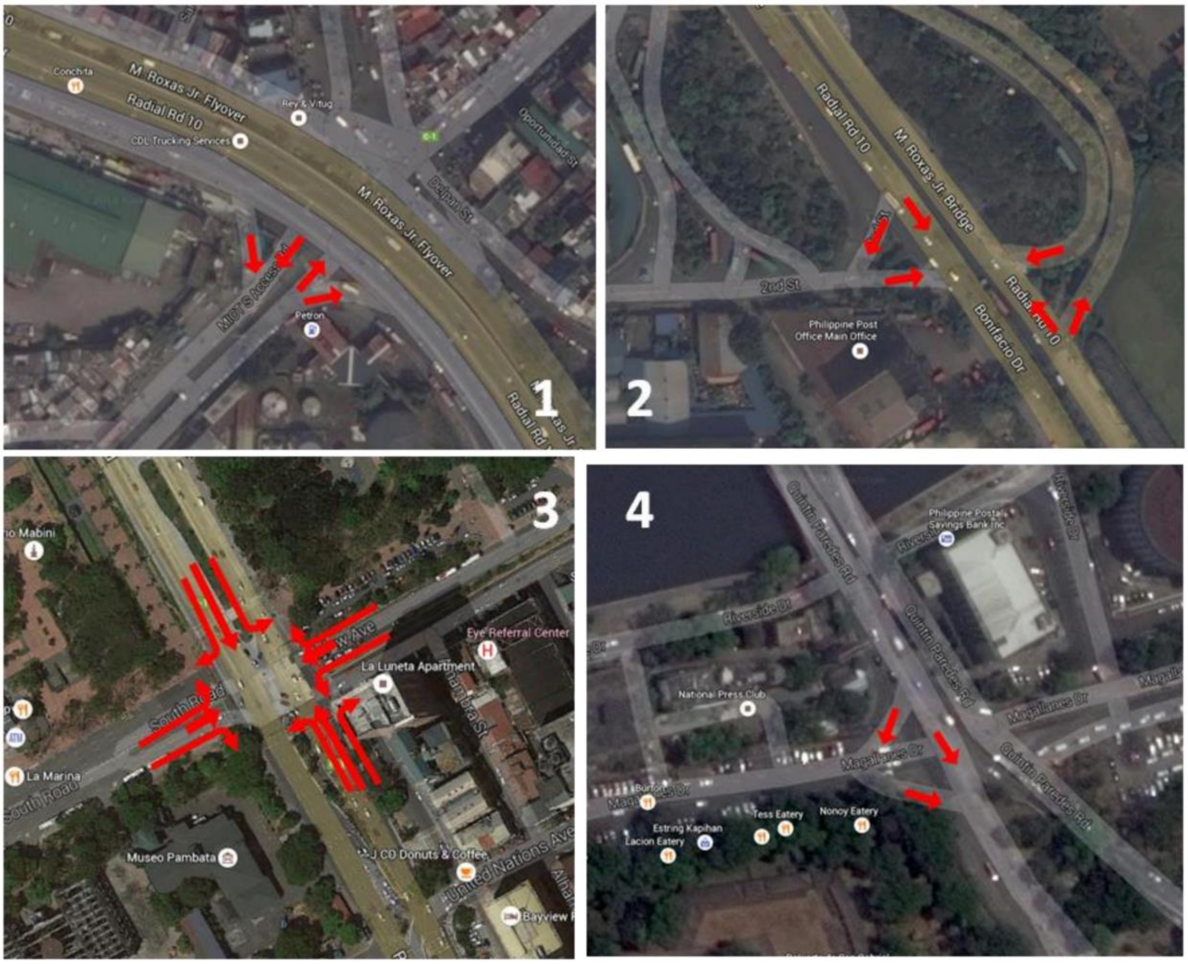


Figure 2-146. Traffic Movements at the Surveyed Junctions

Source: Feasibility Study for the New Manila Reclamation, 2016

Peak Hour Periods of Flow

Based on the results of the 15-minute interval traffic counts, the morning and evening peak hours are determined. An example of histograms of the results from the traffic count for junction 2 is shown in the figures below.

The volume of traffic in the morning is at the highest during 8:15a.m until 9:15a.m. Meanwhile, the evening (PM) peak can be observed to begin at 6p.m. and end at 7p.m.

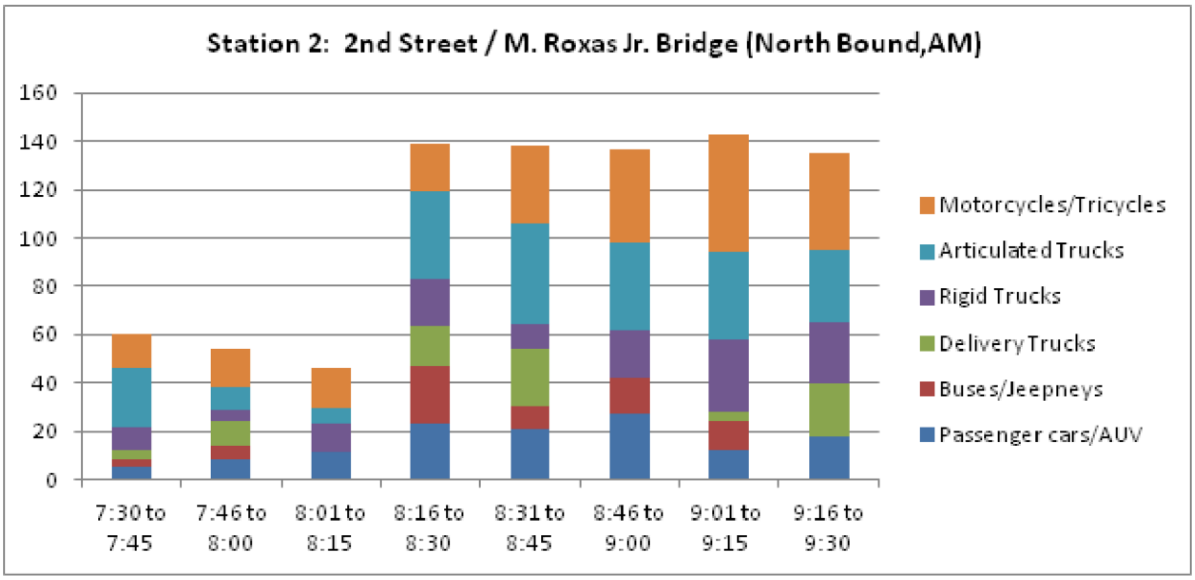


Figure 2-147. Traffic Counts at Station 2, North Bound, during 7.30am to 9.30am.

Source: Feasibility Study for the New Manila Reclamation, 2016

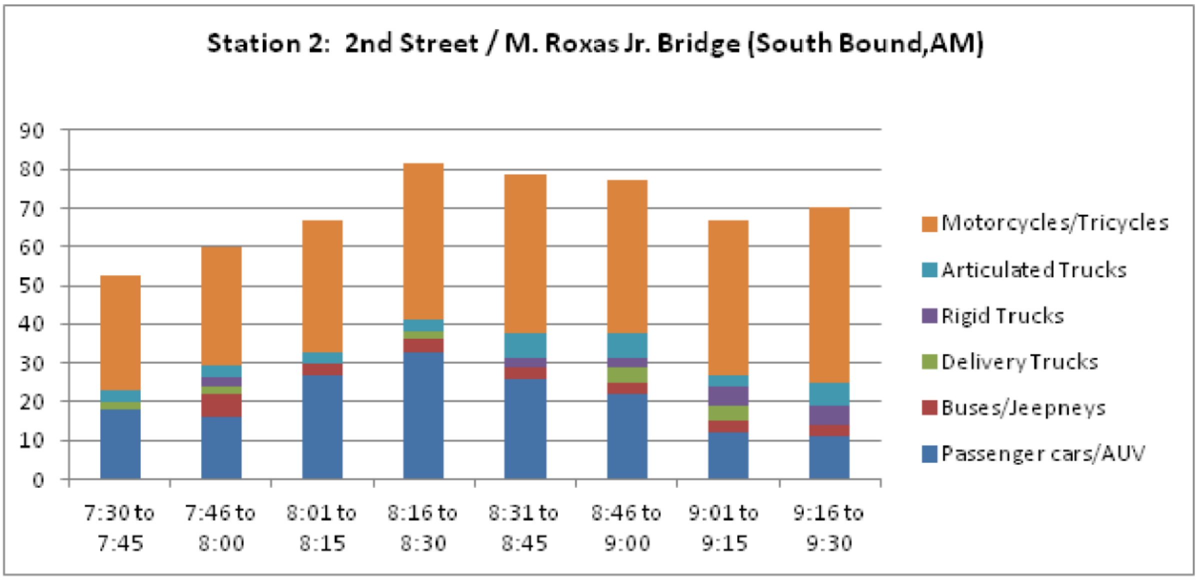


Figure 2-148. Traffic Counts at Station 2, South Bound, during 7.30am to 9.30am

Source: Feasibility Study for the New Manila Reclamation, 2016

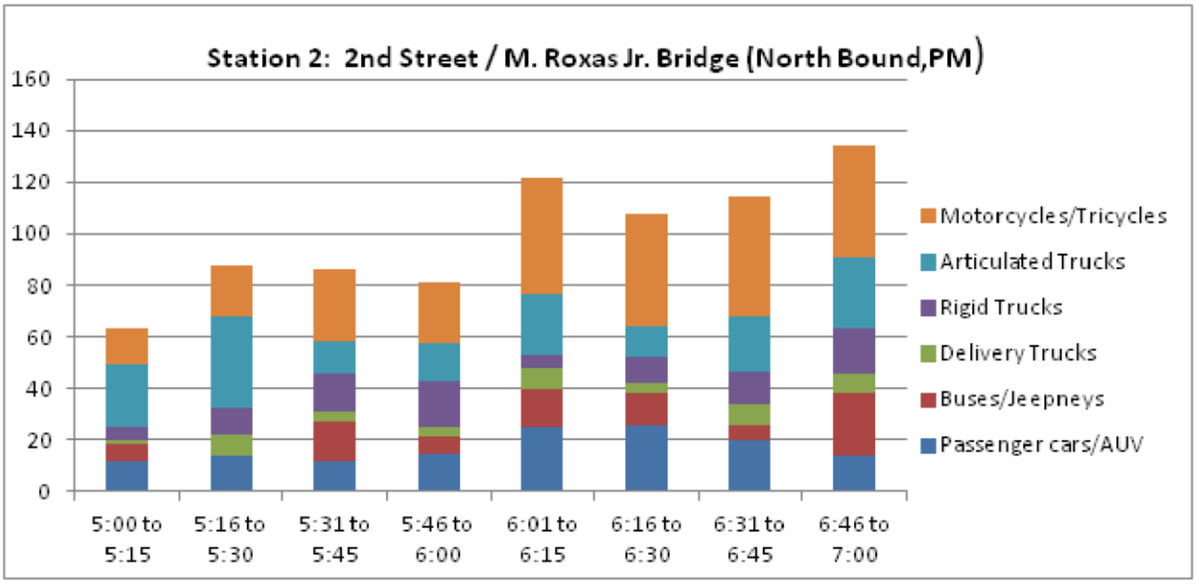


Figure 2-149. Traffic Counts at Station 2, North Bound, during 5.00pm to 7.00pm

Source: Feasibility Study for the New Manila Reclamation, 2016

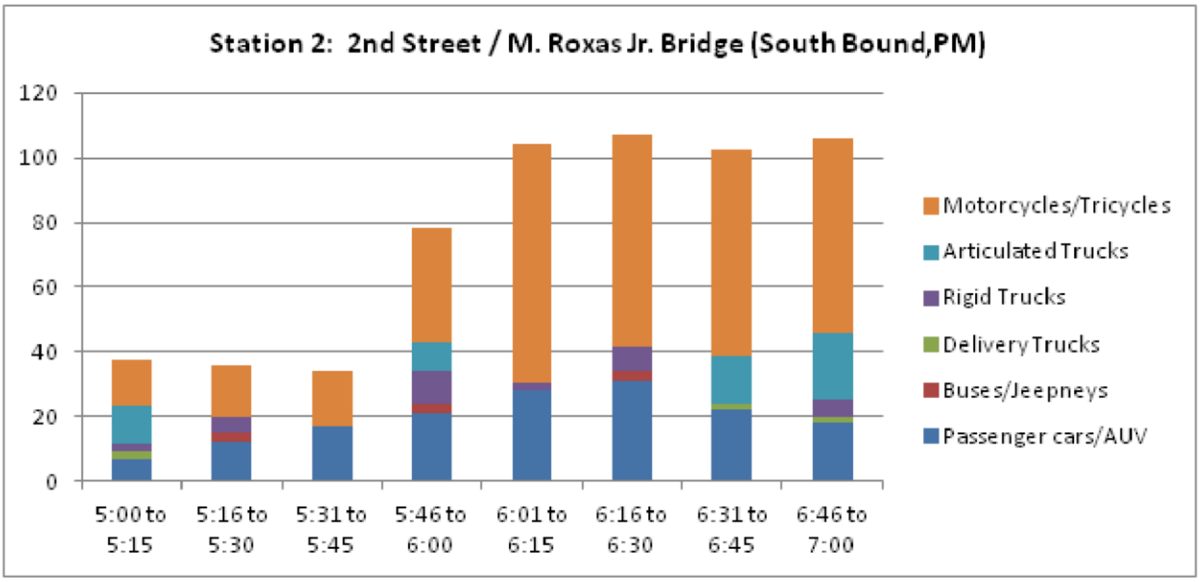


Figure 2-150. Traffic Counts at Station 2, South Bound, during 5.00pm to 7.00pm

Source: Feasibility Study for the New Manila Reclamation, 2016

2.4.2.3.7.3 Water Transport

The port of Manila lying at the mouth of the Manila Bay, is composed of two harbors and one container terminal. The figure below shows the map of piers and harbors in the vicinity of the proposed reclamation project:

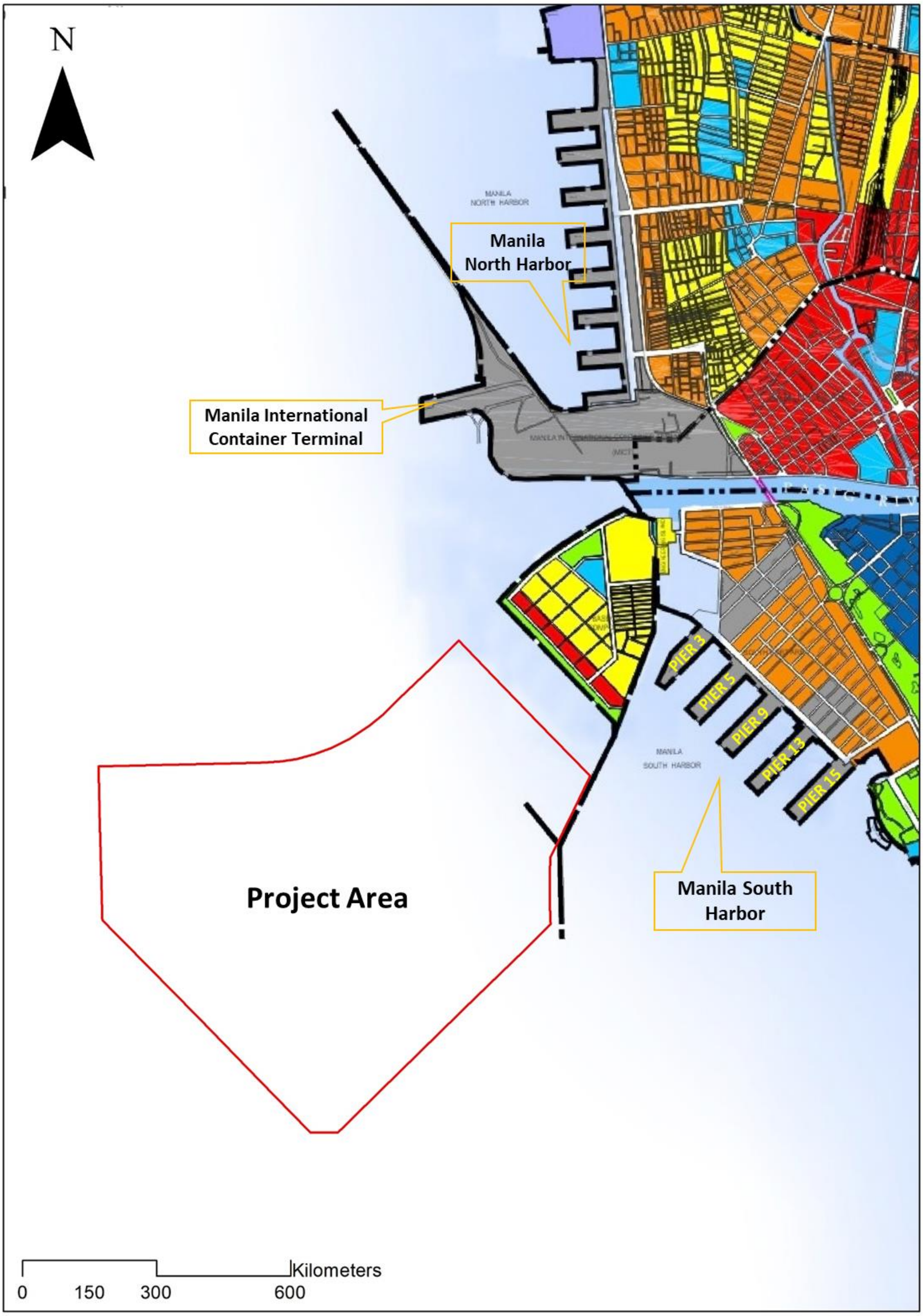


Figure 2-151. Habors and Piers near the Project Site
Source: Manila CLUP (2005-2020), Google Earth Pro (2018)

North Harbor

As per CLUP (2005-2020), North Harbor is situated at the northside of the Manila Bay along the shores of Tondo. It has eight piers and three wharves comprising 43 berths that cover a length of 6,135.01 meters. The intensity of container activities paved the way for the development of the Manila International Container Terminal (MICT), which is considered as one entire wharf. It has four usable berths, with one alternately converted as a Ron-on Roll-off (RORO) and spans some 840 meters in length. Among the shipping lines in the eight piers are the Negros Navigation, Aboitiz, Sweetlines, Gothong & Lorenzo, Sulpicio and William Lines.

Manila International Container Terminal

Manila International Container Terminal is operated by International Container Terminal Services Inc. (ICTSI). It is one of Asia's major seaports and one of the Philippines' most active ports. It is located between the Manila North Harbor and the Manila South Harbor and can be accessed by road through MICT South Access Road. In 2017, the terminal capped with a volume of over 1.1 million teus, nearly six percent higher than 2016 as reported in the 2017 Annual Report of ICTSI.

South Harbor

South Harbor is situated at the southside of the Manila Bay along the shores of the Intramuros area and near the proposed New Manila Reclamation Project. It has five piers (Piers 3, 5, 9, 13, and 15) with berths covering about 4,241 meters in length to accommodate international cargo vessels.

Based on the Marine Vessel Traffic Report for 2018 provided by the Philippine Ports Authority, Pier 5 houses 47% of the overall vessels in Manila South Harbor, followed by Pier 3 with 19%, Pier 15 with 18%, Pier 9 with 1%, and Pier 13 with less than 1%. Anchorage percentage is 15% (**Figure 2-152** and **Figure 2-153**).

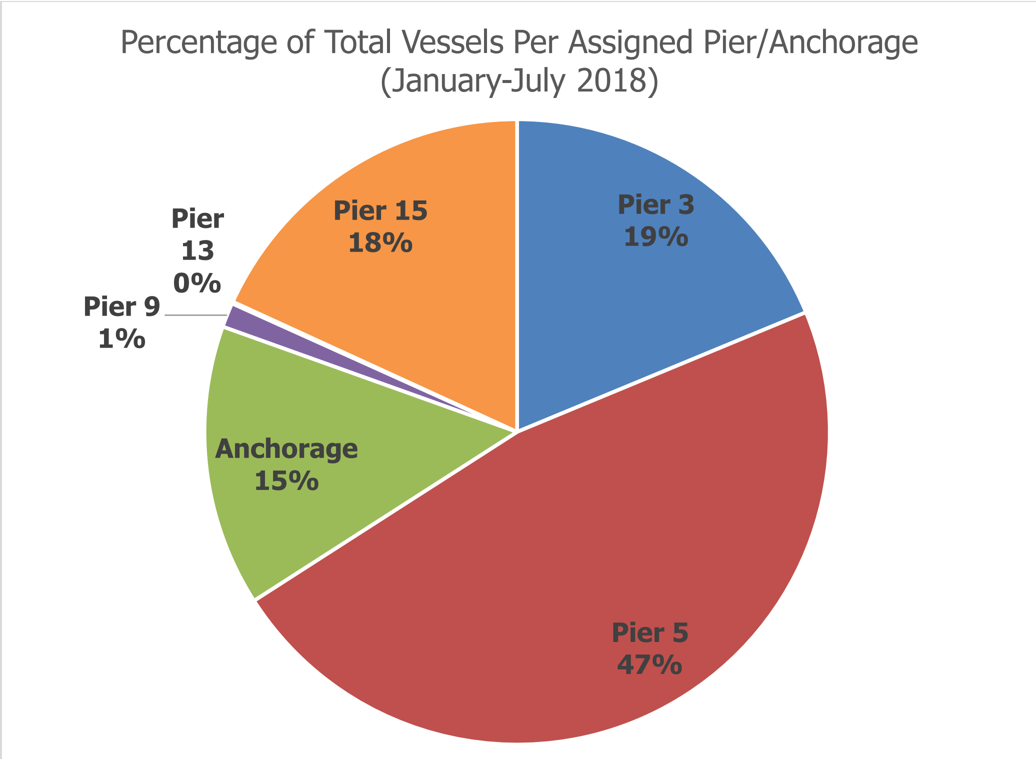


Figure 2-152. Percentage of total vessels per assigned piers in South Harbor, Manila (January-July, 2018)

Source: PMO NCR-South, 2018

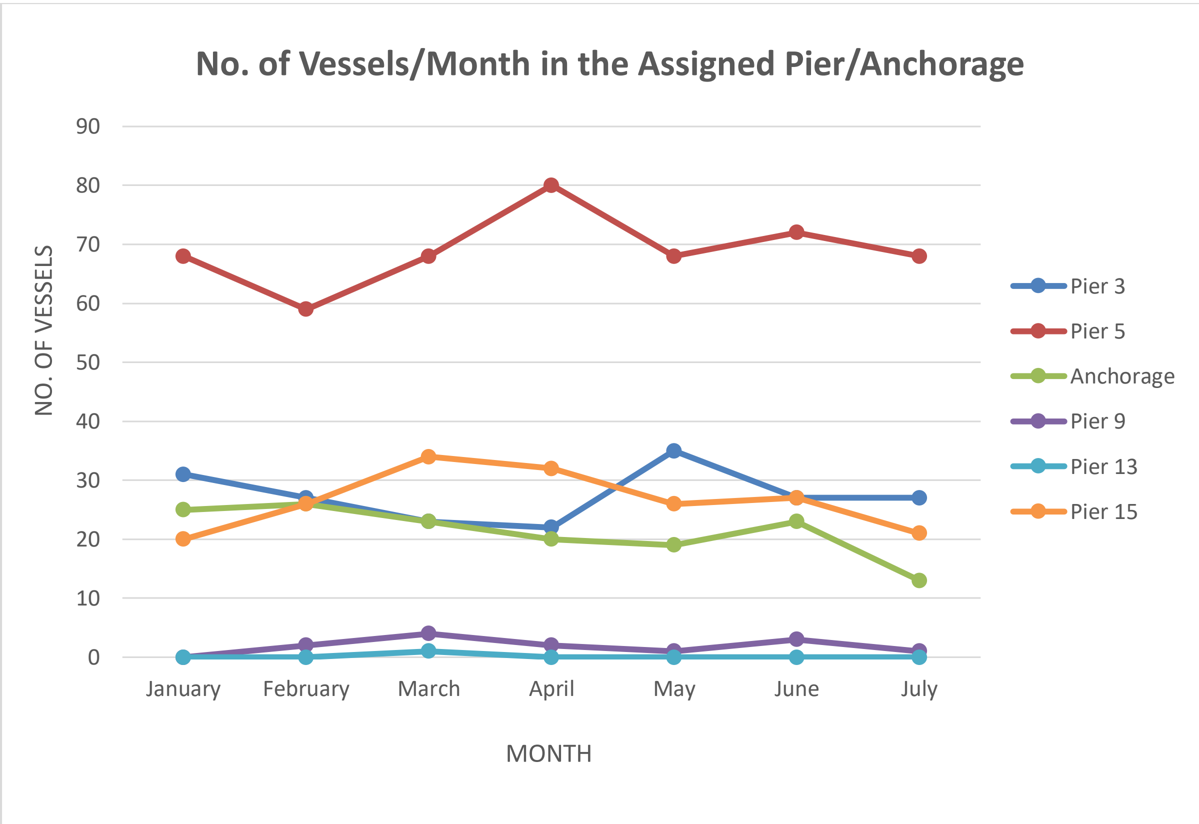


Figure 2-153. Number of vessels per month in the assigned pier/anchorage

Source: PMO NCR-South, 2018

On the average, a total of 69 vessels monthly frequent Pier 5 (**Figure 2-154**). All of these are container vessels. On the other hand, Pier 3 has a monthly average of 27 vessels composed of container and general cargo vessels. For Pier 15, 27 monthly average vessels composed of cargo vessels, cruise, naval, yachts and crafts. On other hand, Pier 9 has an average of only 2 vessels per month composed of cruises and general cargo vessels. Pier 13 has an average of 1 vessel per month (naval vessel). Lastly, a monthly average of 21 vessels anchor near Manila South Harbor composed of the following types of vessels: General Cargo Vessels, Tankers, Fishing Vessels, Tugs, Barges, Bulk, Naval, Navy, Yachts, Heavy Lifts, among others.

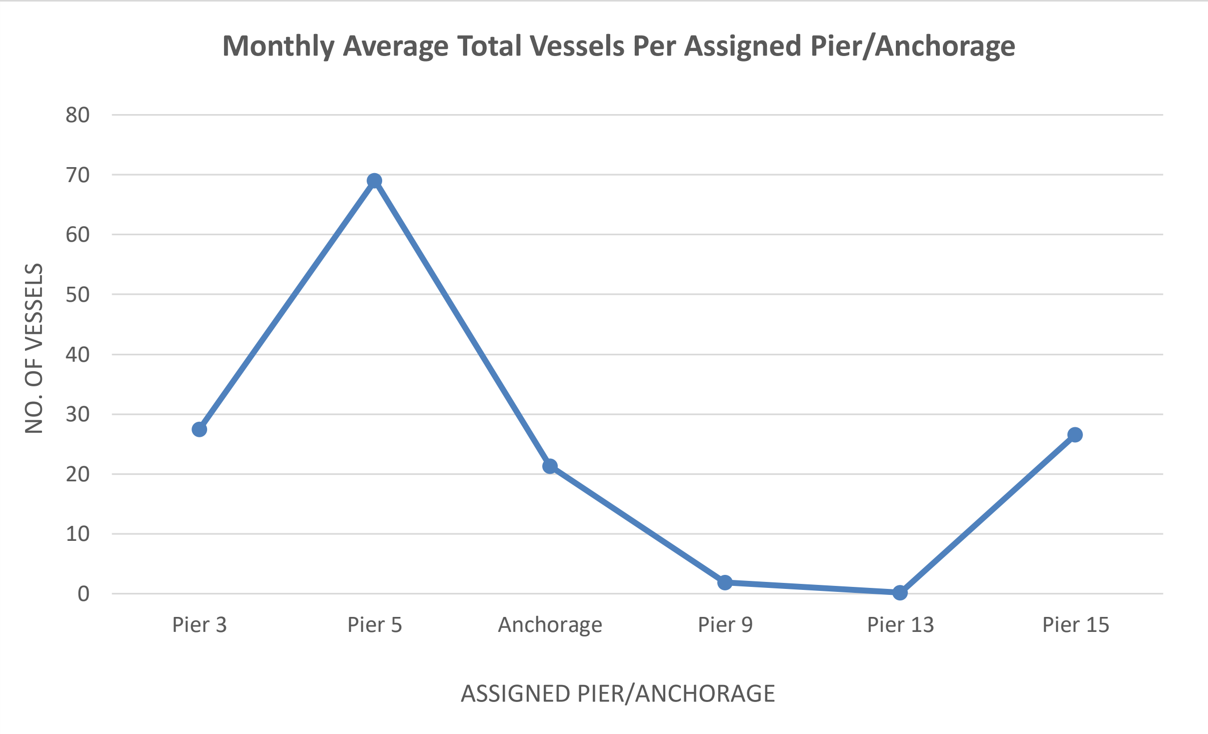


Figure 2-154. Monthly average total vessels per assigned pier/anchorage

Source: PMO NCR-South, 2018

The month of April has the highest number of vessels that access the Manila South Harbor with 156 vessels from January to July 2018. Using the data on Marine Vessel Traffic in April, about 84 vessels or 54% might be affected by the construction and operation of the proposed reclamation project. These vessels are categorized as container vessels and general cargo vessels which mostly dock on Piers 3 and 5.

2.4.2.4 Perception Survey

2.4.2.4.1 Demographic and Socio Economic Characteristics of Respondents

- Most of the respondents (41%) belong to 20-40 age bracket
- Eighty two percent (82%) of the respondents are females

- Forty seven percent (47%) of the respondents finished Elementary, another 47% finished highschool, while only 6% have finished college.
- Majority (76%) of the respondents are Roman Catholics.
- Selling, Salary, and contractual jobs (i.e laundry, garlic peeling) are some of the sources of livelihood of the respondents
- Majority of the respondents did not indicate their monthly income. Six percent of the respondents have monthly income of 1,000-4999 while another 6% have monthly income of more than 20,000 pesos.

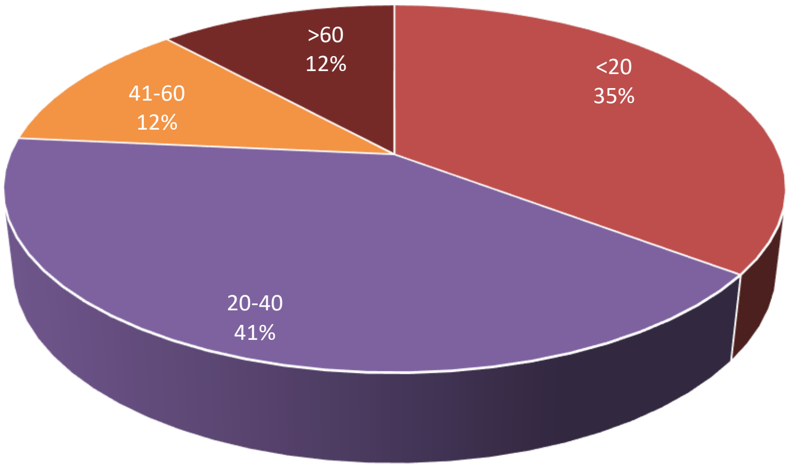


Figure 2-155. Age of Respondents

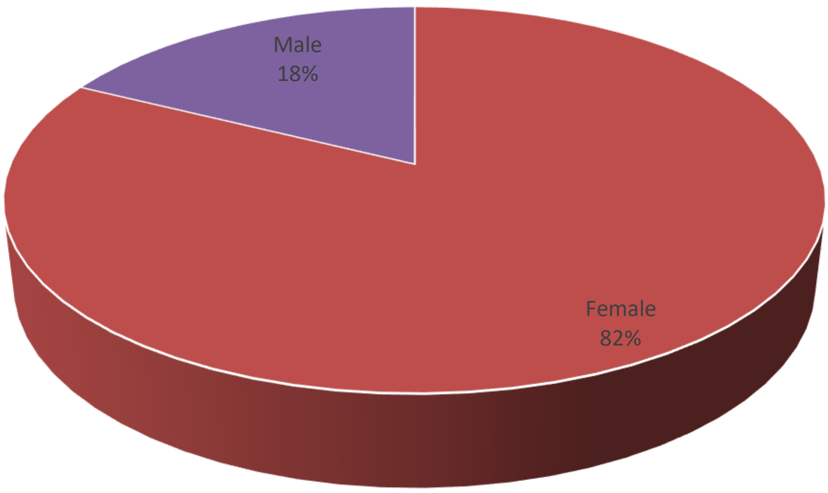


Figure 2-156. Sex of Respondents

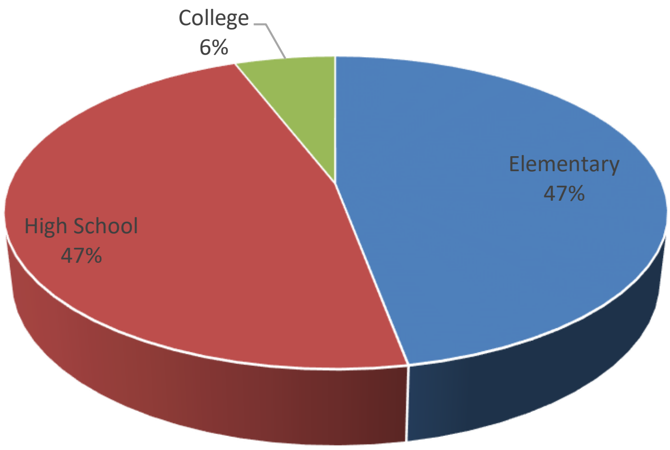


Figure 2-157. Educational Attainment of Respondents

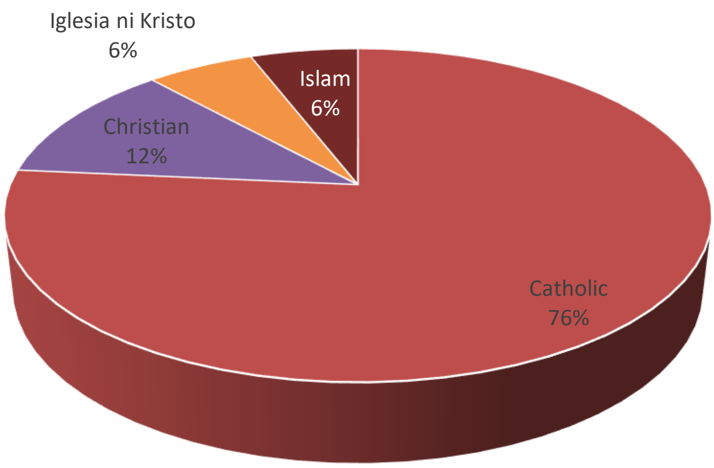


Figure 2-158. Religion of Respondents

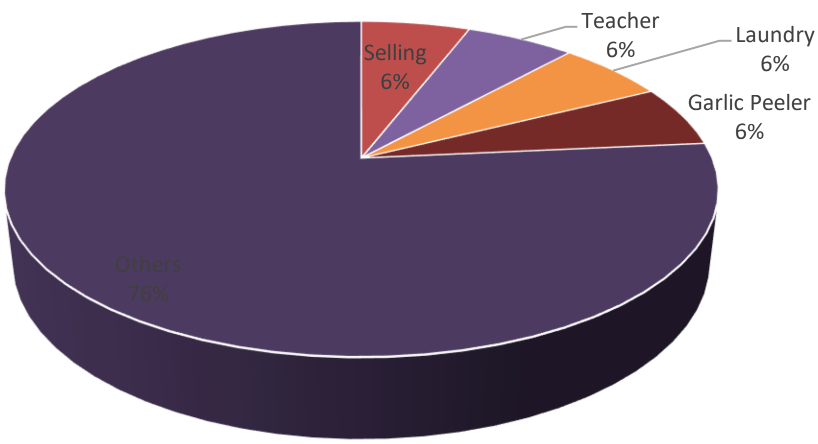


Figure 2-159. Source of Income of Respondents

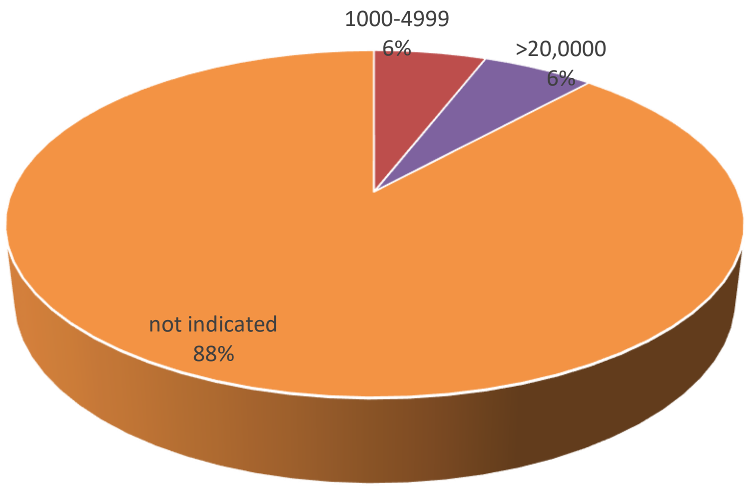


Figure 2-160. Monthly Income of Respondents

2.4.2.4.2 Summary List of Issues and Concerns

After the Perception Survey Activity, the raw data was processed. The key findings are as follows (in decreasing order of level of response):

Biggest Problem the Barangay is currently facing:

1. Cleanliness / Sanitation
2. Peace and Order
3. Livelihood
4. Health
5. Education
6. Water supply
7. Corruption
8. Vices of youth

Respondents fear in the establishment/running of the project:

1. Displacement of residents
2. Loss of livelihood
3. Accidents/disasters
4. Increase in crime

Respondents' perception on what should be done about the project

1. Public Consultation
2. Information Dissemination on Activities regarding the Project
3. Do not continue the project
4. Develop/improve the surroundings

Issues and Concerns about the Project

1. Timeline of ECC application

2. Impact on power supply
3. Systemic problems from the proposed project and other reclamation projects in Manila Bay
4. Impact of access road to the residents
5. Manila Mandamus to be part of EIA study
6. Source of filling materials
7. Involvement of necessary stakeholders during public participation
8. Impact on traffic
9. Impact on flooding
10. Impact on Earthquake hazard
11. Future land classification of the project
12. Impact of waste disposal on Manila Bay (aquatic life) and the community
13. Impact on drainage thereby causing flooding in Las Piñas
14. Impact on upstream of affected rivers
15. Impact on navigable waters
16. Existing breakwater to be part of the project
17. Consideration on international ports
18. Impact of hazardous equipment on water quality
19. Impact of hazardous equipment on historic and aesthetic value of the area
20. Impact of project size on water displacement near Pasig River
21. Flow analysis of bay / study on impact of drainage to the community to be included in the EIA
22. Generation of jobs
23. Displacement of barangay residents
24. Threat of hazards in the community
25. Improvement of the Baseco Community
26. Cleared and open Manila bay to preserve historical value of the area
27. Social preparation for the community;
28. Include in the development of the community
29. Fishing grounds affected by the equipment, ex. Compactor
30. Aid for the fisherfolk
31. Plan for aplaya residents

2.4.2.5 Focus Group Discussion

The FGD Results show the following (each are in order of their frequency and rating):

Perceived Positive Impacts of the Project:
1. Housing projects
2. Livelihood
3. Development of Surroundings

Perceived Negative Impacts of the Project:

1. Environmental degradation
2. Water pollution
3. Soil erosion
4. Dislocation/Demolition
5. Traffic
6. Change in lifestyle
7. Increase of crime

Suggestions about the Project:

1. Provide employment
2. Provide Relocation
3. Stop the project
4. Choose another location for the project
5. Do not construct on the sea
6. Consultation with the community
7. Develop the barangay

2.4.2.6 Key Informant Interviews

Results of the Key Informant Interviews (KII) conducted for the project is presented in the following table:

Table 2-92. Stakeholder Feedback

Stakeholder	Feedback
Local Government Units	
Brgy 20	- Aware of the project - Await schedule for further Public Participation and IEC Activities
Brgy 275	- Aware of the project - Await Schedule for further Public Participation and IEC Activities
Brgy 286	- Aware of the project - Await Schedule for further Public Participation and IEC Activities
Brgy 653	- Aware of the project - Await Schedule for further Public Participation and IEC Activities
Brgy 649	- Aware of the project - Await Schedule for further Public Participation and IEC Activities
Government Agencies w/ related mandate	
Philippine Reclamation Authority	- Issued Memorandum of Understanding (MOU) - Required the Submission of the following mandatory requirements: 1. Detailed Feasibility Study 2. Environmental Impact Statement 3. Engineering Geological and Geohazard Assessment 4. NEDA Regional Development Council and Provincial / City Council Resolutions expressing no objection to the proposed reclamation project

Stakeholder	Feedback
	5. Environmental Compliance Certificate
Philippine Ports Authority	- Issued Letter of No Objection - No Objection; Subject to the following conditions: 1. The proposed reclamation project shall at all times be compliant with the Supreme Court writ of mandamus on the clean-up of Manila Bay and Pasig River 2. Environmental issues and concerns related to the reclamation project shall be governed by the rules and regulations of the Department of Environment and Natural Resources, Philippine Coast Guard, the Authority, and other concerned agencies; 3. Suitable dredged materials shall be used as fill materials for the reclamation project; 4. The proposed reclamation project shall neither obstruct anchorage operations in the Manila Bay nor block the entrance navigational channels, fairways, and berths of South Harbor, North Harbor, and Manila International Container Terminal nor impair the existing breakwater; 5. The port components of the proposed reclamation project, if any, shall be subject to the written consent of the Authority and the detailed feasibility study and plans shall be submitted to the Authority for approval prior to implementation; and, 6. The proposed reclamation project shall be in accordance with the Port Masterplan of the Authority and that the final alignment of coordinates and location thereof shall be subject to the approval by the Authority and shall be in compliance with such guidelines as may be adopted by the National Economic Development Authority and/or other national government agencies or instrumentalities.
Philippine Coast Guards HQ	- Project shall be discussed further within their office - Await Schedule for Public Participation and IEC Activities
Philippine Coast Guards NCR	- Project shall be discussed further within their office - Await Schedule for Public Participation and IEC Activities
Philippine Coast Guards NCR Marine Environmental Protection Unit (MEPU)	- Aware of the project as coordination has been ongoing - Await Schedule for Public Participation and IEC Activities
Bureau of Fisheries and Aquatic Resources (BFAR)	- Issued Letter of No Objection - No Objection but subject to the following conditions: 2. The project will not affect the fishery resources on the south eastern side of Manila Bay based on the study of Santos et al 2017; 3. Filling materials will be sourced outside Manila Bay; and 4. No fisherfolk or fishery enterprise would be disfranchised. 5. Should there be fisherfolk affected by the project, they would be given assistance or alternative livelihood to make up for their loss
Department of Tourism (DoT)	- Issued Letter of No Objection - No objection; Request for: 1. Provision for the construction of a pier to accommodate large

Stakeholder	Feedback
	cruise ships should be made part of the overall plan 2. DOT shall be allowed access to the said facility at no cost whatsoever purposes of carrying out its mandate under RA 9593, as well as to include vibrant welcome ceremonies/ reception, which showcase the world-renowned Filipino hospitality.
Department of Health (DoH-NCR)	- Issued Letter of No Objection - No Objection provided however that all other pertinent laws and ordinances are complied with and strictly followed
Communities/Households/Residents	
Brgy 20 Brgy 275 Brgy 286 Brgy 653 Brgy 649	- Raised concerns on possible displacement of homes and residences - Raised concerns that the project might benefit only/ mostly those of higher socio-economic status
Business Activities/Industries	
Asian Terminals Incorporated	- Not aware of the project - Await Schedule for Public Participation and IEC Activities
Manila Ocean Park	- Not aware of the project - Await Schedule for Public Participation and IEC Activities
Hotel H20	- Not aware of the project - Await Schedule for Public Participation and IEC Activities
Interest Groups (NGOs/POs)	
Samahang Magkakapitbahay ng Valderama (SMV) – Brgy 286	- Not aware of the project - Await Schedule for Public Participation and IEC Activities - Raised concerns on possible displacement of homes and residences - Raised concerns that the project might benefit only/ mostly those of higher socio-economic status
Pasig River Rehabilitation Commission (PRRC) – Baseco Field Office	- Not aware of the project - Await Schedule for Public Participation and IEC Activities - Offered assistance with Activities in the Community
People whose socio-economic welfare and cultural heritage may be affected by the project esp. vulnerable sectors and indigenous people	
Informal Settlers Ambulant Workers	- Raised concerns on possible displacement of homes and residences - Raised concerns that the project might benefit only/ mostly those of higher socio-economic status
Luneta Park Admin (NPDC)	- Not aware of the project - Await Schedule for Public Participation and IEC Activities
Intramuros Admin	- Not aware of the project - Await Schedule for Public Participation and IEC Activities
Local Institutions	
Corazon Aquino High School Hermeginildo Atienza Elementary School	- Aware of the project - Raised community concerns on cleanliness and sanitation of the community - Raised concerns on safety issue of only one ingress/egress to the community - Raised concerns on the proliferation of vagrancy, illegal drug use

Stakeholder	Feedback
	and petty crimes within and in the surrounding areas, and extending even further, which might spillover to the project site - Raised concerns on lack of educational facilities to accommodate the youth/student population

2.4.3 Potential impacts and options for prevention, mitigation or enhancement

2.4.3.1 Cultural and lifestyle change

Positive Impacts

Increase in ability to cope with household and subsistence expenses for:

- stakeholders directly employed by the project
- stakeholders with new and additional livelihood, catering to the activities and direct and indirect personnel of the project

Leading to slight changes in terms of the following:

- Improved Access to Education for studying children of employed and those with new and additional small livelihood
- Improved Nutrition and less health-related worries of Household members of employed and those with new and additional small livelihood
- Improved Access to Recreational Activities for household members of employed and those with new and additional small livelihood
- Decrease in vulnerability to succumbing to juvenile delinquency and unlawful/illegal activities for subsistence of household members of employed and those with new and additional small livelihood
- Decrease in susceptibility to public disorder stemming from economic inactivity of and interpersonal grievances and strained community relationships of household members of employed and those with new and additional small livelihood

Negative Impacts

- Threat of Uptake of Crime in and near the BASECO Community due to increase in economic activity near the area.

Mitigation and Enhancement Measures

- Prioritization of Local stakeholders for employment in the Project
- Livelihood Programs to augment income for indigent stakeholders

- Educational Programs such as Scholarships and contribution to improvements and additions to educational facilities
- Contribution to Peace and order programs and facilities

2.4.3.2 Impacts on physical resources

The single secondary data sourced by the EIA team regarding any archaeological study on the area is relatively old (The Philippine Journal of Science, Outline Review of Philippine Archaeology by Islands and Provinces, 1947). A review of the literature on the archaeological significance of the project area shows that the general area of the project site is rich with archaeological finds. Though the general area has already been systematically explored extensively, still it is of potential further or greater archaeological chance finds.

Potential Destruction, mishandling of Archaeological chance finds/ Workers lack of understanding and care to protect the environment and archaeological/ historical sites and cultural monuments.

1. Include the following specific requirement in bid and contract documents:
   a. Withholding of payment or penalty clauses, to ensure contractor's implementation of environmental and archaeological mitigation measures;
   b. Employment of a designated Environmental Specialist and a designated Archaeologist to oversee environmental and archaeological issues and mitigation; and
   c. Provision of environmental and archaeological orientation/workshop.
2. Environment Protection, Health and Safety Orientation Plan
   i. The purpose of this sub-plan is to document the approach of the general contractor (GC), Subcontractors (SCs), and their workers in the implementation of a training program for construction workers in relation to environmental, archaeological, and occupational health and Safety issues.
   ii. Orientation rationale. The implementation of the EMP will require the involvement of all construction personnel. The nature of the EMP is such that personnel at all levels have a degree of responsibility in relation to environmental, archaeological, and occupational health and safety issues and the implementation of measures contained in the EMP. As such, orientation for all personnel in relation to environmental and archaeological issues and the implementation of the EMP will be critical to ensuring the effectiveness of the EMP
   iii. Orientation objective. The objective is to raise and enhance the awareness of the construction workforce in relation relevant legislation and policy issues:
   a. General environmental awareness, including rules and regulations to be

followed on archaeological, historical, cultural sites, construction site and in the construction camps

3. Physical Cultural Resources Plan

   i. The purpose of this sub-plan is to document the approach of the proponent and contractors and their workers to protect identified archaeological, historical, and cultural sites and monuments and to manage any physical cultural resources that are encountered during the construction works.
   ii. The plan should comply with procedures set by the NHCP.
   iii. For archaeological chance, find the procedures *set by NHCP shall be followed.*

In the event of archaeological chance finds:

i. Inform at once the respective institutions governing such matters, specifically the National Historical Commission of the Philippines (NHCP).
ii. Obtain necessary approvals for construction in areas where archaeological finds have been identified, and follow the archaeological chance-find procedures of the NHCP.
iii. Fix borders of archaeological sites to be excavated for preservation and/or investigated.
iv. Incorporate archaeological excavations in construction schedule.
v. To *avoid potential adverse impacts to historic and cultural resources, the Contractor* shall:
   (a) Protect sites of known archaeological, historic and cultural resources by the placement of suitable fencing and barriers.
   (b) Construction camps shall be located 500 meters away from cultural resources.
   (c) Adhere to accepted NHCP practice and all applicable historic and cultural preservation requirements of the NHCP.
   (d) In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the Engineer and the NHCP. If continuation of the work would endanger the finding, work shall be suspended until a solution for preservation of the artifacts is agreed upon.

2.4.3.3 Generation of local benefits from the Project

The benefits of the project will include items from the existing SDP containing the recommended programs and projects that the different sectors themselves identified. Likewise, these plans and programs were reviewed in reference with the Municipal Development Plans as well as the provisions of the Local Government Code (RA 7160) under which both laws mandated benefits for the host communities.

The Social Development Plan prepared for this project considered the articulated wishes of the community and Local Government of the impact areas, their concerns and issues concerning the environment, health and vulnerable groups and the measures to address them as recommended in the EIS. Focus will be centered on the mitigating measures to abate the possible negative impacts of the project and enhance the positive impacts.

2.4.3.4 Traffic congestion

2.4.3.4.1 Vehicular Traffic

Traffic build-up is very common in the area. Vehicular traffic congestion experienced daily by commuters and drivers is brought about by the over-loaded transport infrastructure, the presence of incorrectly executed infrastructure, and poor traffic management.

It is inevitable that there will be an increase in vehicular traffic. Such situation will pose risks to the residents living along the periphery of the road and school children crossing the streets.

The project's direct impact of addition to traffic congestion will only be very minimal during the pre-construction phase, mostly due to vehicles of the personnel engaging in further studies and planning in areas towards the project location. This impact will increase only during the initial stages of the construction phase upon the arrivals and exits of equipment via land, and on other occasions throughout the project implementation, but not too frequent or long, as the proponents endeavor to use the sea access more for logistical and cost reasons. For the remaining, and longer time the traffic towards and in the areas directly accessing the project location would be limited to select personnel accessing the project location via land.

The proponent will strictly comply with traffic rules and implement speed limits to ensure safety of the potentially affected communities.

2.4.3.4.2 Marine Vessel Traffic

The project is located in what is at present the frontage vicinity of the Manila harbor area terminal facilities for container cargo ships and passenger ships. The project will have no direct impact on the marine vessel traffic of those availing of the terminal service facilities north of the project, namely Manila North Harbor and MICT. But based on the project's location and shape configuration, it will have a more direct impact on marine vehicles availing and accessing the terminal facilities of the Manila South Harbor, wherein such vehicles will have a limited path and passage towards said terminal and other port facilities such as those of the Philippine Coast Guards. The mentioned path and passage will be towards the south and southeastern portion of the project boundaries and follow its shape or direction, impacting the present non-presence of such limitations.

Limitations to access thru this channel may lead to a bottleneck in it. Such limitations may lead to longer time in off-shore anchorage prior to accessing the ports and terminals, along with its inherent cost counterparts in fuel, personnel, and other time affected aspects.

With regards to all those that will be using the south harbor facilities, those vehicles that it will have additional impact on, will be those entering and exiting the south harbor area to and from the north (i.e. Subic, etc.), and those accessing the Northern Terminal Facilities (Manila North Harbor, MICT) to and from the South (i.e. Cavite, Southern Metro Manila Bay Area, etc). This is as the more direct path, shall be encumbered with going around the project area. (Based on the limited data presented above, this accounts for 54% of marine vehicles accessing the south harbor).

Another impact will be the increase in the distance of the anchorage area from the harbor facilities, for those numbers of ships which would have been utilizing the project location or area as its anchorage if the project is not occupying the space.
With the development of the existing terminal facilities alongside the continuous and projected growth with global trade of goods via manila port areas, it is imperative that measures to address the said impacts be commenced upon at the onset of the project.

To address the impacts, the following will be implemented:

- IEC with the parties, especially the pertinent agencies and offices, covering the area and marine vessel traffic and navigation, such as the PPA, the Philippine Coast Guard, Manila Bay Coordinating Office, and others.
- Coordination with the parties, especially the pertinent agencies and offices, covering the area and marine vessel traffic and navigation, such as the PPA, the Philippine Coast Guard, Manila Bay Coordinating Office, and others, on coming up with a Sea Lane Navigation and Traffic Plan in consideration of the Project.

2.4.3.4.3 Access for fishermen

Possible displacement of local fishers from their traditional fishing ground due to coastal development is considered as one of the potential impacts of the project. Increase in sea traffic due to the use of large ships and vessels during reclamation is also unavoidable. To address these impacts, it is recommended that the fisher folk that would be affected (if any) will be provided alternate subsistence and livelihood opportunities. Also, a channel will be established to serve as access by fisher folks possibly to be affected by the project. The proponent will strictly comply with sea traffic rules and consider peak hours of fishing activities during reclamation activities.

3 Environmental Management Plan

The City Government of Manila and UAA Kinming Group are committed to operate the Project in a manner that will prioritize the protection of the existing environment, safety and health of the people and compliance with environmental laws, rules and regulations and other applicable legislations.

This section provides the Project's Impact Management Plan (IMP), which serves as the action plan for implementing the mitigating and enhancement principles, practices and measures aimed at minimizing and/or eliminating the potential impacts of the proposed Project to the surrounding environment.

The identified environmental impacts and corresponding proposed preventive, mitigation and/or enhancement measures for each environmental component during the Project's pre-construction, construction, operation and abandonment phases are detailed in **Table 3-1**.

Table 3-1. Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
I. Pre-construction Phase						
Geotechnical investigation	Land Water	*Contamination of soil, groundwater, and surface water.* (-) Drilling fluid may potentially leak into receiving environment if not managed properly	▫ Use appropriate drilling fluid ▫ Implement proper bunding to avoid spillage into receiving environment. ▫ Prepare emergency spill kits in case of potential leaks.	Proponent / Contractor	Php200,000.00	Part of the project cost
Increased movement of heavy equipment on site and delivery of materials	Air	*Generation of dust* (-) Increased particulate matter due to movement of vehicles (-) Health effects due to inhalation of dust by residents living in areas adjacent to project site	▫ Implement dust suppression techniques. ▫ Cover trucks with tarpaulin loaded with spoils/filling materials when in transit. ▫ Pre-wetting of road surface to minimise dust.	Proponent / Contractor	Php50,000.00 / quarter.	Part of the project cost
	People	*Threat to public safety* (-) Possible injury or fatality as a result of heavy equipment and delivery trucks movement in the project site	▫ Implement speed limits and safety devices /signs. ▫ Ensure competency of drivers to drive safely. ▫ Engage local communities and inform them of site activities through IECs, posting construction “off limits” and safety signage	Proponent / Contractor	Php50,000/year on safety signage and Php50,000.00 on trainings/seminars	Part of the project cost
		Traffic congestion (-) Rapid deterioration of existing national/ municipal/ barangay road condition as a result of heavy equipment movement	▫ Coordinate with DPWH and Municipal Engineering Department in road maintenance and necessary improvements to accommodate increased vehicle movement.	Proponent / Contractor		Part of the regular coordination of the Proponent with the LGU
Geotechnical	People	Occupational Health and Safety	▫ Posting of safety warning and danger signs ▫ Provision and wearing of personal protective	CRO, Envi	Php 1M-2M per year	OSH and

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
investigation			equipment at all times ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	Department	(may vary depending on the SDP program)	Emergency response program
Geotechnical investigation	Socio-Economics	Employment opportunities and economic benefits	▫ Prioritize hiring of local workers ▫ Prompt payment of taxes ▫ Implementation of social development programs for host community ▫ Continuous skills training and development and capacity building program for the impact areas ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	Local hiring report DOLE Report Social Dev't and Mgmt Plan Corporate Social Responsibility Program
Completion of requisite MOAs, endorsements, and clearances	People	Social Acceptance and Support for the project	▫ IEC on Project to inform, respective institutions, agencies, offices, bodies and organizations for providing their respective endorsements and/or clearances ▫ MOAs with respective bodies	CRO, Envi Department	Php 50,000	No commencement of construction until full compliance and completion of required endorsements and clearances
II. Construction Phase (Reclamation Works)						
Site preparation, ground levelling, and drainage improvements	Land	*Change in geomorphology* (-) The Project site's elevation will be altered. The elevation change will result in subsequent change in the hydrology surrounding the Project site	▫ Implement flood control measures which such as construction of proper and adequate drainage systems.	Proponent / Contractor	Php100,000.00/ year – maintenance of the drainage facility	Part of project cost
Site preparation, excavation, and filling	Land	*Inducement of subsidence or collapse* (-) Minor subsidence may occur within the	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of	Proponent / Contractor	Php10M – implementation of site	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		project site when the subsurface is disturbed during excavation activities for preparation of foundation (-) Minor settling may also occur as a result of additional loads from heavy machinery and structures	subsidence or differential settling.		preparation adhering to best engineering practices.	
Site preparation, ground levelling and drainage improvements	Land People	*Inducement of higher flood levels* (-) Occurrence, frequency and magnitude of flooding may be affected due to the change in drainage morphology and changes in ground elevation in the project site (-) Flooding may cause damage to property, assets, and may pose threat to public safety	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of subsidence or differential settling. ▫ Probable modification of drainage systems shall maintain natural outlets or consider similar transport regimes/streamflow as the pre-existing natural drainage ▫ Maximize the capacity of two exit river channels on both sides of the reclamation area through regular desilting and clearing operations	Proponent / Contractor	Php10M – implementation of site preparation adhering to best engineering practices and maintenance	Part of project cost
Site preparation, excavation, and filling	Land	*Soil erosion from onsite activities* (-) Improper storage of construction materials and indiscriminate disposal of fill materials and excavated soils may affect erosion patterns.	▫ Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimise possibility of subsidence or differential settling. ▫ Progressive ground preparation and clearing to minimize total area of land that will be disturbed at any one time, where practical.	Proponent / Contractor	Php100,000.00/ year –ground stabilization and maintenance	Part of project cost
		Contamination of soil / disposal site (-) Excavated soil materials may contain contaminants that may potentially affect soil	▫ Implement best engineering practices such as proper stockpiling and handling of excavated materials. ▫ Implement proper filling and disposal to avoid	Proponent / Contractor	Php 2,000,000.00 – Provision of proper waste	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		and ground and surface water quality	contamination of soil, groundwater, and surface water		disposal.	
Reclamation works	River water quality Marine water quality	(-) Degradation of water quality due to siltation brought about by reclamation activities	▫ Maintain water quality levels prescribed in DAO 2016-08, particularly TSS at 80 g/l. ▫ Sand bunds or other types of bund walls or silt curtains or other appropriate mitigation measures should be provided to prevent dispersion of silt or sediments away from the project site during reclamation works. ▫ Implement best environmental management practices such as, but shall not be limited to, removal of debris along the waterways, proper disposal of construction wastes, installation of silt traps at strategic locations, and spoils to be properly contoured to prevent erosion ▫ Regular dredging works should be conducted adjacent the proposed project site, specifically in vicinities of the mouth of Pasig River where sediment deposition from these highly-silted river inflows would constrict waterways and current flows. ▫ Dredging works shall regularly be conducted adjacent and at immediate vicinities along the eastern part of project boundaries wherein accretion of sediments is likely due to the presence of the reclaimed project site.	Proponent / Contractor	Php10M – implementation of site preparation adhering to best engineering practices and maintenance	Part of project cost.
		(-) Enhanced turbidity (temporary)	▫ The use of steel sheet piles reinforced with silt curtains will effectively reduce sediment stream reaching the river estuary			

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
Generation of wastes		(-) Degradation of water quality due to runoff from sanitary sewage, waste water, solid wastes, and other construction materials that can harm aquatic flora/fauna	▫ Removal of debris along the waterways will be conducted, all construction wastes will be properly disposed, silt traps at strategic locations and spoils will be properly contoured to prevent erosion. ▫ Construction of sediment/ settling ponds and related structures to mitigate siltation or sedimentation of water body ▫ Portalets will be provided for use of the workers and its corresponding wastewater will be properly disposed. ▫ Implementation of Solid waste management program and Hazardous waste management program. ▫ Use of DENR accredited haulers/TSD companies.	Proponent / Contractor	Php50,000 / Year – provision for proper solid waste disposal	Part of project cost
Oil and lubricants	River water quality	(-) River water contamination	▫ Implement oil and grease recovery plan for all marine vessels operating in the reclamation area; ▫ Implement prohibition on releasing ship bilge into the bay.			
Reclamation, soil filling and compacting	Coastal water quality; Benthic communities of marine organisms; Fish resources	(-) Increase in siltation/sedimentation loading in coastal waters; increase in turbidity and suspended solids; (-) Reduction in photosynthesis and primary productivity (-) Suffocation of bivalve veliger in soft bottom benthos;	▫ Use of steel sheet piles and sloping revetment technologies during reclamation; ▫ Provision of silt curtains where sediment streams are likely to occur and escape. ▫ Collection and trans-location of macro-invertebrates found within the reclamation area, if any; ▫ Monitoring of sediment fluxes and application of more stringent control measures when	Proponent / Contractor		Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		(-) Disruption of fish feeding and benthos larval growth; (-) Impairment in fish and shellfish reproductive process.	necessary; or temporary cessation of activities. ▫ Sediment canals in reclaimed areas will be installed to divert sludge into filters and weirs that capture sediments and fugitive reclamation filling materials at source.			
Reclamation, soil filling and compacting	Wastewaters emanating due to influx of reclamation workers can add to marine pollution and negatively affect benthic communities of macro-invertebrates; plankton community fish	(-) Inadvertent spill of domestic wastewaters can cause coastal water pollution, loss of macro-invertebrate population, impairment in fish and shellfish reproductive physiology.	▫ Install liquid waste management system ensuring modern waste retrieval and treatment system. Treatment and disposal of liquid waste at point source will involve collecting liquids of point source origin; directing waste into integrated multiple waste streams facilities or collecting vessels, and application of treatments. Any fluid effluent to be discharged at sea will be monitored and tested before discharging. ▫ Installation of modern latrines and waste receptacles; collection facilities; ▫ Adoption of clean practices by all project operating units and personnel; ▫ Efficient waste retrieval system; ▫ Greening of reclamation area	Proponent / Contractor		Part of project cost
Reclamation, soil filling and compacting	Coastal waters	Oil and grease contamination	▫ Adoption of an oil and grease recovery and treatment system; ▫ Implementation of rigid policies against indiscriminate disposal of oily waste and marine vessel bilge water.	Proponent / Contractor		Part of project cost
Reclamation, soil filling and compacting	Fisheries and mariculture livelihoods	(-) Dislocation of gill net and hook and line fishers	▫ Provision of alternative livelihoods to affected fishers.	Proponent / Contractor		Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
Delivery of construction materials and equipment, construction works	Air People	*Contribution in Terms of Greenhouse Gas Emissions* (-) The sources of carbon dioxide emission in the project are the fuels used in the operation of heavy machinery and equipment such as dredgers, pile drivers and the barges during its construction.	▫ Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR standards on vehicular emissions; and ▫ Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible.	Proponent / Contractor		
	Air People	*Generation of air pollutants* (-) Generation of air pollutants such particulate matter, nitrogen dioxide and carbon monoxide due to heavy equipment used for filling of the reclamation site, soil improvement and civil works. (-) Vehicles extensively used at construction site will also generate air pollutants, primarily nitrogen dioxide.	▫ The use of electrically-powered equipment will be maximized to reduce the volume of the air pollutant that will be generated ▫ Regular preventive maintenance of heavy equipment, machineries and service vehicles shall be undertaken to keep these equipment, machineries and service vehicles in good working condition for lower emission rate of air pollutants.	Proponent / Contractor	Php2,000,000 / year –cost of maintenance of heavy equipment	Part of the construction cost
	Air People	*Generation of dust (temporary)* (-) Air pollution from fugitive dust resulting from ground clearing operations, site preparation, structure erection, and vehicle movement. (-) Health effects due to inhalation of dust by residents living in areas adjacent to project site	▫ Frequent water spraying at dry and unpaved reclaimed sites near ASRs, especially during dry periods where fugitive dusts are potentially dispersed by winds; ▫ Reduction of wind speeds by installing temporary wind barriers at the area, if necessary. These wind barriers could be strategically located at areas close to the ASRs; ▫ Provide wheel washing facilities for vehicles leaving the project site. This wheel washing facility is intended to remove muds from the tires	Proponent / Contractor	Php50,000/ year –operational expenses	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			of the heavy equipment and other vehicles, which are potential sources of dust if detached from vehicles traveling outside the project site (e.g., paved or unpaved roads); ▫ Impose speed limits within the project site and along access roads. Reduction of vehicular speed will significantly reduce generation of fugitive emissions; ▫ If possible, re-route vehicles at considerable distances from the ASRs. This measure (re-routing) is effective means of decreasing release of fugitive emissions to nearby ASRs, especially during very dry conditions where wetting of dry surfaces would be effective for short duration; and ▫ Conduct regular visual inspection at the project site (including monthly sampling of TSP, PM10, SO2, and NO2) to determine areas with high fugitive emissions, and to implement mitigation measures as necessary.			
Construction works	Air (noise)	(-) Generation of noise from construction activities	▫ All machinery will be maintained in accordance with the original manufacturer's specifications and manuals to avoid excessive noise, vibration and vehicle exhaust pollution. Regular maintenance of equipment and engines as per manufacturers requirements will be carried out ▫ Conduct reclamation works during night time at the project area relatively far from the Barangay Baseco. ▫ Reduce the number of equipment to be operated at night time and inform the residents and	Proponent / Contractor	Php100,000.00	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			barangay officials prior to the conduct of reclamation works, especially if equipment need to be operated near residential areas. ▫ Monitor noise levels especially at night time periods (10:00 P.M. to 5:00 P.M) at residences closest reclamation works			
Site preparation activities	People	*Community protests or complaints* (-) Potential adverse community response resulting from access restrictions in working areas.	▫ Conduct of IECs to host and neighboring communities. ▫ Properly implement programs stipulated in the SDP	Proponent	Php150,000.00 / year	Part of project cost
Increased manpower requirements	People	*Opportunities for local employment* (+) Employment opportunities and benefits of employees and its multiplier effect or potential livelihood/business opportunities (-) Bringing in of outside workers may antagonise local communities	▫ Implement priority local hiring policy for qualified local workers. ▫ Provide skills training for local residents ▫ Coordinate with barangay or/and municipal LGU as to relevant ordinance on providing opportunities for local employment.	Proponent / Contractor	Php20,000 / year	Employment generated together with the origins of workers will be validated by the MMT.
Increased manpower requirements	People	*In-migration* (+) Workers will be required during construction (-) In-migrants may compete with locals for employment, project benefits, natural resources (i.e. water competition), local health, welfare services and infrastructure In-migration may also lead to proliferation	▫ Livelihood opportunities will be provided to local communities especially to host barangay ▫ Provide skills training for local residents ▫ Conduct consultation with barangay LGUs on requirements and process of hiring to maximize employment of local residents. ▫ Coordination meetings shall be undertaken regularly with the LGUs to identify threats and vulnerabilities in the society as well as to develop programs to prevent foreseen social	Proponent / Contractor	Php1M / year – SDP budget will be utilized for the implementation of activities such as, livelihood programs, education assistance,	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		of informal settlers in the project impact barangay	problems. ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)		medical assistance, IEC, among others.	
Increased manpower requirements	People	*Cultural and lifestyle change* (+) Increase in ability to cope with household and subsistence expenses for stakeholders directly employed by the project; and stakeholders with new and additional livelihood, catering to the activities and direct and indirect personnel of the project (+) Improved Access to Education for studying children of employed and those with new and additional small livelihood (+) Improved Nutrition and less health-related worries of Household members of employed and those with new and additional small livelihood (+) Improved Access to Recreational Activities for household members of employed and those with new and additional small livelihood (+) Decrease in vulnerability to succumbing to juvenile delinquency and unlawful/illegal activities for subsistence of household	▫ Prioritization of Local stakeholders for employment in the Project ▫ Livelihood Programs to augment income for indigent stakeholders ▫ Educational Programs such as Scholarships and contribution to improvements and additions to educational facilities ▫ Contribution to Peace and order programs and facilities	Proponent / Contractor	Php1M / year – SDP budget that will be utilized for the implementation of activities such as, cultural activities, IEC, among others	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
		members of employed and those with new and additional small livelihood (+) Decrease in susceptibility to public disorder stemming from economic inactivity of and interpersonal grievances and strained community relationships of household members of employed and those with new and additional small livelihood (-) Threat of uptake of crime in and near the BASECO Community due to increase in economic activity near the area				
		Threat to delivery of basic services and resource competition (-) Unplanned population increase due to in-migration or increase in informal settlers/structures puts pressure on basic services (education, health and social welfare) and utilities (water, electricity and waste management).	▫ Develop and implement SDP, which shall involve improvement of basic services such as health and welfare, livelihood, infrastructure, education, among others	Proponent / Contractor	Php1M / year – SDP budget that will be utilized for the implementation of activities such as, cultural activities, IEC, among others	Part of project cost
Increased movement of heavy equipment on site and delivery of materials, Increased manpower requirements,	People	*Traffic congestion* (-) Possible increase in traffic given the number of workers to be employed and delivery of some construction materials.	▫ Implement speed limits, vehicle load limits, vehicle maintenance requirements, and limiting driving hours. ▫ Signs for ongoing construction activities (i.e. speed limit, safety signage) shall be installed at strategic places to notify and warn the general	Proponent / Contractor	Php100,000/ year – Safety and health program will cover this activities.	Part of project cost

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
			public as necessary.			
Reclamation Works	Water People	*Marine Vessel Traffic* (-) limited path and passage towards Manila South Harbor and other port facilities such as those of the Philippine Coast Guards which may lead to: - longer time in off-shore anchorage prior to accessing the ports and terminals, along with its inherent cost counterparts in fuel, personnel, and other time affected aspects. - increase in the distance of the anchorage area from the harbor facilities	▫ IEC with the parties, especially the pertinent agencies and offices, covering the area and marine vessel traffic and navigation, such as the PPA, the Philippine Coast Guard, Manila Bay Coordinating Office, and others. ▫ Coordination with the parties, especially the pertinent agencies and offices, covering the area and marine vessel traffic and navigation, such as the PPA, the Philippine Coast Guard, Manila Bay Coordinating Office, and others, on coming up with a Sea Lane Navigation and Traffic Plan in consideration of the Project.	Proponent / CRO / Contractor	Part of IEC Cost	Sea Lane Navigation and Traffic Plan, IEC Program, MOAs/MOUs
Dredging and reclamation works	Hazards and disaster risks	*(-) Impacts of storm surges, flooding, and other disaster risks*	▫ Residents and workers to evacuate the area in the event of incoming typhoon. Provision of early warning systems and effective dissemination procedures could effectively avoid casualties in the event of extreme weather events. ▫ Reclamation site should be designed considering the projected sea level rise in Manila Bay, including the heights of the highest astronomical tide and wave effects during southwest monsoon (not storm surges).	Proponent / Contractor	Php 1M-2M per year (may vary depending on the SDP program)	OSH and Emergency response program
	People	(-)*Occupational Health and Safety*	▫ Posting of safety warning and danger signs ▫ Provision and wearing of personal protective equipment at all times ▫ SDP (see Chapter 5 in Section 5.1) ▫ IEC (see Chapter 5 in Section 5.2)	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	OSH and Emergency response program

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential impact (+/-)	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangement
	Socio-Economics	*Loss of livelihood* (-) Loss of livelihood and income source for fisher folks previously mooring in the coastal area within the vicinity	▫ Just Compensation and relocation package ▫ Provision and development of alternative livelihood	CRO, Envi Department	Php 1M-2M per year (may vary depending on the SDP program)	▫ Plan for Compensation ▫ Livelihood programs ▫ Fund for compensation
IV. Decommissioning Phase						
Clearing and removal of structures	Land Water People	*Ground and water contamination* (-) Clearing and removal of structures and facilities that may result to improper disposal of contaminated materials or release of toxic and hazardous wastes / compounds	▫ Proper implementation of the approved Abandonment/ Decommissioning Plan that details the decommissioning, rehabilitation, and social activities which shall include the methodology, timing, and techniques. ▫ Use of DENR accredited haulers/TSD companies for wastes classified under RA No. 6969.	Proponent / Contractor	Php2M – for the handling, transport, and disposal of all hazardous waste and chemicals.	Part of project cost
	People	Loss of employment / livelihood	▫ Abandonment for SDP (see Chapter 5 in Section 5.1) ▫ Abandonment for IEC (see Chapter 5 in Section 5.2)		Part of SDP / IEC Cost	Contractor's contract/ Abandonment Plan

Legend:

+/- Positive or negative impact

4 Environmental Risk Assessment and Emergency Response Policy and Guidelines

4.1 Environmental Risk Assessment

This section discusses the Environmental Risk Assessment (ERA) of the proposed Project. An ERA is an evaluation tool for a project or an activity that determines the level of hazard that it may pose to humans, properties, and to the environment.
This section will discuss whether the proposed Project poses a significant risk to its surrounding environment. Also, this section will determine whether the surrounding environment poses significant risks to the proposed Project.

4.1.1 Methodology

The general guidelines and outline for an Environmental Risk Assessment (ERA) preparation are prescribed in Annex 2-7e of DAO 2003-03. However, the guidelines focused more on the risks and hazards posed by activities and/or manufacturing methods that involve chemical storage, processing, and use. Although this is applicable for the proposed Project, this shall only form part of the overall ERA. Major environmental risks identified were the geological hazards posed on the proposed Project.

4.1.2 Risk Screening Level

A risk screening level exercise refers to specific facilities or the use of certain processes that has the potential to pose significant risks to people and its surrounding environment. The Plant is covered by the risk screening level exercise, as indicated in **Table 4-1**.

4.1.2.1 Risk Identification and Analysis

The proposed Project entails risks that are natural, man-made, or a combination of both. Natural risks are hazards caused by phenomena such as earthquakes, geological instability and typhoons. Meanwhile, man-made risks are caused by accidents such as fires, structural/equipment failure, chemical spillages, and human error. Man-made risks could also be aggravated as a direct consequence of natural risks.

Table 4-1. Risk Screening Matrix

Activities Requiring Risk Screening Exercise[1]	ERA Applicability to the Project
1) Facilities for the production or processing of organic/inorganic chemicals using: Alkylation, Esterification, Polymerization, Distillation Amination, Halogenation, Sulphonation, Extraction Carbonylation, Hydrogenation, Desulphurization, Solvation Condenstation, Hydrolysis, Nitration, Pesticides & pharmaceutical prod. Dehydrogenation, Oxidation, Phosphorus prod.	Not Applicable
2) Installations for distillation, refining, and other processing of petroleum products	Not Applicable
3) Installations for total or partial disposal of solid or liquid substances by incineration or chemical decomposition	Not Applicable
4) Installations for the production or processing of energy gases (e.g., LPG, LNG, SNG.)	Not Applicable
5) Installations for the dry distillation of coal or lignite	Not Applicable
6) Installations for the production of metals and non-metals by wet process or electrical energy	Not Applicable
7) Installations for the loading and unloading of hazardous materials as defined by RA 6969 (or DAO 29)	Not Applicable
CONCLUSION	**Risk screening level exercise is not applicable**

Note:
[1]Based on Annex 2-7e of DAO 30-2003 Revised Procedural Manual

4.2 Hazard Analysis

4.2.1 Geologic Hazard

4.2.1.1 Seismic Hazards

Major causes of damage during earthquakes include hazards due to 1) ground shaking, 2) liquefaction, 3) landslide, 4) surface rupturing, and 5) tsunami. The first two hazards are directly related to actual ground movements while the others are mainly due to the indirect effects of the earthquake shocks.

4.2.1.1.1 Ground Shaking Hazard

Most of the damages incurred during earthquakes mainly result from strong ground vibrations that are caused by the passage of seismic waves from the earthquake source to the ground surface. The intensity of ground shaking is generally influenced by the magnitude of the earthquake, distance of the site from the earthquake generator, and the modifying effects of subsoil conditions. Observations of effects of large magnitude earthquakes have shown that ground shaking on bedrock is less in intensity than on areas of soft foundation made up of sediments as gravel, sand, silt and/or clay. **Figure 4-1** shows the general relationship between near-surface earth material and amplification of shaking during a seismic event.

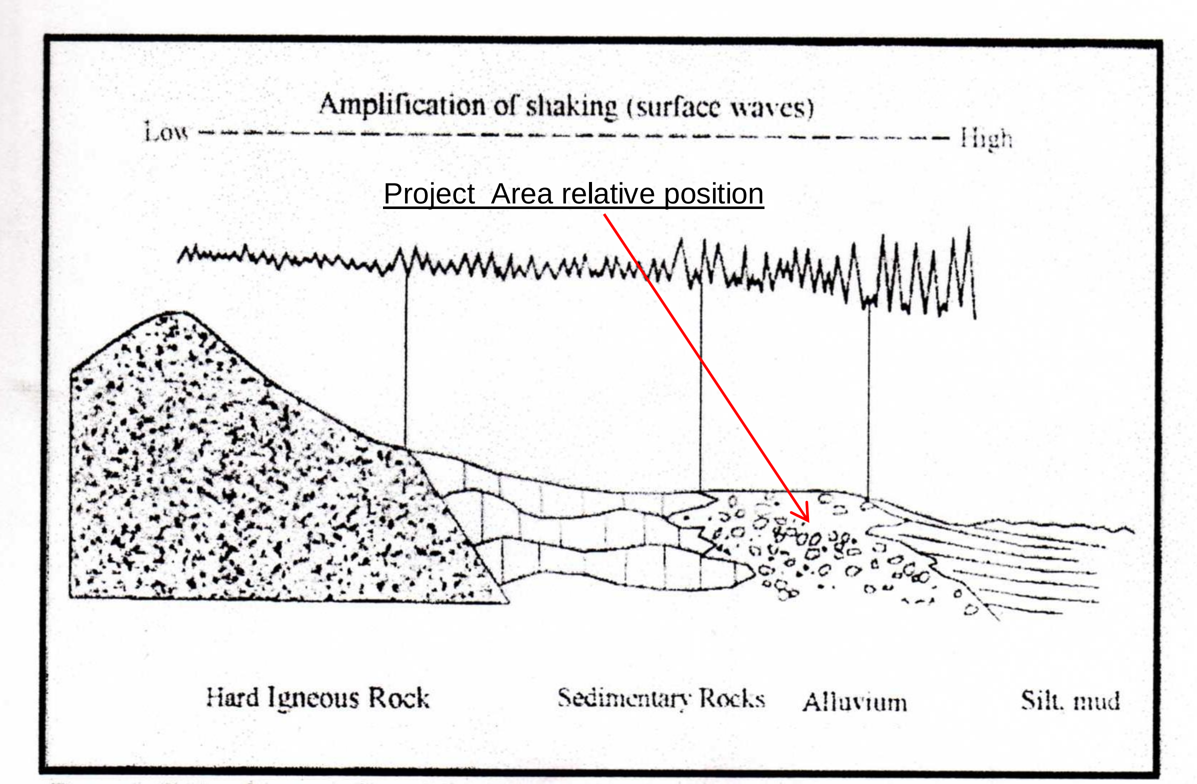
The project area is prone to ground shaking hazards due to the presence of several earthquake generators. The site is considered as high seismic area and has a recorded and experienced intensity of VI during the July 1990 Luzon earthquake (**Figure 4-2**).

Table 4-2 presents the different areas Metro Manila which are vulnerable to ground shaking and within the identified zones. The zone where ground shaking is expected to be below average is more or less defined by the outline of the tuff deposit of the Guadalupe Formation which corresponds to the bedrock in Metro Manila. The areas underlain by soft and thick sequence of fine sediments will most likely experience average to above average levels of ground shaking depending on the thickness of the soft materials. Areas covered with 10 m or less of these deposits are expected to experience average levels of ground shaking while those underlain by soft materials in excess of 10 m may experience above average shaking.

Table 4-2. Areas Vulnerable to Strong Ground Shaking in Metro Manila

Possible Level of Ground Shaking	Area
Above Average	Manila proper inclusive of the reclaimed areas along Manila bay, the municipalities of western Malabon, Navotas, eastern Pateros, Marikina (valley side) and the eastern section of Pasig
Average	Pasay City, western portion of Makati, northeastern and eastern Quezon City (within the Marikina Valley), the extreme southwestern part of Caloocan City, eastern Malabon, western section of Valenzuela, the coastal and northern portions Paranaque and Las Pinas, and the lakeshore areas of taguig and Muntinlupa
Below Average	Areas within Diliman Plateau

Figure 4-3 presents the ground shaking and surface rupture hazard map of Metro Manila.

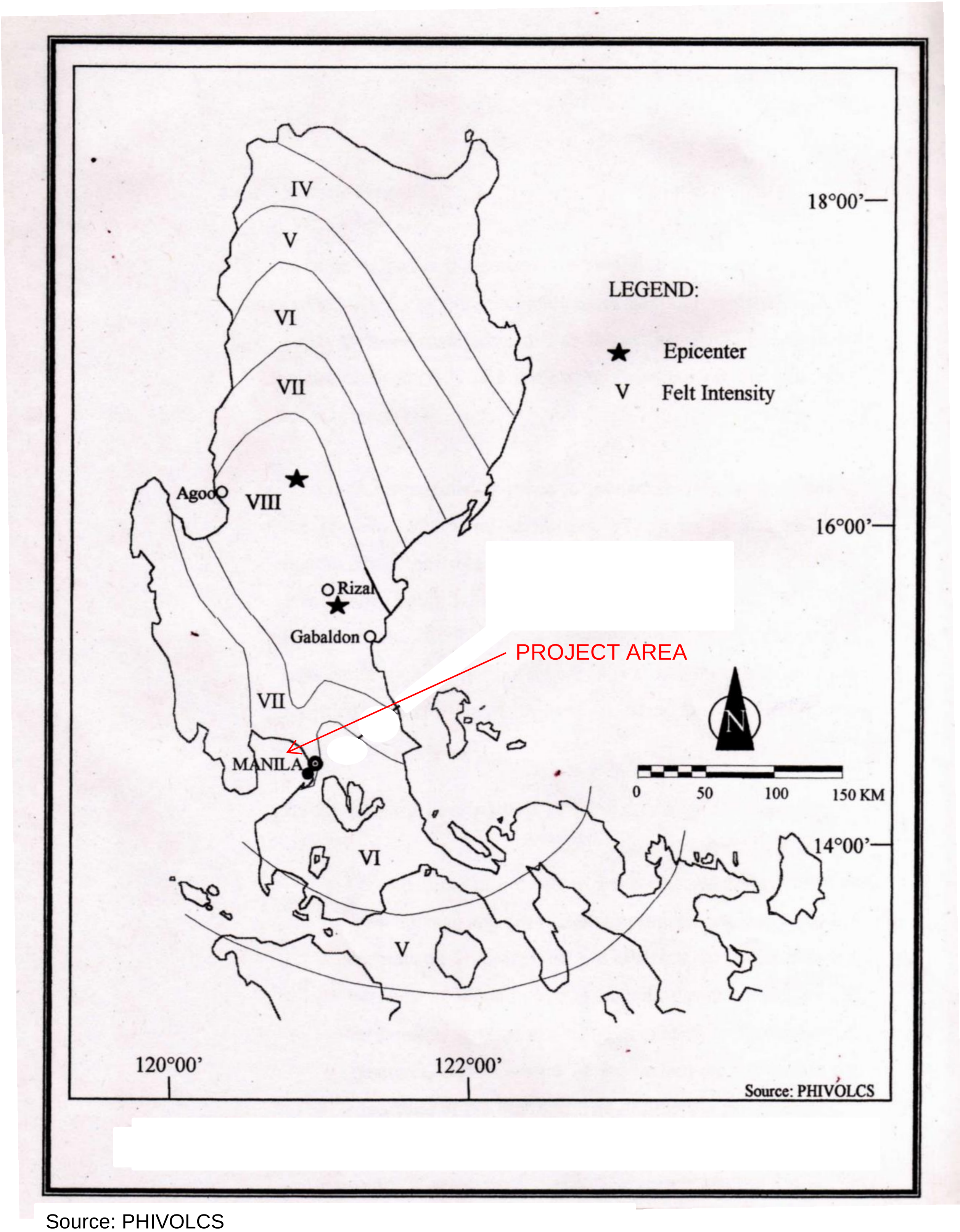


Source: (Keller, E. J., 1996)

Figure 4-1. General Relationship between Near-surface Earth Material and Amplification of Ground Shaking during a Seismic Event

4.2.1.1.2 Surface Rupturing

Surface or ground rupturing is a result of significant movement along faults. It occurs within zones of active fault. Damage can be severe for structures directly straddling and located within a narrow zone of the active fault traces. For the 1990 Luzon earthquake, the deformation zone was within 5 m from the surface rupture. The location, pattern and style of surface faulting generally appear to occur along pre-existing active fault traces, thus, a precise delineation of these traces is very important in mitigating damages due to surface rupturing.



Source: PHIVOLCS

Figure 4-2. Intensity Map of the July 1990 Earthquake

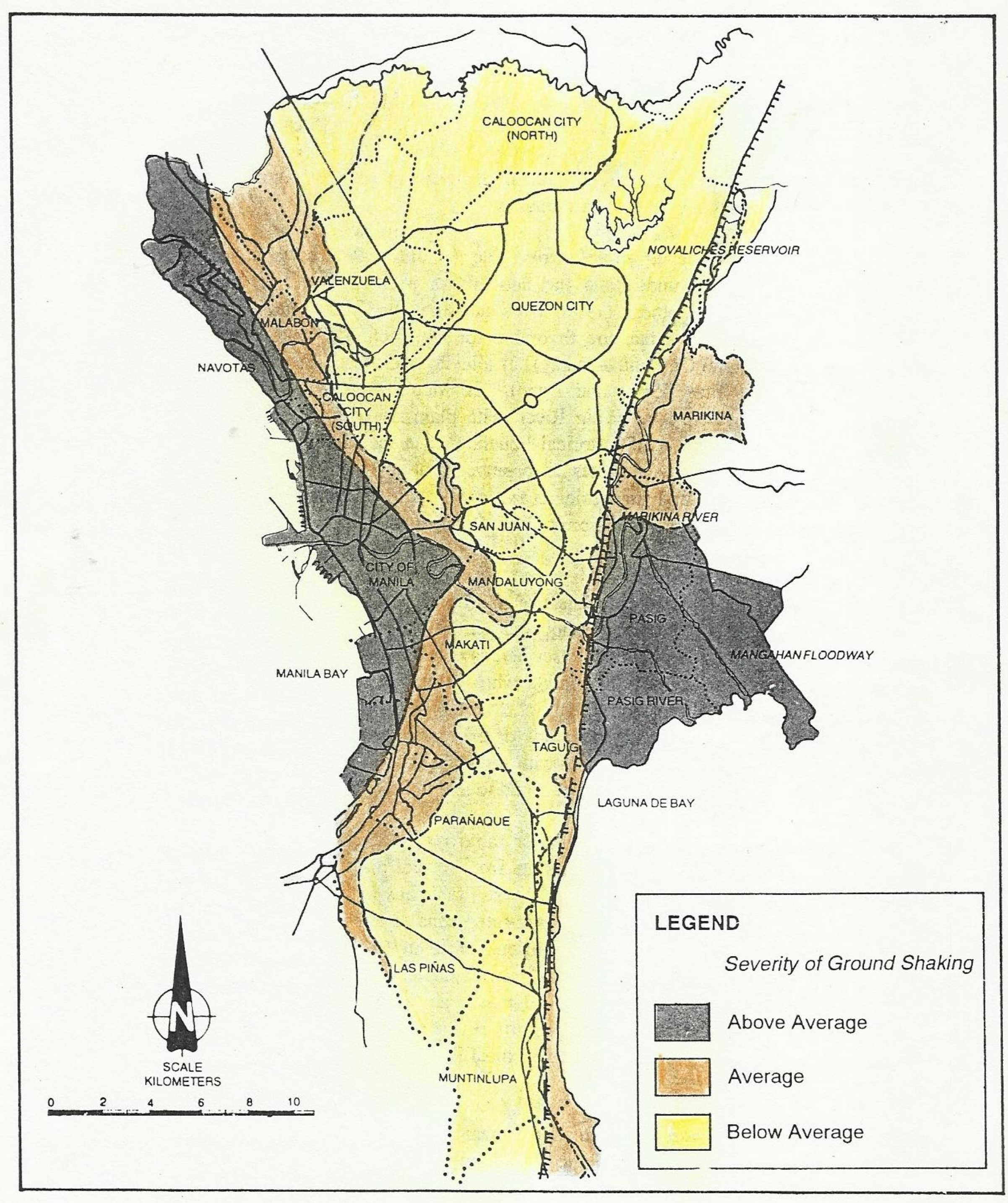


Figure 4-3. Ground Shaking and Surface Rupture Hazard Map of Metro Manila

4.2.1.1.3 Ground Acceleration

Since the Philippines is a tectonically active place with noted active faults that are usually the sources of major earthquakes, the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and the United States Geological Survey (USGS) conducted ground motion hazard mapping in terms useful to engineering design using modern probabilistic methodology. In their study, the peak horizontal ground acceleration that have a 10% probability of being exceeded in 50 years have been uniformly estimated for rock, medium soil and soft soil site condition. Results of their study show an estimate on rock ranging from a low of 0.11g in Visayas to a high of 0.30g in the vicinity of Casiguran Fault in Eastern Luzon (Thenhaus, et al, 1994). Estimates for soft soil conditions are considerably higher and range between 0.27g for Visayas and 0.80g along the Casiguran Fault zone.

The estimated horizontal and vertical peak accelerations during an earthquake likely to occur in an area are useful information for designing buildings and other structures to withstand seismic shaking. Maps of Acceleration in Soft Soil, Medium Soil, Hard Soil and Rock are presented in **Figure 4-4** to **Figure 4-7**.

In order to determine the ground acceleration that a site can experience in case of a major earthquake, the attenuation model of Fukushima and Tanaka is applied (Thenhaus et al, 1994). A design earthquake is assumed to occur at a point along the causative fault that is nearest to the site. Correction factors are then applied depending on the type of foundation material.

The attenuation model of Fukushima and Tanaka (In Thenhaus, 1994) is written as:

$$\log_{10} A = 0.41M - \log_{10}(R+0.032\times10^{0.4M}) - 0.0034R + 1.30$$

where:

A = mean peak acceleration (cm/sec^2)

R = shortest distance between the site and the fault rupture (km)

M = surface-wave magnitude.

Correction factors are applied depending on the type of foundation material: rock, 0.6; hard soil, 0.87; medium soil, 1.07; and soft soil, 1.39.

The most logical causative fault is the Philippine Fault. It may be considered as a near-source earthquake generator. The Philippine Fault is probably the most active of earthquake generators in the country. Though presently inactive, both the West Valley Fault, the Lubang Fault and Casiguran Fault can also be considered as potential earthquake generators.

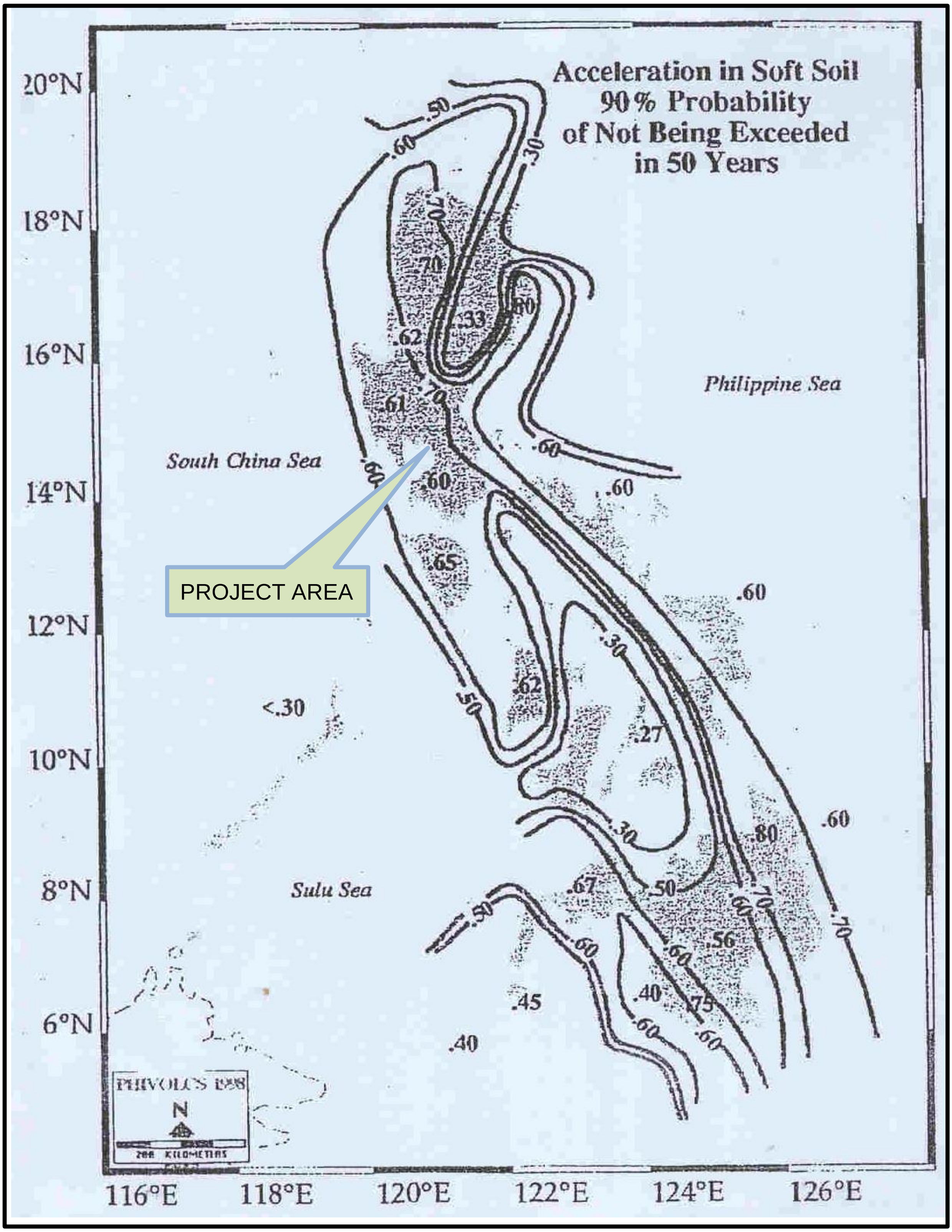


Figure 4-4. Ground Acceleration in Soft Soil

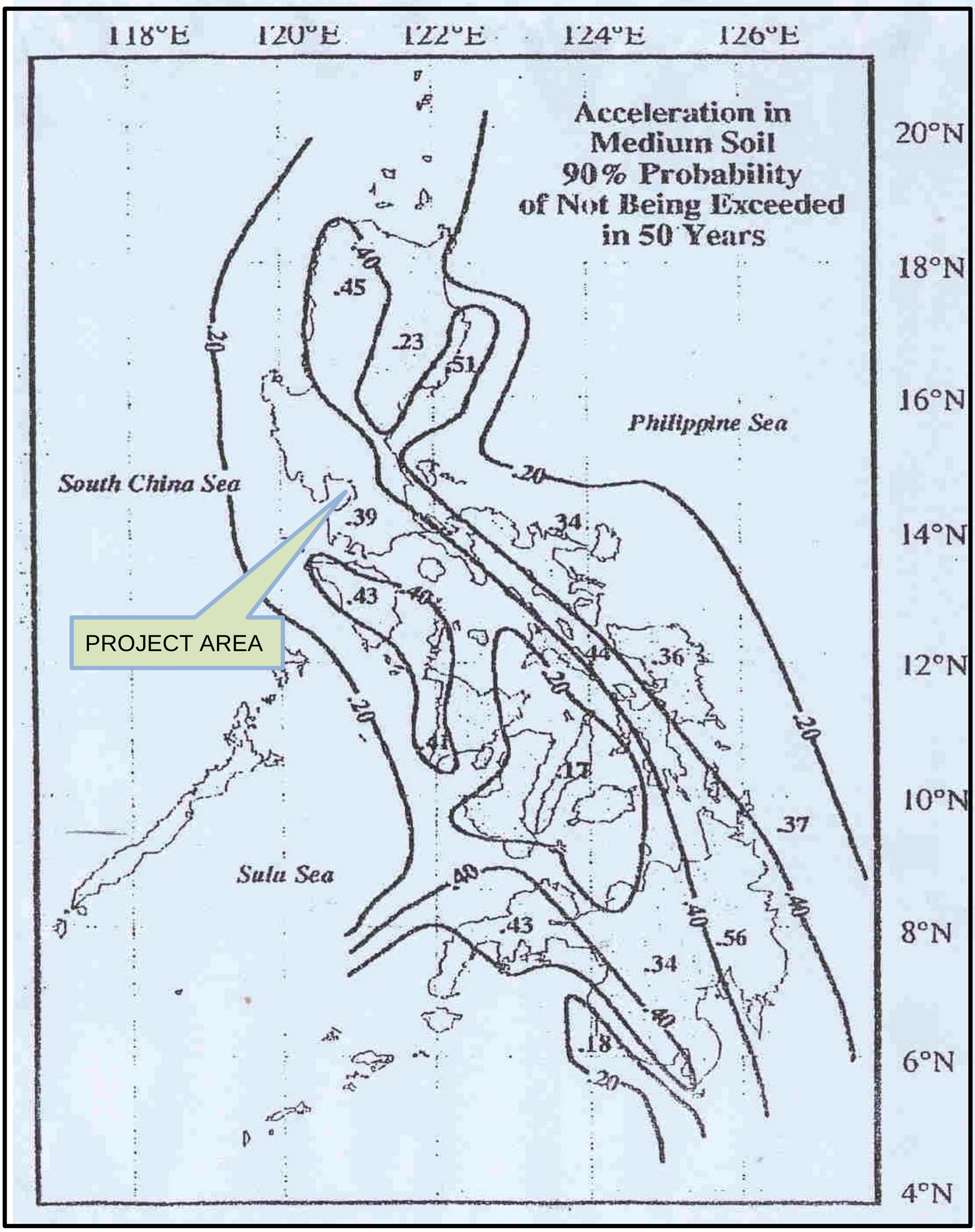


Figure 4-5. Ground Acceleration in Medium Soil

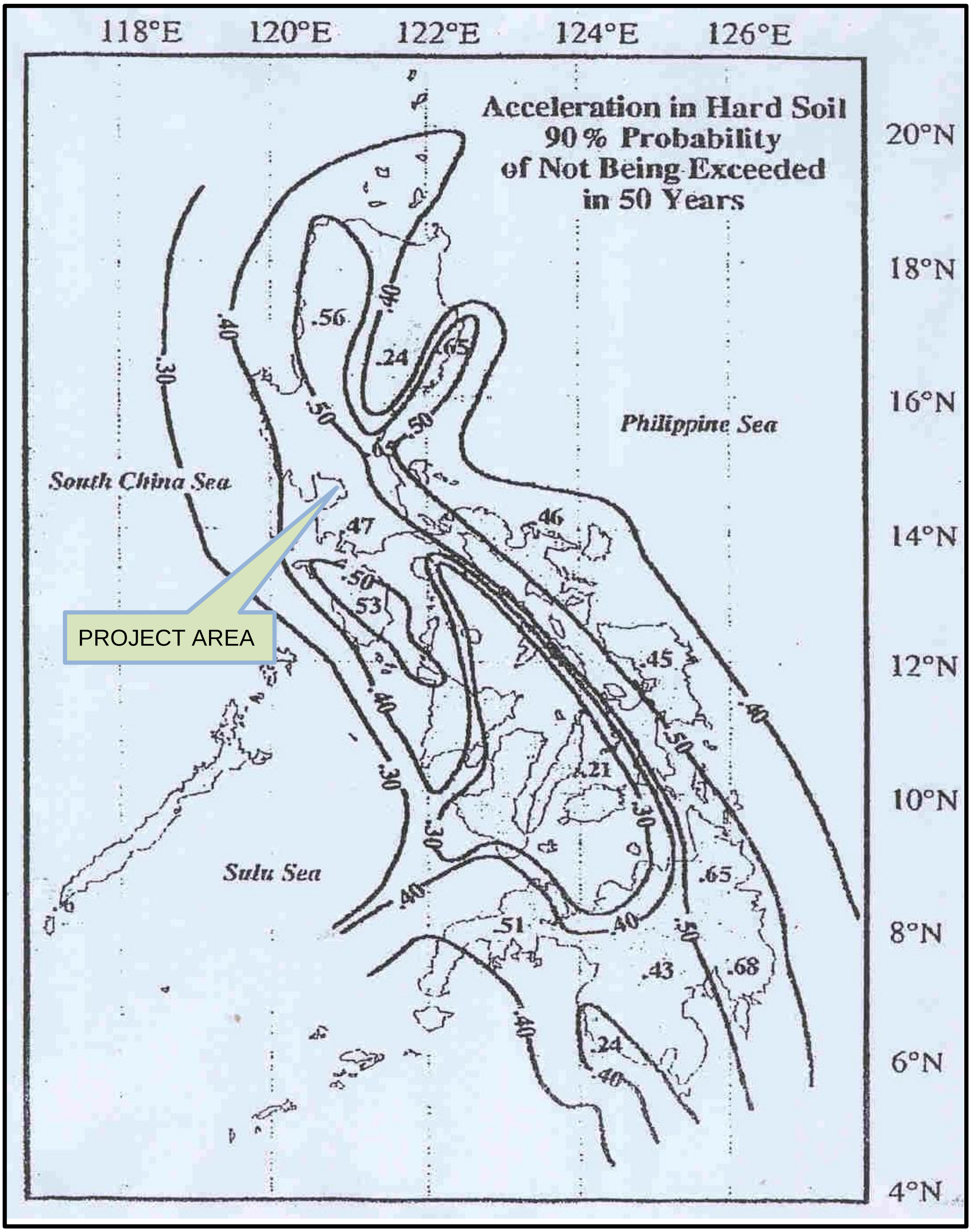


Figure 4-6. Ground Acceleration in Hard Soil

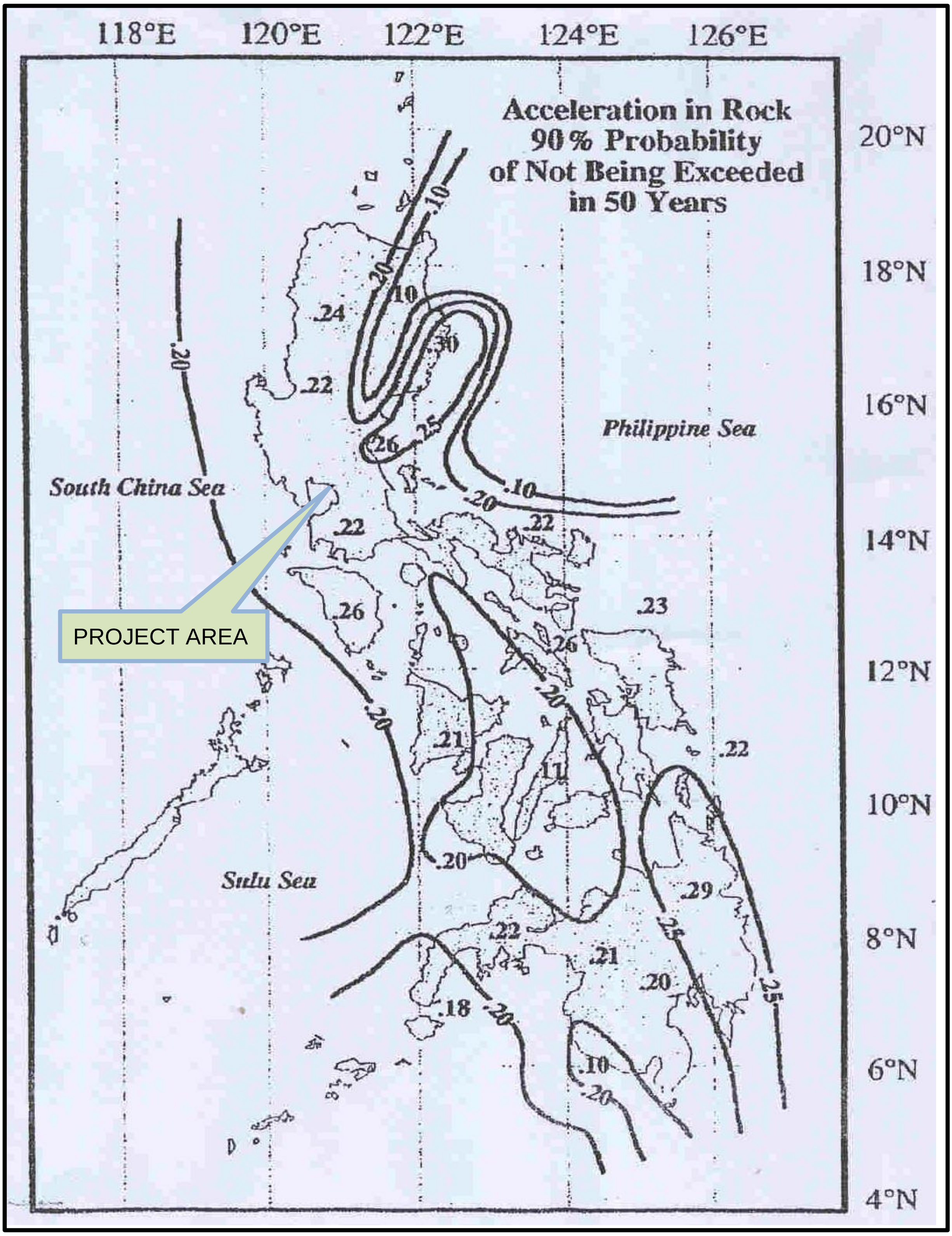


Figure 4-7. Ground Acceleration in Rock

Design Earthquake. The Philippine Fault is such a major fault that it is capable of generating a rare magnitude 8.0 earthquake. Magnitude 7.5 or 7.8 earthquakes might be more reasonable as design earthquake.

Peak Ground Acceleration. Assuming a distance of 70 km from the project area to the Philippine Fault, peak ground accelerations are estimated for different design earthquakes (magnitudes 7.6, 7.8, 8.0) and foundation conditions (rock, hard soil, medium soil, soft soil). Ground accelerations from earthquakes that can be generated from the West Valley Fault, Lubang Fault, Casiguran Fault and Manila Trench were also estimated. Excessively high acceleration values can be expected particularly from those earthquake generators which are relatively close to the project area.

Table 4-3. Computed Ground Acceleration (using Attenuation Model of Fukushima and Tanaka) for Earthquake Magnitudes of 8.0, 7.8 and 7.5 and Different Foundation Conditions

Earthquake Generator	R	M	PGA	Rock	Hard Soil	Medium Soil	Soft Soil
West Valley Fault	11.60 km	8.0	0.488	0.293	0.424	0.522	0.678
	11.60 km	7.8	0.472	0.283	0.411	0.505	0.656
	11.60 km	7.5	0.445	0.267	0.387	0.476	0.618
Philippine Fault	70 km	8.0	0.171	0.103	0.149	0.183	0.238
	70 km	7.8	0.154	0.092	0.134	0.165	0.214
	70 km	7.5	0.129	0.078	0.113	0.138	0.180
Lubang Fault	95 km	8.0	0.118	0.071	0.103	0.126	0.164
	95 km	7.8	0.105	0.063	0.091	0.112	0.146
	95 km	7.5	0.086	0.052	0.075	0.092	0.120
Casiguran Fault	130 km	8.0	0.073	0.044	0.064	0.078	0.102
	130 km	7.8	0.064	0.039	0.056	0.069	0.089
	130 km	7.5	0.052	0.031	0.045	0.056	0.072
Manila Trench	190 km	8.0	0.035	0.021	0.030	0.037	0.049
	190 km	7.8	0.030	0.018	0.026	0.323	0.042
	190 km	7.5	0.024	0.014	0.021	0.026	0.033

4.2.1.1.4 Liquefaction / Differential Settlement

In areas underlain by loosely compacted, water-saturated fine sediments such as sand and silt, strong ground vibrations could also cause the underlying foundation to temporarily assume a semi-liquid behavior. Such process is called liquefaction. The July 16, 1990 earthquake has opened opportunities to better understand the liquefaction phenomenon. The studies conducted by Torres and others in 1990 had identified and characterized at least three sedimentary environments that are favorable to liquefaction to take place, namely, 1) deltaic (e.g. Dagupan City and Aringay, La Union), alluvial plain (e.g. Tarlac), and sandpit environment (e.g. Agoo, La Union). Typically, these environments are characterized by the presence of thick accumulation of fine sediments that are water-saturated.

Metro Manila has suffered liquefaction in certain areas of the city in many of earthquakes that have affected it. Several occurrence of liquefaction within a certain area in Manila particularly near the vicinity of Pasig River were recorded in the past. The identified liquefaction-prone areas have characteristically shallow water table (3 m or less) with thick (10m or more) piles of water-saturated fine sediments (sand to clayey sand). These areas are those on the shore areas of Manila including the newly-reclaimed areas, the Pasig River delta plain, the Marikina alluvial plains and those lying on the floodplain deposits and abandoned meanders of the Pasig and Marikina rivers. Various points within these areas have been subjected to liquefaction in the past and are therefore likely to be affected again in the future.

Liquefaction is generally accompanied by *differential settlement* as a result of withdrawal of materials beneath the ground surface. Buildings, houses and other structures built with no special engineering designs against this hazard tend to settle or sink as the underlying foundation losses strength. These structures normally remain intact though some may tilt.

Sand fountaining, lateral spreading, and ground undulation which may also cause damage to roads, bridges and other infrastructures are some of the effects associated to liquefaction.

Figure 4-8 shows the sites of historical liquefaction in Metro Manila.

4.2.1.1.5 Subsidence / Differential Settlement

Subsidence is the motion of a surface (usually, the earth's surface) as it shifts downward relative to a datum such as sea level. Land subsidence can occur in various ways during an earthquake. Large areas of land can subside drastically during an earthquake because of offset along fault lines. Land subsidence and/or differential settlement can also occur as a result of settling and compacting of unconsolidated sediment from the shaking of an earthquake.

Many soils contain significant proportions of clay. Because of their very small particle size, they are affected by changes in soil moisture content. Seasonal drying of the soil results in a lowering of both the volume and the surface of the soil. If building foundations are above the level reached by seasonal drying, they move, possibly resulting in damage to the building in the form of tapering cracks. Any structures founded on soft clay are very susceptible to subsidence or differential settlement.

4.2.1.1.6 Tsunami

Tsunami or giant sea waves are produced as a result of faulting under submarine conditions at shallow depths. Tsunami can also be triggered by submarine landslides, volcanic eruptions and movements along subduction zones. Areas vulnerable to this hazard are the coastal zones fronting an open sea. The edge of the cities fronting Manila Bay may be exposed to potential tsunami.

Tsunami and earthquakes can happen anytime around the Pacific Ring of Fire - from California up and around Alaska down through Japan, Taiwan, the Philippines and Indonesia.

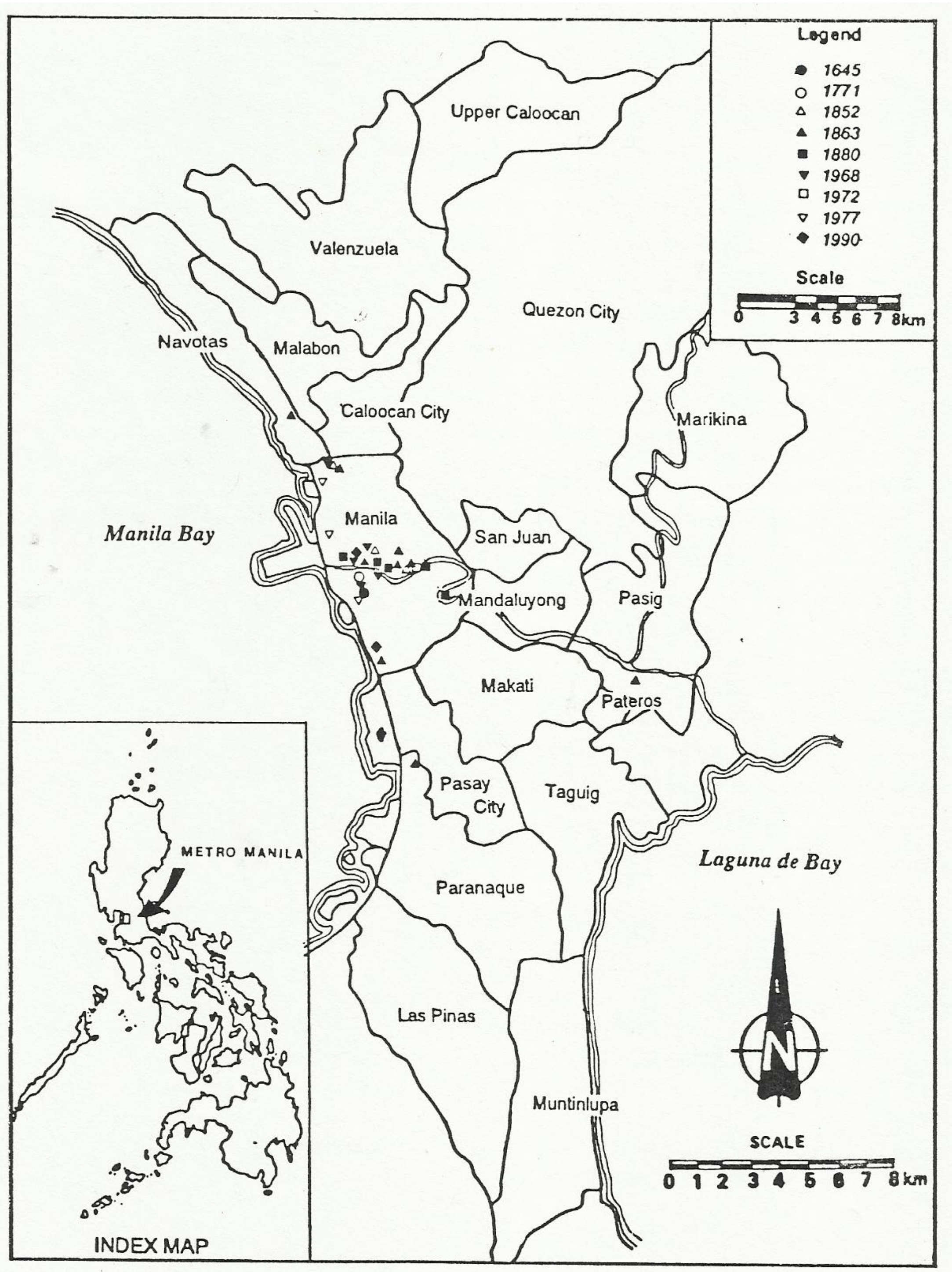


Figure 4-8. Sites of Historical Liquefaction in Metro Manila

The Philippines is no stranger to earthquakes - the Philippine archipelago was largely created by the tectonic squabble between the Eurasian and Pacific plates, forming the Philippine Plate as a distinct entity.

Tsunamis in the Philippines are extremely rare. The last significant tsunami in the Philippines occurred in the Verde Island Passage (between Batangas & Mindoro Island and affecting Puerto Galera) in 1976. The tsunami wave was minor (only 2-3 meters) when it reached land. Because tsunami in the Philippines are so rare, those who were drowned were actually opportunist beachcombers who were interested to extract goodies from the suddenly exposed deep coral pools, not realizing that the tsunami wave would follow the rapidly receding water.

Remarkable historical tsunamis that have affected Manila were those generated by the 1677 and 1863 earthquakes, possibly from the Manila Trench. During the 1677 event, Repetti (1946) reports of boats at sea almost submerged by waves. For the 1863 earthquake, a large wave coming from Manila Bay was reported by the same writer. Other accounts of the latter event describe a retreat of the sea and a subsequent rise in the height of incoming waves. In both cases there were no reports of any damage along the coastal areas of Manila.

The apparent low vulnerability of Metro Manila in terms of this hazard is attributed to the following factors.

1. The narrow configuration of the mouth of Manila Bay has an over-all abating effect to the incoming tsunami wave thus lessening any tsunami impact on the project area. However, coastal areas along the adjoining provinces of Cavite and Bataan near the mouth of Manila Bay are more likely to be highly-prone to this hazard.
2. The presence of the Island of Corregidor near the mouth of Manila Bay likewise tends to deflect and abate the effects of incoming tsunami waves.
3. For any moderate to strong tsunami to significantly affect Metro Manila, the earthquake source or hypocenter should be within the Manila Bay itself. Even considering a modest dip of 45º for the subducting layer of the Manila Trench, such a situation is highly unlikely as the descending tectonic slab would be too deep as an earthquake source and consequently, too weak to generate a sizable tsunami.

The hazard posed by tsunami is probably only comparable to, or less than that from storm surges.

4.2.1.2 Volcanic Hazards

Most of the hazards associated with the eruptions of Mount Pinatubo and Taal Volcano with the exception of ashfall, are very much localized and are generally confined within the immediate vicinities of these two volcanoes.

A violent eruption of Mount Pinatubo and/or Taal Volcano which may result into a base surge or a rapid expanding cloud at the base will definitely has severe effect at the areas close to them.

Only a minor quantity of ash has affected Metro Manila based on the review of the extent of impacted areas from the largest eruptions of Mount Pinatubo. It is thus conceivable that should Mt. Pinatubo will erupt with the same magnitude in the future, the same level of ashfall impact is expected to likely affect the island.

The 1911 eruption of Taal Volcano killed about 1,300 and wounded 800 people. The solid ejecta produced by the 1911 eruption which was estimated to be around 80,000,000 million cubic meters spread over an area of 230 km^2 while ashes spewed from the volcano reached as far as Manila and nearby provinces.

The 1965 eruption killed 180 people and displaced some 55,000 evacuees from the Volcano Island and nearby settlements surrounding Taal Lake. Eruption clouds rose 15 – 20 km high, depositing fine ash on downwind areas up to 80 km away. The eruption blanketed an area of about 60 km^2 with 25 cm of ash.

Based on the recorded hazards associated with the eruption of Taal Volcano, the project area being 70 km away from the said volcano could only experience minor ashfall.

4.2.2 Hydrologic Hazards

4.2.2.1 Flooding

Flooding is usually caused by heavy rains accompanying typhoons or the southwest monsoons. Flooding is a chronic problem, affecting large areas in Metro Manila, especially the low-lying areas like the City of Manila. Because of the local climate condition, the city is experiencing an average of 18 – 20 flood events yearly, although only a few of these caused severe damage.

In Metro Manila, floodwater is usually due to excessive rainfall particularly during the months of May to November when the southwest monsoon coincides with the typhoon season.

The flooding problems in Metro Manila are aggravated by rapid urbanization, inadequate or non-existent of drainage system, improper waste disposal, low river capacity and lack of maintenance, tidal transgression, reclamation activities and storm surges, squatter settlements, and constraints in the implementation of proper flood control facilities and countermeasures.

4.2.2.2 Storm Surge

Storm surge refers to the temporary increase at a particular locality in the height of the sea due to extreme meteorological conditions: low atmospheric pressure and/or strong winds. It is caused primarily by strong winds pushing on the ocean's surface causing the water to pile up higher than the ordinary sea level. The rise in water level due to the combined force of storm surge and normal tides could cause severe flooding in coastal areas.

Due to the combination of coastal configuration and seasonal wind regime, waves generated during the rainy southwest monsoon also raise tide levels by as much as 80% at the northern end of Manila Bay (Siringan and Ringor, 1998). Waves three meters high can be generated even along the limited western fetch. Southerly wind speeds at Manila can exceed 220 kph and waves 3.7 meters high have been recorded at Manila's port. PAGASA unpublished records shows storm surges occurred seven times between 1960 and 1972 (Rodolfo and Siringan, 2003).

Recent storms demonstrated wind induced waves breaking at the seawall of the reclamation area and Roxas Boulevard covering the strip with garbage. Portions of the seawall along Roxas Boulevard suffered damage due to consistent pounding of the waves.

As seen during Typhoon Pedring and reported unnamed and named typhoons, Manila Bay coastline is considered highly vulnerable to storm surges and coastal floods.

Table 4-4 presents the different reported storms surges that affected Manila Bay.

Table 4-4. Storm Surges that Affected Manila Bay

Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
June 29, 1589	Unnamed Typhoon	-	Manila Bay	-	-
Aug. 29, 1863	Unnamed Typhoon	-	Manila Bay	-	Destroyed Bagumbayan Drive due to inundation.

Date of Occurrence	Associated Tropical Cyclone	Surge Height (m)	Affected Areas	Casualties	Damage
					Several houses were destroyed
Sept. 20-26, 1867	Unnamed Typhoon	-	Manila Bay	-	17 ships were tossed onto Santa Lucia and Tondo shores
Nov. 19, 1970	Typhoon Yoling	4	Manila Bay - southeast	-	Destroyed $40M properties, sank 21 fishing boats
June 23-25, 1972	Typhoon Konsing	-	Manila Bay	1	Several ships were washed ashore
July 2, 1983	Typhoon Bebeng	4	Bataan and at least 10 villages on Manila Bay's western bank	182	49,000 houses
Sept. 26-28, 2011	Typhoon Pedring	6	Coastal Areas of Manila Bay, Barangay San Rafael 3 and 4 in Cavite	12	Damaged the breakwater and seawall along Roxas Boulevard
Oct. 11, 2013	Typhoon Santi	-	Manila Bay	-	-

Source: Project NOAH – Compilation of Storm Surge occurrences in the Philippines, Feb. 4, 2014

4.2.3 Conclusions and Recommendations

Based on the conducted researches, review of the Feasibility Report of the New Manila Reclamation and Development Project, Report on the Disaster Prevention and Mitigation in Metropolitan Manila, other relevant technical reports and field investigation, the following conclusions and recommendations can be deduced:

4.2.3.1 Conclusions

- The subsoil is generally weak (very soft to soft) with thick sequence of Quaternary alluvium made up principally of unconsolidated strata of plastic silty clay and clay. Very stiff to hard clay layers are generally deeper.
- The project area may experience ground shaking of Intensity VI as felt during the July 1990 Luzon Earthquake.
- The seismic hazards to which the project will be exposed to are ground shaking, liquefaction and surface rupturing.
- In terms of ground shaking, five major earthquake generators, namely, the West Valley Fault, the Philippine Fault Zone, the Lubang Fault, the Casiguran

Fault and Manila Trench have been identified as the most likely sources of future earthquakes that could affect the project. Of these sources, the WVF and the PFZ are most likely to generate the strongest levels of ground shaking. The worst-case scenario is a large magnitude event on the West Valley Fault.

- Three zones of average, below and above average levels of ground shaking have been identified in Metro Manila. Areas within the above average are those underlain by thick piles of water-saturated sediments. These include the reclaimed areas in Manila, Navotas, Malabon, eastern Pateros, the valley side of Marikina and eastern section of Pasig.
- Identified liquefaction-prone areas in Metro Manila are essentially within the zone of average to above average zone of ground shaking. Several areas in Manila (particularly those close to the Pasig River), Navotas and Malabon have high potential to liquefaction.
- In addition to ground-shaking related hazards, surface rupturing may also occur from West Valley Fault. The surface rupture is expected to essentially follow the pre-existing fault trace and restricted to a narrow zone. For a magnitude 7.5 earthquake, the empirical data suggest an associated 70 km long surface rupture and maximum displacement of 2 to 3 meters along the fault trace. Damages as a result of this hazard is expected to be substantial for structures directly straddling and located within few meters from the rupture zone.
- Tsunamis may occur but are not expected to significantly impact the project area.
- The project area is 70 km away from Taal Volcano and 85 km from Mount Pinatubo and therefore not susceptible to major volcanic hazard even if violent eruption will happen. Based on the recorded hazards associated with the eruption of Taal Volcano, the project area being 70 km away from the said volcano could only experience ashfall.
- Only a minor quantity of ash has affected Metro Manila based on the review of the extent of impacted areas from the largest eruptions of Mount Pinatubo. It is thus conceivable that should Mt. Pinatubo erupt with the same magnitude in the future, the same level of ashfall impact is expected to likely affect the project area.
- Manila being situated in low grounds is very much prone to flooding.
- As seen during Typhoon Pedring and other previously reported storm surges that affected Manila Bay, Manila Bay coastline is considered highly vulnerable to storm surges and coastal floods.

4.2.3.2 Recommendations

- Study the likely impacts of the seismic and hydrologic hazards on the proposed project and consider them in the design and construction and locations of gravity walls, slope revetments, steel sheet filing and also in deciding the height of the fill of land reclamation.
- Proper planning and executions of dredging, removal of soft clay layers, filling and compaction of the fill materials have to be carried out by the proponent and the contractor/s to prevent the occurrence of subsidence or differential settlement. The proposed pre-fabricated vertical drains and surcharge will be of great importance in attaining the desired soil/fill compaction.
- Prepare clear plans, infrastructures and mitigations for possible disaster/s that might happen and affect the project.
- Flood control infrastructures for the onshore areas should be considered in the design and implementation of land reclamation.
- Designers and/or Engineers have to assess the structural resistance of the different infrastructures related to land reclamation.
- The designs of all the structures to be constructed by the proponent must conform to the National Structural Code of the Philippines. These structures should withstand an earthquake with magnitude of intensity VIII on the Rossi-Forel Intensity Scale.
- The Project should conform with the requirements, permits and clearances prescribed by the Philippine Reclamation Authority.

4.3 Emergency Response Policy and Guidelines

4.3.1 Emergency response policy

The Project is committed to ensuring the health, safety and security of its personnel, assets and surrounding environment through the prevention of accidents by eliminating potential threats/hazards and anticipating other probable causes. Hence, the Project shall adhere to the primary approach to emergency response–that is the prevention of circumstances that can create emergency conditions.

The Project shall designate a safety officer, who will regularly conduct safety briefings and periodically conduct emergency response drills. The safety officer will supervise the daily safety performance of operations and maintenance procedures. The safety officer will inspect the work and crew situation to ensure maintenance of and compliance to safety guidelines.
Personnel selection and hiring policy will require all personnel to be capable of swimming and basic water survival skills.

Aside from the occupational safety accidents, the project area is also exposed to various geologic hazards such as ground shaking, liquefaction, surface rupturing, storm surges and coastal flooding.

The potential incidents and emergency situations that may be encountered in the future operation of the proposed Project are detailed in the table below.

Table 4-5. Emergency scenarios for the Project

Type of emergency situation	Possible causes	Potential effects
Occupational safety accidents	• Improper training and supervision of personnel • Equipment or facility failure • Lack of full understanding regarding the surrounding environment	• Injuries and fatalities to personnel • Partial or total loss of equipment
Earthquakes	• Movement/rupture of nearby fault lines • Volcanic eruption	• Failure of structures • Injuries or fatalities to personnel and communities
Tsunami	• Movement/rupture of nearby fault lines • Volcanic eruption • Intense earth movement	• Failure of structures • Injuries and fatalities to personnel and communities
Flooding	• Typhoon-prone area • Flood-prone/ topography of area • Complex weather systems	• Collapse of structures • Destruction of project facilities • Injuries and fatalities to personnel and communities
Storm surge	• Typhoon-prone area • Complex weather systems • Intense rainfall, wind and high tides	• Injuries and fatalities to personnel and communities

In order to reduce, if not eliminate, extreme emergency situations leading to loss of life and property, hereunder are the Project's initial safety guidelines which will be refined during construction.

4.3.2 Generic guidelines for the prevention, alleviation or response to emergency situations

4.3.2.1 Safety

1. All construction personnel, staff, and crew shall undergo proper and complete training for them to understand the job/tasks assigned to understand and implement necessary safety procedures.
2. All working personnel shall be required to don personnel protective equipment including life vest and whistle.
3. No work will be allowed under typhoon or extreme weather conditions.
4. Sea walls under construction shall be adequately braced and provided with cross-drain courses until the stability of the structure under construction is secured. The supervising structural engineer shall have added responsibility of checking or providing the safety officer with guidelines in checking the integrity/stability of all structures under construction.
5. The leadman for each phase/work sector shall likewise check his crew during work to ensure compliance with safety guidelines and to prevent progress of a critical condition into an emergency.
6. All safety guidelines promulgated by the Occupational Health and Safety Guidelines of the OHSC-DOLE shall be implemented.

4.3.2.2 Emergency response

The proponent shall designate a leadman (incident commander) to serve as the primary emergency respondent. The leadman shall have access to communications equipment at all working hours.

1. Equipment

A motorized transportation vessel with first aid facilities, stretcher, breathing equipment, a capable wireless communication equipment and trained first aid personnel will be available at site as long as there in on-going work.

2. Communication links

The wireless communication equipment shall have stored emergency numbers for the following:

- Hospital emergency numbers to call for an ambulance when necessary
- Boat-mounted crane in the event the emergency response will require removal of heavy rocks or equipment
- The supervisors and project manager in the event important decisions need to be made, following social protocol, for them to inform the concerned family/ies regarding any incident.

3. Emergency plan/response system

The Project shall establish an orderly and systematic approach in addressing emergency situations to ensure safety of personnel and property. The Project will follow the schematic diagram/procedure presented in **Figure 4-9**, while the roles and responsibilities of each personnel involved in the emergency plan are listed in **Table 4-6**.

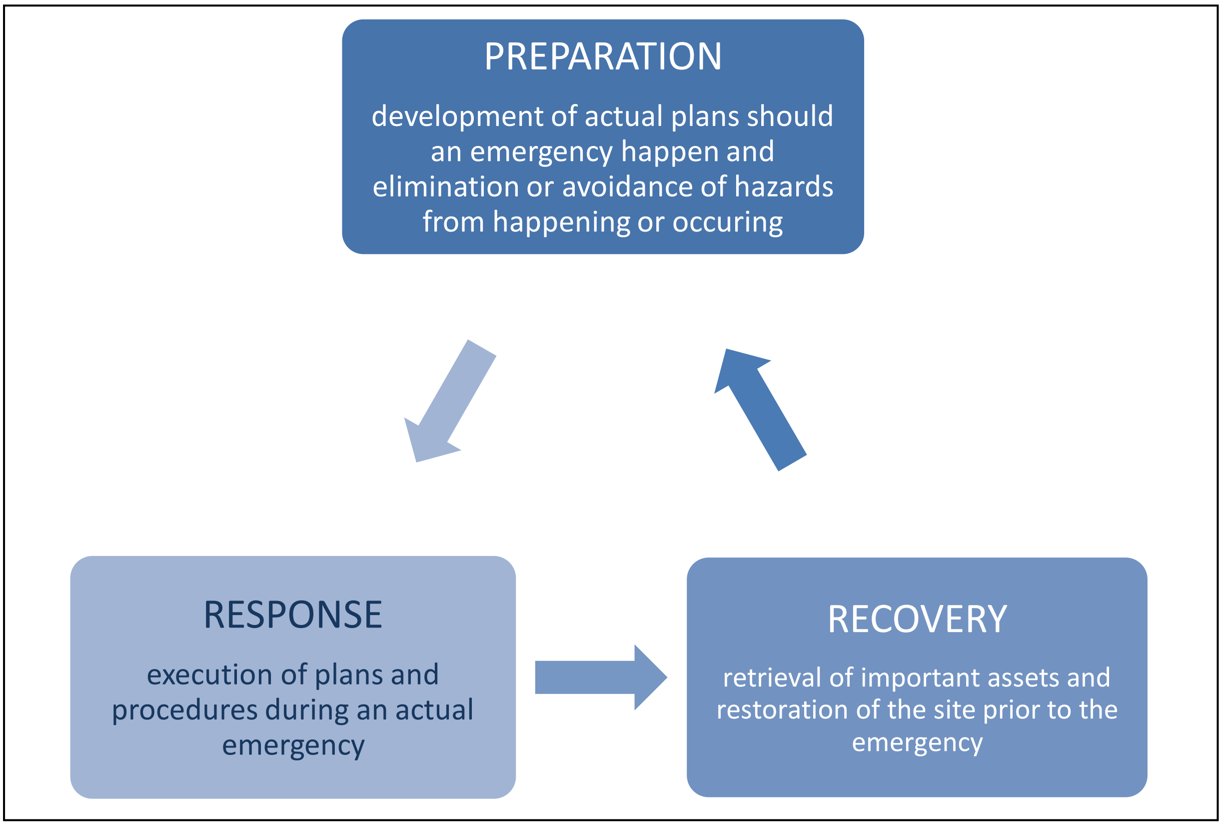


Figure 4-9. Emergency response procedure

Table 4-6. Key personnel in emergency response operations

Emergency response personnel	Roles and responsibilities
Leadman (incident commander)	• Overall in-charge of operations during an emergency event • Provides direction and orders to the response team in managing the emergency • Informs supervisor/project manager about the incident
Supervisor/ Project Manager	• Assists at site when necessary • Know the condition of people involved in the emergency, assess the situation, give instructions to First Aid Team in case necessary • Inform family/ies concerned, providing information of hospital location and other necessary details
Safety officer	• Supervises daily safety performance of operations and maintenance procedures, including emergency response procedures
Liaison officer	• Secures the necessary permits and training certification for the personnel
First aid team	• Performs the actual response, rescue and retrieval of personnel and equipment during an emergency event • Calls for ambulance or needed specialists to immediately assist case when necessary, or arrange for case forwarding to better equipped hospital, if needed equipment is not available in nearby hospital
Logistics team	• Provides the necessary supplies and equipment for the First aid team • Provides additional support/assistance to the First aid team

5 Social Development Plan and IEC Framework

5.1 Social development plan

Indicative social development planning is necessary in formulating programs and strategies that would mitigate the major impacts of the project. This would guide the proponent in preventing/mitigating and/or enhancing a project's adverse and positive impacts on people's livelihood, health and environment.

Social Development Plan (SDP) aims to assess and identify the basic needs of the communities which will be affected by the project. SDP should be patterned in the Municipal and Barangay Development Plans of the host communities and in accordance with the mandated Corporate Social Responsibility. It aims to establish a strong relationship between the Project Proponent, community institutions, and stakeholders towards the goal of achieving an improved quality of life of the residents of the host localities.

The issues that were raised during the public scoping were considered and addressed in the formulation of SDP. Moreover, issues obtained from perception survey and Public Scoping were also included. These are the following:

1. Timeline of ECC application
2. Impact on power supply
3. Systemic problems from the proposed project and other reclamation projects in Manila Bay
4. Impact of access road to the residents
5. Manila Mandamus to be part of EIA study
6. Source of filling materials
7. Involvement of necessary stakeholders during public participation
8. Impact on traffic
9. Impact on flooding
10. Impact on Earthquake hazard
11. Future land classification of the project
12. Impact of waste disposal on Manila Bay (aquatic life) and the community
13. Impact on drainage thereby causing flooding in Las Piñas
14. Impact on upstream of affected rivers
15. Impact on navigable waters
16. Existing breakwater to be part of the project
17. Consideration on international ports
18. Impact of hazardous equipment on water quality
19. Impact of hazardous equipment on historic and aesthetic value of the area
20. Impact of project size on water displacement near Pasig River

21. Flow analysis of bay / study on impact of drainage to the community to be included in the EIA
22. Generation of jobs
23. Displacement of barangay residents
24. Threat of hazards in the community
25. Improvement of the Baseco Community
26. Cleared and open Manila bay to preserve historical value of the area
27. Social preparation for the community;
28. Include in the development of the community
29. Fishing grounds affected by the equipment, ex. Compactor
30. Aid for the fisherfolk
31. Plan for aplaya residents

The details of the indicative SDP indicating the major program and activities are presented in **Table 5-1**.

Table 5-1. Social Development Plan

CONCERN	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services (Indicative Specific Services)	Proponent	Indicative Timeline	Source of Fund
1. Gender Responsive • **Livelihood/Employment and Credit Facilities** ***Men*** - **Skills development for project employment** - **Training and workshop on Efficient Fishing Methods** ***Women, Youth and Elderly*** - **Livelihood trainings for skill development**	• Barangay Kagawad for livelihood • Qualified identified workers within the area who will be affected by the project. • BFARMC President and qualified identified affected fisher folks. • Qualified identified affected residents in the vicinity of the project area	• LGU City Planning Officer • CSWD ○ Pro-poor Livelihood programs • CAO ○ Workshop on efficient fishing methods	Community Relations Officer	• Pre-construction • Construction • Operation	LGU-IRA/ PROPONENT
2. Health and Safety • **Health & Safety Training for employees**	• Barangay Kagawad for Health ▪ Barangay Health Workers ▪ Barangay Nutrition scholars • Barangays affected by the project • Project employees	• City Health Officer ○ Maternal Care and Child Health Care - Prenatal, Intranatal, Postnatal - Child birth in health centers or hospitals ○ Malnutrition - Supplemental feeding • Manila City DRRMC	PROPONENT Community Relations Officer	• Pre-construction • Construction • Operation	LGU-IRA/ PROPONENT
3. Education and Recreation • **Assistance for**	• Barangay Kagawad for Education	• CPDO & ME of the City	PROPONENT	• Pre-construction	LGU-IRA/ PROPONENT

CONCERN	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services (Indicative Specific Services)	Proponent	Indicative Timeline	Source of Fund
development of school facilities • **Provision of scholarship to qualified students**	• Barangay Elementary/ Primary School Principal	• DEPED of the City • Barangay Elementary Schools - Sports and Recreation Program	Community Relations Officer	• Construction • Operation	
4. Environment and Sanitation	• Barangay Kagawad for Environment	• CAO/ENRO of the City • CHO of the City - Implement the Ecological Solid Waste Management (RA 9003) - Implement Clean & Green for Barangay buffer zones - Implementation of Health & Sanitation Program - Solid Waste Management Program - Set-up community based health program in project affected areas; regular monitoring	PROPONENT Community Relations Officer and Pollution Control Officer	• Pre-construction • Construction • Operation	LGU-IRA/ PROPONENT

CONCERN	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services (Indicative Specific Services)	Proponent	Indicative Timeline	Source of Fund
		and consultation on medical services.			
5. Peace and order • **Entry of migrant workers** • **Conflict of project workers and the community**	• Barangay Kagawad for Peace and Order • Barangay Tanods	• PNP of the City ○ Provision of equipment and facilities as aid in keeping order in the community	PROPONENT Chief Security Officer	• Pre-construction • Construction • Operation	LGU-IRA/ PROPONENT
6. Spiritual	• Barangay Assigned Catholic Priest, Pastor of different denomination	• Parish Priest and Pastor ○ Spiritual Development Programs to the company and community ○ Provision of materials and facilities for spiritual programs	PROPONENT Community Relations Officer	• Pre-construction • Construction • Operation	PROPONENT
7. Impact on Fishing and Livelihood	• Fisher folks within the area • Qualified identified workers within the area who will be affected by the project. • Qualified identified beneficiaries in the vicinity of the project area that might be adversely affected.	• OCVAS • BFAR • CAO ○ Provision of offshore and in water structures in designated areas to assist in the facilitation of marine growth. Examples of structures are artificial reefs and corals, floating rigs	PROPONENT Community Relations Officer	• Pre-construction • Construction • Operation	PROPONENT

CONCERN	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services (Indicative Specific Services)	Proponent	Indicative Timeline	Source of Fund
	• BFARMC President and qualified identified affected fisher folks.	with lights, etc. ○ Designation of possible regulated docking areas catering to fishing vessels ○ Resource, Financial or material assistance for the provision of larger fishing vessels (such as trawlers) capable of further distances to accommodate organized fishing expeditions in further areas where more fish abounds ○ Training for fishing and fishing related skills development including fish processing, marketing, etc			
8. Disaster Risk Reduction/Climate Change Adaptation	• Barangay Kagawad for Environment • Barangays and communities around the project area	• CDRRMC • Barangay Kagawad for Envi • Disaster Risk Management Plan ○ IEC on Disaster Risk Management ○ Seminars/training for	PROPONENT Community Relations Officer	• Pre-construction • Construction • Operation	PROPONENT

CONCERN	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services (Indicative Specific Services)	Proponent	Indicative Timeline	Source of Fund
		communities and plant workers on Disaster Risk Preparedness and Mitigation ○ Provision of equipment and aid in response and recovery of affected communities			

5.2 Information, education and communication framework

A comprehensive and intensive Information Education Communication (IEC) Campaign to better inform and educate the communities and the general public as to the objective, necessity and benefits of the project, as well as the processes involved for the construction and operation of the project. These shall be done thru distribution and posting of written materials such as brochures, newsletters, media statements and articles, bulletins and posters, and online presence. Also as well as non-written types such as fora, symposia, community discussions and hearings, audio visual presentations (such as powerpoint and DVD), radio and TV programs and/or guestings, etc. The IEC materials and activities will also serve as a venue for continuous dialogue, feedback and check and balance mechanism for the parties involved.

Table 5-2 below presents the proposed IEC Plan for the Reclamation Project.

Table 5-2. Indicative Information, Education and Communication (IEC) Plan

Target Sector identified as needing project IEC	Major topics of concern in relation to project	Strategy/ Methods	Information Medium	Indicative Timeline/ Frequency	Cost Estimate
Different sectors, organizations and resource users in the project affected barangays (i.e. education and health sectors; women's, youth, senior citizen and fishermen organizations, City and Barangay LGUs)	• Project description • EIA process • EIS findings	Group methods (Meetings, Focused Group Discussions)	• Invitation letters • Multi-sectoral cluster meetings • Audio-visual presentation • Illustrative primer about the project	Prior to project implementation	Php 50,000 per activity
Agencies and offices covering the area and marine vessel traffic and navigation, such as the PPA, the Philippine Coast Guard, Manila Bay Coordinating Office, and others.	• Sea Lane Navigation and Traffic Plan	Group methods (Meetings, Consultations, Presentations, and Audio-Visual Materials)	• Invitation letters • Partnership meetings • Audio-visual presentation	Prior to project implementation	Php 50,000 per activity
Different sectors, organizations and resource users in the project affected barangays (i.e. education and health sectors; women's, youth, senior citizen and fishermen organizations, City and Barangay LGUs)	Project impact and mitigating measures	Group methods (Meetings, Focused Group Discussions)	• Invitation letters • Partnership meetings • Focus group discussions	• Before project construction • Regular consultation during project operation	Php 50,000 per activity
• City Government of Manila • Barangay Officials of 649	Project benefits	Group method (Meetings,	• Invitation letters • Partnership	• Before project construction	Php 50,000 per activity

Target Sector identified as needing project IEC	Major topics of concern in relation to project	Strategy/ Methods	Information Medium	Indicative Timeline/ Frequency	Cost Estimate
		Focused Group Discussions, Public Meetings)	meetings • Focus group discussions	• Regular consultation during project operation	
• City Government of Manila • Barangay Officials of 649	City/ barangay requirement (i.e. clearances) of workers and employees	Group methods (Meetings, Focused Group Discussions) Multi-media	• Newspaper publication • Radio broadcast • Posters/ Flyers Meetings with LGU	At least two to three months before construction	
• Fisher folks	• Performance against ECC conditions and EMP during construction period • Actual impacts during construction period and control measures implemented	Group methods (Meetings, Focused Group Discussions)	• Multi-sectoral cluster meetings (e.g. MMT meeting) • Meetings with fisherfolks association • Individual letters • Multi-sectoral cluster meeting (e.g. MMT meetings) • Local radio broadcast • Announcement in	• Regular/as needed during construction period • During unloading activities	Php 50,000 per activity

Target Sector identified as needing project IEC	Major topics of concern in relation to project	Strategy/ Methods	Information Medium	Indicative Timeline/ Frequency	Cost Estimate
			barangay LGU		
• Members of Multi-Partite Monitoring Team	• Increase resiliency of the community to disasters and climate change	Group methods (Meetings, Focused Group Discussions)	• Multi-sectoral cluster meetings	Regular MMT meeting during construction	Php 50,000 per activity

6 Environmental Compliance Monitoring

As required under DENR Memorandum Circular 2010-14 and the Revised Procedural Manual for DAO 2003-30, the following section presents the environmental compliance monitoring plan for the project to monitor the identified key environmental impacts of the Project. This monitoring plan includes "Environmental Quality Performance Level" (EQPL) values, which are threshold/limit levels identified for each critical parameter associated with the identified significant project impacts. The limit level shall be the regulated threshold of pollutant (standard that must not be exceeded) while the action level is set lower than the limit level wherein management measures must be implemented so as not to reach the regulated threshold.

The following mechanisms and monitoring schemes are discussed in the succeeding subsections:

- Self-monitoring plan;
- Multi-sectoral Monitoring Framework; and
- Environmental Guarantee and Monitoring Fund/ Contingent Liability and Rehabilitation Fund Commitments

6.1 Self-Monitoring Plan

The proponent will undertake regular self-monitoring for parameters indicated in **Table 6-1**. A quarterly environmental monitoring report in the form of the Self-Monitoring Report (SMR) will be prepared by the proponent and submitted to the DENR-EMB accordingly.

Table 6-1. Self-Monitoring Plan

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
Land													
Geology and Geomorphology	Geohazards	Liquefaction and ground subsidence monitoring	Periodic monitoring of ground stability	5 years or immediately after a major geologic event has taken place	Project area	Engineering Department	No additional cost; in-house	Noticeable ground subsidence and surface creep	Continuous occurrence of ground subsidence and creep	Significant ground subsidence and surface creep; Formation of cracks in columns, beams, pavement; Misalignment of structures; Impoundment of water due to liquefaction	Increase in monitoring frequency and measurement of magnitude of movement for cracks and surface creep	Check impact of ground subsidence to integrity of infrastructures. Implement necessary engineering measures.	Temporary cessation of construction; Retrofitting of damaged structures; Implement necessary engineering measures. Consider abandonment or relocation if necessary
Water													
Water Quality	Ambient Water Quality (marine water)	▫ pH ▫ Temperature ▫ Total Dissolved Solids ▫ Conductivity ▫ Total Suspended Solids ▫ Biochemical Oxygen Demand (BOD); ▫ Chloride (Cl-); ▫ Color (Apparent); ▫ Dissolve Oxygen	In-situ measurement and laboratory analyses	Monthly sampling, Quarterly Reporting through the SMR	Baseline water quality monitoring stations (may be adjusted accordingly)	PCO	Php 50,000 per sampling station	▫ pH below 6.8 and above 8.3 ▫ Temp: 2.6°C rise in the receiving water body ▫ DO: 7 mg/L ▫ TSS: 40 mg/L ▫ As:0.003 ▫ Cd: 0.001 ▫ Cr+6: 0.03 ▫ Cu:0.009 ▫ Pb:0.008 ▫ Hg:0.001	▫ pH below 6.9 and above 8.4 ▫ Temp: 2.8°C rise in the receiving water body ▫ DO: 7 mg/L ▫ TSS: 45 mg/L ▫ As:0.005 ▫ Cd: 0.002 ▫ Cr+6: 0.04 ▫ Cu: 0.01 ▫ Pb:0.009 ▫ Hg:0.001	▫ pH below 7.0 and above 8.5 ▫ Temp: 3°C rise in the receiving water body ▫ DO: 6 mg/L ▫ TSS: 50 mg/L ▫ As:0.01 ▫ Cd: 0.003 ▫ Cr+6: 0.05 ▫ Cu:0.02 ▫ Pb:0.01 ▫ Hg:0.001	▫ Re-conduct testing to verify ▫ Investigate the source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source.	▫ Re-conduct testing to verify ▫ Investigate the source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source. ▫ If source is not project construction, inform MMT	▫ Re-conduct testing to verify ▫ Temporarily stop construction works: investigate source ▫ If the problem is within the construction area, conduct adjustments/ appropriate corrective action at identified pollutant source. ▫ If source is not project construction,

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		(DO); ▫ Fecal Coliform; ▫ Nitrate as Nitrogen (N03--N); ▫ Phosphate as Phosphorous (P043--P); ▫ Ammonia as Nitrogen (NH3-N); ▫ Total Suspended Solids (TSS); ▫ Sulfate (S042-); ▫ Arsenic (As); ▫ Cadmium (Cd); ▫ Hexavalent Chromium (Cr6+); ▫ Lead (Pb); ▫ Mercury (Hg); ▫ Oil and Grease; ▫ Sulfactants (MBAS)										regarding possible source for the group's investigation and coordination with LGU	inform MMT regarding possible source for the group's investigation and coordination with LGU
Air													
Air Quality	Ambient Air Quality	TSP SO2 NO2	TSP Hi-volume/ Gravimetric 1-hour averaging	Monthly sampling, Quarterly Reporting through the SMR	Baseline air quality monitoring stations (may be adjusted	PCO	Php 50,000 per sampling station	TSP: 161 ug/ncm SO2: 126 ug/ncm	TSP: 184 ug/ncm SO2: 144 ug/ncm	TSP: 230 ug/ncm SO2: 180 ug/ncm	▫ Check weather condition during sampling and if location is downwind of	▫ Check weather condition during sampling and if location is	▫ Check weather condition during sampling and if location is downwind of construction site

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			period SO2 and NO2 24-hr gas bubbler		accordingly)			NO2: 105 ug/ncm	NO2: 120 ug/ncm Complaint lodged by community	NO2: 150 ug/ncm Complaint lodged by community	construction site ▫ Check possible source ▫ If source is project construction, inform contractor for their corrective action (i.e. dust suppression) ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU	downwind of construction site ▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project construction, inform contractor for their corrective action, and conduct retesting to confirm results of the mitigation measures ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU	▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project construction, immediately stop all works involving soil excavation and movement, increase the frequency of the contractor's dust mitigation, resume work only upon visual clearing of the sampling station, and conduct retesting at the said sampling station ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Noise	Ambient noise levels	Noise levels	24hr sound measurements using sound meter	Monthly sampling, Quarterly Reporting through the SMR	Baseline noise level monitoring stations (may be adjusted accordingly)	PCO	Php 10,000 per sampling station	71dB (daytime) 66dB (morning/ evening) 61dB (night time)	73dB (daytime) 68dB (morning/ evening) 63dB (night time)	75dB (daytime) 70dB (morning/ evening) 65dB (night time)	Identify possible noise source	▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project, do corrective action, and conduct retesting to confirm results of the mitigation measures ▫ If source is not project inform MMT regarding possible source for the group's investigation and coordination with LGU	▫ Conduct visit at said sampling station and conduct retesting using a 3rd party DENR accredited sampling firm to confirm ▫ If source is project, reduce use of noisy equipment, conduct retesting at the said sampling station and resume operation only upon clearance of the sampling station, ▫ If source is not project, inform MMT regarding possible source for the group's investigation and coordination with LGU
People													
People	Acceptability of the project to the community	Perception of the Community regarding the site development and	Coordination with the Community	Quarterly	Community	CRO / Envi Department	Part of the Cost for the IEC	Negative verbal feedback on the ongoing activities	Formal complaint lodged against the ongoing activity	Multiple complaint s by the community lodged in various forms or/and	▫ Investigate/ Inspect and Address the subject of negative feedback. ▫ Coordinate	▫ Determine and address the root cause. ▫ Conduct consultation with the	▫ Conduct consultation with concerned and relevant stakeholders in the community. ▫ Release an

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		construction process of the project									with the Brgy LGU and MMT.	Municipal LGU, MMT and EMB Regional	official statement for general consumption and employees.
	Workers	Health and safety of workers	Review of health and safety records of company Incident reports	Annual	Project site	Community Relations Officer / PCO	Part of the construction cost	Negative verbal feedback of worker	Formal complaint lodged by worker	Multiple complaints lodged by workers	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with Contractor and MMT.	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate with contractor and MMT.	▫ Release official statement for general consumption and employees. ▫ Coordinate with contractor and MMT.
	Labor and Wage issues	Wage Rate, Benefits, and Schedule of Payment Other worker's rights related issues	HR Management	Monthly	Project Area/Office	CRO / Envi Department	Part of the construction cost	Negative Verbal Feedback	Complaints lodged by employees	Multiple complaints by the workers lodged in various forms and agencies, or/and captured by media	▫ Investigate/ inspect and Address the subject of negative feedback.	▫ Facilitate dialogue with concerned parties. ▫ Formulate program and timetable to address the issues raised in agreement with the concerned parties	▫ Dialogue with concerned parties and with 3rd party agency/ institution involvement, ie DOLE, BLR, churches that are neutral yet competent and conducive with conflict resolution. ▫ Formulate program and timetable to address the issues raised in agreement with the concerned parties
	Social Development and Management Plan	Projects initiated by the Proponent under the approved SDP	Community Coordination, social engagements	Quarterly	Host barangay	Community Relations Officer	Part of the SDP Cost	Negative verbal feedback of community	Formal complaint lodged by the community	Multiple complaints by the community	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with barangay	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate	▫ Conduct consultation with concerned members of the community. Release official statement.

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											LGU and MMT.	with barangay LGU and MMT.	▫ Coordinate with barangay LGU and MMT.
	Information, Education, and Communication	Implementation of IEC activities	Community Coordination, social engagements	Quarterly	Host barangay	Community Relations Officer	Part of the IEC Cost	Negative verbal feed back to the Proponent	Formal complaint lodged by the community	Multiple complaints by the community captured by local media organizations	▫ Proponent to investigate the subject of negative feedback. ▫ Coordinate with barangay LGU and MMT.	▫ Investigate cause of complaint, determine and address the root cause. ▫ Coordinate with barangay LGU and MMT.	▫ Conduct consultation with concerned members of the community. ▫ Release official statement. ▫ Coordinate with barangay LGU and MMT.
	Unauthorized Prohibition (may either be setting up of physical barriers or prohibition of security personnel) of Access to Public Areas	Security Prohibition Practices	Community Grievance / Complaints Registry	Monthly	Project Area and Adjacent Vicinity	CRO / Envi Department	Part of the construction cost	Negative Verbal feedbacks on Security prohibition	Formal Complaint lodged	Incidence of confrontation between project security personnel	▫ Investigate/inspect and Address the subject of negative feedback. ▫ Coordinate with the Brgy LGU and MMT to validate feedback. ▫ Conduct IEC on Protocols, Rules, Regulations and other dynamics re-access and prohibition issues and security measures ▫ Investigate/ inspect and Address the subject of negative	▫ Determine and address the root cause. ▫ Coordinate with the Municipal LGU, MMT and EMB Regional Office to validate complaints and determine causes, and formulate corrective actions.	▫ Conduct consultation with concerned and relevant stakeholders in the community. ▫ Release an official statement for general consumption and employees. ▫ Coordinate with MMT and EMB Central Office to discuss and implement corrective actions.

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											feedback.		
	Marine Traffic	No. of vessels affected by the project in terms of cost, fuel, personnel, and other time affected aspects	Records	Quarterly	Manila Harbor Area	CRO/ Envi Department / External Liaison or equivalent	Minimal Cost	_% of affected vessels	_% of affected vessels	_% of affected vessels	▫ Coordinate with the pertinent agencies and MMT to validate feedback. ▫ Conduct IEC on Protocols, Rules, Regulations and other dynamics on the Sea Lane Navigation and Traffic Plan ▫ Investigate/ inspect and Address the subject of negative feedback.	▫ Determine and address the root cause. ▫ Coordinate with the pertinent agencies, MMT and EMB Regional Office to validate complaints and determine causes, and formulate corrective actions.	▫ Conduct consultation with concerned and relevant stakeholders ▫ Coordinate with MMT, pertinent agencies and EMB Central Office to discuss and implement corrective actions.
	Emission and Water Contamination Health Issues	Respiratory And Digestive System Ailments of Worker s and People in the Community	Health records	Quarterly	Project Area	CRO/ Envi Department	Minimal Cost	Reported/ recorded incidences of minor ailments/ illness	Formal Complaints lodged. Rapid Increase in reported/ recorded Incidences of minor ailments/ illnesses	Rapid Increase in Reported/ recorded incidences of grave ailments/ illnesses necessitating intensive treatments , or resulting in death	▫ Investigate the possible source of the subject of complaints attributed to the project. ▫ Address the root cause if investigation confirms source is from the project ▫ Provide for	▫ Conduct intensive Project-wide inspection and address root cause if upon inspection the source is confirmed to be from the project. ▫ Provide for compensation of affected	▫ Decrease the level of operation/ aspects of operation commensurate to addressing the problem (fixing the equipment, materials, etc). ▫ Release Statement on the Issue.

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person / Office	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Methods	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											compensation if confirmed source of ailment is from the project	individuals if confirmed source of ailment is from the project ▫ Provision of personal protective equipment (PPE) to at-risk personnel and individuals	▫ Assist/facilitate medical care/ response to those affected. ▫ Provide for compensation of affected individuals if confirmed source of ailment is from the project

6.2 Multi-Sectoral Monitoring Framework

A Multipartite Monitoring Team (MMT) will be formed immediately after the issuance of the ECC to undertake monitoring of compliance with the ECC conditions, the EMP, and applicable laws, rules and regulation. The proponent will provide the budget for the MMT monitoring activities in accordance with the approved Work and Financial Plan.

As stipulated in DAO 2003-30, a MMT will be organized to regularly monitor the activities stipulated in the approved EMP, and conditions set in the ECC. Further, in accordance with DAO 2017-15 or the guidelines on public participation under the Philippine EIS System, the MMT for this project shall be composed of a maximum of ten (10) members to include the following:

- City Environment and Natural Resources Officer (City ENRO) of Manila City
- Philippine Reclamation Authority Representative
- Philippine Ports Authority Representative
- Philippine Coast Guard Representative
- Manila Bay Coordinating Council Representative
- City Health Unit (CHU) Chief
- Barangay Captain of Barangay 649
- 1 Representative from LGU-accredited local NGOs (related to the Project's activities)
- Maximum of 2 representatives from locally recognized community leaders who represent vulnerable sectors including women, senior citizens, urban poor, and academe

The general roles and responsibilities of the MMT chairperson and members are presented in the following table:

Table 6-2. MMT Composition

MMT Member	MMT Role	Responsibilities / Activities
City ENRO	Chairperson	• Team leadership to ensure that the Proponent's compliance with the ECC is monitored. • Strengthening of monitoring, analytical, and reporting capabilities of the Team. • Resolution of any conflicts and issues within the Team. • Management of the Monitoring Trust Fund. • Reporting of MMT activities and accomplishments • Reporting of ECC accomplishment through the MMT Compliance and Validation Report
Philippine Reclamation Authority Representative Philippine Coast Guard	Member	• Participation in actual monitoring activities, and review and verification of monitoring reports • Concur with the compliance monitoring and verification reports • Advice to MMT of any issues and recommendations

MMT Member	MMT Role	Responsibilities / Activities
Representative Philippine Ports Authority Manila Bay Coordinating Council Representative		concerning the project
City Health Unit (CHU) Chief Barangay Captain of Barangay 649 Representative from LGU-accredited local NGOs (related to the Project's activities) Representatives from locally recognized community leaders who represent vulnerable sectors including women, senior citizens, urban poor and academe	Member	• Participation in actual monitoring activities • Provision of information to the MMT about the environmental and socio-economic conditions as well as issues, problems, and suggestions of the stakeholders • Preparation and review of MMT reports • Provision of information on policies, plans, and programs of the IPs, NGOs, POs particularly to affected areas of the Project • Advice to MMT of any complaints, issues, and recommendations concerning the project

6.3 Environmental Fund Commitments

6.3.1 Environmental Monitoring Fund

An environmental monitoring fund (EMF) amounting to Six Hundred Thousand Pesos (Php 600,000) will be established in support of the compliance monitoring activities and fund the annual work and financial plan (AWFP) of the MMT. The AWFP will be proposed by the MMT and concurred by the project proponent for the approval of the EMB Regional Director.

The EMF will be utilized to cover all expenditures of the MMT operations to include the following expenses:

- Monitoring cost (equipment, laboratory service fee)
- Hiring of outside experts (technical and financial)
- Preparation and distribution of MMT reports
- Public information campaign (i.e. IEC framework)
- MMT meetings and plant visits
- Transportation
- Meals and accommodation
- Allowances/honoraria
- MMT trainings
- Others

6.3.2 Environmental Guarantee Fund

An environmental guarantee fund (EGF) will be established in accordance with the guidelines of the DAO 2003–30 through a MOA with EMB (NCR) Regional Office and the proponent.

Generally, EGF has two major components, as follows:

- The Trust Fund amounting to Five Million Pesos (Php 5,000,000) will be established to compensate aggrieved parties for any damages to life or property, undertake community-based environmental programs, conduct environmental research aimed at strengthening measures to prevent environmental damage, and to finance restoration and rehabilitation of environmental quality of the project-affected area
- The Environmental Guarantee Cash Fund amounting to One Million Pesos (Php 1,000,000) will be used for immediate rehabilitation and compensation of affected communities in case of damage or accidents. This can also be utilized for community-based environmental programs and information campaign. The Environmental Guarantee Cash Fund will also be used to cover the operational costs of the EGF Committee, in line with the Project's MMT Manual of Operations that will be approved prior to project implementation

6.3.3 EMF and EGF administration and management

The EMF will be managed and administered by the MMT Executive Committee of the Project. The disbursement of the EMF will be carried out according to the annual monitoring work and financial plan submitted by the MMT, which will be reviewed and concurred with by the Proponent and approved by EMB.

An EGF Committee will be formed to manage, control, and operate the EGF in accordance with the agreed internal procedures established regarding the mechanisms for fund disbursement, processing, validation, accounting and documentation. The committee will be composed of the MMT Officers, with the EMB Regional Director as the Chairperson.

7 Decommissioning / Abandonment / Rehabilitation Policy

Once the Project is completed, there are no plans to abandon the reclaimed area as it shall be maintained to perpetuity.

The project shall be implemented by phase/section, such that each section is secured from erosion on a compartmentalized basis. Should the completion of a phase/section under construction be deferred for another time, the filled materials will be protected from erosion through appropriate engineering measures such as the use of anchored fine mesh geotextile to minimize loss of filled materials. The specific phase/area shall also be secured from illegal encroachment.

In the future, should the facilities within the Project area be removed, the proponent shall ensure that the abandonment will be in accordance with the applicable laws and regulations of the national and local government units.

8 Institutional Plan for EMP Implementation

The institutional organization of the proposed Project is shown in **Figure 8-1**. The Project will be headed by the Project Manager and supported by the Assistant Project Manager.

The objective of this organization is to achieve the following:

- Implementation of company policies
- Economical and safe operations and maintenance of the project
- Environmental compliance and sustainability; and
- Promotion and enhancement of the social acceptability of the project.

The implementation of the Environmental Management Plan (EMP) provided in this document will be specifically handled by the Environmental, Health and Safety Department. The proponent, through the said department, is committed to comply with the conditions that will be stipulated in the ECC and other related environmental laws.

The proponent will also establish a partnership with relevant government agencies, various stakeholders and local host communities in relation to the project. This partnership is necessary to maintain a transparent and positive relationship for the project and its stakeholders, as well as to ensure compliance with environmental protection and enhancement measures.

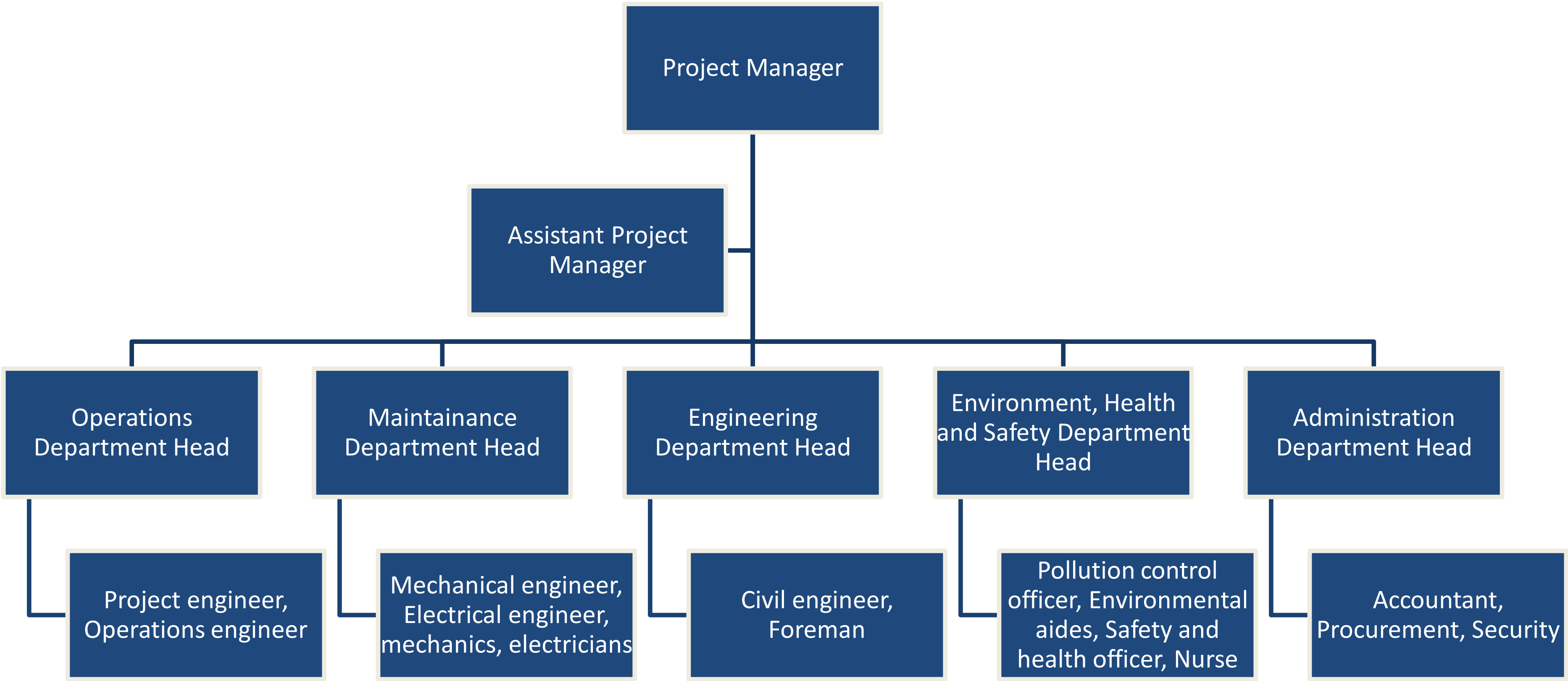


Figure 8-1. Organizational chart for Construction and Operation Phases

9 References

Administration Coastal Ocean Office, Washington D.C., 36 pp.

Allen, G, R. Stene, P. Humann, and N. deLoach, 2003. Reef Fish Identification - Tropical Pacific. New World Publications.

Azanza, R. V. and Miranda, L. N. 2001.Phytoplankton composition and Pyrodinium bahamense toxic blooms in Manila, Bay Philippines. J. Shellfish Res. 20: 1251–1255.

Bajarias, FA, Montojo UM, Relox JJR, Sato S, Kodama M, Yoshida M, Fukuyo Y. 2003.Paralytic shellfish poisoning due to Alexandrium minutum Halim in Northwestern Philippines. In: Nitithamyong, C. (ed) Proceeding of the First Joint Seminar on Coastal Oceanography, 14-16 December, 2003, Chiang Mai, Thailand. Department of Marine Science, Chulalongkorn University.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. "Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition." U.S. Environmental Protection Agency, Washington, DC. 1999. Document No. 841-B-99-002.

Carmichael, W.W., 1992. A Status Report on Planktonic Cyanobacteria (Blue-Green Algae) and Their Toxins, EPA/600/R-92/079, Environmental Systems Laboratory, ORD, USEPA, Cincinnati, OH 45268, June, 1992, 141 pp.

Carpenter, K and V. Niem, eds (1998). FAO Species Identification Guide, Vol. 1: Seaweeds, corals, bivalves and gastropods.

Chang, K.C., Mano, A.A., Iller, T.W.M., Sobe, T.I., Aneja, R.M., Iringan, F.P.S., Mai, H.I., Akano, S.N., 2009. Pollution Study in Manila Bay : Eutrophication and Its Impact on Plankton Community. Environ. Res. 261–267.

Craig, Paul M. (2017): *CVLGrid 2D Grid Generator User's Manual Version 1.1*. Developed by Dynamic Solutions-International LLC. Edmonds, Washington, U.S.A.

Craig, Paul M. (2017): *EFDC Explorer User's Manual, Release 171004*. Developed by Dynamic Solutions-International LLC. Edmonds, Washington, U.S.A.

Ellis, Jean and Douglas J. Sherman (2014): Coastal and Marine Hazards, Risks, and Disasters. Academic Press, November 2014.

English, S., C. Wilkinson and V. Baker, Editors (1997). Survey manual for tropical marine resources. 2nd ed. Australian Institute of Marine Sciences, Queensland, 390 p.

Francisco, B., Villegas, J.R., Quimpo, R., and E. Fontamillas (2015), Results of Resource assessment in the Proposed Marine Protected Area in Barangay Maroyogroyog, Linapacan, Palawan; FAO.

Francisco, B, Villegas J.R., Quimpo R., and E. Fontamillas (2015), Results of Resource Assessment in the Proposed Marine Protected Area in Barangay Calibangbangan, Linapacan, Palawan; FAO.

Faust, M.A. and R.A. Gulledge. 2002. Identifying harmfulmarine dinoflagellates. Smithsonian InstitutionContributions U.S. Nat. Her., 42:1-144.

Food and Agriculture Organization. 2004. Marine Biotoxins. Chief Publishing and Multimedia Services. Rome, Italy.

FAO, 2004. Marine Biotoxins, FAO Food and Nutrition Paper, 80. Food and 7 Agriculture Organization of the United Nations, Rome, 278.

Harris, G.P. 1986. 1986. Phytoplankton Ecology. Chapman and Hill Ltd, London, pp 384.

Hinga, K.R., Jeon, H., Lewis, N.F., 1995. Marine Eutrophication Review Part I: Quantifying the effects of nitrogen enrichment on phytoplankton in coastal ecosystem.

Intergovernmental Panel on Climate Change (2013): Projections of Sea level Rise. Climate Change 2013: The Physical Basis. Working Group I contribution to the IPCC Fifth Assessment Report. Jonathan Gregory, Lead Author, Chapter 13, Sea level Change.

Jacinto GS, Azanza RV, Velasquez IB, Sirigan FP (2006) Manila Bay: Environmental challenges and opportunities. p. 309–328. In The Environment in Asia Pacific Harbours (ed. Wolanski E). Springer, The Netherlands.

Jacinto GS, Azanza RV,Velasquez IB and FP Siringa. 2006. Manila Bay: Environmental challenges and Oppurtunities. In: The Environment in Asia Pacific Harbours. Springer Netherlands.

Kasten F., Czeplak G., 1980, Solar and Terrestrial Radiation dependent on the Amount and Type of Cloud, Solar Energy, Vol. 24, 177-189

Lapidez, J. P., Suarez, J. K., Tablazon, J., Dasallas, L., Gonzalo, L.A., Santiago, J., Cabacaba, K.M., Ramos, M.M.A., Lagmay, A.M.F., Manalo, V. (2014); Identification of Storm Surge Vulnerable Areas in the Philippines through Simulations of Typhoon Haiyan-Induced Storm Surge Using Tracks of Historical Typhoons. Department of Science and Technology, Nationwide Operational Assessment of Hazards. Project NOAH Open-File Reports, Vol. 3 (2014), pp. 118, 121, 122.

Margalef, R. 1978. Diveristy. In: Phytoplankton Manual (Ed): A. Sournia, UNESCO, Paris, 251-260

Moestrup, O., Lindberg, K., and Daugbjerg, N.: Studies on woloszynskioid dinoflagellates IV: the genus Biecheleria gen. nov., Phycol. Res., 57, 203–220, 2009

Montojo UM, Sakamoto S, Furio EF, Gatdula NC, Borja VM, Formeloza MA, Yoshida M, Fukuyo Y, Ogata T, Kodama M. 2003. Occurrence of Three Species of Toxic Dinoflagellates in Manila Bay, Philippines. In: Nitithamyong, C. (ed) Proceeding of the First Joint Seminar on Coastal Oceanography, 14-16 December, 2003, Chiang Mai, Thailand. Department of Marine Science, Chulalongkorn University.

National Water Council, 1981 National Water Council (1981) River Quality: the 1980 survey and future outlook.

National Mapping and Resource Information Authority (2016): Philippines Tide and Current Tables 2016. Hydrography Branch, 421 Baracca St., San Nicolas, Manila

Okaichi, T. 1967. Red tides found in and around the Seto Inland Sea in 1965. Tech. Bull. Fac. Agricul. Kagawa Univ. 15: 181-185.

PAGASA : Historical Storm Surge Map of Manila Bay. Prepared by Nestor B. Nimes (2009), (2011), HTMIRDS, RDTD. PAGASA. Science Garden Complex, Agham Road, Diliman, Quezon City

Pokavanich, Tanuspong and Kazuo Nadaoka (2006): *Three-dimensional Hydrodynamics Simulation of Manila Bay*. Symposium on Infrastructure Development and the Environment, University of the Philippines, Diliman, Quezon City.

Reynolds, C. S. 2006. The Ecology of Phytoplankton. Cambridge University Press.

S. Sabater, Diatoms, In Encyclopedia of Inland Waters, edited by Gene E. Likens,, Academic Press, Oxford, 2009, Pages 149-156

Siringan, Fernando P and Cherry L. Ringor (1998): Changes in Bathymetry and Their Implications to Sediment Dispersal and Rates of Sedimentation in Manila Bay. Science Diliman, July-December 1998.

Stewart I and Falconer IR (2008) "Cyanobacteria and cyanobacterial toxins" Pages 271–296 in Oceans and human health: risks and remedies from the seas, Eds: Walsh PJ, Smith SL and Fleming LE. Academic Press, ISBN 0-12-372584-4.

Stull, Roland (2011): Wet-Bulb Temperature from Relative Humidity and Air Temperature. American Meteorological Society, November 2011.

Sverdrup, H. U., M. Johnson, and R. Fleming. 1942. The Oceans. Prentice- Hall, Inc., New York. 1087 p.

Tetra Tech, Inc. (2007): Environmental Fluid Dynamics Code Theory and Computation Volume 1: Hydrodynamics and Mass Transport.EFDC was originally developed by Dr. John M. Hamrick, 101306 Eaton Place, Suite 340, Fairfax, VA 20030

Tetra Tech, Inc. (2007): Environmental Fluid Dynamics Code User Manual. EFDC was originally developed by Dr. John M. Hamrick) USEPA Version 1.01. 101306 Eaton Place, Suite 340, Fairfax, VA 20030.

Tomas, C. R. 1997. Identifying marine phytoplankton. Academic Press, California.

Valiela, I 1984.Marine Ecological Process. Springer-Verlag, New York, pp546

Villanoy, Cesar and Marilou Martin (1997): Modeling the Circulation of Manila Bay: Assessing the Relative Magnitudes of Wind and Tide Forcing. Science Diliman, 1997.

Wilhm, J.L. 1975. Biological indicators of pollution. In *Aquatic Ecology,* ed. B.A. Whitton, pp. 375-402. Univ. of California Press, Berkeley, CA.

Websites:

www.epa.gov/exposure-assessment-models/efdc)

www.michigan.gov/documents/deq/wb-npdes-TotalSuspended

Solids_247238_7.pdf