2018

Project Description for Scoping

for the Proposed

New Manila Reclamation Project

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Project Information

Project Name	New Manila Reclamation Project
Project Type	Reclamation Project
Project Location	Manila City
Project Size	407.42 hectares

Proponent Profile

Project Proponent	**CITY GOVERNMENT OF MANILA**
Proponent 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

CHAPTER 1 PROJECT DESCRIPTION

1.1 PROJECT LOCATION AND AREA

1.1.1 PROJECT LOCATION

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.

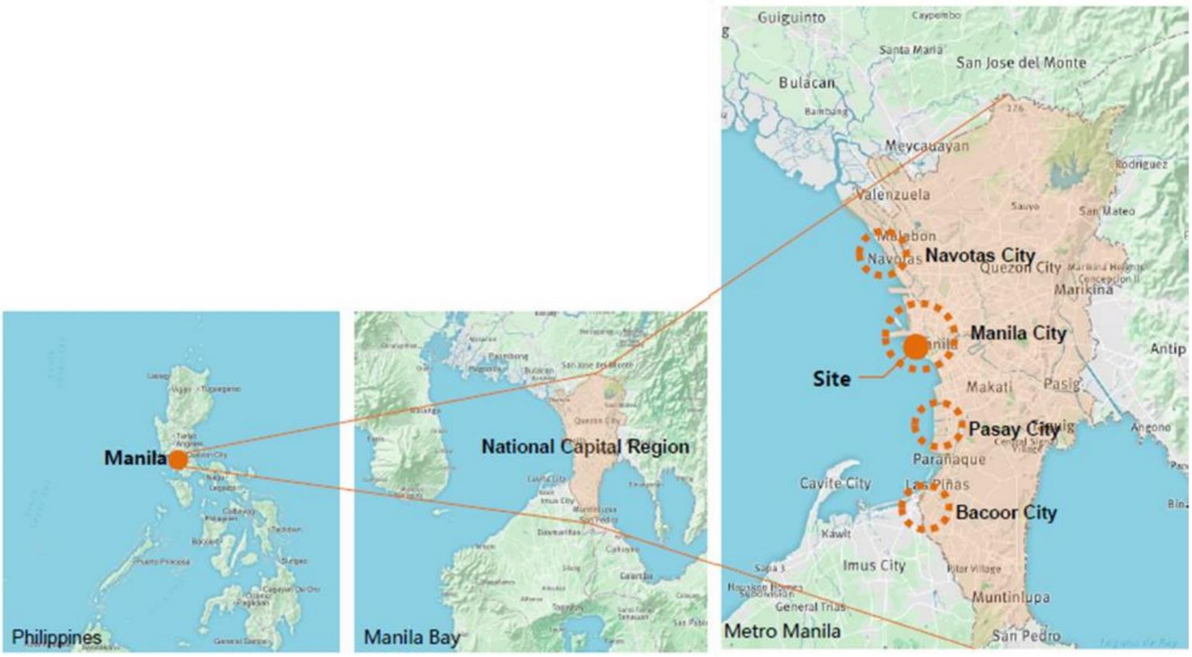


Figure 1. Project Location

Table 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

Corner	Easting	Northing
15	279902.358	1613013.344
16	279663.650	1613278.259
17	279435.495	1613523.028
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

1.1.2 SITE ACCESSIBILITY

The Project site is currently accessible by 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, 2ndStreet is connected to the M. Roxas Jr. Bridge and subsequently to radial road R10. R10 road conveys traffic from the city centre 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 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.

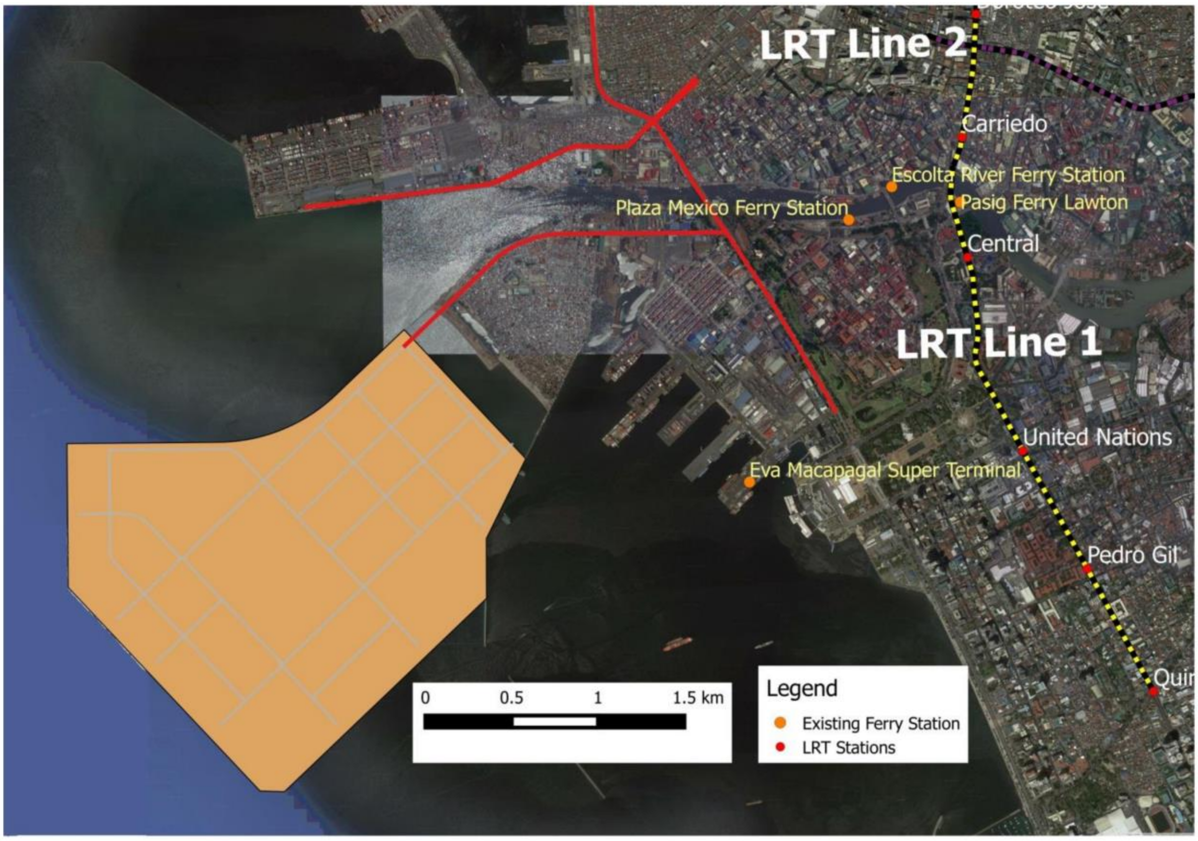


Figure 3. Public Transport Systems within Close Proximity of the Project Site

1.1.3 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.

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

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 neighboring countries, serving as the Philippines' gateway for social-economic developments.

Figure 4. Transformation of Manila

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.

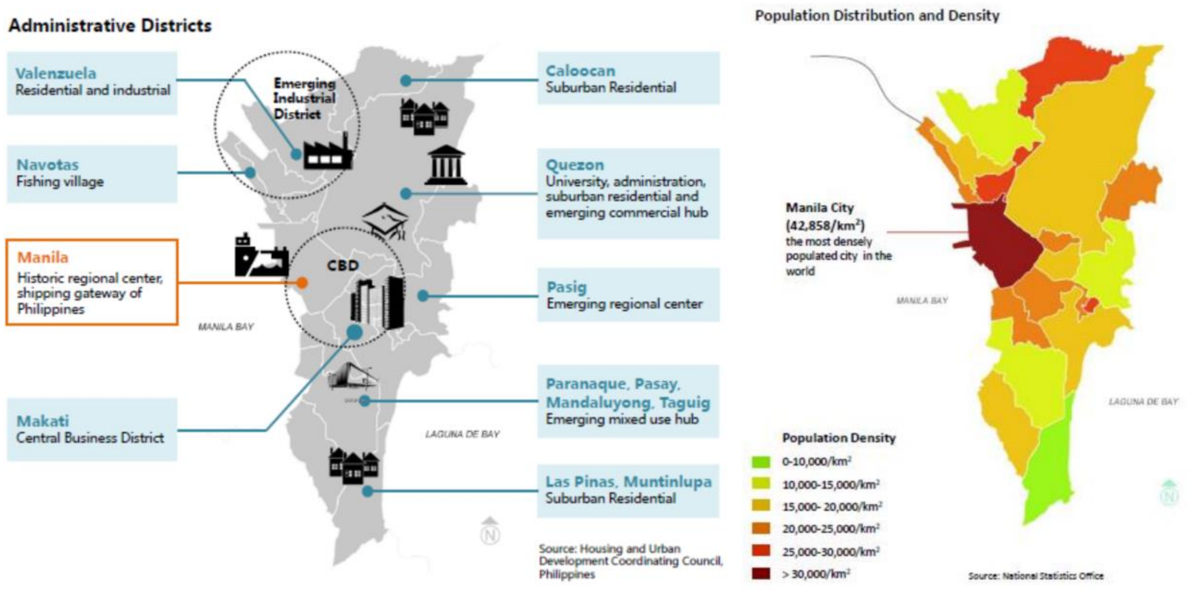


Figure 5. Regional Structure of Manila

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.

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.

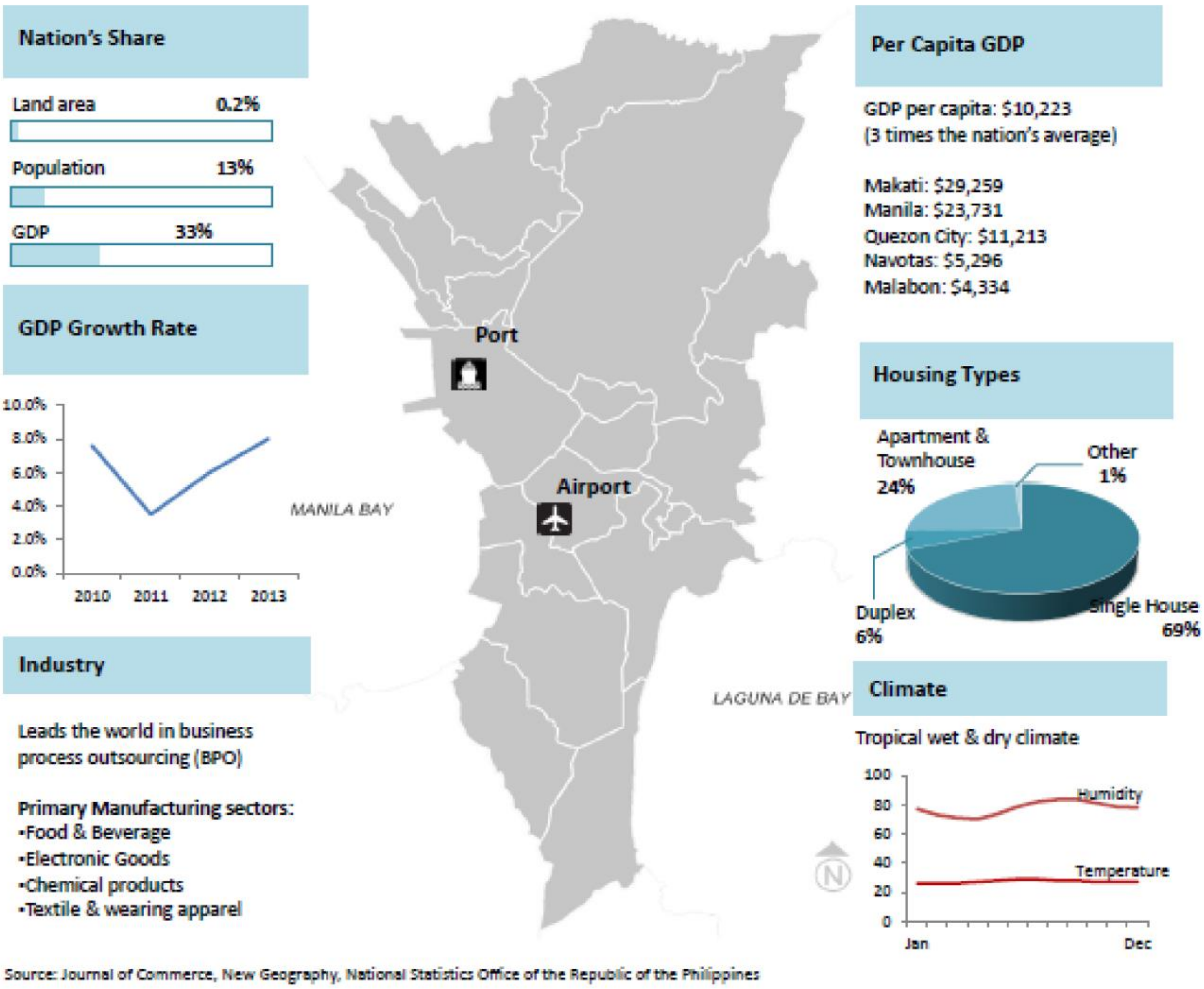


Figure 6. Economic Outlook of Manila

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.

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.

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.

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.

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:

Reference No.	Title
BS 5400	Steel, Concrete and Composite Bridges
BS 6031	Code of Practice for Earthworks
CP 4	Code of Practice for Foundations

Reference No.	Title
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:

Gravity Wall

Gravity wall in the form of concrete block work is proposed to be constructed at the outer marina as shown in **Figure 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 7. Location of proposed gravity wall

Figure 8. Typical example of gravity wall

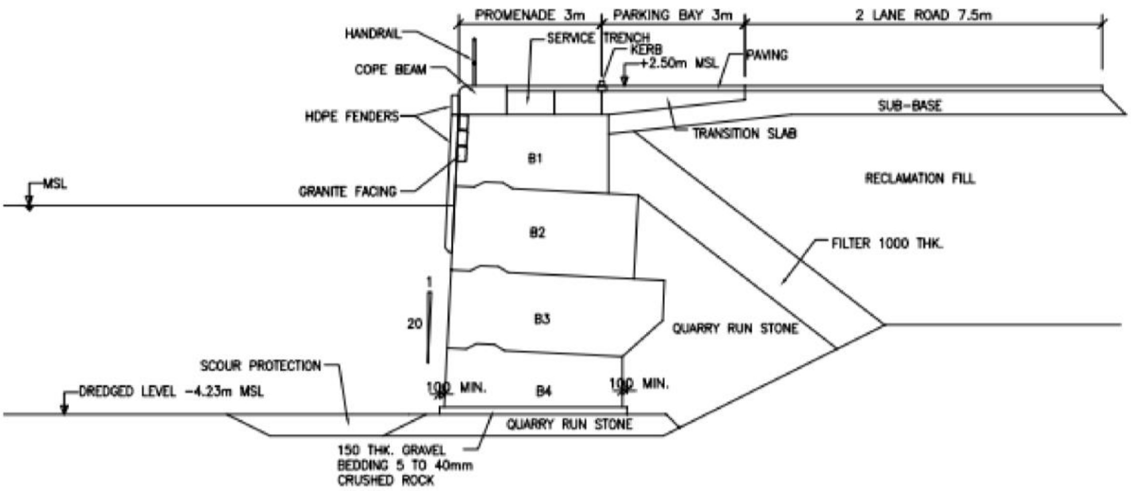


Figure 9. Typical cross section of concrete blockwork.

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 10**).

Figure 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 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 11. Location of proposed SSP.

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 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 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 14**.

Figure 12. Location of sloping revetment

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

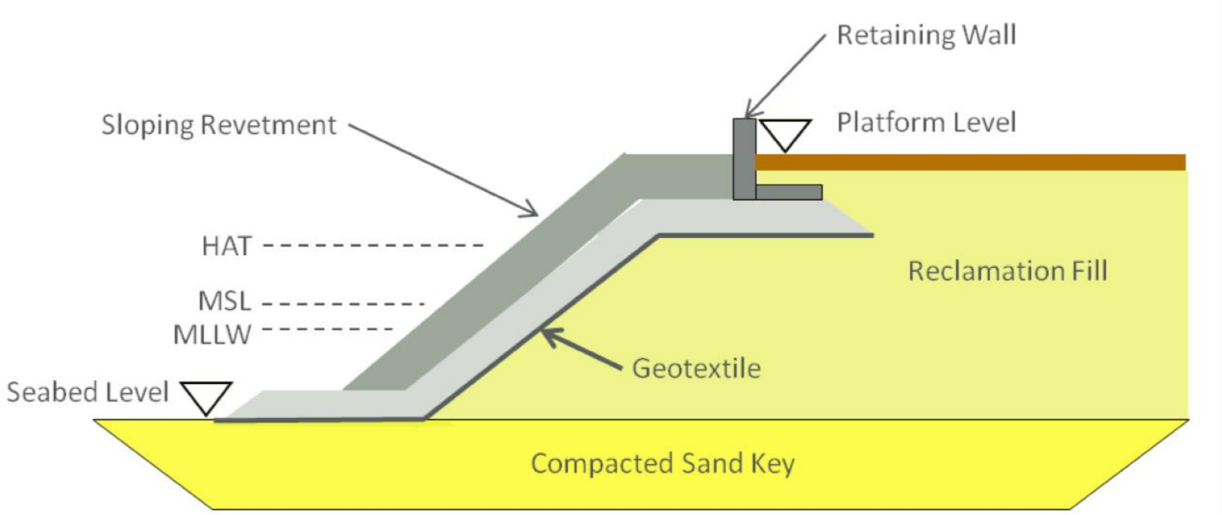


Figure 14. Typical cross section of sloping revetment

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 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 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.

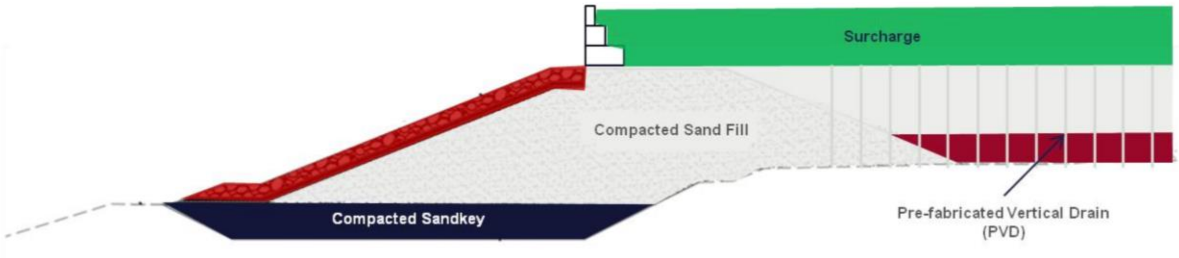


Figure 16. Typical cross section of surcharge with PVDs Installation

1.3.3 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 17**). 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.

Figure 17. Proposed borrow area of the Project

1.3.4 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.

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. 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.

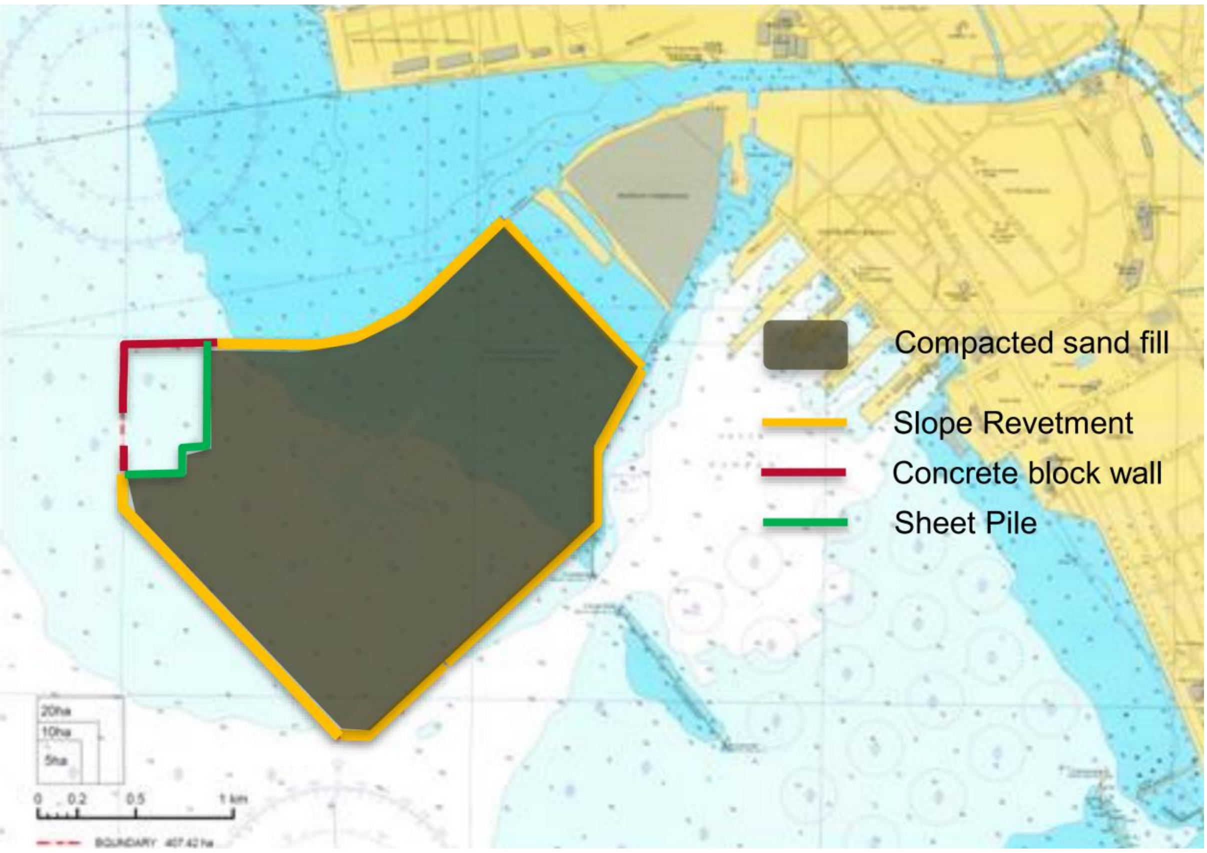


Figure 18. Proposed Reclamation Extent of the Project

1.4.1 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 2**. 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 2. 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 DREDGING AND RECLAMATION EQUIPMENT

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:

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 19. Typical TSHD (Source: IADC, 2014)

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 20**). 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 a 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.

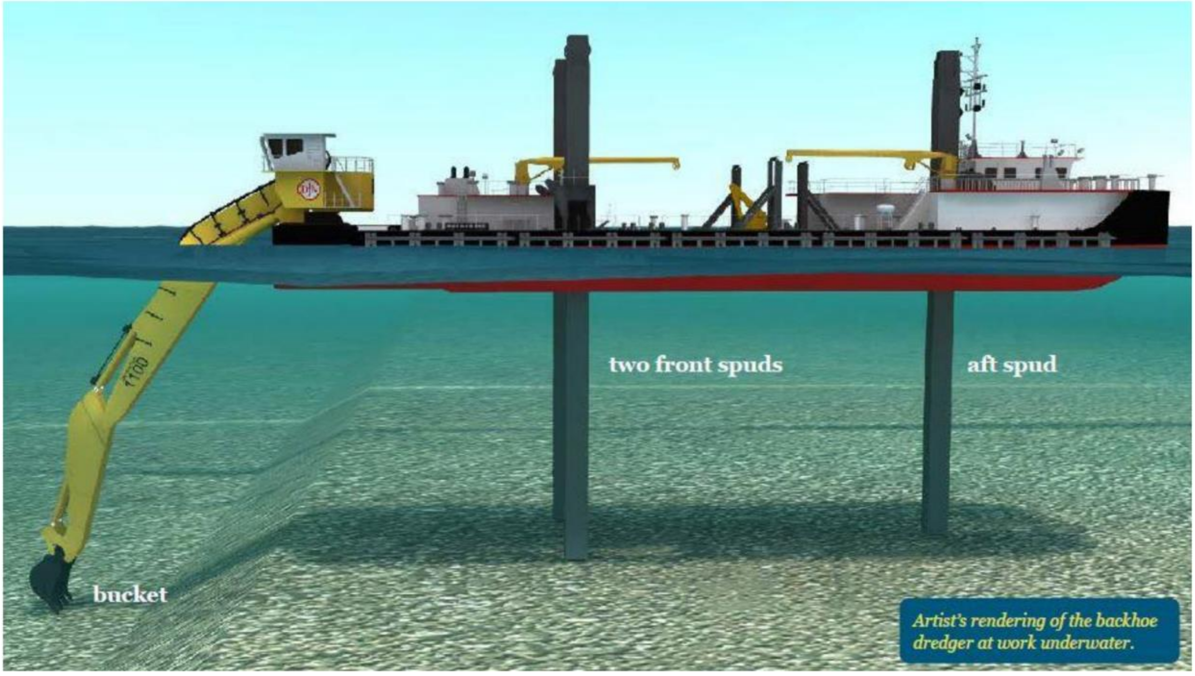


Figure 20. Typical BHD (Source: IADC, 2014)

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 21**). 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.

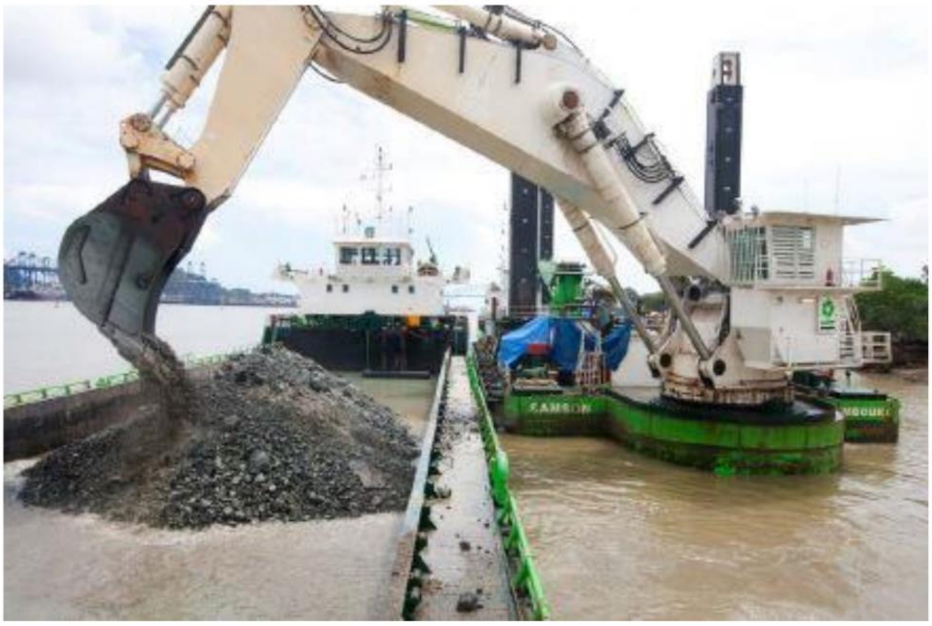


Figure 21. Illustration of loading operations using BHD and Hopper Barge (Source: IADC, 2014)

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 22** below illustrates a typical excavator unloading the materials from a hopper barge.

Figure 22. Typical excavator unloading the materials from a Hopper Barge (Source: IADC, 2014)

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 23. Typical tug boat

1.5 PROCESS/TECHNOLOGY OPTIONS

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 and these activities are elaborated in the following sections:

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.

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.

Reclamation Sequence

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 the following figure:

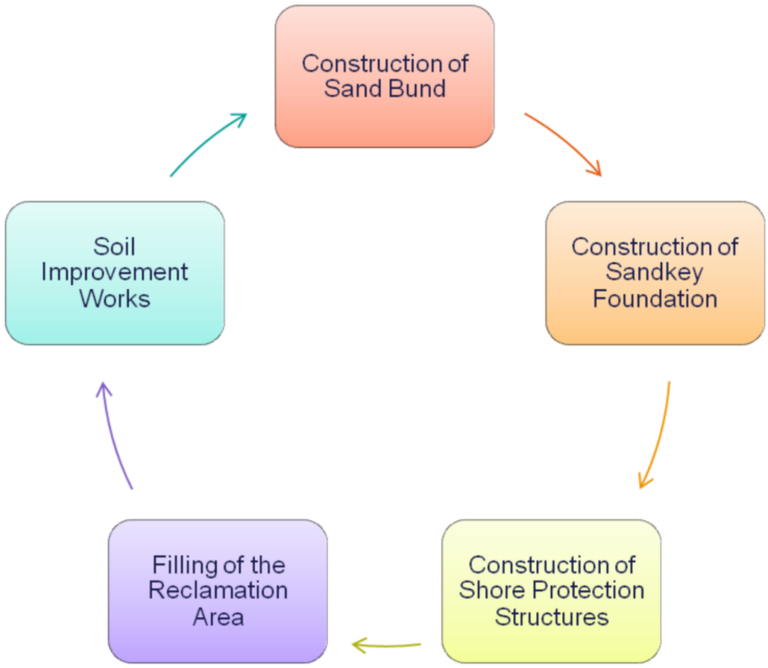


Figure 24. Reclamation cycle

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.

The reclamation schedule for the project is shown below:

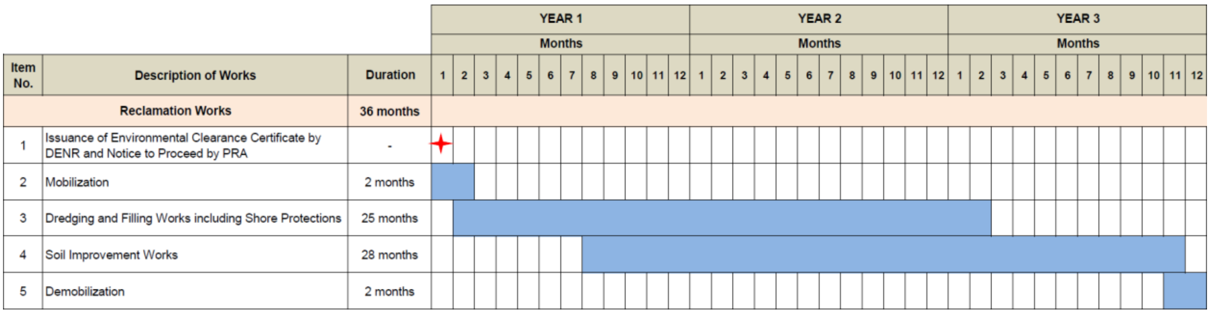


Figure 25. Reclamation Schedule

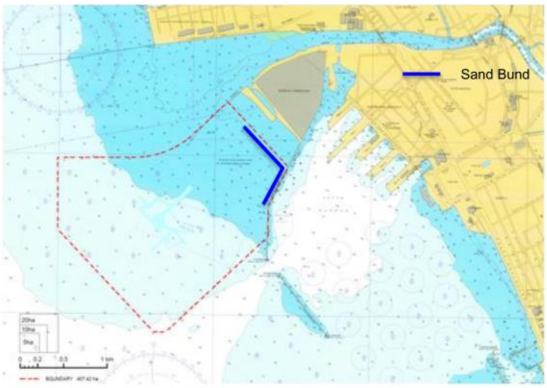
The reclamation works will be carried out in one go – a one off development, and will commence from the land side towards the sea to the extent of the reclamation profile.

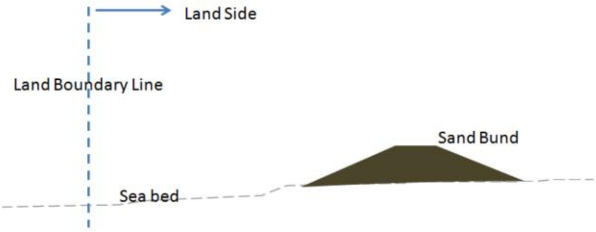
The reclamation profile has been studied and modified hydraulically such that it will not affect the existing hydraulic condition, navigation channel as well as nearby harbor operations. Overall, the entire reclamation project is proposed to be completed within a 36-month period inclusive of soil improvement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





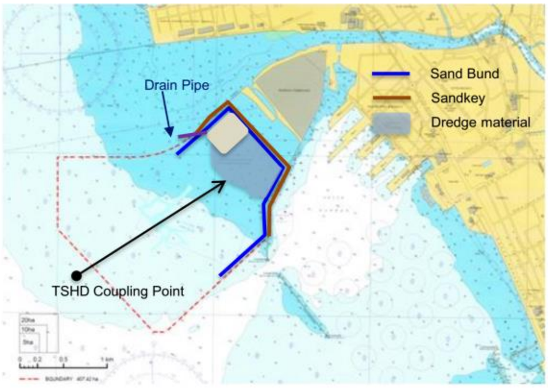
2. Continuing the Construction of Sand Bund and starting the Construction of Sand-Key.

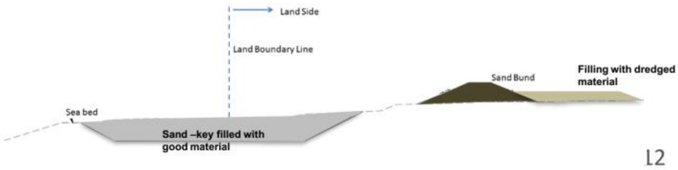
a. Dredging the existing seabed for sand-key at the boundary location using backhoe dredger.

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.

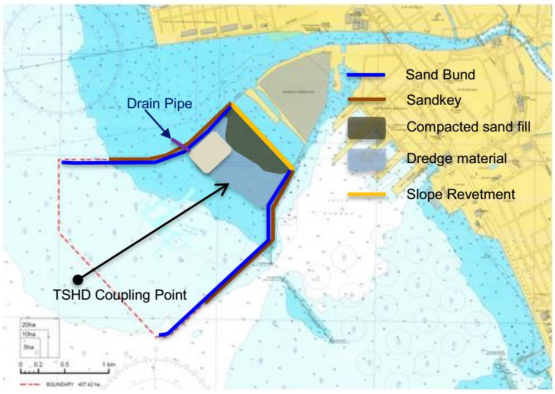
Equipment	Total	To date
TSHD	1	1
Tug Boat	4	2
Backhoe dredger	3	2
Excavator	4	1
Bulldozer	4	0
Clamshell and barge	2	0
Wheel loader	4	0
Vibratory Roller	4	0

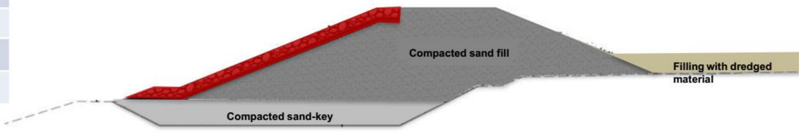




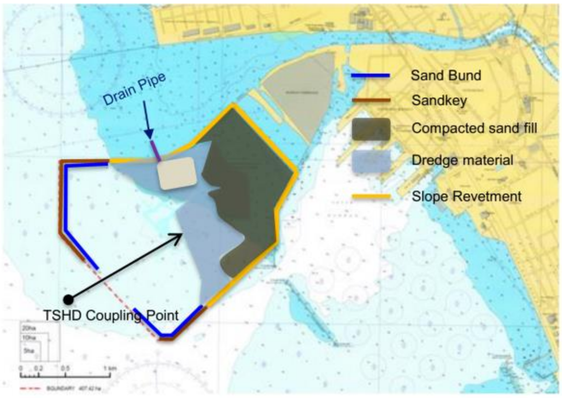
3. Continuing the sand bund and sand key construction, starting the slope revetment construction.

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

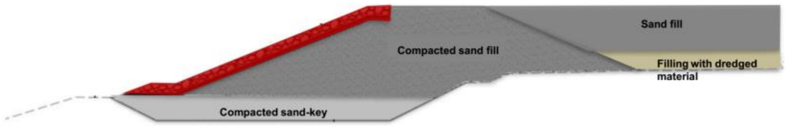




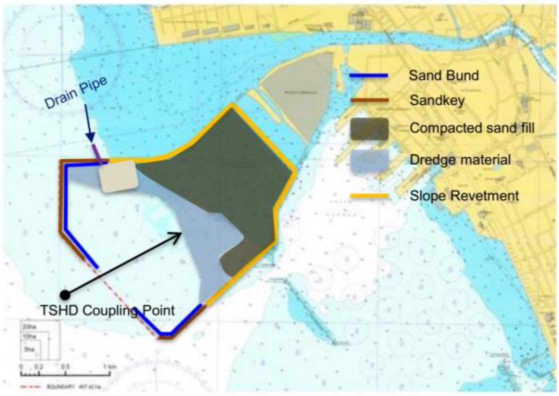
4. Start to fill the reclamation area with sand from borrow area to the reclamation level +4.40 m MLLW.



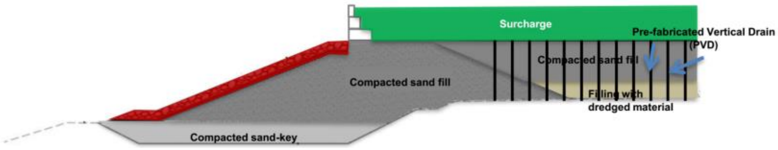
Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4



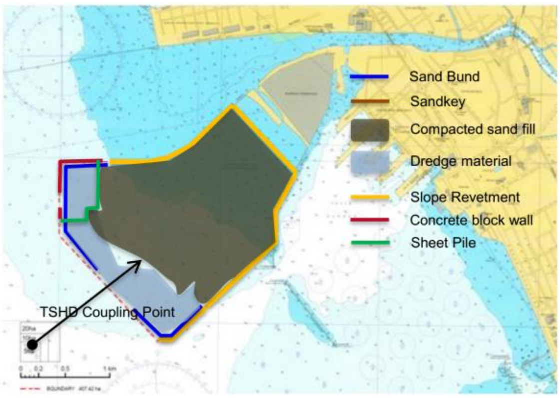
5. Continuing the previous works, starting soil improvement with PVD and Surcharge.



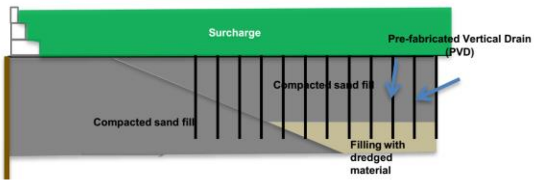
Equipment	Total	To date
TSHD	1	1
Tug Boat	4	4
Backhoe dredger	3	3
Excavator	4	4
Bulldozer	4	4
Clamshell and barge	2	2
Wheel loader	4	4
Vibratory Roller	4	4



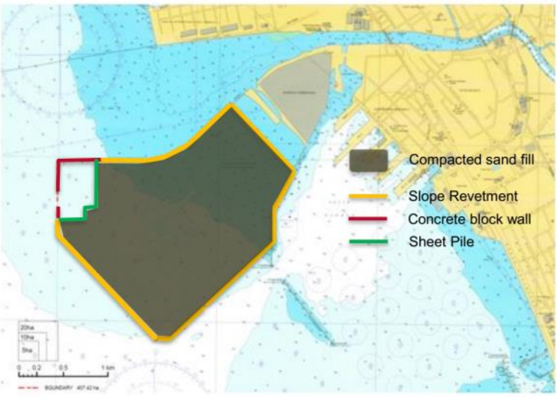
6. Continuing the previous work, starting the construction of concrete block wall and sheet pile.



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



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

1.7.3 DECOMMISSIONING AND ABANDONMENT PHASE

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

- All equipment used during the reclamation activity will be pulled out of the project area
- All existing facilities that are not useful will be removed.

1.8 MANPOWER REQUIREMENTS

1.8.1 MANPOWER REQUIREMENTS

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 3. 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 is PhP 43.7 billion. The cost is preliminary and will be subjected to revision based on the actual final reclamation planning and design.

1.10 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATING MEASURES

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 times 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 realised 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. However, a detailed assessment of the final profile and the proposed construction methodologies should be made at the EIA stage, along with seabed samples to understand the chemical composition of the in-situ material which may be disturbed during the construction. 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.