Environmental Impact Assessment of the Old Coal Wharf for the Port Royal Cruise Pier Development Project

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1. Executive Summary

1.1 Project Description

The multi-phased Port Royal Cruise Pier Development includes landside and marine works in addition to the installation of a floating cruise pier and associated buildings and infrastructure at the Old Coal Wharf, Port Royal.

The "Cruise Ship Pier" concept envisages: a terminal area, administrative building and a series of bus and tram loading structures with a gross area of approximately 39,080 ft^2 (~3,632 m^2). The estimated year of inaugural operation of the port and harbour facility is 2020.The PAJ will operate a cruise shipping pier at the Old Coal Wharf located in Port Royal. The facility is expected to see a maximum of two (2) cruise ships per week which will be docked for a maximum of 24 hours.

The pier will be visited by Royal Caribbean International Vision class vessels, including the Vision of the Seas Cruise Liner and the MS Legend of the Seas.

A sewage treatment plant will be constructed to handle wastewater generated by users of the port facility.

1.2 Methodology and Approach

The assessment of the proposed project was conducted through literature review, fieldwork and stakeholder consultation.

The literature review included plans and maps of the site and proposed development, relevant laws, regulations and international agreements. Repositories consulted included NEPA/NRCA, Jamaica National Heritage Trust (JNHT), PAJ, Port Royal Marine Lab (PRML), Water Resources Authority (WRA), TEM Network, and the University of the West Indies (UWI), the Fisheries Division and the Caribbean Maritime University.

Fieldwork

Fieldwork was conducted to determine baseline environmental conditions with emphasis on coastal/marine ecology, hydrogeology, coastal dynamics and socioeconomics. Baseline data generated during site surveys were used to describe the physical, chemical, biological and socioeconomic attributes of the study area.

The physical/chemical environment was assessed and includes land, soils, hydrogeology, coastal dynamics, meteorology, air, and noise and water quality.

Coastal surveys of the project site and its surroundings were conducted in order to characterize the plant and animal communities present within the project area. Rare, threatened, endangered, endemic, protected, invasive, and economically or nationally important species are identified. In the context of the Palisadoes/Port Royal/ Protected Area special attention was given to any sightings of crocodile, turtle or bird nests observed in or around the project area.

Demography, regional setting, and location assessment were carried out in the immediate vicinity of the project area. A review of the profile of current and potential land-use patterns (of neighbouring properties) included in addition to other assets.

A socio-economic survey/public consultation to determine public perception of the project concept (both negative and positive) has been completed. Interviews were the main methods used in consultations. Questionnaires designed to determine the socioeconomic characteristics of the study area (baseline) and perspectives of the public on the level and types of impact the proposed development would have on individuals, their local community, the region and the country were administered to the general public (households and local business operators).

An assessment of the overall project alternatives and analyses of the potential environmental and social impacts during construction and after the upgrade was done using the rapid impact assessment matrix (RIAM).

1.3 Description of the Environment

The Palisadoes-Port Royal Protected Area (P-PRPA) is approximately 7,523 hectares (75.23 km2) and consists of cays, shoals, mangrove lagoons and islands, coral reefs, seagrass beds, sand dunes, beaches and shallow water. Port Royal is of important historical and archaeological significance.

Physical/Chemical Environment

Coastal Dynamics

The study site is located along the southern coast of Kingston Harbour, just to the east of the wide and deep entrance. Surrounding mangrove islands and the associated shallow water provide wave sheltering to the project site.

Landscape Evolution and Topography

The proposed development is located at the distal end of a 14km long strip of land called the Palisadoes. Historical records suggest that Port Royal was once an island disconnected from the main land, and that over time the Port Royal island and other smaller cays were linked together by sediment buildup resulting from longshore drift. Over time it is believed that a series of spits, coupled with anthropogenic interventions, linked these islands to the mainland.

Geology and Soils

The site is situated to the distal end of the Liguanea Fan and to the west of several large river systems, namely the Hope River, Cane River, Chalky River and Yallahs River, which are over 10km east of the site along the coast. Other sources along the northern shore include several gullies notably, the Sandy Gully and the Rio Cobre. These river systems to varying degrees provide the source material of sand and gravel that describes the geology of the Palisadoes tombolo. The upper sediments at the site will comprise peat, clays, silts, fine sands and gravels typical of alluvium systems. The anticipated thickness ranges between 10 – 30m; but can be shallower in places.

At the site the upper 1m of soils comprised compacted sands and gravels to the west and compacted marl to the east (this marl likely represents the base and sub base of the asphalt pavement). There was also a consistent coal dust zone across the site as a result of the stockpiling of coal.

Hydrology

There are no rivers or streams running through or located in the vicinity of the site. All drainage at the site is natural meaning there are no designed areas to channel and concentrate runoff to a specific channel. There is no municipal drainage that passes through or close to the site. Runoff either percolates into the subsurface or discharges to the marine environment.

Potential Hazards

Recent seismicity records show that the site is located in an area that has experienced two of the most devastating earthquakes in Jamaica's recorded history:

- June 7, 1692 Maximum Modified Mercalli Intensity of X
- August 14, 1907 Magnitude of 6 to 6.5

Meteorology and Air quality

The projected fallout concentrations of criteria air pollutants from the proposed ships were predicted to be compliant with the Jamaica National Ambient Air Quality Standards (JNAAQS) as shown in **Table 1.3-1**.

Table 1.3-1. Summary of predicted fallout concentrations of air pollutants from the proposed cruise ship traffic at the Port Royal site.

				SHIP EMISSIONS	COORDINATES	
Pollutant	**AVG. TIME**	**Background Conc. (µg/m3)**	**JNAAQS**	**MAX MODEL PREDICTED CONC (µg/m3)**	**UTME**	**UTMN**
Sulphur Dioxide (SO2)	1hr		700	599.2204	300488.34	1985906.45
	24hr		365	72.57065	305181	1984489
	Annual	7.09	80	23.97603	304544.38	1984910.15
Nitrogen Dioxide (NO2)	1hr		400	102.59164	300488.34	1985906.45
	Annual	34.96	100	36.89839	304544.38	1984910.15
Particulate Matter (PM10)	24 hr	34.84	150	39.69036	300488.34	1985906.45
	Annual	34.84	50	35.91878	304544.38	1984910.15
Carbon Monoxide (CO)	1hr	0	40000	6.63806	300488.34	1985906.45
	8hr	0	10000	2.34908	300488.34	1985906.45
Volatile Organic Compounds (VOC)	1hr	0		239.87851	300488.34	1985906.45
	Annual	0		238.53633	304544.38	1984910.15

Noise

The baseline noise measurements did not exceed the standards for residential areas.

Water Quality

The results revealed that **turbidity** was low at all sites (2NTU - 5NTU) with the lowest level determined in the mangrove lagoon (W4).

Biological Oxygen Demand (BOD) was in the range 0.11mg/l to 0.72mg/l. BOD was lowest in the mangrove lagoon (WQ4) and were within the NRCA standard (1.16 mg/L).

Dissolved oxygen was in the range 2.5mg/l to 5.48mg/l at all sites. In the mangrove lagoon (WQ4) DO was 2.5mg/l at the surface and 2.6mg/l at the bottom of the water column. This level was well below the USEPA salt water standard and resulted in a significant deficit (61%).

Phosphate was below the test detection limit (<0.02mg/l) for the marine sites (WQ1 to WQ3) and .08mg/l at the site in the mangrove lagoon. The phosphate concentration exceeded the local standard of 0.003 mg/l.

Nitrate was in the range 0.6mg/l to 0.9mg/l. Nitrate was .6mg/l for all the marine sites while in the mangrove lagoon east of the development site it was .9mg/l. These levels were all in excess of the NEPA/NRCA ambient standard for marine water (0.014 mg/l).

Total petroleum Hydrocarbons was in the range .8 to .9mg/l at the sites monitored.

The following **trace metals** were detected at the parts per billion level to be within the USEPA criteria for wildlife: Arsenic, chromium, copper, lead, and zinc. Mercury and tin were undetected at <.1µg/L and <2.0µg/L respectively.

<u>Ecology</u>

Marine Ecology

The old wooden piles at the project site are encrusted with fauna typical of turbid environments, including a variety of sessile organisms such as oysters, sponges, ascidians, bryozoans, hydroids and macroalgae. Scleractinian corals and Alcyonaceans were scarce, and found mostly on hard surfaces closer to shore where the water is shallow enough (2-4m) to allow light to penetrate the turbid water column. Seven Scleractinian coral species were observed during the survey, namely *Siderastrea siderea, Siderastrea radians, Solenastrea bournoni, Porites astreoides, Manicina areolata, Occulina diffusa* and *Phyllangia americana.*

Immediately in front of the proposed SeaWalk™ anchor point, the muddy rubble zone gives way to a mixed seagrass bed ~10 m offshore, comprised primarily of *Thalassia testudinum* interspersed with *Halodule wrightii* closer to shore. Seagrass density is variable, ranging from ~60 -100 shoots/m^2 with shoot lengths ranging from10 -25cm. Associated fauna observed in the seagrass included the cushion starfish (*Oreaster sp.*), thorny sea star (*Echinaster* sp.), sea cucumbers (Holothuriidae), various bivalves, sea plumes (*Pseudopterogorgia sp.),* and urchins (*Tripneustes ventricosus*) (**Figure 1.3-1**). The piles provide habitat for sessile organisms and for juvenile fish. Due to poor visibility, fish were mostly observed around piles, sunken debris, and in seagrass areas.

Figure 1.3-1. Fauna observed on the inshore seafloor and in the seagrass area at the Old Coal Wharf.

In the vicinity of the sunken vessel along the eastern boundary of the project site, the substrate (at site M3) is a mixture of mud and coarse sand, with seagrass beds immediately south of the Red mangrove (*Rhizophora mangle)* stands on shore (**Figure 1.3-2**). The barge is overgrown with encrusting gorgonians, sponges, ascidians and macroalgae (**Figure 1.3-3**). Schools of fish were observed around the barge.

Figure 1.3-2. Mangrove stand on the eastern boundary of the project footprint.

Figure 1.3-3. The frame of the sunken barge at M3 is overgrown by various sponges, tunicates, bryozoans and macroalgae. Patchy seagrass beds can be found closer to shore, near a lush, healthy mangrove stand.

The second submerged vessel located northeast of the fishing beach, rests on a shallow muddy shoal. The wreck provides habitat for juvenile parrot fish which were observed schooling around the wooden remains. The framework of the vessel is entirely overgrown with sponges, tunicates, hydroids and macroalgae (**Figure 1.3-4**).

Figure 1.3-4. Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Sites located to the east of the project site, in the basin near the Rosey Hole included dense patches of *Thalassia testudinum (>100 shoots/m^2)* with Lytechinus *variegatus* and *Tripneustes ventricosus* densities estimated at *1-2/m^2.*

Northwest of the project site dense seagrass areas with >150 shoots/m^2 intermingled with mixed coarse sand and rubble substrate heavily overgrown with macroalgae. Solitary coral colonies (*Solenastrea*) and Alcyonaceans (sea fans and sea plumes) were observed, along with other fauna typically associated with seagrass beds (i.e., urchins and sea stars).

The seafloor near the main shipping channel (M11 – depth 4-5m) is heavily impacted by maritime traffic. The silty/sandy substrate is mostly barren except for patches of algal cover and sparse seagrass. The condition of the site represents the likely outcome for the seagrass areas that are located in or near the approach channel for cruise ships docking at the Old Coal Wharf pier.

The Port Royal marine ecosystem is dominated by the mangrove-seagrass complex which not only shapes the community assemblages but is also essential for maintaining the biodiversity of the area. Seven Scleractinian coral species were observed during the survey, namely *Siderastrea siderea*, *Siderastrea radians, Solenastrea bournoni, Porites astreoides, Manicina areolata, Occulina diffusa* and *Phyllangia americana*. None of the coral species are considered endangered according to the IUCN Red List (2004).

Terrestrial Ecology

The plant species observed throughout study area were categorized as wetland, beach/sand dune and shrub land/scrub forest.

A total of seventy seven (79) species of plants from 48 different families were identified during the study. For each species, the name, perceived dominance and its growth form was noted.

Of the 78 plant species found within the study site, only 3 endemic species (*Hylocereus triangularis, Melocactus communis* and *Oputina jamaicensis*), all of which are cacti, were encountered.

All of the above mentioned endemic plant species are classified as locally common according to Adams (1972). None of the endemic species encountered during this study are deemed as endangered, threatened or requiring any special conservation needs.

Three species of mangroves were identified during the mangroves assessment: dominant Red Mangrove (*Rhizophora mangle*), White Mangrove (*Laguncularia racemose*) and Black Mangrove (*Avicennia germinans*). Button wood, *Conocarpus erectus* (Combretaceae) was identified under the fringe of the mangrove wetland. Mangroves provide structural complexity both above and below the water’s surface.

The American crocodile (*Crocodylus acutus*), the largest reptile in Jamaica, is known to inhabit the wetlands and surroundings waters of the Palisadoes- Port Royal Protected Area. During the crocodile assessment, two adult crocodiles were observed within the Rosie Hole area of Port Royal (adjacent to Morgan's Harbour).

Of the 27 species of amphibians found in Jamaica, only 2 species were recorded in the assessment both of which are introduced.

A total of 5 species of reptiles were recorded. One species is introduced while the others are endemic to Jamaica. No snakes were encountered during assessment. A few Jamaican Galliwasp were also observed.

Insect fauna was very limited and consisted of 9 species of butterflies, 3 species of wasps, 2 bees, 3 species of ants and 4 dragonflies. The dominant species was the Pygmy Blue Butterfly, the smallest butterfly in the world; the larvae of this butterfly feed on *Batis maritima* and *Sesuvium portulacastrum*, which are common on most shore line around Jamaica. The low number of insects is not surprising as the work was done during an intense dry period and most of the herbs and shrubs had either dried up of in very poor condition. The number of species and number of individuals is likely to increase significantly during the rainy season.

While no sea turtle nests were observed on the beach during the assessment, it should be noted that the survey was not carried out during the peak nesting season for turtles. Sea turtles are known to nest on the sandy beaches in the Port Royal/ Palisadoes protected area. The National Environment and Protection Agency and the Jamaica Environmental Trust conduct sea turtle monitoring in the area.

Several crabs and their holes were observed in the mangrove wetland during the survey.

A total of thirty two (32) species of birds were observed during the field visits, most of which were breeding residents. The one Jamaican endemic bird species observed was the Jamaican mango hummingbird (*Mangeo anthrocothorax)*. Three Jamaican endemic sub-species were detected: the bananaquit (*Coereba flaveola flaveola*), Commmon Ground Dove (*Columbina* *passerine jamaicensis)* and the Loggerhead Kingbird (*Tyrannus caudifasciatus jamaicensis*). All three species are common and widespread even in urbanized habitats.

The marine habitat located next to the site had several seabirds some of which were high flying and could be seen from several counting points; extra care was exercised in order to avoid recounting the same individuals from more than one site.

The Seabirds included the Magnificent Frigatebird (*Fregata magnificens*), and the Brown Pelican (*Pelecanus occidentalis*) as well as the Royal Tern (*Thalasseus maximus*). The mangrove area supports a number of birds in Heron family, (Ardeidae) including the Snowy Egret (*Egretta thula*), the Cattle Egret (*Bubulchus ibis*), the Green Heron (*Buteroides virescens*) and the Tricholoured Heron (*Egretta tricolor)*.

No summer migrants were detected since the surveys were conducted prior to their arrival.

Endangered Species

There were no endangered bird species observed during field visits to the Palisadoes area. The West Indian Whistling Duck (*Dendrocygna arborea*) is one endangered species that is a potential visitor to the area and is known to occur in coastal wetlands across the entrance to the Kingston Harbour in wetlands along the Hellshire coast.

Night surveys were not conducted however Barn Owls (*Tytoalba*) are known to be located at the nearby Norman Manley Airport. Jamaican Owls (*Pseudoscopsgrammicus*) has also be previously observed in Port Royal and is almost certain to frequent this site as well as the open ground around the Old Wharf is a good hunting location for Owls which can more easily observe potential prey such as rats and mice in open ground than in vegetated areas. The Antillean Nighthawk (*Chordeillesgundlachii*) is a nocturnal summer migrant that was not observed during the surveys but is known to occur all over Jamaica when they return in summer to breed.

Socio-Economic and Cultural Environment

Port Royal and Harbour View are the two (2) communities found within the designated Impact Zone of the proposed Cruise Pier. The communities combine for a total population of 10,046 persons (STATIN, 2013). Harbour View is the most populous community within the impact zone, accounting for an estimated 88% of the total population (**Table 6.3-5**) . Though the national 2011 census estimates the population of Harbour View to be below 9,000, a community profile by the Social Development Commission estimates the overall population of the community to be approximately 13,400.

Port Royal's population declined by approximately 24% between the intercensal period 2001 to 2011. In 2011, the town's total population was 1,251, compared to 1,651 total recorded in 2001. Both Port Royal and Harbour View are considered as urban areas, with the latter divided into five districts.

An estimated 28.8% of participants identified with the *Skilled/trade/technical/clerical/sales* occupational category while 19.7% belong to the *Unskilled/labourer/domestic category. Another* 15.9% are in the *Unemployed/Housewife/Student* category. Four percent of participants did not respond to the question.

Public Participation

As a means of gathering information from the public on the potential impacts of the proposed project, perception surveys were administered using a questionnaire. Questionnaires were administered to a representative sample in each community within the study area/ zone of influence.

The representative sample for questionnaire administration was determined using a margin of error of 5.5%, a confidence level of 95% and a response distribution of 50%. Sample size was calculated using the total number of the population in the Port Royal and Harbour View, Kingston. With a total population of 1,997, a sample size of 308 persons was used to administer the perception survey.

Approximately 77.5% of respondents were aware of the Port Authority's plan to develop a cruise ship pier and terminal in Port Royal prior to being interviewed during the public consultation process. The most popular source of project information was community members with 40% of fishers learning about the project from that source. The second most popular source of project information is television (17.5%). Other sources of information reported was community meeting and meeting with Port Authority representatives.

Fifty nine percent (60%) of participants believe that the project is very important to Jamaica's Tourism and Cruise industries, while 35.0% believe that the project is important. With regards to its importance to Port Royal and its environs, 62.5% believe the project is very important and another 27.5% believe it is important to Port Royal and its environs.

Reasons for the importance rating were based on the perception that the project will contribute to the following:

- Economic growth and development
- Foreign exchange/ Income earnings
- Job opportunities
- Promote Jamaica and add to the country's global image as a top destination
- Boost the industry

The project was thought to be important to Port Royal and its environs because it is believed that it will contribute to the following:

- Increase visibility of Port Royal to international and local visitors
- New business opportunities
- Employment/ job opportunities
- Infrastructural development
- Increased customer base for fishers and other sectors
- Boost the local economy

Concerns expressed included:

- Worry about safety due to threat of violence
- Opportunities going to persons who do not reside in Port Royal and none or not enough local residents made available to local residents

1.4 Impact Identification Assessment and Mitigation

Impact assessment and mitigation are examined for the construction and operation phases for three options:

- No action
- Construction of a fixed pier
- Construction of a Sea Walk.

The impacts and mitigation are summarized in **Table 1.4-1**. The alternatives are scored using the Rapid Impact Assessment Matrix (RIAM). Scores are summarized in 13.11-**RIAM Detailed Matrix**.

Potential Impacts during construction will be temporary and mainly related to the influx of heavy duty vehicles to the area most of which will be diesel powered. Specific impacts include:

- Increased PM10 especially from inadequately maintained diesel engines;
- Increased PM10 from soils pilled on the roadway.

Mitigation measures include:

- Ensuring all vehicles working at the site are properly maintained to minimize emission of soot/smoke;
- Ensure all vehicles are covered effectively to prevent spillage of material to the roadways.

Noise

Impacts to noise during construction will be mainly due to heavy duty equipment entering and leaving the site and operating on the roadways. Specific impacts include:

- Indiscriminate use of Jake brake (Engine brake);
- Unnecessary revving of engines;
- Defective silencers/mufflers.

Mitigation measures:

- Erect signage onsite and on roadway restricting use of engine brake;
- Enforcing speed limit;
- Checking vehicles for roadworthiness especially with regard to effective silencer/muffler. This could be a condition for selection of trucking providers.

Geology/Soils/Landscape

Impact: The construction of the new onshore facilities will be erected on already developed lands and as such the proposed construction will not affect any "natural" topographic or geological features in the area. During the constructions phase there will be temporary changes to the landscape and upper soils. Alternations will occur during excavation and demolition of old foundations.

Mitigation: ensure coal dust layer is not remobilized or areas with organics contamination (e.g. Coal tar storage areas. Coal tar was used to waterproof ships in the past. Coal tar has a distinctive 'organic' odour and can appear as a black/brown viscous liquid). Such areas will need to be covered with hardstanding or removed and appropriately disposed of at a landfill. Zones of peat may also be within the site footprint.

Hydrology

Impact: Potential contamination of groundwater from oil, fuel and chemical spills and runoff from waste is the main impact during construction. Vehicles and machinery taking part in the construction/demolition activities are potential sources of fuel leaks and oil leaks. If construction material piles, demolition debris (excavated coal dust) and other waste are not stored, transported and disposed of properly, contaminants may be released to the aqueous environment (both groundwater, surface runoff and marine water).

Coal dust and other construction dust may also be transported into water by wind. Similarly, as the geology at the site comprises high permeability sands and gravels, liquid waste or fuels or oils may contaminate groundwater and marine water through rapid infiltration and movement to the sea.

Excavating soil contaminated with any historically material (e.g. coal tar) used for ship maintenance may also mobilize contaminants and eventually facilitate their release to the hydrologic environment.

Mitigation: Regular maintenance checks should be carried out on all vehicles/equipment to minimize the risk of leaks. All repairs should be carried out on hardstanding and away from water resources and local drainage flow paths.

All none-natural construction materials, oils, fuel and other chemicals kept on site should be appropriately stored and monitored to prevent leaks or spillage. Any excavated coal dust must be covered and kept away from any natural drainage flowpaths to avoid marine contamination via runoff.

The implementation of an agreed waste management plan as well as appropriate waste transportation, handling and disposal methods will effectively mitigate the majority of the potential adverse impacts outlined.

Impact: Pollution from in-water construction works for the SeaWalk and other terminal works is possible. Work vessels taking part in the construction works will all be possible sources of contaminant leaks and spills to the marine environment.

In addition any activity such as pile driving, deposition of rubble, the dumping of boulders/rocks, sand compaction and diffusion from in-water concrete works and the escape of fine sediments from material used in filling will also result in re-suspension of sediments with impacts similar to dredging.

Mitigation: Adverse effects of in-water construction works can in general be reduced through the selection of appropriate, globally-accepted equipment and techniques for undertaking marine/coastal pile driving works and in-water/near-water construction. Rocks, machines and other material containing fine sediments should be washed before being used/deposited into the sea to avoid the potential release of pollutants into the marine environment.

Coastal Dynamics

Impacts to coastal dynamics during the construction stage will be nil.

Water Quality

Potential Impacts to water quality during the construction phase include:

- Silt laden runoff from the site to coastal water from uncovered stockpiles
- Contamination of coastal water by sewage and grey water from facilities for construction site workers;
- Site runoff to coastal water contaminated with oily residue from heavy duty equipment.

Mitigation of impacts to water quality during construction can be achieved by the following:

- Effective bunding of stockpiles onsite;
- Effective containment of black and grey water from onsite sanitary convenience for final disposal offsite;
- Control site runoff and strategic placement of interceptor(s) to minimize or eliminate risk of oily waste reaching coastal water.

Coastal/Terrestrial

The EIA identifies likely impacts to the embayment NE of the project site as "Changes in water currents and sediment fluxes (due to construction and subsequent ship traffic) that can result in increased sedimentation rates on nearby seagrass beds and mangroves and may affect the marine flora and fauna in the area." This impact is likely during both the construction and operational phases.

The potential for the introduction of invasive species, given the proximity to and increased flushing of the adjacent embayment has also been identified.

On the terrestrial side, the increased traffic to the area from visitors leaving in buses and other vehicles may impact the air quality, and contribute to increased noise levels which may impact certain fauna (e.g., avifauna), light pollution and solid waste if not dealt with properly. Any foot tours (i.e., hiking) through the area can also negatively impact the flora and fauna (i.e., trampling).

Operation Stage

Noise

Impact to noise levels during the operational phase is expected from noise sources at the cruise terminal (delivery traffic, pier equipment) and onboard the cruise ships (engines, ventilation, HVAC, ship horn, and PA-system.

Mitigation to reduce noise could include:

- Encourage public transport rather than private cars for moving passengers would minimize volume of vehicles and thus decrease noise emission from traffic;
- If the noise emitting equipment on the pier and at the terminal area cannot be attenuated sufficiently, noise barriers can be installed – this may be necessary to protect the CMU/Admiralty House from noise exposure;
- Restrict berthing of cruise ships to daytimes, which would also restrict terminal activities to daytimes.

Air Quality

The model runs predicted the cruise ships expected to dock at the new pier will not create a significant impact on the air quality of the Kingston and St. Andrew Airshed. The predicted fallout concentrations of criteria air` pollutants from the proposed ships were predicted to be compliant with the Jamaica National Ambient Air Quality Standards (JNAAQS) as shown in Table 1-1**.**

Geology/Soils/Landscape

Impact: The development will be a major improvement to the area and the regeneration will significantly upgrade the aesthetic profile of the landscape. The buildings should complement the architecture of the wider Port Royal and be low-rise.

Mitigation: While the proposed terminal will establish itself as a local landmark, all buildings and facilities should be designed in such a way that does not conflict with the existing Port Royal architecture and landscape. Suitable construction materials, appropriate colours and the use of indigenous vegetation should be used to improve site scenery.

Once the recommendation and designs of the marine consultants are followed there should be no impact on the coastal hydraulics and as such no mitigation measures should be necessary.

Hydrology

Impact: Potential contamination of groundwater from oil, fuel and chemical spills and runoff from operational material/processes is the main impact during operation. The terminal may act as a point source of pollutant discharge to the hydrologic environment as pollutants could be introduced into the aqueous environment (groundwater and marine) from the various uses of material in the operation of the facility.

Contamination of water may occur via runoff from public parking areas from leaking buses/vehicles. Similarly, improper storage and handling of other toxic/harmful substances (anitfoulants, paints, etc.) could be another avenue for potential contamination of marine and groundwater resources from onsite uses such as dock repairs etc. Landscaping and paving with impermeable surfaces without the appropriate drainage consideration can result in increased water runoff and exacerbated impacts.

Mitigation: All materials and waste on site should be handled, transported or disposed of using best practice techniques and monitored regularly. Implementation of a waste management plan and the implementation of a sustainable urban drainage system will effectively mitigate the majority of impacts.

In addition, some general measures outlined below should be enforced:

- Provide oil/water separators on areas such as the public parking areas;
- Pave areas around storage tanks to prevent seepages into soil and groundwater;
- Provide liners under any storage for tank wash down and cleaning waters, to prevent them from entering any drainage network;
- Provide adequate space for example sumps to capture spills and leaks and clean the area regularly;
- Conduct inspections to handling and storage areas for leaks and maintain them regularly.

Ensure that any landside sewerage systems are located over the thickest soil cover above static groundwater which is located at the east of the site.

Impact: Discharges and leaks/spills from ships and other vessels can potentially impact the aquatic environment. Several international ship-source pollution regulations/standards prohibit the discharge of contaminants from ships to marine waters. Increased shipping activity will probably result in higher marine pollution levels from accidental oil and fuel leaks/spills as well as illegal discharge of pollutants such as oil, garbage, bilge water, ballast water, tank washing and sewage regardless of the regulations governing operations.

Mitigation:

- It should be ensured that the appropriate measures and contingency plans are available to contain and mitigate any major spills at the terminal.
- Authorities should monitor vessels operating in the area and carry out inspections to ensure conformity with local and IMO regulations.

Impact: Maintenance dredging may become necessary because of the natural accretion of material or because of a build-up of material over time. However, the volume of dredged material at this stage will be relatively small and therefore impacts from increased turbidity and potential sediment plumes will be more moderate.

Mitigation: Use of silt curtains

Water Quality

Possible impacts to water quality include:

- Discharge of effluent from sewage treatment plant
- Release of chemicals used in maintenance of the facility including the sewage treatment plant
- Release of oil to the environment due to shipping accidents spills
- Increased release of storm water runoff

Mitigation of water quality impacts should include:

- Tertiary treatment of sewage to include effective removal of nutrients (nitrogen and phosphorous);
- Containment and treatment onsite of hazardous chemicals where possible;
- Offsite disposal of any hazardous chemicals in keeping with NRCA/NEPA regulations;
- Effective contingency planning to minimize or prevent release of oil to the environment and to respond quickly to spill incidents large or small.

Table 1.4-1. Summary of impacts and suggested mitigation measures anticipated during construction and subsequently during the operation of the cruise ship terminal.

IMPACTS	MITIGATION
Site Preparation and Construction Phase	
Physical and Chemical Components:	
Water Quality - Marine	
The proposed project may affect increase the turbidity and TSS levels of marine water due to runoff from activates such as clearing of vegetation.	Use sediment traps and storm water run-off intervention, containment
Discharge of sewage could increase nutrient levels and decrease dissolved oxygen	Use adequate portable sanitary convenience and containment of grey water
Water Quality - Storm water	
No impact expected to dissolved oxygen	
High TSS in storm water runoff	
Insignificant impact on nutrients, pH and heavy metals	
Gaseous Emissions - Ambient	
Insignificant impact on Sox and Nox from traffic	
Possible impact to local levels of PM10 from operation of heavy duty equipment	Ensure heavy duty equipment in proper working order and suppression of dust e.g. sprinkling
No significant impact from CO or VOCs expected due to dispersion by wind	
Occupational Emissions - Port Area	
No significant impact to air quality expected due to dispersion by wind	
Dust	

Topography	
The construction of the new onshore facilities will be erected on already developed lands and as such the proposed construction will not affect any "natural" topographic features in the area. Alterations will occur during excavation and demolition of old foundations.	Following demolition, backfilling of the excavated areas will restore the site surface profile.
Geology	
The construction of the new onshore facilities will be erected on already developed lands and as such the proposed construction will not affect any geological features in the area.	
Hydrology	
Potential contamination of groundwater from oil, fuel and chemical spills and runoff from waste is the main impact during construction. Vehicles and machinery taking part in the construction/demolition activities are potential sources of fuel leaks and oil leaks. If construction material piles, demolition debris (excavated coal dust) and other waste are not stored, transported and disposed of properly, contaminants may be released to the aqueous environment (both groundwater, surface runoff and marine water) Coal dust and other construction dust may also be transported into water by wind. Similarly, as the geology at the site comprises high permeability sands and gravels, liquid waste or fuels or oils may contaminate groundwater and marine water through rapid infiltration and movement to the sea. Excavating soil contaminated with any historically material (e.g. coal tar) used for ship maintenance may also mobilize contaminants and eventually facilitate their release to the hydrologic environment.	Regular maintenance checks should be carried out on all vehicles/equipment to minimize the risk of leaks. All repairs should be carried out on hard standing and away from water resources and local drainage flow paths. All non-natural construction materials, oils, fuel and other chemicals kept on site should be appropriately stored and monitored to prevent leaks or spillage. Any excavated coal dust must be covered and kept away from any natural drainage flow paths to avoid marine contamination via runoff. The implementation of an agreed waste management plan as well as appropriate waste transportation, handling and disposal methods will effectively mitigate the majority of the potential adverse impacts outlined.
Pollution from in-water construction works for the SeaWalkTM and other terminal works is possible. Work vessels taking part in the construction works will all be possible sources of contaminant leaks and spills to the marine environment. In addition any activity such as pile driving, deposition of rubble, the dumping of boulders/rocks for, sand compaction and diffusion from in-water concrete works and the escape of fine sediments from material used in filling will also result in re-suspension of sediments with impacts similar to dredging.	Adverse effects of in-water construction works can in general be reduced through the selection of appropriate, globally-accepted equipment and techniques for undertaking marine/coastal pile driving works and in-water/near-water construction. Rocks, machines and other material containing fine sediments should be washed before being used/deposited into the sea to avoid the potential release of pollutants into the marine environment.

Soils	
During the constructions phase there will be temporary changes to the landscape and upper soils. Care will need to be taken to not disturb the coal dust layer so that it forms dust as mobilization by wind which could result in dispersal over a wide area and affect adjacent properties.	Ensure coal dust layer is not remobilized or areas with organics contamination (e.g. Coal tar storage areas. Coal tar was used to waterproof ships in the past. Coal tar has a distinctive 'organic' odour and can appear as a black/brown viscous liquid). Such areas will need to be covered with hard standing or removed and appropriately disposed of at a landfill, reducing any possibility of interaction with persons using the facilities. Zones of peat may also be within the site footprint.
Noise & Vibration	
Heavy equipment used in construction will increase the noise levels	Noise barriers can in some cases lower the noise impact of access roads.
Solid Waste Management	
Solid waste will be generated by demolition and construction activity	Dispose of waste in accordance with NSWMA
Putrescible Solid Waste will be generated by onsite kitchen and food providers	Dispose of waste in accordance with NSWMA
Metal scrap may result from the need to dispose of abandoned vessels and demolition	Engage scrap metal collectors
Hydrodynamics	
No changes to the local current patterns from ships approaching, departing and at anchor	Avoid unnecessary use of thrusters especially when at anchor
Waves and Sediments	
Resuspension of sediments and subsequent release of contaminants due to prop wash	Avoid unnecessary use of thrusters especially when at anchor; use bubble screens
Dispersion of silt and fine sediments throughout adjacent areas	Avoid unnecessary use of thrusters; use bubble screens
Changes to the wave patterns in the form of reflection from the revetment	
Natural Hazards:	
Site is susceptible hurricanes, earthquakes, tsunamis	Develop site specific emergency response plans
Climate Change (rising SST's; storm activity)	Apply adaptive management principles

Biological and Ecological Component	
Terrestrial Biota and Habitats	
It is anticipated that the project will have some/temporary impacts on the terrestrial flora and fauna during the construction phase. These include impacts from : *noise *dust *improper storage of construction materials *habitat degradation from improper solid waste disposal and on site management of sewage *habitat alteration	The project area is already disturbed however, measures can be taken to ensure nearby areas are not disturbed or otherwise impacted by construction related activities: *restricting construction to daylight hours *ensure covered trucks are used for transporting construction materials to the site *ensure proper storage of materials at the site (e.g. cover to prevent dispersal) *implement a comprehensive waste management program for all types of garbage generated at the construction site *provide onsite chemical toilets *use only native flora for landscaping. *Visible signage indicating that the area is a protected area and should be treated accordingly.
Construction Phase: Transportation of heavy machinery and building supplies/materials implies heavy traffic on the roads, and this carries possible negative impacts including dust, spillage and emissions.	Strict adherence to traffic regulations especially regarding, road worthiness, covering of loads and speed control.
Runoff during storm events (construction phase)	*Placement of bund / berms along the shore to contain runoff from the construction site during heavy rains. *Use of permeable materials (permeable pavers and asphalt) for parking areas on the landside to minimize runoff into coastal waters. *Plant mangroves along the shore to minimize runoff into coastal waters.
Marine Ecology	
Increased turbidity causing decrease in light penetration and smothering of nearshore and nearby marine resources	Minimizing dispersal of sediments to nearby habitats by placement of berms and silt curtains.
Resuspension of sediments (prop wash & bow wave)	Limit use of thrusters in favor of using tugs to maneuver during final approach to or departure from the pier
Habitat alteration/destruction (seagrass)	Seagrass relocation. Consider environmental compensation (e.g. contributing to marine debris removal efforts underway in the Kingston Harbour area or restoration of seagrass and/ or mangrove areas in other areas within the PR Marine Protected Area.
Habitat fragmentation of nearshore habitat (seagrass and mangroves). Nearshore seagrass beds will be damaged by shoreline development.	Planting mangrove seedlings in the latticework formed by the shoreline revetment structure. Seagrass beds within the project footprint could harvested and used for seagrass rehabilitation in other areas in the Harbour (e.g., areas in the vicinity of the 5ft navigation channel i) 17°56'58.06"N;

	076°50'22.59"W or ii) 17°56'52.65"N; 076°50'8.06"W
Habitat alteration (sea turtle)	Sea turtle friendly lights should be used on the buildings on the beach.
Loss of biodiversity (Scleractinian coral) threatened corals	Coral relocation
Loss of biodiversity (other reef fauna)	Silt curtains/air screens
Impacts from the installation of pilings, dolphins, etc. *Sound/vibration on marine fauna *Damage to marine habitat/fauna *Accidental spills, dropping of concrete, metal, other construction materials into marine environment	Measures should be taken to minimize impact from construction, including: *restricting construction to daylight hours *ensure covered trucks are used for transporting construction materials to the site *ensure proper storage and of materials near the marine environment *implement a comprehensive waste management program for all types of garbage generated at the construction site *implement and enforce proper handling of materials to prevent dispersion of dust, accidental spills, or other inadvertent introduction of noxious substances and materials into the marine environment.
Transportation, storage and disposal of construction material and debris	Comprehensive waste management plan for the construction phase. Use of bunds / berms to prevent dispersal of construction debris in the marine environment.
Collisions, damage from placement of anchors/spuds of the barge that holds pile driver	Restrict/limit anchor use during construction. Install moorings for securing barges used to carry heavy equipment. In case of accidents, immediate implementation of emergency management measures to minimize damage. Include habitat compensatory measures as appropriate.
Socio-Economic and Cultural Components:	
Sociological and Cultural Components	
Community Development, Infrastructure & Social Services: Increased demand for social services such as emergency services, water consumption, electricity; increased pressure on infrastructure.	Communication with local emergency services and utilities providers to accommodate increase demand and avoid disruptions to the community
Public Perception (Socio-Economic): Increased construction job opportunities; displacement of fishers who will no longer be able to use or traverse the project site.	Develop communication strategy to keep fishers informed of project activities

Public Perception (Environment): Negative impact on fisheries resources and water quality	Public education and outreach
Public Health & Safety: Potential for increased crime with increased construction activity and movement of people; increased noise and dust.	Increased security; dust suppression e.g. sprinkling; establish no jake brake policy and speed control to minimize noise; Communicate with neighbouring school regarding construction activities and put in place additional safety measures as necessary; establish noise barriers as necessary.
Heritage/Historical Sites (Other): Historic/heritage value of the site will be impacted; artifacts could be lost or damaged during site preparation/construction.	Archaeological Impact Assessment to identify, quantify and recover artifacts.
Traffic and Pedestrian	
Operation Stage	
Physical and Chemical Components:	
Water Quality - Marine	
The main effects of water transport operations on water quality may arise from ship operations such as waste, ballast waters and fuel spills.	Cruise ships should abide by MARPOL regulations. Sewage, solid waste and oily bilge water release are regulated through MARPOL. However there are no restrictions on the release of treated wastewater. MARPOL restrictions typically prescribe the allowed distance from shore and rate at which wastes can be released or requires ships to deposit them in shore-side reception facilities.
Impact on nutrients from sewage effluent	Land side sewage treatment system should be to the tertiary stage.
Water Quality - Storm water	
No impact expected to dissolved oxygen	
High TSS in storm water runoff	Intercept storm water to remove sediment and oil and grease
Gaseous Emissions - Ambient	
Ships will increase air emissions of area. Traffic will also contribute	Adherence to MARPOL regulation of sulfur content in fuel oil
Occupational Emissions - Port Area	
VOCs	
Dust	

Topography	
Geology/Soils	
The impact to geology and soils will be insignificant	
Hydrology	
Discharges and leaks/spills from ships and other vessels can potentially impact the aquatic environment.	The appropriate measures and contingency plans should be available to contain and mitigate any major spills at the terminal. In addition authorities should monitor vessels operating in the area and carry out inspections to ensure conformance with MARPOL.
The terminal may act as a point source of pollutant discharge to the hydrologic environment as pollutants could be introduced into the aqueous environment (groundwater and marine) from operation of the facility. This could include: runoff from public parking areas from leaking buses/vehicles, storage and handling of other toxic/harmful substances (anitfoulants, paints, sewage plant maintenance), discharge of treated sewage	All materials and waste on site should be handled, transported or disposed of using best practice techniques and monitored regularly. Implementation of a waste management plan and the implementation of a sustainable urban drainage system will effectively mitigate the majority of impacts. Specific actions should include: • Provide oil/water separators on areas such as the public parking areas; • Pave areas around storage tanks to prevent seepages into soil and groundwater; • Provide liners under any storage for tank wash down and cleaning waters, to prevent them from entering any drainage network; • Provide adequate space for example sumps to capture spills and leaks and clean the area regularly; • Conduct inspections to handling and storage areas for leaks and maintain them regularly; Ensure that any landside sewerage systems are located over the thickest soil cover above static groundwater which is located at the east of the site.
Noise & Vibration	
Impact from noise and vibration will be insignificant due to the nature of the operation and the sewage treatment system to be used.	
Solid Waste Management	
Solid waste: will be generated by port operation	Dispose of solid waste in accordance with NSWMA Act
Putrescible Solid Waste: Will be generated by operating of concessionaires	Dispose of solid waste in accordance with NSWMA Act
Metal Scrap: will not be generated in significant quantities during operation.	

Hydrodynamics	
Changes to the local current patterns from ships at anchor: This will not be significant	
Waves and Sediments	
Effects of prop wash (resuspension of sediments): Can be significant	Avoid use of thrusters; use tugs to maneuver during final approach to or departure from the pier
Distribution of silt and fine sediments to adjacent areas: Can be significant	Avoid use of thrusters; use tugs to maneuver during final approach to or departure from the pier
Natural Hazards:	
Hurricanes, Earthquakes, Tsunamis: The area is prone to natural hazards	Develop emergence response plans in accordance with Disaster Preparedness & Emergency Management Act/ODPEM
Climate Change (rising SST's; storm activity)	Apply adaptive management principles
Biological and Ecological Component	
Terrestrial	
Impacts on biota & habitats	Maintenance of onsite landscaping to include only native species.
Terrestrial (Avifauna)	Maintenance of onsite landscaping to include only native species that attract avifauna.
Impacts of increased tourist traffic (solid waste, trampling, noise pollution).	Minimize use of single use plastics and help promote the marine clean-up initiatives underway (UWI/PRML). Ensure adequate waste disposal bins are readily available.
Lack of enforcement of environmental rules and regulations	Enforcement of cruise ship compliance with Jamaica and MARPOL regulations

Marine Ecology	
Increased exposure to repeated propeller wash and bow waves, will result in chronic increase in turbidity, and resuspension of sediments which may contribute to shoreline erosion and ongoing degradation of nearby habitats.	Limit ship speed by using tugs to maneuver during approach to or departure. Compensating for habitat destruction through habitat restoration in the vicinity of the of the cruise ship pier and facilities
Loss of habitat-from collision, anchor damage	Restrict anchor usage. In case of accidents, apply adaptive management principles to include habitat compensatory measures.
Continued habitat degradation	Long term monitoring plan for ecosystems within 1k radius. Work with NEPA, UWI-PRML to implement adaptive management strategies aimed at minimizing habitat degradation, including plans for removing marine debris (floating garbage) in the mangrove areas surrounding the site.
Ballast water and invasive species	Enforcement of cruise ship compliance with Jamaica and MARPOL regulations
Contaminated bilge water and accidental pollution events	Enforcement of cruise ship compliance with Jamaica and MARPOL regulations
Potential for vessel grounding during ship berthing	Use of 2 tug boats for all docking/departure maneuvers. Restrict access to port during high wind conditions (25 knot maximum). Regular update of inshore bathymetry to detect possible changes resulting from continued sediment (gully) inputs to harbour. Ensure proper navigational buoyage is installed.
Socio-Economic and Cultural Components:	
Sociological and Cultural Components	
Community Development, Infrastructure & Social Services: Increased demand for social services such as emergency services, water consumption, electricity; increased pressure on infrastructure.	Communication with local emergency services and utilities providers to accommodate increase demand and avoid disruptions to the community.
Public Perception (Socio-Economic): Increased job opportunities; displacement of fishers who will no longer be able to use or traverse the project site.	Develop strategy with fishers and Fisheries Division
Public Perception (Environment): Negative impact on fisheries resources and water quality	Public education and outreach
Public Health & Safety: Potential for increased crime with increased movement of people.	Increased security; Additional police post or strengthen existing arrangements.
Heritage/Historical Sites (Other): Historic/heritage value of the site could be impacted due to increased visitors.	Establish carrying capacities for various attractions

Traffic and Pedestrian	
Increased pedestrian and vehicular traffic to transport cruise passengers	Improved road signage and increased security presence
Cruise Shipping	
Decline of Cruise Market Patronage at Other Sites	
Economic and Operational components	
Macro-economic (Cruise Tourism): Increased income from cruise shipping, use of ports	
Macro-economic (Employment and Income): Increased employment opportunities in service sector (transportation, tours/entertainment)	
Micro-economic (Business District): Increased economic activity in Port Royal	
LVIA (Land Use): Land presently not being used for any productive purpose.	
LVIA (Visual Aesthetics): Site aesthetics will be improved	

2 Introduction

The Port Authority of Jamaica (PAJ) intends to develop a cruise ship terminal and floating pier on the Old Coal Wharf (OCW) property, Port Royal, Jamaica.

2.1 Need for the Project

This project is deemed to be in line with the Vision 2030 Jamaica – National Development Plan Goal #1 - "Jamaicans are Empowered to Achieve their Fullest Potential" and with the National Outcome #12 – development of "Internationally Competitive Industry Structures" (PIOJ 2009). That tourism continues to be the biggest driver for economic growth in Jamaica is evident with the industry contributing consistently about 10% of GDP and accounting for over 50% of foreign exchange earnings ahead of remittances. The Ministry of Tourism's Five-Year Strategic Vision for Tourism Development recognizes that diversification of the country's tourism product is essential to …..Significantly expanding the country's share of the global tourism market" (MOT 2018).[1]

To this end, development of a cruise port facility at Port Royal would likely result in one of the most attractive cruise ports in the Caribbean. The potential of Port Royal as an appealing

[1]https://www.mot.gov.jm/speeches/ministry-tourism%E2%80%99s-five-year-strategic-vision-tourism-development-jamaica
Planning Institute of Jamaica A Vision 2030 Jamaica - National Development Plan © 2009.https://knoema.com/atlas/Jamaica/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP
World Data Atlas Jamaica Topics Tourism Travel & Tourism Total Contribution to GDP

cruise destination is undeniable given its setting at the entrance to Kingston Harbour with scenic views of Kingston's waterfront and the Blue Mountains in the background. The history of Port Royal has international and domestic appeal which up to now represents a largely untapped resource in the development of the Jamaican Tourism Product.

2.2 Context

The Palisadoes, Port Royal area is an important economic, ecological and historical site that was designated as a Protected Area on September 18, 1998 and a Ramsar Site on April 22nd 2005. The site is classified as a *Wetland of International Importance* under the Ramsar Convention[2] and is designated as a *Protected National Heritage Site* under the Jamaica National Heritage Trust Act. These sites are also recommended for designation as a World Heritage Sites under the United Nations Educational, Scientific and Cultural Organization's World Heritage Convention.

The Palisadoes-Port Royal Protected Area (P-PRPA) **(Figure 2.2-1**) encompasses approximately 7,523 hectares (75.23 km2), and includes cays, shoals, mangrove lagoons and islands, coral reefs, seagrass beds, sand dunes, beaches and shallow water. Port Royal is of important historical and archaeological significance; some 200 years ago the site was England's biggest naval base in the Caribbean.[3]The history of Port Royal can be traced to the Spanish, pirate and buccaneer occupations and finally to British colonisation.

It is recognized that any proposal for the development and operation of the Cruise Ship Pier within the Protected Area would only be acceptable if the delicate ecology and rich archaeological features of the area are fully safeguarded.

The proposed project lies just outside the conservation Zone B (**Figure 2.3-3**).

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[2]https://www.global-wetland-outlook.ramsar.org/

[3] Port Royal http://www.jnht.com/site_port_royal.php

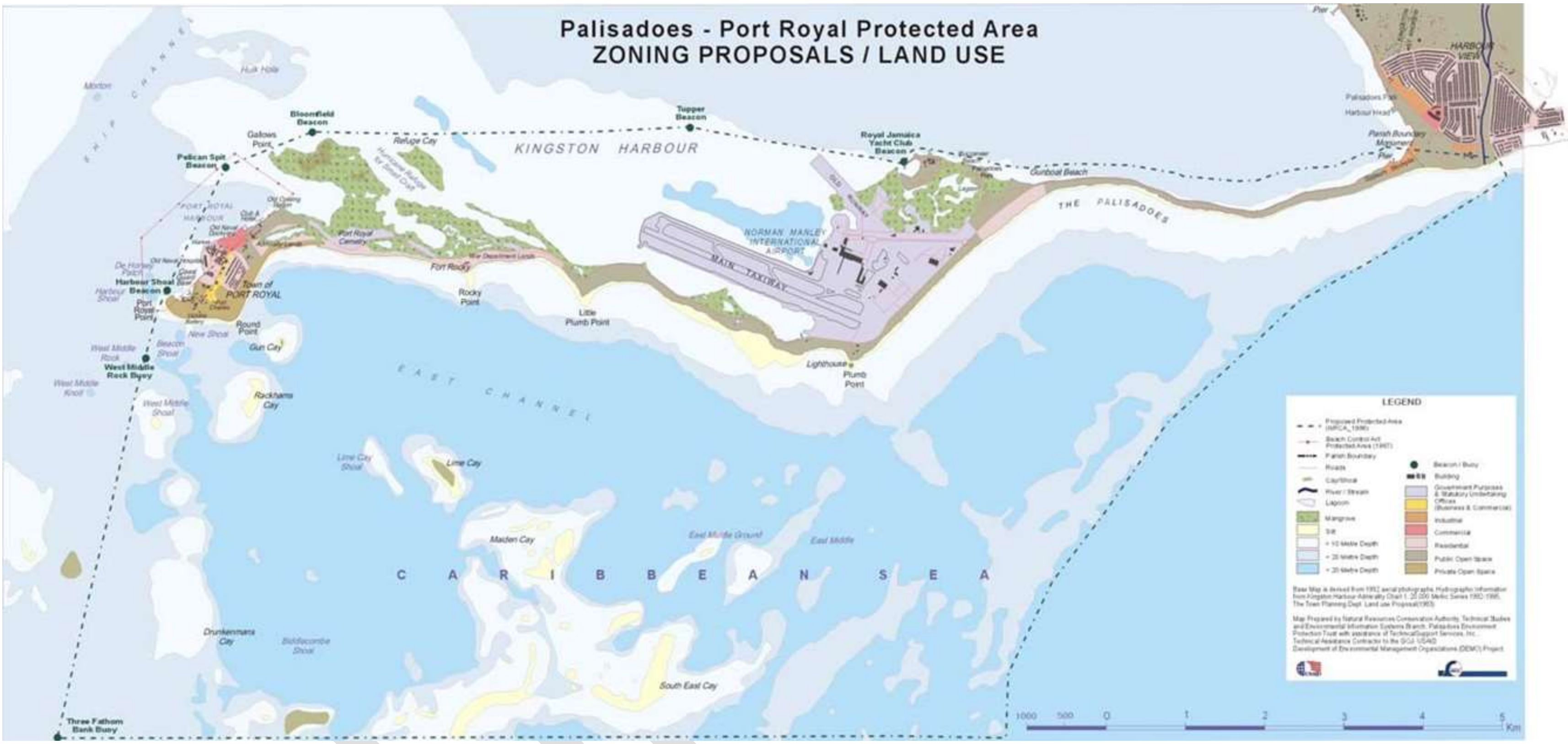


Figure 2.2-1. Palisadoes-Port Royal Protected Area.

2.3 Delineation and Justification of Boundary of the Study Area

Port Royal is located in the Kingston and St. Andrew municipality on the south coast of the island at approximately 17.936652° N and -76.841061° W as shown in **Figure 2.3-1.**

Figure 2.3-1. Map of Jamaica depicting the location of Port Royal.

The proposed development is in the vicinity of the Old Coal Wharf Property. The project study area is encompasses a 1 km radius of the development site as shown in **Figure 2.3-2.**

Figure 2.3-2. The Port Royal Cruise Pier EIA Study Area (1km radius).

The boundary (1km radius) of the study area was considered to be sufficient for characterizing the biophysical attributes and the socioeconomic climate of the area, and for identifying, predicting, evaluating and mitigating the effects that the proposed development may have both on the physical environment and the community of Port Royal. The study was conducted by a multidisciplinary team of environmental professionals with expertise in marine and terrestrial ecology, hydrogeology, coastal dynamics, environmental chemistry and socioeconomics.

Given the nature of the study and the limited time to carry out the surveys, it was necessary to adopt the rapid assessment approach for depicting the biophysical and socioeconomic aspects of the impact zone at a given point in time. This approach, however, did not allow for temporal assessments of changes in resources/environment resulting from weather or seasonal patterns. The data collected and analyzed during the study, in conjunction with historical data, provide the basis for informing the decision making process.

Figure 2.3-3. Palisadoes-Port Royal Protected Area – Conservation Zone B. Source: Protected Areas Branch, 2013.

2.4 Project Overview

The Port Authority of Jamaica (PAJ) proposes to develop a Floating Cruise Ship Pier (Sea Walk^{TM}) and Terminal at the Old Coal Wharf site in Port Royal. The proposed development site is situated immediately outside of the Port Royal World Heritage property delineation but falls within the proposed buffer zone. The proposed development site comprises approximately 9 acres and is sited at the extreme eastern end of the Port Royal township.

The project is regarded as a potential catalyst for the "preservation and restoration of historic and archaeological assets, while fostering improvement in the quality of life for the Port Royal community". (JNHT 2019).

Its importance as a potential major earner of tourism dollars is underscored by the UNESCO ranking as one of the most important archaeological sites in the Caribbean and a unique site worldwide.

This study was carried out according to the Terms of Reference approved by NEPA (Terms Of Reference).

3 Legislation and Regulatory Consideration

There are 12 Laws and regulations, 6 Policy Initiatives and 9 International Conventions that are relevant to this project (**Table 2.4-1**).

The Natural Resources Conservation Authority (NRCA) Act is the main legislation providing the regulatory framework for activities affecting the environment. This Act creates the NRCA, which is the executing agency with responsibility for environmental permitting and licencing. The NRCA Act is executed by the National Environment and Planning Agency (NEPA). Instruments of particular relevance to this project that fall under the NRCA/NEPA framework include: The Beach Control Act, Wastewater and Sludge Regulations, Air Quality Regulations and the Permits and Licences Regulations.

Other Legal instruments include the Town and Country Planning Act, Provisional Development Order for Kingston and St. Andrew, National Solid Waste Management Act, the Port Authority Act and the Parish Councils Building Act. Policy Initiatives of particular relevance include the Protected Areas System Master Plan, Policy on Sea Grass Beds and the Wetlands Policy.

The International Treaties and Conventions to which Jamaica is a signatory include:

- Cartagena Convention for The Protection and Development of The Marine Environment of the Wider Caribbean Region
- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
- Protocol on Land Based Sources (LBS) of Marine Pollution of the Wider Caribbean Region
- Protocol on Specially Protected Areas and Wildlife (SPAWS)

- RAMSAR Convention on the Protection of Wetlands of International Importance and Water Fowl
- Convention on Biological Diversity
- Oil Spill Protocol
- International Convention for the Prevention of Pollution from Ships (MARPOL)

Table 2.4-1. Laws/Regulations, Policy Initiatives and International Environmental Conventions applicable to the project.

National Laws/Regulations			
Instrument	**Ministry/ Agency**	**Scope**	**Relevance to Project**
Beach Control Act, 1956 (amended 2004)	NEPA	The Act deals with issues such as access to the shoreline, and rights to fishing and public recreation and any future development of the land adjoining the foreshore. Framework for licencing of coastal works and encroachment on the floor of the sea.	The Port and Harbour facility will need to be apply for a beach licence.
Endangered Species (Conservation and Regulation of Trade) Act, 2000	NEPA	Deals with the protection, conservation, management and regulation of trade and related matters for endangered wild fauna and flora species	The location is a Port of entry for tourists
Fishing Industry Act	MOAF	Legal framework for the sustainable management of Fisheries resources (species and habitat)	Some habitat loss is expected from this project
Harbours Act	PAJ	Legal framework for regulation of marine traffic, provision of port facilities and ensuring safety within ship channels and harbour	Execution of the project is within the mandate of the PAJ
Jamaica National Heritage Trust Act	JNHT	The Act establishes the Jamaica National Heritage Trust which has responsibility inter alia for promotion and reservation of national monuments and anything designated as protected national heritage	Port Royal is of particular importance to the JNHT because of its heritage value with regard to buildings, monuments artifacts and historical significance
Local Improvements Act.	KSAC	Developer to deposit with KSAC plans, sections and estimates required by regulations made by the Council.	Construction for pier development

Maritime Areas Act		Declares the sovereignty of Jamaica as an Archipelagic state	Provides the legal framework for prosecution for offences committed in Jamaican waters e.g. discharge of pollutants
National Solid Waste Management Act, 2001	National Solid Waste Management Authority	Regulation and management of solid waste in order to safeguard public health. The Act provides the legal and institutional framework for ensuring that solid waste materials are collected, stored, transported, recycled, reused or disposed of, in an environmentally sound manner and enhancing public awareness in relation to such waste	Construction and Operation Phases will produce solid waste
Natural Resources Conservation Authority Act, 1991	NEPA	Granting of Environmental Permits in the areas of enterprise, construction or development. Under this legislation NEPA has the authority to request an Environmental Impact Assessment (EIA). The Act also provides framework for effective management of the physical environment, marine parks, national parks and protected areas (NEPA). Formulates standards and codes for the improvement of the quality of the environment.	An EIA is being completed for this project in addition there location is in proximity to the Port Royal Protected Area
Natural Resources Conservation Authority Act (Ambient Air Quality Standards) Regulations	NEPA	Sets ambient standards for specific air pollutants	Pollutants regulated can be emitted by shipping e.g. SOx, NOx and PM10
Natural Resources Conservation (Palisadoes-Port Royal Protected Area) Order, 1998.	NEPA/NRCA	Declares and provides geographic delineation of the P-RPPA as including the Palisadoes spit inclusive of Port Royal and the Port Royal Cays.	The proposed location of the development is within the boundaries of the P-RPPA.

Natural Resources Conservation Authority Act Wastewater and Sludge Regulations	NEPA	Legal framework for the permitting and licencing of wastewater treatment plants and discharge of effluent	The development will include a sewage treatment plant and discharge of treated waste
Parish Councils' Building Act	KSAMC	Regulates the carrying out of construction within KSA	Applications for construction must be made to the KSAMC
Port Authority Act	PAJ	Empowers the PAJ to provide and operate port facilities and recommend measures to maintain or improve port facilities	This project is within the mandate of the PAJ
Public Health Act (Public Health Food Handling Regulation, 1998	MOH/EHU	Outlines requirements of the environment of the food establishment. Provisions for food of this Act include the rules for preparation, packaging, preservation, transportation and storage of food for consumption.	Licence to operate food handling establishment (Phase 1B - restaurant)
Town and Country Planning (Kingston and Saint Andrew and the Pedro Cays) Provisional Development Order	Town & Country Planning Authority/NEPA	Guides development in the Kingston and Saint Andrew and the Pedro Cays, allowing the regulation of land developments within the Development Order Area.	The TCPA formulates and coordinates strategic plans for area development in the form of Development Orders consistent with the Town and Country Planning Act (1975). This act is now administered by NEPA, and the NRCA board functions as the Town and Country Planning Authority.
Town and Country Planning Act, 1957 (amended 1987)	NEPA/Local Planning Authority and/or the Town and Country Planning Authority	Outlines permission granted for development	Concerned with the application to develop land. This is only applicable where a Development Order exists.
Wildlife Protection Act	NRCA/NEPA	Provides the Legal framework for the identification and preservation of protected species	This project is located within a known habitat of the crocodile which is a protected species under the WPA. Marine turtles are also possible

			occupants.

Policy Initiatives			
Instrument	**Ministry/ Agency**	**Regulation Scope**	**Relevance to Project**
National Strategy and Action Plan on Biological Diversity in Jamaica 2016-2021	Ministry of Economic Growth and Job Creation	Involves comprehensive biodiversity strategies and plans to contribute to conservation of Jamaica's habitats (protected areas), ecosystems, species and genetic resources. This includes the integration of economic, social and environmental objectives, polices, strategies, plans and programmes to effectively utilise human and financial resources increase positive impacts. Conservation aligned to CBD.	The Project site is located within the Port Royal Protected Area (PRPA) boundary
Policy on Sea Grass	NEPA	Framework for promoting conservation of seagrasses in order to sustain their important ecological role	Seagrasses are found in the footprint of the project
Protected Areas System Master Plan (PASMP)	Protected Areas Committee (PAC)	The PASMP sets out guidelines for establishing and managing a comprehensive system of protected areas that supports national development by contributing to long-term ecological viability; maintaining ecological processes and systems; and protecting the country's natural and cultural heritage	According to map, *Legally Declared Protected Areas in Jamaica, 2009 (*National Ecological Gap Assessment Report NEGAR) the project area is a part of the Palisadoes Port Royal Protected Area
Revised draft zoning plan for the Palisadoes-Port Royal protected area 2014-2019	NEPA	The zoning plan defines the "limits of acceptable use" and the types of developments and activities that can and/or cannot occur in each zone. It rationalizes and regulates the use of the protected area and its resources, defining where activities can be undertaken and how to achieve the area's management objectives.	The proposed project lies within the section of the Protected area identified as Multiple Use and is just outside the north east border of Conservation Zone B.

The Wetlands Policy Natural Resources Conservation Authority (Draft)	NEPA	Framework for management of coastal wetlands to ensure that the many benefits they provide are sustained	The proposed project is located in close proximity to mangrove wetlands
UDC Downtown Kingston and Port Royal Redevelopment Plan 2010-2030	UDC	Presents plans for upgrading of infrastructure public amenities and housing in Port Royal.	UDC plans identify the proposed development site as warehouse/storage
International Environmental Considerations			
Instrument	**Ministry/ Agency**	**Regulation Scope**	**Relevance to Project**
Convention Concerning the World Cultural and Natural Heritage (World Heritage Convention)	UNESCO/JNHT	The Convention sets out the duties of participating states in identifying potential sites and pledging their commitment to not only conserve the World Heritage sites situated on its territory, but also to protect its national heritage.	Port Royal is a candidate World Heritage Site
Convention for the Control and Management of Ships' ballast water and Sediments	NEPA	Parties agree to prevent minimise and eliminate the transfer of harmful aquatic organisms and pathogens from one region to an9other through the control and management of ships' ballast water and sediment using certain standards and procedures	Cruise ships are a potential source of ballast water

Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention)	NEPA	Signatories agree to reduce and control pollution of the Convention area and to ensure sound environmental management, using the best practicable means at their disposal and in accordance with their capabilities.	Operation of a sewage plant carries the risk of pollution of the Convention area; operation of shipping carries the risk of air pollution, oil spills.
Convention on Biological Diversity	NEPA	The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components	Signatory required to introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures;
Convention on International Trade in Endangered Species (CITES) of Wild Flora and Fauna	NEPA	Regulate trade in endangered species	Visitors may wish to take plant or animal species and would need a permit from the management authority
Convention on the Prevention of Mariner Pollution by Dumping of Waste and Other Matter (London Convention)	IMO	Contracting parties agree to take eff3ective measures to prevent pollution of the mariner environment caused by dumping at sea	Cruise ships are a potential source of pollutants
International Convention for the Prevention of Pollution from Ships (MARPOL)	NRCA/CG	The main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.	The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations

Protocol on Land Based Sources (LBS) of Marine Pollution of the Wider Caribbean Region	UNEP/NEPA	Concerned with national, sub-regional and regional action through a national political commitment at the highest level, and international cooperation to deal (prevent, control) with the problems posed by pollutants entering the Convention area from land-based sources and activities.	Mentions use of EIA to reduce harmful effects of land based activities. Location of development in proximity to coast and operation of sewage plant and effluent
Protocol on Specially Protected Areas and Wildlife (SPAW Protocol)	UNEP/ The Caribbean Environment Programme	Administers measures to protect, preserve and manage in a sustainable way, areas that require protection to safeguard their special value, and threatened or endangered species of flora and fauna.	The project area is within the Palisadoes Port Royal Protected Area
Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat	NEPA	Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance. The Contracting Parties shall formulate and implement plans to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.	Palisadoes - Port Royal Protected area is a Ramsar Site (Ramsar site No. 1454. Most recent RIS information: 2005) that is home to endangered and protected species. The site contains cays, shoals, mangrove lagoons, mangrove islands, coral reefs, seagrass beds and shallow water, thus hosting a variety of underrepresented wetland types.
The Oil Spill Protocol	ODPEM	Strengthen national and regional preparedness and response capacity of the nations and territories of the region; Facilitate co-operation and mutual assistance in cases of emergency to prevent and control major oil spill incidents	With the introduction of cruise shipping preparedness and response capacity regarding oil spills is relevant
World Heritage Convention	JNHT	Forms links concepts of nature conservation and the preservation of cultural properties in a single document, recognising the way in which people interact with nature, and the fundamental need to preserve the balance between the two.	Only site in Jamaica is Blue and John Crow Mountains

National Solid Waste Management Act, 2001	National Solid Waste Management Authority	Regulation and management of solid waste in order to safeguard public health. The Act provides the legal and institutional framework for ensuring that solid waste materials are collected, stored, transported, recycled, reused or disposed of, in an environmentally sound manner and enhancing public awareness in relation to such waste	Construction and Operation Phases will produce solid waste
Natural Resources Conservation Authority Act (Ambient Air Quality Standards) Regulations	NEPA	Sets ambient standards for specific air pollutants	Pollutants regulated can be emitted by shipping e.g. SOx, NOx and PM10
Natural Resources Conservation Authority Act Wastewater and Sludge Regulations	NEPA	Legal framework for the permitting and licensing of wastewater treatment plants and discharge of effluent	The development will include a sewage treatment plant and discharge of treated waste
Natural Resources Conservation Authority Act, 1991	NEPA	Granting of Environmental Permits in the areas of enterprise, construction or development. Under this legislation NEPA has the authority to request an Environmental Impact Assessment (EIA). The Act also provides framework for effective management of the physical environment, marine parks, national parks and protected areas (NEPA). Formulates standards and codes for the improvement of the quality of the environment	An EIA is being completed for this project in addition there location is in proximity to the Port Royal Protected Area
Parish Councils' Building Act	KSAC	Regulates the carrying out of construction within KSA	Applications for construction must be made to the KSAC

Port Authority Act	PAJ	Empowers the PAJ to provide and operate port facilities and recommend measures to maintain or improve port facilities	This project is within the mandate of the PAJ
Port Royal Brotherhood Act	Port Royal Brotherhood	Creates the Brotherhood of Port Royal, a body corporate vested with authority over designated lands to undertake an encourage the construction and development of Port Royal in the aftermath of the 1951 hurricane	The Port Royal Brotherhood represents a significant owner of land in Port Royal
Public Health Act (Public Health Food Handling Regulation, 1998	MOH/EHU	Outlines requirements of the environment of the food establishment. Provisions for food of this Act include the rules for preparation, packaging, preservation, transportation and storage of food for consumption	License to operate food handling establishment (Phase 1B - restaurant)
Town and Country Planning (Kingston and Saint Andrew and the Pedro Cays) Provisional Development Order	Town & Country Planning Authority/NEPA	Guides development in the Kingston and Saint Andrew and the Pedro Cays, allowing the regulation of land developments within the Development Order Area	The TCPA formulates and coordinates strategic plans for area development in the form of Development Orders consistent with the Town and Country Planning Act (1975). This act is now administered by NEPA, and the NRCA board functions as the Town and Country Planning Authority

Policy Initiatives			
Instrument	**Ministry/ Agency**	**Scope**	**Relevance to Project**
National Strategy and Action Plan on Biological Diversity in Jamaica 2016-2021	Ministry of Economic Growth and Job Creation	Involves comprehensive biodiversity strategies and plans to contribute to conservation of Jamaica's habitats (protected areas), ecosystems, species and genetic resources	The Project site is located within the Port Royal Protected Area (PRPA) boundary
Policy on Sea Grass Beds	NEPA	Framework for promoting conservation of seagrasses in order to sustain the important ecological role	Seagrasses are found in the footprint of the project
Port Royal Brotherhood Act	Ministry of Housing		
Protected Areas System Master Plan (PASMP)	Protected Areas Committee (PAC)	The PASMP sets out guidelines for establishing and managing a comprehensive system of protected areas that supports national development by contributing to long-term ecological viability; maintaining ecological processes and systems; and protecting the country's natural and cultural heritage	The proposed project area is within the Palisadoes Port Royal Protected Area
The Wetlands Policy Natural Resources Conservation Authority (Draft)	NEPA	Framework for management of coastal wetlands to ensure that the many benefits they provide are sustained	The proposed project is located in close proximity to mangrove wetlands

Town and Country Planning Act, 1957 (amended 1987)	NEPA/Local Planning Authority and/or the Town and Country Planning Authority	Outlines permission granted for development	Concerned with the application to develop land. This is only applicable where a Development Order exists
International Environmental Considerations			
Instrument	**Ministry/ Agency**	**Scope**	**Relevance to Project**
Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)	IMO/NEPA	Parties prevent, minimize and eliminate the transfer of harmful aquatic organisms and pathogens from one region to another through the control and management of ships' ballast water and sediments using certain standards and procedures.	The port will be receiving cruise ships
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention)	NEPA	Signatories agree to reduce and control pollution of the Convention area and to ensure sound environmental management, using the best practicable means at their disposal and in accordance with their capabilities	Operation of a sewage plant carries the risk of pollution of the Convention area; operation of shipping carries the risk of air pollution, oil spills

Convention on Biological Diversity	NEPA	The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components	Signatory required to introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures
Convention on International Trade in Endangered Species (CITES) of Wild Flora and Fauna	NEPA	Regulate trade in endangered species	Visitors may wish to take plant or animal species and would need a permit from the management authority
International Convention for the Prevention of Pollution from Ships (MARPOL)	NRCA/CG	The main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes	The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations

Protocol on Land Based Sources (LBS) of Marine Pollution of the Wider Caribbean Region	UNEP/NEPA	Concerned with national, sub-regional and regional action through a national political commitment at the highest level, and international cooperation to deal (prevent, control) with the problems posed by pollutants entering the Convention area from land-based sources and activities	Mentions use of EIA to reduce harmful effects of land based activities. Location of development in proximity to coast and operation of sewage plant and effluent
Protocol on Specially Protected Areas and Wildlife (SPAW Protocol)	UNEP/ The Caribbean Environment Programme	Administers measures to protect, preserve and manage in a sustainable way, areas that require protection to safeguard their special value, and threatened or endangered species of flora and fauna	The project area is within the Palisadoes Port Royal Protected Area
Ramsar Convention on the Protection of Wetlands of International Importance and Waterfowl	NEPA	Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance. The Contracting Parties shall formulate and implement plans to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory	Palisadoes - Port Royal Protected area is a Ramsar Site (Ramsar site No. 1454. Most recent RIS information: 2005) that is home to endangered and protected species. The site contains cays, shoals, mangrove lagoons, mangrove islands, coral reefs, seagrass beds and shallow water, thus hosting a variety of underrepresented wetland types

The Oil Spill Protocol	ODPEM	Strengthen national and regional preparedness and response capacity of the nations and territories of the region; Facilitate co-operation and mutual assistance in cases of emergency to prevent and control major oil spill incidents	With the introduction of cruise shipping preparedness and response capacity regarding oil spills is relevant
World Heritage Convention	JNHT	Forms links concepts of nature conservation and the preservation of cultural properties in a single document, recognizing the way in which people interact with nature, and the fundamental need to preserve the balance between the two	Only site in Jamaica is Blue and John Crow Mountains

4 Methodology and Approach

The assessment is conducted through literature review, fieldwork, stakeholder consultation.

4.1 Literature Review

The literature review included but was not restricted to plans and maps of the site and proposed development, relevant laws, regulations or international agreements. Any historical data on or close to the site was reviewed. Repositories consulted included NEPA/NRCA, Jamaica National Heritage Trust (JNHT), PAJ, Port Royal Marine Lab (PRML), Water Resources Authority (WRA), TEM Network, and the University of the West Indies (UWI), the Fisheries Division and the Caribbean Maritime University.

Laws, regulations and international agreements were reviewed, with those relevant to the project summarized in **Table 2.4-1.**

4.2 Fieldwork

Fieldwork was conducted to determine baseline environmental conditions with emphasis on coastal/marine ecology, hydrogeology, coastal dynamics and socioeconomics.

Baseline data generated during site surveys were used to describe the physical, chemical, biological and socioeconomic attributes of the study area.

4.2.1 Physical Environment

The physical/chemical environmental assessment includes land, soils, hydrogeology, coastal dynamics, meteorology, air, and noise and water quality.

4.2.1.1 Land Soils and Hydrogeology

In order to establish a reference point from which to assess the impact of the proposed development the following natural environmental elements were analysed:

- Landscape and Coastal Topography
- Geology and Soils and Potential Hazards (e.g. seismic)
- Hydrology: aquifers/groundwater bodies

A detailed description of the physical environment included a desktop literature review as well as site reconnaissance to "ground-truth" the published literature and to evaluate any temporal changes. Emphasis is placed on the hydrology/hydrogeology/geomorphology, defining the boundaries of the system and the site's relationship with adjacent/neighbouring areas. Environmental impacts, including cumulative impacts, were identified as they relate to hydrology and groundwater bearing in mind potential contaminants that may be released during construction or operations of the pier and its facilities. Seismic characteristics of the area are described using published literature. Consideration was given to spatial and temporal flows of visitors which may impact hydrological systems with limited water resources. A geotechnical survey of the site was reviewed and used in assessing site geological characteristics.

4.2.1.2 Meteorology and Air quality

4.2.1.2.1 Meteorology Data and Processing

Meteorological information was provided using MM5 pre-processed modelling data for a 5 year period provided by Lakes Environmental. Lakes Environmental offers a service providing **modeled meteorological data** for any location in the world. Lakes Environmental obtain this data by running the NCAR MM5 (visit this website for more information on NCAR; http://www.mmm.ucar.edu/mm5/mm5-home.html) (5th-generation Mesoscale Model) prognostic meteorological model for a specified location and site domain.

Once the MM5 preprocessing was completed, the MM5 output file was converted into a format recognized by the **AERMET model** (meteorological preprocessor for the AERMOD model). The final output is generated by creating a pseudo met-station at the specified site location.

No other complete meteorological data set was available from the Norman International Airport for a comparative analysis with the MM5 data to be completed. The onsite meteorological station wind rose was plotted for wind speed and wind direction and the results were similar. However, a complete data set for all required model input parameters was not available to run the AERMET processer for comparison with the MM5 data model.

4.2.1.2.2 Air Quality

Background concentrations are an essential part of the total air quality concentration to be considered in determining source impacts. Background air quality includes pollutant concentrations due to:

- Natural sources;
- Nearby sources other than the one(s) currently under consideration;
- Unidentified sources.

Typically, air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration. The monitoring network used for background determinations should conform to the same quality assurance and other requirements established at the regulating Agency, in this case NEPA. An appropriate data validation procedure should be applied to the data prior to use. TEMN set up two sets of passive monitors at sites upwind and downwind of the proposed facility to collect Sulphur Dioxide and Nitrogen Dioxide (**Table 4.2-1)**. Total volatile organic compounds (TVOC) and PM10 data were captured using portable instrumentation.

Table 4.2-1. PM10 Monitoring Duration and Location for Nitrogen Dioxide and Sulphur Dioxide.

Sample ID	Sample Location	Date
PR1	Old Coal Wharf	17/3/19
PR2	Port Royal Town	17/3/19
PR2A	Port Royal Town Duplicate	17/3/19
PR1	Old Coal Wharf	18/3/19
PR2	Port Royal Town	18/3/19

A survey for nitrogen dioxide (NO2) and Sulphur dioxide (SO2) was carried out from Saturday night (March 16th) to Monday night (March 18th) using commercially available Ogawa passive sampling devices (PSDs) with pre-coated filters (**Figure 4.2-1**).

Figure 4.2-1. Ogawa passive sampling devices (PSDs).

A NO_2 filter element is housed within one end of the small, cylindrical PSD body and an SO_2 filter element is housed within the other end. NO_2 and SO_2 passive sampling devices were strapped to a pole at the OCW, as shown in **Figure 4.2-2** and also at one in the town (**Figure 4.2-3**). This height of approximately 2 m above ground level represented typical human inhalation exposures. The samplers were mounted under a custom built shelter to protect them from sunlight and rainfall (**Figure 4.2-4**). Use of the small, portable and passive monitors is a readily deployable method without requirements for local power, thus allowing for flexibility in sampling site selection.

Total Volatile Organic Compounds (TVOCs) were monitored using the Gray Wolf TVOC sensor.

Figure 4.2-2. PSDs were attached to this pole at the fence boundary of the OCW and the Admiralty building.

Figure 4.2-3. Site in proximity to Gloria's Seafood Restaurant and the Police Station where the PSDs were placed.

Figure 4.2-4. The samplers were mounted under a custom built shelter.

Two sites were monitored to establish baseline air quality and noise – one at the Old Coal Wharf and the other in the town of Port Royal in proximity to the Police Station (**Figure 4.2-3**). The monitoring of PM10 was carried out for a 24 Hr. period commencing March 18, 2019 (**Table 4.2-2**).

Table 4.2-2. PM10 Monitoring Duration and Location.

Location ID	Interval approx. (hours)	Date Start	Time Start
OCW	**24**	3/18/19, Mon.	0:01:01

Data from NEPA was also utilised. Since sources don't typically operate at their maximum allowable capacity (which may include the use of "dirtier" fuels), modeling is used to express the potential contribution of background sources, estimate impact that would not be captured via monitoring. Background concentrations are determined for each critical (concentration) averaging time.

4.2.1.3.3 Dispersion Modeling Assessment and Methodology

The model approach used was to compare the model predictions plus the relevant background concentrations with Jamaica National Ambient Air Quality Standards (JNAAQS) – see **Table 4.2-3**.

Table 4.2-3. Jamaican National Ambient Air Quality Standards (JNAAQS).

Pollutant	Averaging time	Standard Maximum concentration µg/m3
Total Suspended Particulate Matter (TSP[4])	Annual	60
	24 h	150
PM_{10}[5]	Annual	50
	24 h	150
Lead	Calendar Quarter	2
Sulphur Dioxide[6]	Annual	80 Primary; 60 secondary
	24 h	365 Primary; 280 Secondary
	1 h	700
Ozone	1 h	235
Carbon Monoxide	8 h	10,000
	1 h	40,000
Nitrogen Dioxide[7]	1 h	400
	Annual	100

The assessment methodology for the air dispersion modeling exercise follows the guidelines specified in the Natural Resources Conservation Authority (NRCA) Ambient Air Quality Guideline Document 2006. A detailed modeling exercise was conducted.

[4]TSP – all particles and aerosols with aerodynamic diameter of 100 micrometers or less and can be measured by the high volume sampling method

[5]PM_{10} refers to particles with an aerodynamic diameter of 10 micrometers or less as measured by the PM_{10} sampler.

[6]The secondary standards for sulphur dioxide are designed to protect public health and welfare. They represent the long term goal for air quality and provide the basis for an anti-degradation policy for unpolluted areas of the country and for continuing development of pollution control technology.

[7]1h averaging standard for Nitrogen Dioxide is a guideline standard concentration and not actually apart of the JAAQS but is still used by National Environment and Planning Agency as material consideration

The detailed model recommended in the Ambient Air Quality Guideline Document is the AMS/EPA Regulatory Model AERMOD. The model selected was the ISC-AERMOD View dispersion model, developed by Lakes Environmental. This model is used extensively to assess pollution concentration and deposition from a wide variety of sources. ISC-AERMOD View is a, Microsoft Windows application and runs in Windows applications. AERMOD is a regulatory steady-state plume modeling system with three separate components:

- AERMOD (AERMIC Dispersion Model),
- AERMAP (AERMOD Terrain Preprocessor)
- AERMET (AERMOD Meteorological Preprocessor).

The AERMOD model includes a wide range of options for modeling air quality impacts of pollution sources, making it a popular choice among the modeling community for a variety of applications. Some of the modeling capabilities of AERMOD include the following:

- AERMOD model may be used to model primary pollutants and continuous releases of toxic and hazardous waste pollutants.
- Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source or for a group of sources. On this project all emission rates were treated as constant.
- The model can account for the effects of aerodynamic downwash due to nearby buildings on point source emissions. PRIME building downwash algorithms based on the ISCPRIME model has been added to the model.
- Receptor locations can be specified as grid and/or discrete receptors in a Cartesian or polar coordinate system. A new type of receptor was included, the discrete Cartesian receptors that allows for grouping of receptors.
- For applications involving elevated terrain, the user must also input a hill height scale along with the receptor elevation. The U.S. EPA AERMAP terrain

preprocessing program was used to generate hill height scales as well as terrain elevations for all receptor locations.

- The model contains algorithms for modeling the effects of settling and removal (through dry deposition) of large particulates and for modeling the effects of precipitation scavenging for gases or particulates.
- AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles. These two files are provided by the U.S. EPA AERMET meteorological preprocessor program.

4.2.1.2.2.1 Model Inputs: Domain, Grids and Receptors

The model domain selected was 20km (east-west) by 20km (north-south) with an origin (center) at 1984910.15m E, 305558.39m N in UTM coordinates. All UTM distances are in meters (m) and the notation m will be omitted hence forth.

Estimates of ground level concentrations were calculated at the intersection of the following grids and along the fence line for a total of up to 441 receptors as follows:

- Uniform grid covering the entire domain, with a spacing of 1000m, covering a distance of 20km,
- Seven discrete receptors located in the residential communities and commercial areas along with the Ambient Monitoring Station (AMS) used to monitor background air quality (**Table 4.2-4)**.

Table 4.2-4. Special receptor grid.

ID	DESCRIPTION	UTME	UTMN	ELEV	HILL
GLOR	Gloria's	304850	1984399	3.97	3.97
MHH	Morgan's Harbour Hotel	305181	1984489	6.06	6.06
GSF	Seafood restaurant	305238	1984268	5.63	5.63
STPAC	St. Peters Anglican Church	304976	1984212	4.59	4.59
CMU	Caribbean Maritime Institute	304849	1984135	5.83	5.83
SP1	TEMN monitoring site 1	305473	1984685	3.1	3.1
SP2	TEMN monitoring site 2	304829	1984430	3.46	3.46

Figure 4.2-5 illustrates the model domain, the regular Cartesian grids with the site boundary near the center and special receptors.

Digital elevation data with 90m spacing (**Figure 4.2-6**) were obtained for the study area from www.webgis.com. The elevation data were used to construct digital elevation model (DEM) files which are required for use in the model.

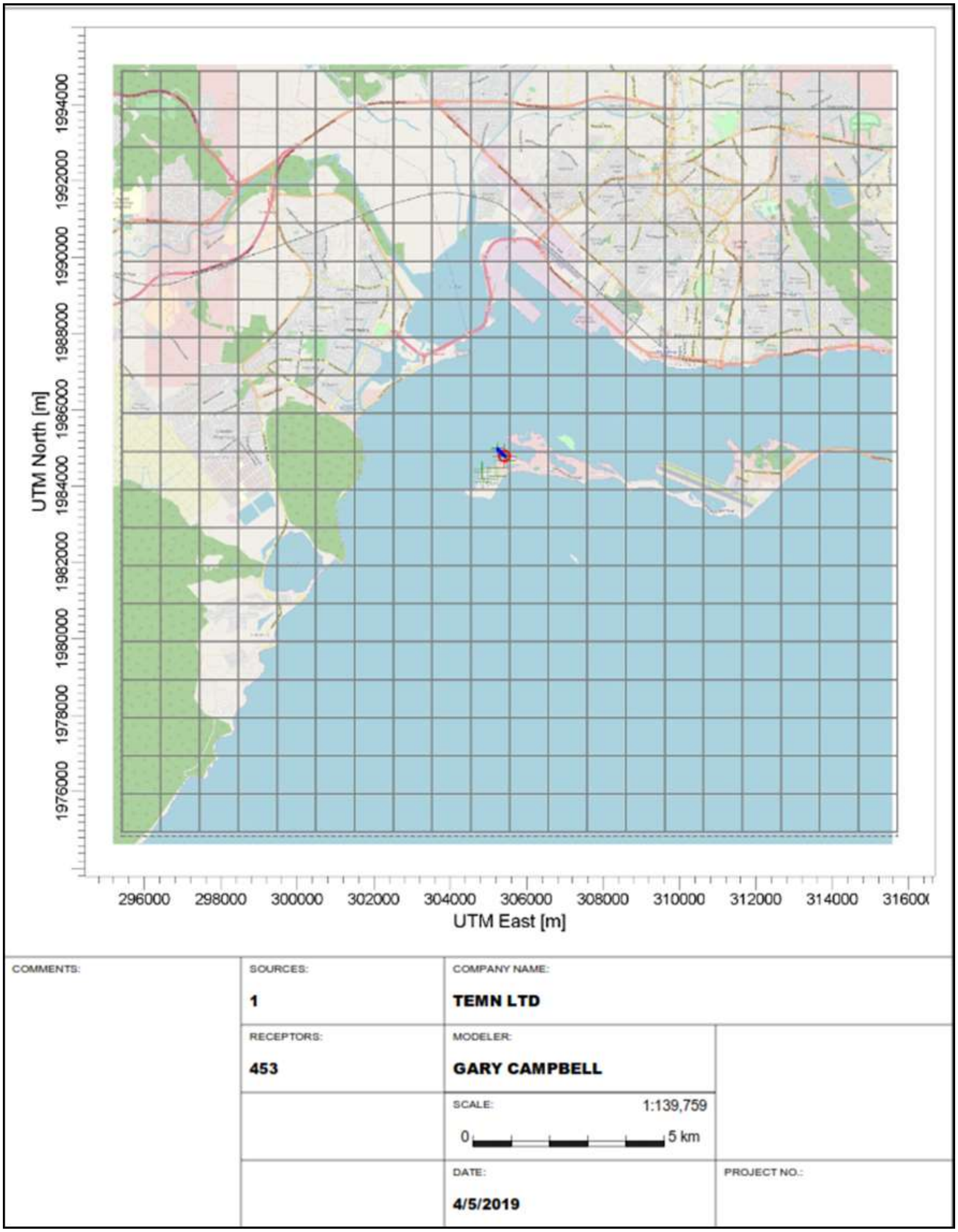


Figure 4.2-5. Grid and Receptor Map

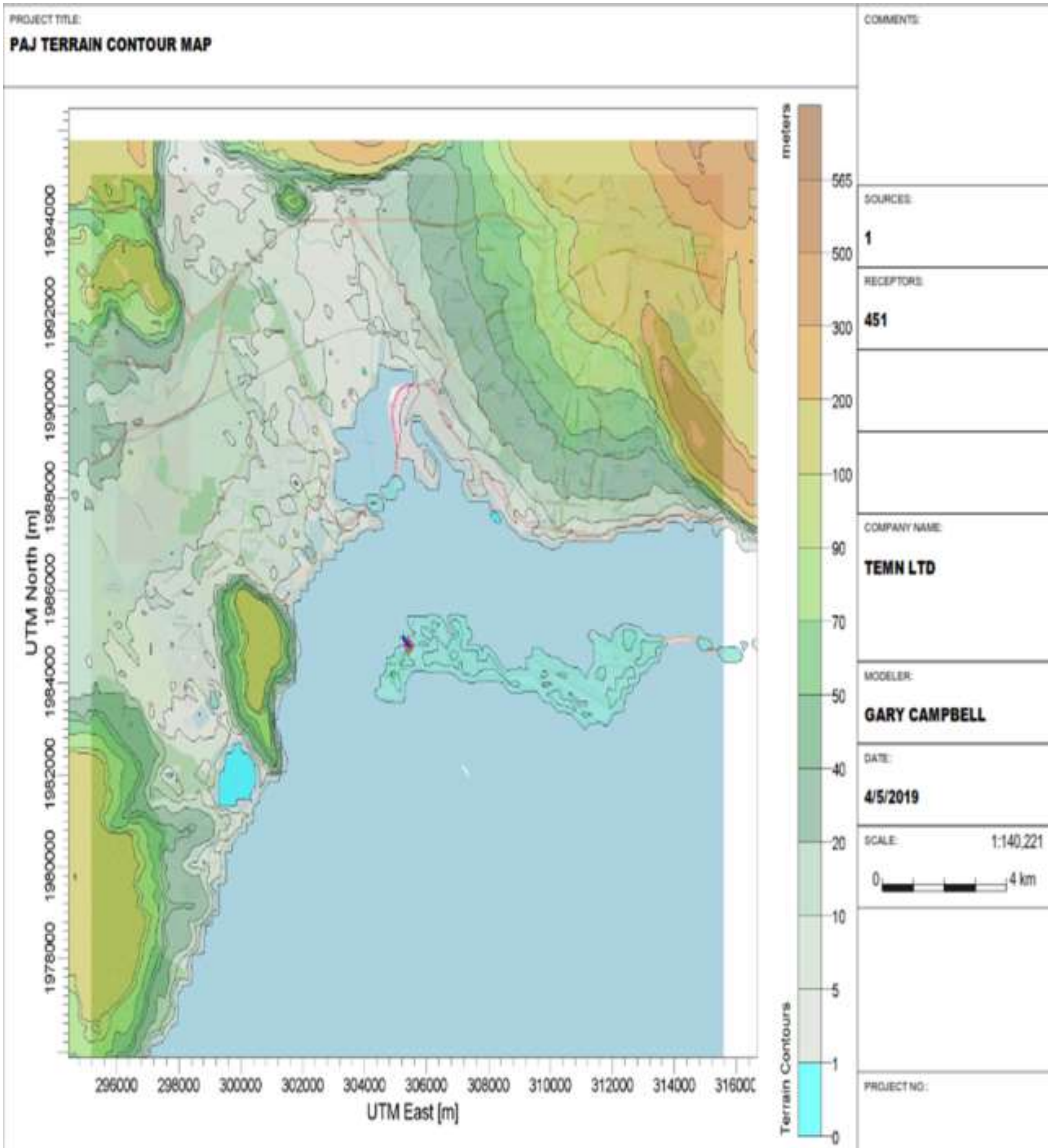


Figure 4.2-6. Digital Terrain Elevation Map Overlap.

4.2.1.2.2.2 Emissions Inventory for the Facility

An Emissions inventory was conducted using information provided by developers of the project. This information included:

- Types of ships expected
- Details on ship engines and emission sources
- Type of fuel used
- Fuel quality
- Expected ship frequency

The emissions inventory was developed using emission factors from *AP42 Fifth Edition Volume 1 Chapter 1 section 1.3*

The emissions inventory was generated using the methods outlined in the Natural Resources Conservation Authority Ambient Air Quality Guideline Document and the *AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*. Source input files were created according to the USEPA modelling guidance 40 CFR Part 51.

4.2.1.3 Noise

A-Weighted broadband noise measurements were done using the CR:831B Sound Level Meter (which meet the ANSI S1.4 Standard for Type I or Type II accuracy). Noise levels were compared with international standards. Measurements were made on Sunday, March 17th between 00:00 and 12:00 hours at the site and environs to establish present background or baseline conditions (

Table 4.2-5**)**. Noise measurements were analysed in conjunction with other relevant data such as time of day, weather conditions, and source of noise.

Table 4.2-5. Noise Monitoring Duration and Location.

Location	Run Time (hours)	Date Start	Time Start
OCW	24	3/17/19, Sun.	0:00:40

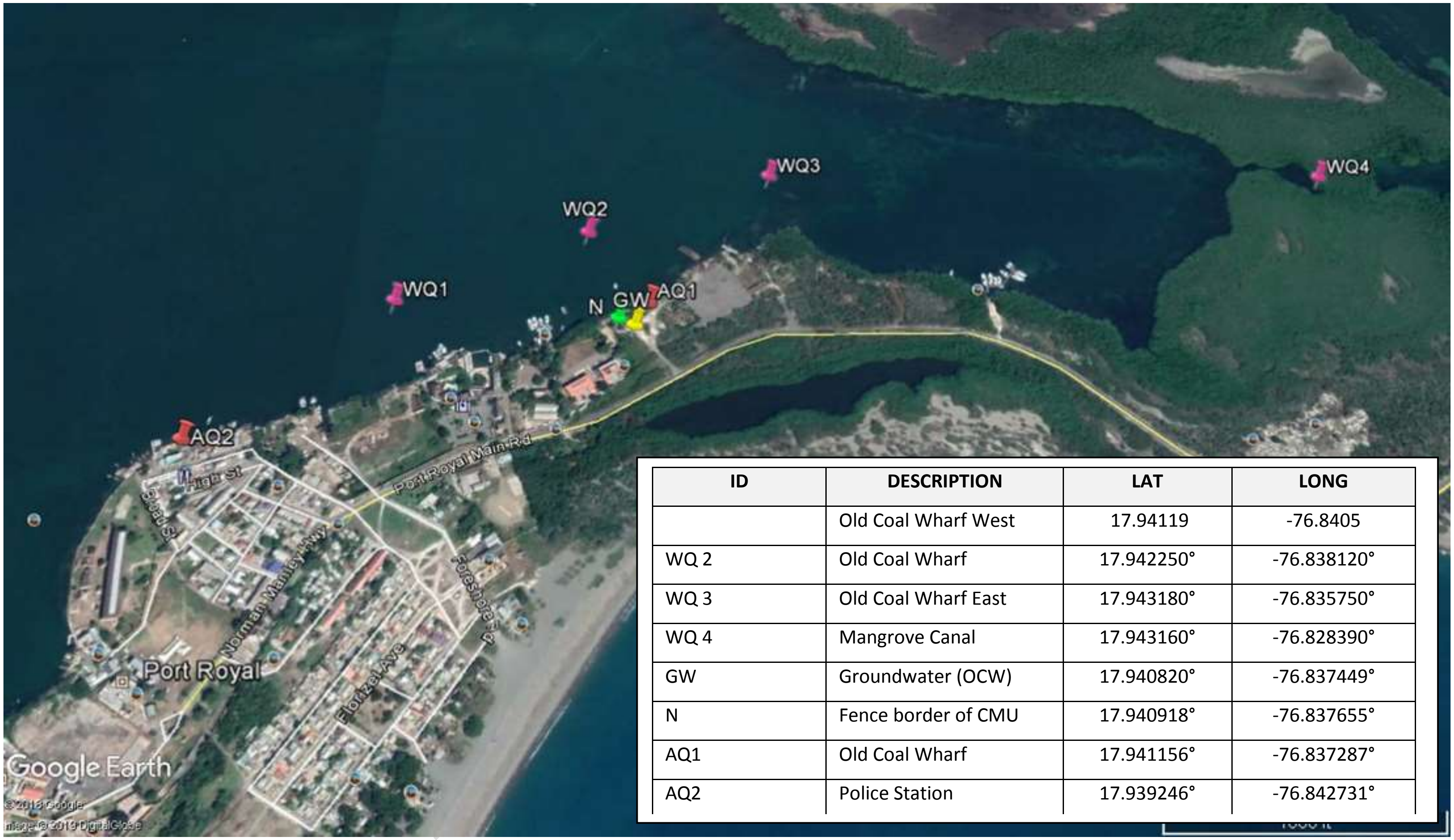
4.2.2 Biological Environment Assessment

4.2.2.1 Baseline Data on Chemical Parameters

Four sites were monitored to establish baseline water quality in the vicinity of the old coal wharf and a lagoon in the mangroves to the east (**Figure 4.2-7).** In addition groundwater samples were obtained from trenches located on the Old Coal Wharf property (**Figure 4.2-8**).

Baseline water quality was evaluated using a combination of portable equipment and collection of samples within the proposed port area as well as coastal open water. Labelled samples were stored in the respective containers specific to the parameter being analysed and placed in igloos of ice (**Figure 4.2-9**). The samples were transported to accredited laboratories for analysis. These included Environmental Health, Scientific Research Council, University of the West Indies (Mona), Bureau of Standards Jamaica and ALS Environmental Jacksonville, Florida.

Parameters measured in the field included salinity, pH, temperature, turbidity and dissolved oxygen. Water samples were analysed to determine biological oxygen demand (BOD), faecal coliforms, nutrients (N and P), oil and grease, petroleum range organics (PRO), total suspended solids and trace metals. Water quality analytical methods are summarized in **Table 4.2-6**.



ID	DESCRIPTION	LAT	LONG
	Old Coal Wharf West	17.94119	-76.8405
WQ 2	Old Coal Wharf	17.942250°	-76.838120°
WQ 3	Old Coal Wharf East	17.943180°	-76.835750°
WQ 4	Mangrove Canal	17.943160°	-76.828390°
GW	Groundwater (OCW)	17.940820°	-76.837449°
N	Fence border of CMU	17.940918°	-76.837655°
AQ1	Old Coal Wharf	17.941156°	-76.837287°
AQ2	Police Station	17.939246°	-76.842731°

Figure 4.2-7. Sampling Sites for Physico/Chemical Baseline Assessment.

Figure 4.2-8. Samples at Site GW (Groundwater) at Old Coal Wharf.

Figure 4.2-9. Storage of water samples for transport to labs.

Table 4.2-6. Summary of Water Quality Methods.

Parameter	Method
Field Analysis	
Dissolved Oxygen	YSI Meter
Turbidity	Horiba Water Quality Checker U-10
pH	Horiba Water Quality Checker U-10 (Glass Electrode)
Depth	Speedtech Portable Depth Sounder
Lab Analysis	
Faecal Coliform	9222 D. Fecal Coliform Membrane Filter Procedure
Nitrates	Colourimetric Automated Cadmium Reduction 353.2
Ortho-phosphate	Colourimetric Automated Ascorbic Acid Method 365.1
TSS	2540D Total Suspended Solids Dried at 103-105°C
BOD	5210 B. 5-Day BOD test
Oil and Grease	5520 B. Partition – Gravimetric Method
Petroleum Range Organics (PRO)	FL-PRO Gas Chromatography/Flame Ionisation Detection (GC/FID)

The assessment was based on a comparison of baseline levels with established local criteria as well as criteria from the United States Environmental Protection Agency (USEPA), Environment Canada, the National Environment and Planning Agency (NEPA - Jamaica) and the National Oceanic and Atmospheric Administration (NOAA). Impacts of the proposed project on site water quality, such as the potential influence on existing shoreline discharges or outfalls were considered.

4.2.2.2 Coastal and Oceanographic Assessment

Baseline hydrodynamics in the project area were investigated through field work, literature research and numerical modeling. Field work entailed visual inspection of the wave-climate, including effects of wakes from passing craft. Changes (if any) to surface currents due to different winds were also recorded. There may be a propensity for floating waste to accumulate during periods of north winds coupled with high rainfall. The modeling efforts simulated wave and current field within the greater Kingston Harbour and along the Port Royal shoreline. The wave and current modeling was conducted using the Coastal Modeling System (CMS) developed by the US Army Corps of Engineers (USACE). The CMS is composed of the CMS-Wave Module that simulates wave fields and the CMS-Flow Module that simulates current fields.

Since there are no long-term wave measurements in the greater study area, computed wave conditions by US NOAA's WAVEWATCHIII model were used to characterize the wave conditions in the study area. Statistical wave conditions, including both average and storm conditions, were analysed based on at least 10 years of WAVEWATCHIII data. The statistical wave conditions have been used as the input conditions for the CMS-WAVE model to simulate the wave field within the port and at the disposal site. Predicted tides were used to drive the flow model.

The historical hurricane database, as compiled by NOAA National Hurricane Center, was analysed to examine hurricane impacts to the study area, as well as any other potential risks. Potential storm surge was examined using well-established empirical formulas as recommended by the USACE's Coastal Engineering Manual.

Shoreline conditions were examined based on field investigations. The existing coastal revetment was also examined and compared to the proposed much larger boulder revetment. This is important to examine the effects of wave-reflection on the floating pier. Historical shoreline changes were analysed using time-series aerial photos. Potential trends of shoreline change are discussed based on numerical modeling and present shoreline conditions.

4.2.2.3 Flora and Fauna

Coastal surveys of the project site and its surroundings**, Figure 4.2-11)** were conducted from March 13th -23rd, 2019 in order to characterize the plant and animal communities present within the project area. The assessment includes the present status of the terrestrial and marine resources in the project area and identifies a range of impacts to these resources during the construction and operational phases of the project. Survey results are used to inform a preliminary assessment of ecosystem functions.

A species list has been generated and cross-referenced with the "IUCN Red List of Threatened Species" in order to determine the conservation status of the flora and fauna within the project footprint. Rare, threatened, endangered, endemic, protected, invasive, and economically or nationally important species are identified. Species diversity, community structure, and habitats/niche specificity are characterised, and impacts to these communities resulting from project related activities (e.g., habitat fragmentation/loss) identified. The assessments of the coastal and marine ecosystems were carried out according to international (scientific) standards and include a photographic inventory.

4.2.2.3.1 Terrestrial Flora

A survey of the flora at the project site and its immediate surroundings (**Figure 4.2-10)** was carried out in order to characterize the species composition and to identify the presence of any rare, endemic, protected or endangered species. Based on the topography and species observed during a reconnaissance visit to the site, it was determined that the most appropriate method of assessing the vegetation was to do a series of ‘walkthroughs’.

The common names of most species sighted were assigned *in-situ*. In the case of unknown species, voucher specimens were collected and identified at the University of the West Indies (UWI) Herbarium. All plants were identified to the species level by examining morphological features such as leaf arrangement, leaf pattern, and pattern of branching and morphology of floral and fruiting structure in conjunction with the use of Adam's (1972) *Flowering Plants of Jamaica* and preserved reference specimens of the herbarium (Adams, 1972). The relative abundance of each species was graded using the DAFOR scale (i.e. D=dominant, A= abundant, F= frequent, O=occasional and R=rare).

Figure 4.2-10. Location of sampling sites for terrestrial flora, avifauna and other fauna within the study site.

4.2.2.3.2 Terrestrial Fauna

4.2.2.3.2.1 Herpetofauna and Invertebrates

A daytime assessment of the herpetofauna and insects consisted of a walkthrough in selected areas. Various habitats and possible hiding places were carefully searched or examined; these included tree trunks, leaves and dry wood and sticks. Insects in flight were recorded. A sweep net was used to collect insects from the foliage. Most of the arthropods encountered in the field were identified on location. Arthropods which could not be identified in the field were identified using collections at the University of the West Indies.

4.2.2.3.2.2 Avifauna

Timed Interval bird counts were conducted at designated sites (T1-T8) selected randomly based on pre-determined selection criteria recommended for sampling of birds in Caribbean habitats (Wunderle 1994). All birds detected were recorded to generate a species list for the sites.

The compact size of the site combined with the fact that much of the site is not vegetated made it was difficult to adhere to the normal rules regarding selections of points to conduct timed survey counts. Specifically, it was not possible to use the preferred minimum number of ten isolated points within the survey zone. The number of survey points was reduced to eight and most were closer than the typical minimum distance of 200 meters apart. The guidelines are intended to reduce the incidents of double counting individual birds from adjacent points.

All bird species observed during the field visit were recorded, however, during the counting periods those detected by sound but not seen, were recorded separately. Every effort was made to exclude errors caused by counting individuals that could be detected from more than one site but this can be difficult given the very small area of the site. Point Counts were six minutes in duration. Counts were conducted in the morning before 10:00am in order to capture data during the period of peak activity for most diurnal birds.

4.2.2.3.2.3 Protected Fauna

In the context of the Palisadoes/Port Royal/ Protected Area[8] special attention was given to any sightings of crocodile, turtle or bird nests observed in or around the project area; these were recorded, and supported by existing data/information pertaining to crocodile and sea turtle nesting sites, seasons and habitat use by migratory species.

Crocodile Assessment

A crocodile survey was conducted March 21st, 2019, commencing during the day and continuing into the night using a boat and on foot where applicable. The day's activity included walking along the coast of the project area to note crocodile presence and/or activity such as tail drag, foot prints, basking areas and nesting areas. In general, crocodiles are more difficult to detect during the day than at night because of their secretive habits. The night's survey included the use of the spotlight survey method to detect crocodiles by noting the reflective eyes (Sullivan, Holden and Williams, 2010); this is the most popular method used to estimate crocodile numbers in an area.

Turtles

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[8] NRC Act Palisadoes-Port Royal Protected Area, Order 1998 (http://nepa.gov.jm/symposia_03/laws/Environmental_Laws/NRC(Palisadoes-Port_Royal_Protected_Area)Order_1998.pdf

The Sea turtle survey method entailed looking for evidence of past/ present nesting activities. Activities were classified into two categories; nests and false crawls (or non-nesting emergences). In the day, the beach areas were traversed along the most recent high tide line to 12-meters inland where possible, looking for all evidence of sea turtle emergences. When a crawl was located, measurements were taken of the width of the crawl as well as photographs and GPS locations. For nest sites, the GPS coordinates were recorded over the most likely location of the egg chamber.

4.2.2.4 Marine Flora and Fauna

The seafloor within the project/impact area was surveyed for the purpose of characterizing the benthic habitat and any associated marine resources that will be immediately impacted by the project. Sites were selected along the shoreline on either side of the proposed anchor point for the pier, in the basin to the east, and the harbour basin to the northwest (**Figure 4.2-11** and **Table 4.2-7).**

Surveys were conducted using SCUBA and a submersible ROV.

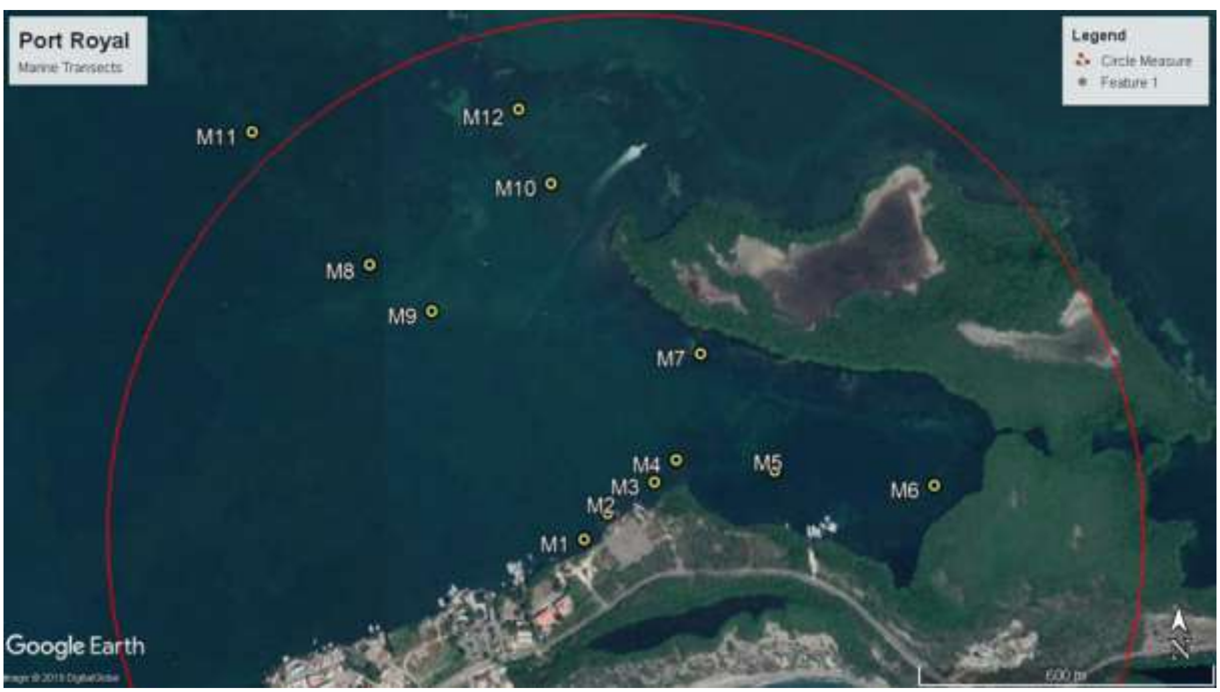

Figure 4.2-11. Marine survey sites in Port Royal.

Table 4.2-7. Latitude and longitude of marine survey sites.

Survey Site	Latitude	Longitude
M1	17.941659°	-76.837171°
M2	17.942050°	-76.836802°
M3	17.942623°	-76.835903°
M4	17.943029°	-76.835483°
M5	17.942828°	-76.833587°
M6	17.942563°	-76.830516°
M7	17.944972°	-76.835015°
M8	17.946601°	-76.841385°
M9	17.945750°	-76.840189°
M10	17.948088°	-76.837894°
M11	17.949030°	-76.843648°
M12	17.949445°	-76.838516°

The nearshore area, 100m on either side of the proposed shoreline anchoring point for the pier, was surveyed by divers recording the substrate along 30m long x 1m wide transects. Independent counts of macroinvertebrates (urchins, sea cucumbers) were made by a second diver inspecting a 1m wide swathe of the substrate along the same transect line. A transect perpendicular to the coastline was also surveyed to ascertain the change in benthic community structure along the depth gradient.

A benthic survey of other sites was conducted using the Sofar Trident Underwater Drone (ROV). The ROV was deployed at each site, moving approximately 0.5m above the substrate, to record a 1m wide swathe of the benthos along ~ 20m long transects.

Photoquadrats and video transects were analysed to generate a species list and obtain baseline metrics for the following marine ecosystem variables:

i. Substrate composition – seafloor components, substrate type;
ii. Coral species;
iii. Algal species composition;
iv. Fish species;

v. Other fauna – presence/absence of urchins, sea-cucumbers and mollusk densities;
vi. Seagrass–shoot density/status (groundtruthing select areas).

4.2.3 Socio-Economic and Cultural Assessment

4.2.3.1 Socio-Economic

Demography, regional setting, and location assessment were carried out in the immediate vicinity of the project area. A review of the profile of current and potential land-use patterns (of neighbouring properties) included in addition to other assets. The report includes a description of existing infrastructure such as wastewater, roads and transportation, electricity, water, telecommunications, and health facilities. This information was obtained through desktop research of existing documents and literature including but not limited to Population Censuses, Socio-Economic Studies, relevant studies conducted within the area, other studies being conducted for the project, previous environmental and socio-economic impact assessments, Vision 2030: Jamaica National Development Plan and relevant Sector Plans, the Survey of Living Conditions and the Economic and Social Survey of Jamaica.

There was an assessment of the present and proposed uses of the site and surrounding areas. Present land use and development activities were undertaken from desktop research and a land use survey. Baseline data is determined through the review of available satellite imagery and topographic maps, aerial photographs and additional information accessible through the relevant GOJ agencies. Field verification of land use was made during visits to the study area. Effects on socioeconomic status such as changes to public access and recreational use, impacts on existing and potential economic activities, public perception, contribution of development to national economy and development of surrounding communities were evaluated.

4.2.3.2 Cultural and Heritage

The cultural and heritage attributes of Port Royal are reviewed. Assessment of the cultural and heritage value of the OCW in particular is informed by the Archaeological Impact Assessment done by the JNHT (**JNHT 2019**).

4.2.4 Public Participation

A socio-economic survey/public consultation to determine public perception of the project concept (both negative and positive) has been completed. Interviews were the main methods used in consultations. Questionnaires designed to determine the socioeconomic characteristics of the study area (baseline) and perspectives of the public on the level and types of impact the proposed development would have on individuals, their local community, the region and the country were administered to the general public (households and local business operators). Surveys were administered through personal interviews. While personal interviews are noted to be associated with high costs and tend to be time intensive, they have the advantage of high response rate and tend to be more favorable for open-ended questions. The questionnaires included an overview of the project. The public participation methods is described, including the timing, type of information provided and collected from public and stakeholder target groups meetings. The sampling methodology employed is appropriate for the population size and distribution and was weighted towards the communities/interest groups in closest proximity to the proposed development. The instrument used to collect the information is included in the **Appendix 13.7 - Survey Instrument**.

Public consultation incorporates key stakeholders. Stakeholder meetings were held to inform the public of the proposed development and the possible impacts. This gauged the feeling/response of the public toward the development.

The list of stakeholders consulted includes but is not limited to:

- Ministry of Industry, Commerce, Agriculture and Fisheries – Fisheries Division
- National Works Agency
- Ministry of Tourism
- Maritime Authority of Jamaica
- Jamaica National Heritage Trust
- Caribbean Maritime University
- Tourism Product Development Company
- Urban Development Corporation
- Port Royal Brotherhood
- Kingston and St. Andrew Municipal Corporation
- Port Royal Citizens' Association
- Resource Users: Fisher folk and other local marine interests
- Kingston and St. Andrew Municipal Corporation
- ODPEM
- Social Development Commission
- Airports Authority of Jamaica
- Jamaica Defense Force Coast Guard
- UWI Port Royal Marine Lab
- Royal Yacht Club
- Forestry Department
- Jamaica Fire Brigade

A public meeting will be held to present the preliminary findings of the EIA and obtain the comments of the broader public. Comments from the public meeting are incorporated or addressed in the EIA for final submission and consideration. Further public meetings took place pending any material change to the design of the project by the developer. Subsequent changes were made to the document. Public Meetings will be held in accordance with the Guidelines for Conducting Public Presentations (www.nepa.gov.jm) at a time and location signed off by the National and Environment and Planning Agency (NEPA).

4.3 Impact Identification and Analysis

An assessment of the overall project alternatives and analyses of the potential environmental and social impacts during construction and after the upgrade was done using the rapid impact assessment matrix (RIAM)[9].

The environmental impacts specified in the Terms of Reference are grouped into the following components (study disciplines), namely:

- Physical/Chemical,
- Biological/Ecological,
- Sociological
- Economic/Macroeconomic and
- Risk Assessment - Impact of natural hazard, including but not limited to, hurricanes, earthquakes, landslides and flooding potential shall be examined.

[9] Pastakia, C.M.R. and Jensen, A. (1998) The Rapid Impact Assessment Matrix (RIAM) for EIA

Physical/chemical

Covering all physical and chemical aspects of the environment, including finite (non-biological) natural resources, and degradation of the physical environment. Generally for the proposed development this will include effects on geology and soil, air, water, landscape, and assessment of natural hazards and material assets.

The physical impact includes the following:

- Construction Activities
- Accidental oils and spills
- Air quality (Air Dispersion Modelling)
- Water Quality

Impacts/ Demands/ Requirements of the following have been quantified:

- Water Supply
- Drainage
- Sewage Treatment and Disposal
- Wastewater Disposal
- Trade Effluent Discharge and Disposal
- Solid Waste Disposal
- Electrical Power
- Communications and Utility Requirements
- Transport Systems and Support Infrastructure
- Operations and Maintenance of Waste Disposal, Site Drainage, Sewage Treatment and Disposal Solution and Air Quality
- Visual Aesthetics and Landscape

- Noise
- Dust
- Vibration
- Change in Drainage Pattern
- Carrying Capacity of the Proposed Site

Biological / ecological	Covering all biological aspects of the environment, including renewable natural resources, conservation of biodiversity, species interactions pollution of the biosphere. The impacts of noise, dust and vibration on floral and faunal species are explored.
Socioeconomic	Covering all human aspects of the environment, including social issues affecting individuals and communities; together with cultural aspects, including conservation of heritage (artifacts, archaeological, geological and paleontological features), and human development. In addition socio-economic and cultural impacts include land use/resource effects, and health safety of the potential worker and residents. The Public perception study explores property value and aesthetic impacts.
Macroeconomic	Covering macroeconomic consequences of environmental change, both temporary and permanent within the context of the project activities.

Risk Assessment Risks (climate change, earthquakes, and tsunamis) posed to the development and by the development have been assessed and analysed in terms of:

1) Identification
2) Assessment of potential consequences
3) Characterization

The impact assessment considers various project stages, preconstruction, construction, operational and decomissioning/closure stages to identify the impacts that are positive or negative, as well as their significance and magnitude.

Impacts assessed include:

- Project design and engineering
- Visual aesthetics and landscape
- Noise and vibration
- Operation and Maintenance activities
- Effects of operation and Maintenance
- Ecological and
- Socioeconomic

Sensitive parameters in all the study disciplines that describe the impacts for the current situation, during construction of the pier and in the operational phase were assessed for their overall impact. The RIAM method provides an overall assessment where there are multi-disciplinary factors since the method allows data from different disciplines to be analysed against common important criteria within a common matrix, thereby providing a clear assessment of the major impacts. Such an assessment can be done for each project alternative and in the present case will be done for the "do nothing" case and for the preferred alternative (during construction and operation).

Details of the scoring methodology are presented in the **Appendix 13.10**. **RIAM Scoring Methodology**.

4.4 Impact Mitigation

Mitigation strategies are proposed to address impacts identified during and after construction. Mitigation strategies are proposed for the following areas:

- Natural hazards (seismic and hurricane events, landslide and flooding potential)
- Air quality
- Occupational exposure mitigation
- Vibration impacts during and after construction
- Surface and groundwater
- Terrestrial and marine ecosystem
- Socioeconomic

4.5 Identification and Analysis of Alternatives

Alternatives to the development, including the no-action alternative were examined. These were assessed according to the physical, ecological, climatic variability and socio-economic parameters of the site. This examination of alternatives incorporates the use of the history of the overall area in which the site is located and previous uses of the site itself. Alternatives address specific aspects of the project such as methods, locations, layouts [costs] and technologies proposed in the execution of the project (works) that have been identified as being causes of major impacts. The alternatives were assessed using the methodology described in the Impact Identification and Assessment section above.

4.6 Risk Analysis and Emergency Response

A Risk Analysis was carried out to identify potential credible hazards, to mitigate severity and to aid in preparing effective Emergency Response Plans (ERP) to handle on-site and off-site emergencies and to effectively deal with all kinds of port-related hazards. The ERP caters to worst-case disaster scenarios with reference to specific cases including fire, explosion, toxic dispersion, oil/chemical spills, floods, cyclones, terrorist attacks etc. The plan includes early detection, command and coordination of response organization along with trained personnel, availability of appropriate resources for handling emergencies, and emergency response actions.

4.7 Environmental Monitoring and Management

An environmental monitoring and management plan has been developed which details the requirements for the various phases of the project. This includes, but not be limited to recommendations to ensure the implementation of mitigation measures, long term minimising of negative impacts, compliance reporting and identification of the responsible reporting parties.

The monitoring programme outlines:

- The location of monitoring stations;
- The parameters monitored for each activity or implemented mitigation measure;
- The methodology, analysis and data evaluation employed for monitoring of the various parameters – during construction and operational stages;
- The frequency of the monitoring and sampling;

- Changes and trends with reference to baseline data and compliance with the stipulated conditions as detailed in the regulatory instruments;
- The proposed format that the monitoring reports took;
- The frequency of submission of the monitoring reports;
- The responsible parties for the monitoring;
- Responsible parties for preparing the audit report

5 Project Description

5.1 Project Elements

The multi-phased Port Royal Cruise Pier Development includes landside and marine works including the installation of a floating cruise pier and associated buildings and infrastructure at the Old Coal Wharf as illustrated in the site plan (**Figure 5.1-1**).

The elements of this development are detailed in **Table 5.1-1**. Element 10 will not be implemented in this phase and is for future consideration.

Table 5.1-1. Development Elements.

Elements ID No.	Description	Phase
1	Floating Pier and Promenade	1
2	Terminal Building	1
3	Main Plaza	1
4	Bus loading with retail and restrooms	1
5	Bus loading with retail and restrooms	1
6	Market Place (Craft Shops)	1
7	Taxi, Coaster and Tram	1
8	Restaurant with outdoor dining	1
9	Small Vessel Jetty (for future consideration)	2
10	Train Station and Railway track (For Future Consideration)	2
11	Tram Loading	1
12	Staff and Public Parking	1
13	Entry / Exit: Taxi, Coaster Tram	1
14	Pedestrian Crosswalk and Improved Walkway	1
15	Entry / Exit: Taxi, Coaster Tram	1
16	Staff Office / Maintenance and Service	1
17	Bus Loading Building	1
18	Bus Loading Building	1
19	Bus Loading Building with Retail and Restrooms	1
20	Amphitheater	1

Figure 5.1-1. Old Coal Wharf Cruise Pier Development – Site Layout.

5.1.1 Cruise Ships and Terminal

The "Cruise Ship Pier" concept envisages: a terminal area, administrative building and a series of bus and tram loading structures with a gross area of approximately 39,080 ft^2 (~3,632 m^2) as shown in **(Table 5.1-1)**.The estimated year of inaugural operation of the port and harbour facility is 2020.The PAJ will operate a cruise shipping pier at the Old Coal Wharf located in Port Royal. The facility is expected to see a maximum of two (2) cruise ships per week which will be docked for a maximum of 24 hours.

The pier will be visited by Royal Caribbean International Vision class vessels. This includes the Vision of the Seas Cruise Liner and the MS Legend of the Seas.

The Vision of the Seas has an overall length of 279m. It has a maximum molded breadth of 32.2m and a maximum draft of 7.75m. Its deadweight is 6,300t at 76m. For safety, the vessel is compartmentalised by 32 watertight division doors. Its steel weight is 15,000t and it has a steel plate surface area 750,000m². The international Gross Tonnage is recorded at 78,500t and it has a 22.3-knot service speed. The Vision of the Seas can carry a maximum of 2,435 passengers and 765 crew.

The proposed pier would accommodate one cruise ship at a time, to avoid overwhelming the historic Port Royal. [10]

The Scoped Environmental Impact Assessment (EIA) for Phases 0 – 1C of the proposed Port Royal Cruise Pier Development is carried out in accordance with the Terms of Reference approved by the National Environment and Planning Agency (NEPA).

Site preparation for the installation of the retractable floating pier (Sea Walk) and the erection of terminal structure and other amenities, will involve the following:

- Removal of remnants of the early 20th century iron and concrete pier in order to install the new retractable floating apparatus;

- The relocation of a decommissioned Jamaica Defense Force Coast Guard vessel and the clearance of remnants of other vessels from the shoreline;

- Removal of secondary vegetation comprising mainly of acacias and other shrubs along with household and commercial debris dumped on the property;

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[10] Jamaica signs with SeaWalk to open cruise ship access to historic Port Royal, Anne Kalosh

18 January 2018

- Raising the site surface above high tide and storm surge levels by dumping 60 cm thick stone aggregate on the property.

5.1.2 Tram Service

The tram service will be similar to that used in Falmouth with a basic main Diesel powered car that pulls one or two cars linking the cruise pier with the bus loading bays.

5.1.3 Sewage Treatment Plant

A sewage treatment plant will be constructed to handle wastewater generated by users of the port facility. The capacity of the plant is based on 4000 passengers, 40 liters per person per day to yields a total demand of 160 cubic meters daily.

Treatment will be to a tertiary level utilising the Membrane Aerated Bio Reactor (MABR) method of waste water treatment. The MABR method is an odourless and noiseless system and is regarded as a revolutionary improvement in aerobic wastewater treatment particularly for its high energy efficiency and improved treatment capacity, compared to traditional wastewater treatment systems.

Based on information available from the supplier (**Appendix 13.2 Sewage Plant**) and typical sewage characteristics (Pescod FAO 1992), the proposed wastewater treatment process for the Old Coal Wharf STP is expected to meet NEPA's Sewage Effluent Standards, for discharge to the environment (**Table 5.1-2**).

The wastewater treatment system for the Old Coal Wharf STP will include the following components:

1. Screening
    a. Influent coarse screen
    b. Influent fine screen
2. Grit removal through aerated chamber complete with scraper for disposal of grit;
3. Oil and grease trap
4. Equalization tank
5. Anaerobic Chamber for phosphorous removal (together with the aerobic tank);
6. Anoxic tank with MABR modules that will achieve simultaneously nitrification and denitrification;
7. Aerobic tank for BOD_5 and COD polishing;
8. Secondary clarifiers;
9. UV disinfection;
10. Aerobic digester
11. Sludge drying beds.

Final disposal will be to the adjacent wetland which will provide additional polishing of the effluent (**Figure 5.1-2**). Based on information available from the supplier (**Appendix 13.2 Sewage Plant**) and typical sewage characteristics (Pescod FAO 1992), the proposed wastewater treatment process for the Old Coal Wharf STP is expected to meet NEPA's Sewage Effluent Standards, for discharge to the environment (**Table 5.1-2**).

Table 5.1-2. MABR Predicted Effluent Quality Compared to Jamaica Effluent Standard.

Parameter	Jamaica Effluent Standard	MABR Effluent Quality
pH	6 - 9	6 - 9
5-Day Biological Oxygen Demand	< 20 mg/L	16
COD	< 100 mg/L	80
Total Suspended Solids	< 20 mg/L	22
Fecal Coliforms	200 MPN/100 mL	<200
Total Residual Chlorine	< 1.2 mg/L	
Total Nitrogen	< 10 mg/L	7 mg/l
Total Phosphorus	< 4 mg/L	2 mg/l

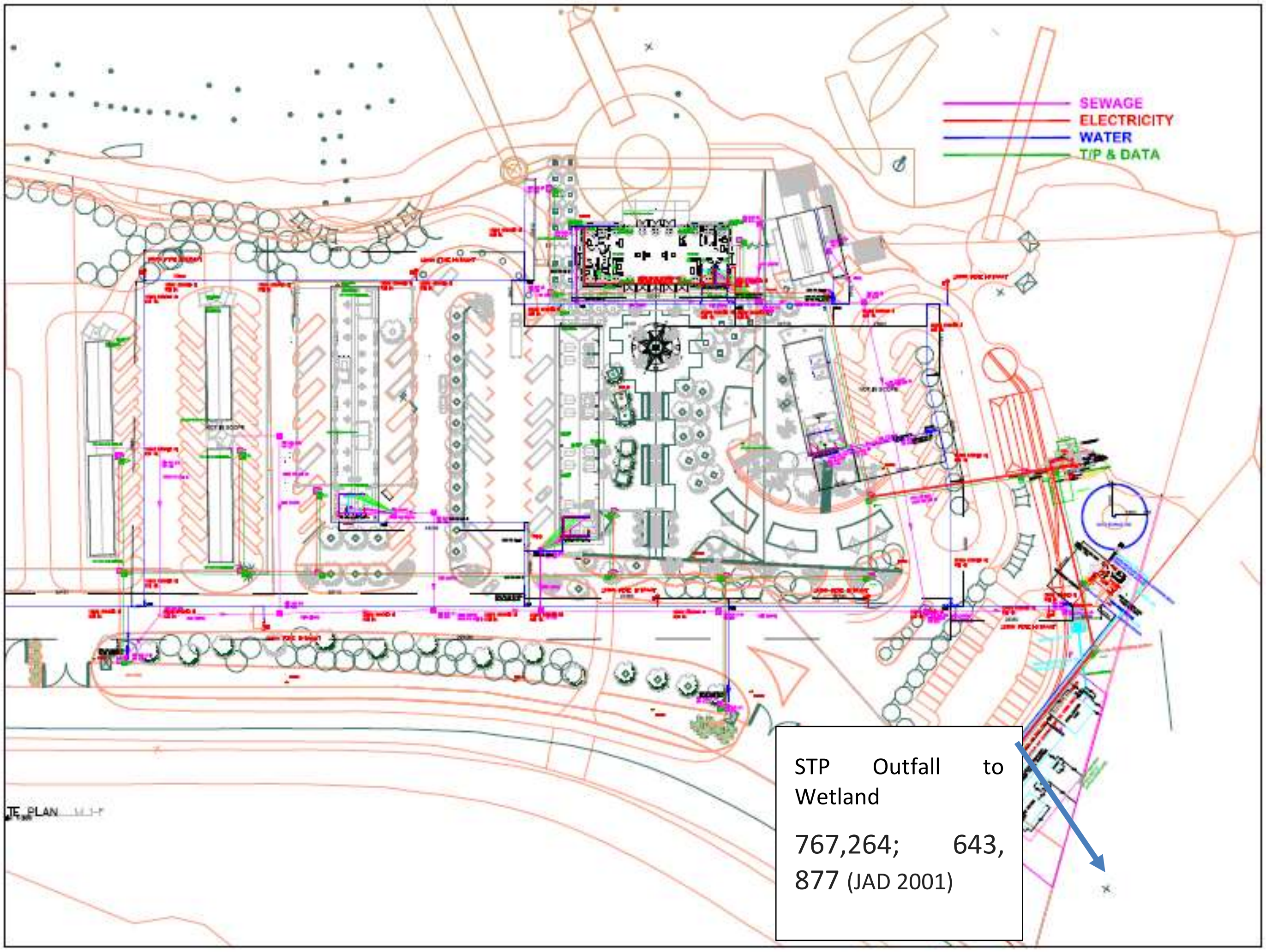

Figure 5.1-2: Old Coal Wharf – Site Layout Showing Sewage Outfall.

6 Description of the Environment

6.1 Physical/Chemical Environment

6.1.1 Landscape Evolution and Topography

The proposed development is located at the distal end of a 14km long strip of land called the Palisadoes. Palisadoes is considered a tombolo (a pit of sand connecting an island to the mainland or other islands). Historical records (**Figure 6.1-1**) suggest that Port Royal was once an island disconnected from the main land, and that over time (**Figure 6.1-2** and **Figure 6.1-3**). Port Royal Island and other smaller cays were linked together via sediment due to longshore drift. Over time it is believed that a series of spits, coupled with anthropogenic interventions such, linked together these islands to the mainland.

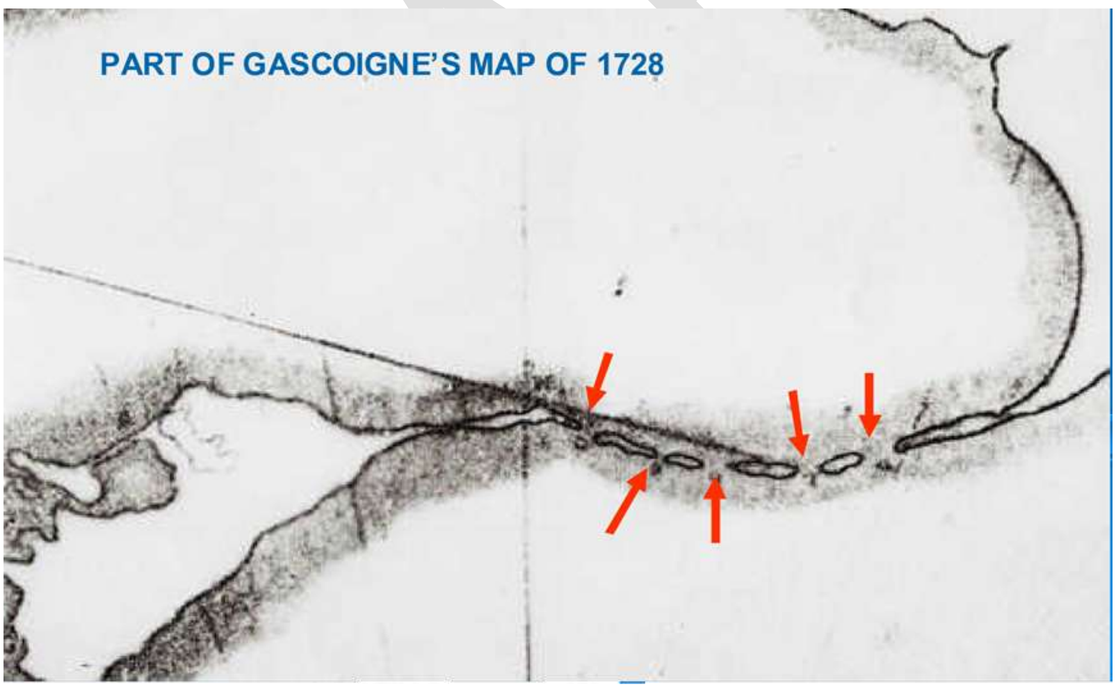

Figure 6.1-1. Historical map by Gascoigne 1728 showing several break points in the Palisadoes resulting from the 1722 hurricane.

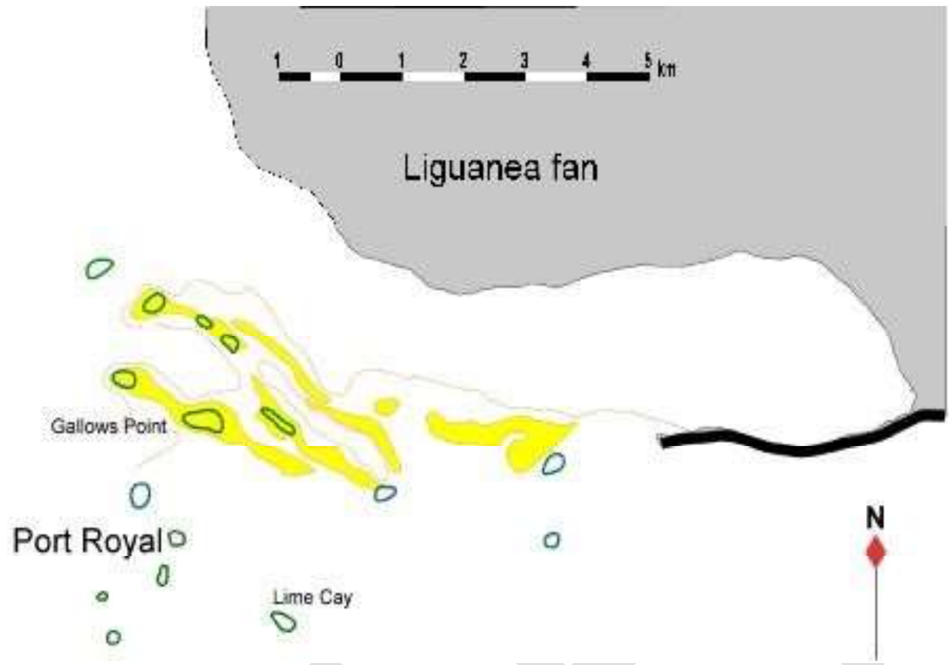

Figure 6.1-2. Initial state of Port Royal and other cays over 4,000 yrs. ago (modified after Robinson and Rowe, 2004). Initial spit from mainland (black polyline); Cays/islands (green polygons); shoals (yellow shaded polygons) and thin polyline shows the assumed extend of shallow water.

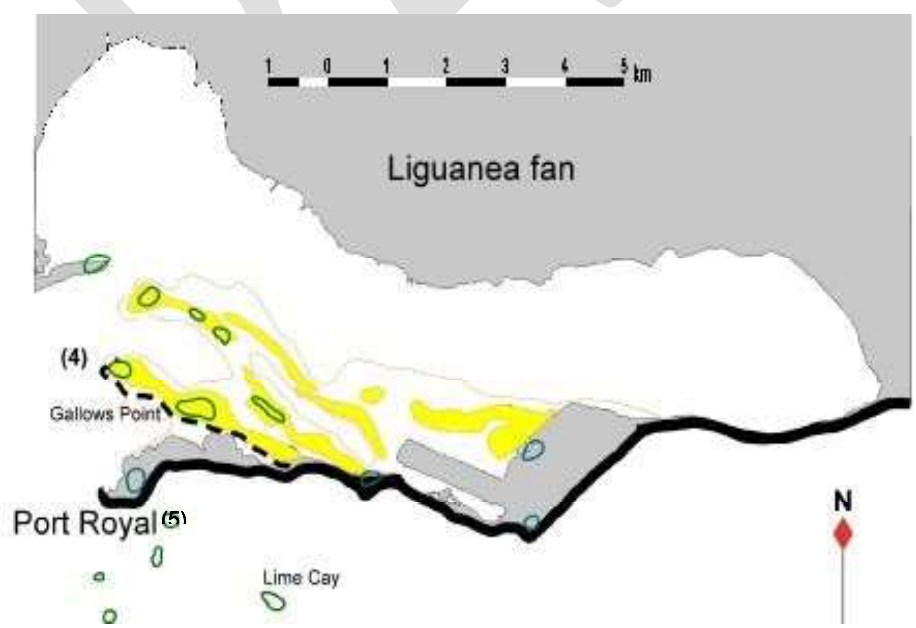

Figure 6.1-3. Present day evolution of the Palisadoes (5) as the spit complex/tombolo extended to Port Royal (black polyline).

The height of the Palisadoes above sea level is between 2-4 meters depending on the location of sand dunes. At the project site the land surface ranges between 0.8m and 1.6m. The site is largely flat with no slopes. The majority of the site's surface (around 65%) is covered with man-made paving from brick-work to asphalt. It also includes a derelict section. Aesthetically, the site includes various noteworthy elements such as a buried ships anchor to the north-east of the site **(Table 6.1-4)**. These are described in detail in the AIA (**Appendix 13.1.3**).

Figure 6.1-4. Partially buried ship's anchor and chain.

6.1.2 Geology and Soils

The site is situated to the distal end of the Liguanea Fan and to the west of several large river systems, namely the Hope River, Cane River, Chalky River and Yallahs River, which are over 10km east of the site along the coast. These river systems to varying degrees provide the source material of sand and gravel that describes the geology of the Palisadoes tombolo (**Figure 6.1-5**).

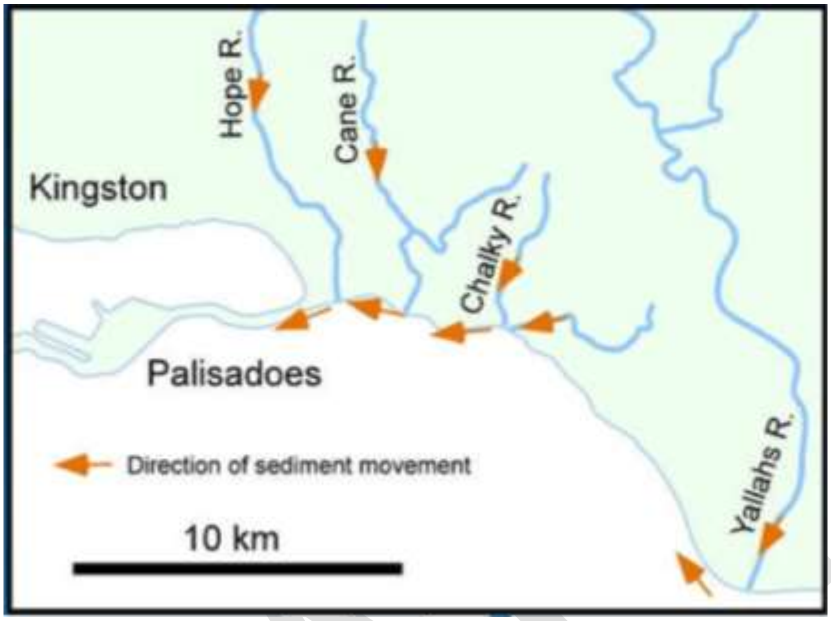

Figure 6.1-5. Palisadoes sediment sources

The geology (**Figure 6.1-6**) comprises Pleistocene sediment (Ql – Harbour View and Liguanea Formation) at the surface and the deeper solid geology is likely limestone reefs from the Coastal Group Limestone. The upper sediments at the site will comprise peat, clays, silts, fine sands and gravels typical of alluvium systems. The thickness ranges between 10 – 30m; but can be shallower in places.

Details of the soil characteristics are to be found in the soil investigation report (**Appendix 13.1.1 Soil Investigation Report**).

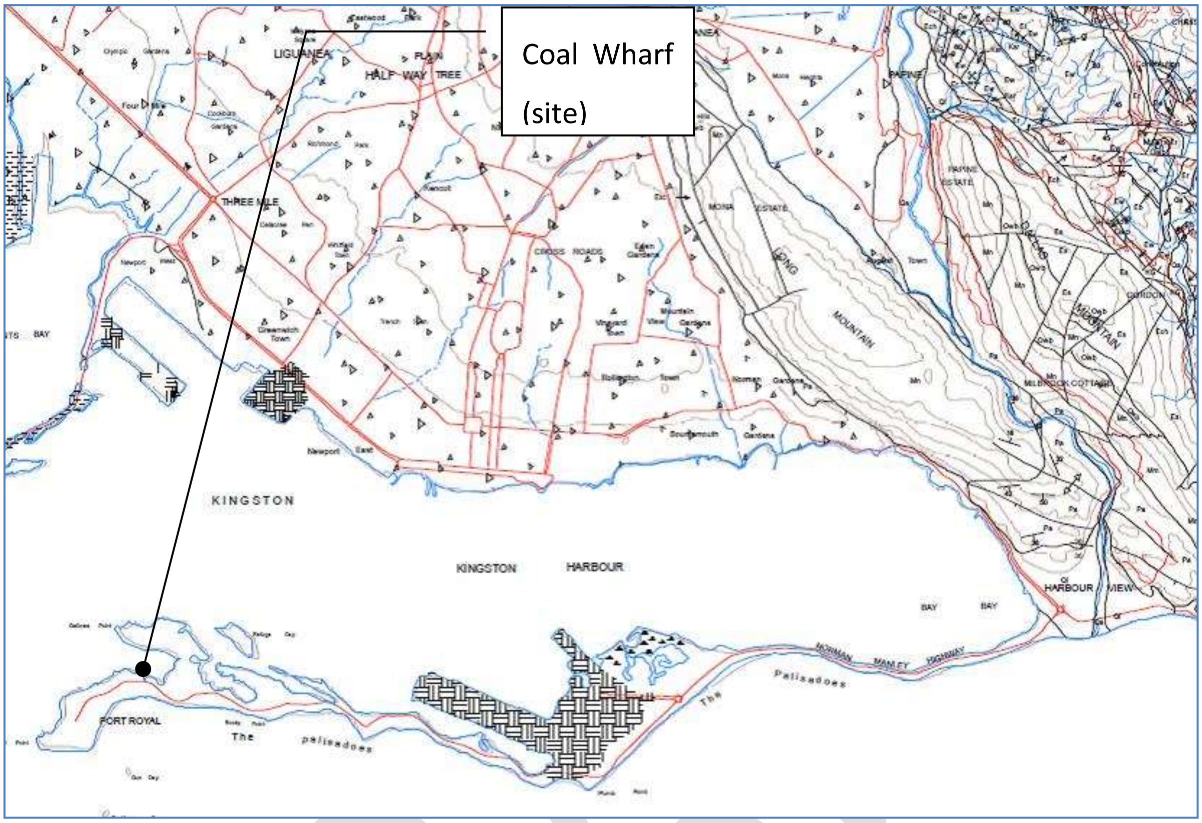

Figure 6.1-6. Geology map (Sheet 18 metric series) of The Palisadoes

During the site walkover, the upper 1m of soils was exposed (**Figure 6.1-7** and **Figure 6.1-8**) these comprised compacted sands and gravels to the west and compacted marl to the east (this marl likely represents the base and sub base of the asphalt pavement). There was also a consistent coal dust zone across the site. This as a result of the stockpiling of coal and this layer is likely to be thicker in former coal storage areas of the site. The coal dust layer can be recognized by its blackened colour and the presence of large coal particles. The coal wharf was used for "coaling" of steam ships in the 18 and 1900s.

Evidence of other human activity is also visible in the shallow subsurface where a crushed red brick layer was identified beneath the asphalt pavement.

Figure 6.1-7. The eastern portion of the site is described by Calcareous Marl layer – made ground (approx. 15cm) with blackened/grey sand and gravel layer at depth (>20cm).

Figure 6.1-8. Western portion of the site is characterised by grey sands and gravels to approx. 0.8m followed by a mixture of soil and coal dust layer at depth. Standing groundwater at 3m depth in the background.

6.1.3 Hydrology

This section analyses the hydrological characteristics of the project area. This section looks specifically at any surface water courses (rivers, streams, and channels) running through the property or located within the vicinity of the site, underlying aquifers and any historical water quality issues.

There are no rivers or streams running through or located in the vicinity of the site. All drainage at the site is natural meaning there are no designed areas to channel and concentrate runoff to a specific channel. There is no municipal drainage that passes through or close to the site. Runoff either percolates into the subsurface or discharges into the sea.

Pre- and post-development runoff calculations (**Table 6.1-1**) indicate that the percentage change in runoff post-development is 125%. This increase is largely due to the majority of the site changing to hard standing (e.g. pavements, roofs etc.) to accommodate the development. This increase can be easily mitigated by undertaking sustainable urban drainage (SUDs) design which use a sequence of techniques such as source control (e.g. roof runoff reused for irrigation or directed to soak-away or rain gardens), infiltration at source (e.g. infiltration trenches around paved areas or permeable pavements mimic natural recharge allowing runoff to soak in to the ground). Where runoff is from areas with potentially deleterious chemicals etc. runoff should be pre-treat to remove pollutants before discharge to the subsurface. Overall a simple 3 point approach method to SUDs can easily mitigate the 125% increase in runoff. The project engineers will need to design a SUDs system that considers everyday rain (80% of the rain volume), storms (19% of all rain volume) and cloudbursts (1% of rain volume) rather than focusing drainage designs on only one type of rain event.

Proper incorporation of SUD design can mitigate most negative impacts posed by uncontrolled runoff.

Table 6.1-1. Pre- and Post-Development Runoff Calculations.

Project: Port Royal Terminal				
Location: Port Royal. Old Coal Wharf				
Client: TEMN				
Date: April 2019				
Rational Equation				
Q=0.00278 CIA	Metric units			
Q=1.008 CIA	SI units			
Where,		Explanation		
Q = peak runoff rate (cfs, m^3/s)				
C = runoff Coefficient from Table in Sheet 2	0.9	Industrial Area runoff co-efficient for FAA method		unitless
I = average rainfall intensity (in/hr, mm/hr)	47	FAA method calculated time of concentration (t_c)		mm/hr
A = the drainage area (acres, hectares)	4	Site drainage area		hectares
Pre-development	**10 year return**			
C (75% treees & brush and 25% hardstanding)	0.4			unitless
I	47.0			mm/hr
A.	4			hectares
Conversion factor	0.00278			
Calculated Peak Discharge, Q	0.21			m^3/s
TOTAL	0.2	m^3/s		
Post-development	**10 year return**			
C (100% hardstanding)	0.9			unitless
I	47.0			mm/hr
A	4			hectares
Conversion factor	0.00278			
Calculated Peak Discharge, Q	0.47			m^3/s
TOTAL	0.5	m^3/s		
Percentage change	125%			

The hydrostratigraphic map (**Figure 6.1-9**) describes the subsurface as an Alluvium Aquifer. There are no notifications of contamination; however, the groundwater is likely to be brackish due to tidal influence. Soil and groundwater contamination with metals (mercury, nickel etc.) and other organics (aromatics and PAHs) is probable given that the site was used for coaling of steam ships. The use of coal tar for waterproofing is also an activity linked to coal storage and dockyards of the historic past.

Groundwater was encountered across the site and static groundwater will be deeper (approximately 3m) on the western portion of the site, possibly due to thick ground cover, and shallow to the east (approximately 0.5m). Principal groundwater direction, if present, would be toward the sea at all times. No groundwater maps exist for the location. An iridescent film was noted on exposed ground water in trenches at the site, however, it is unclear if these films are due to humic soils or introduced contaminant from the recent heavy equipment activity.

Figure 6.1-9. Hydrostratigraphic map indicating the site as an "Alluvium Aquifer" (light blue polygon).

6.1.4 Meteorology and Air quality

6.1.4.1 Meteorology

Meteorological data was obtained from the Meteorological Service station at the Norman Manley International Airport. A dataset of at least one year was used to develop a wind rose for the project site and provide a statement on current meteorological conditions at the site. The wind rose for the site is shown in **Figure 6.1-10** is the output wind rose.

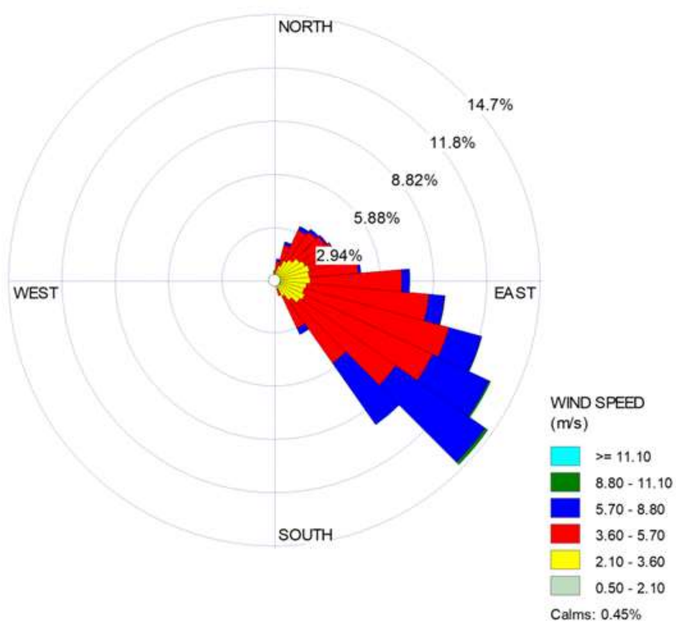

Figure 6.1-10. Wind Rose for MM5 Data 2013-2017 for Pseudo Meteorological Station.

6.1.4.2 Air Quality

POLLUTANTS

The pollutants modeled are SO_2, NO_2, CO, and PM_{10}. The rates of emission are presented in **Table 6.1-2**. **Table 6.1-3** summarizes the full emissions inventory for the facility for annual estimated emissions. Emission source data used in the model are shown in **Table 6.1-4.**

Table 6.1-2. Estimated Emission rates for boilers using HFO.

Small Boiler (4.3t/p)								
FUEL	**SCC**	**POLLUTANTS**	**Emission Factor (kg/L)**	**Max throughput (L/hr)**	**Max annual operating hours**	**Max Annual Emissions tonnes/yr**	**Max Annual Emissions tonnes/yr for four waste heat boilers**	**Hourly Emissions g/s**
HFO	01-02-004-02/03	PM Particulate Matter Filterable	0.00369	470.6	2496.0	4.3	17.4	1.9
HFO	01-02-004-02/03	Sulphur Dioxide (SO2)	0.05652	470.6	2496.0	67.9	271.5	30.2
HFO	01-02-004-02/03	Nitrogen Dioxide (NO2)	0.00660	470.6	2496.0	7.8	31.0	3.5
HFO	01-02-004-02/03	Carbon Monoxide (CO)	0.00060	470.6	2496.0	0.7	2.8	0.3
HFO	01-02-004-02/03	Total Organic Compounds (TOC)	0.00012	470.6	2496.0	0.1	0.6	0.1

Table 6.1-3. Annual Emissions Inventory facility.

Category	Pollutants	tonnes/yr
CRITERIA POLLUTANTS	Particulate Matter	17.35979
	Sulphur Dioxide	271.4758
	Nitrogen Dioxide	31.0097
	Carbon Monoxide	2.819064
ORGANIC COMPOUNDS	Total Organic Compounds	0.586365
GREEN HOUSE GASES	Nitrous Oxide	0.298821
	Carbon Dioxide	12403.88
PRIORTY AIR POLLUTANTS/HEAVY METALS	Arsenic	0.000744
	Barium	0.001449
	Beryllium	0.001567
	Cadmium	0.000224
	Chloride	0.195643
	Chromium	0.000476
	Chromium VI	0.00014
	Cobalt	0.003394
	Copper	0.000992
	Fluoride	0.02103
	Lead	0.000851
	Manganese	0.001691
	Mercury	6.37E-05
	Molybdenum	0.000444
	Nickel	0.047642
	Phosphorous	0.005334
	Selenium	0.000385
	Vanadium	0.017929
	Zinc	0.016407

Table 6.1-4. Emission source data for all sources used in model.

Type	ID	Desc.	Base Elev	Height	Diam	Exit Vel	Exit Temp	Release Type	UTME	UTMN
			[m]	[m]	[m]	[m/s]	[K]		[m]	[m]
POINT	**B1**	**BOILER1**	**3.07**	**60**	**0.381**	**12.2**	**460**	**VERTICAL**	**305419.4**	**1984800**

BACKGROUND CONCENTRATIONS

The results of monitoring of Sulphur Dioxide, Nitrogen Dioxide, PM10 and TVOCs are presented below in **Table 6.1-5**.

Table 6.1-5. Results of passive and ambient onsite monitoring.

Sample_ID	UTME	UTMN	SO2 µg/m3	NO2 µg/m3	PM10 (µg/m3)	T°C	RH %	TVOC (µg/m3)
PR1 17/3/19	305473.1	1984685	6.5	28.2	36	26.9	76	248
PR2 17/3/19	304829.5	1984431	7.6	41.4	21	24.5	88	229
PR2A 17/3/19			11.5	32.0				
PR1 18/3/19			5.6	35.7				
PR2 18/3/19			4.3	37.6				

The results of the background analysis are shown in the **Table 6.1-6**. The pollutants which background was determined are PM_{10}, SO_2 and NO_2. CO was left as zero as information on this pollutant is yet to be adequately gathered by NEPA.

Table 6.1-6. Background concentrations developed form ambient monitoring data 2013 to 2017.

Pollutant	AVG. TIME	Background Conc. (ug/m3)	NEPA Recommended Values
Sulphur Dioxide (SO_2)	1hr	65.8	0
	24hr	50.6	0
	Annual	7.09	0
Nitrogen Dioxide (NO_2)	1hr	36.9	0
	Annual	36.9	0
Particulate Matter (PM_{10})	24 hr	34.84	20
	Annual	34.84	14
Particulate Matter ($PM_{2.5}$)	24hr	0	N/A
	Annual	0	N/A
Carbon Monoxide (CO)	1hr	0	0
	8hr	0	0

DISPERSION MODEL EXERCISE RESULTS

The Input files created by auxiliary programs were used to perform runs for Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Volatile Organic Compounds (VOC) and Particulate Matter less than 10 Microns (PM_{10}). A summary of the maximum average concentrations at the averaging periods related to the JAAQS is shown in **Table 6.1-7**. All runs were conducted using the averaging times that correspond to the JAAQS. Background concentrations were taken from the Ambient monitoring done onsite and NEPA monitoring data from station located in KMA. The Graphical display maps overlaid on Google Earth are shown in **Appendix 13.9 –Dispersion Model Maps**. These maps show clearly the concentration contours and indicate the location of the maximum predicted concentrations in relation to communities and business in the air shed.

Table 6.1-7: Summary of highest predicted concentration Fallout from the Pier.

				SHIP EMISSIONS	COORDINATES	
Pollutant	**AVG. TIME**	**Background Conc. (ug/m3)**	**JNAAQS**	**MAX MODEL PREDICTED CONC (ug/m3)**	**UTME**	**UTMN**
Sulphur Dioxide (SO_2)	1hr		700	599.2204	300488.34	1985906.45
	24hr	50.6	365	72.57065	305181.00	1984489
	Annual	7.09	80	23.97603	304544.38	1984910.15
Nitrogen Dioxide (NO_2)	1hr		400	102.59164	300488.34	1985906.45
	Annual	34.96	100	36.89839	304544.38	1984910.15
Particulate Matter (PM_{10})	24 hr	34.84	150	39.69036	300488.34	1985906.45
	Annual	34.84	50	35.91878	304544.38	1984910.15
Carbon Monoxide (CO)	1hr	0	40000	6.63806	300488.34	1985906.45
	8hr	0	10000	2.34908	300488.34	1985906.45
Volatile Organic Compounds (VOC)	1hr	0		239.87851	300488.34	1985906.45
	Annual	0		238.53633	304544.38	1984910.15

Table 6.1-8 shows the calculated significant impact level based on the modelled concentrations that the ships would contribute. This table clearly shows that all pollutants released by the ships do not have a significant impact on the Air shed.

Table 6.1-8. Maximum Impact & Significant Impact Level of ships.

Pollutant	AVG TIME	Significant Air Quality Impact conc. (ug/m3)	Calculated Significant Impact Level ships (ug/m3)
Sulphur Dioxide (SO2)	1hr		
	24hr	80	22
	Annual	20	17
Nitrogen Dioxide (NO2)	1hr		
	Annual	20	1.93
Particulate Matter (PM10)	24 hr	80	4.85
	Annual	20	1.07

6.1.5 Noise

At the fence line between the proposed development site and the Caribbean Maritime University / Admiralty House, equivalent continuous sound level or the time-average sound level (Leq) was 50.4dB for the 24-Hr period from midnight to midnight, March 17th. Noise measurements ranged from 31.1 dB to 84.4 dB, as shown in **Table 6.1-9** and **Figure 6.1-11.** The average maximum Leq dB (A) was experienced at around 18:15 hours on Sunday. The sound level exceeded 90% of the time (L90) also known as the baseline was 37.4 dBA. These compare to the residential standard of 55dB during the daytime, 5odB during the night time and the commercial standard of 65dB during the day time and 60dB at night.

Table 6.1-9. Noise Results, March 17, 2019.

Site	Noise Metrics (dB)							
	Leq	**L1.0**	**L5.0**	**L10.0**	**L50.0**	**L90.0**	**Lmin**	**Lmax**
OCW	50.4	58.4	53.1	50.5	41.6	37.4	31.1	84.4

KEY FOR TABLE 6.1.11

Leq = average noise level

L1 = volume exceeded 1% of the time

L10 = volume exceeded 10% of the time

L50 = volume exceeded 50% of the time

L90 = volume exceeded 90% of the time

Lmin = minimum volume recorded

Lmax = maximum volume recorded

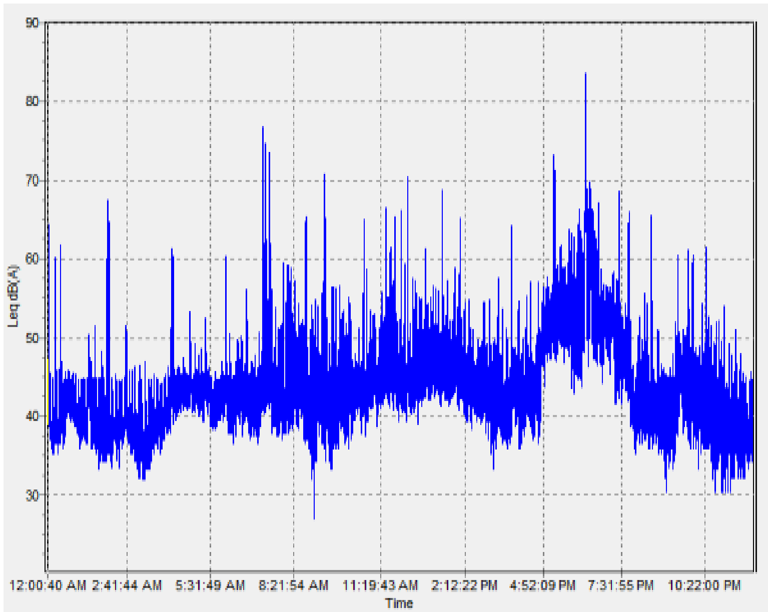

Figure 6.1-11. Noise Data log for the Old Coal Wharf, March 17, 2019.

6.1.6 Potential Hazards

6.1.6.1 Seismic Hazards

According to the recent seismicity records from the Earthquake Unit of University of the West Indies, and **Figure 6.1-12** the site is located in an area that has experienced two of the most devastating earthquakes in Jamaica's recorded history:

1. June 7, 1692 Maximum Modified Mercalli Intensity of X
2. August 14, 1907 Magnitude of 6 to 6.5

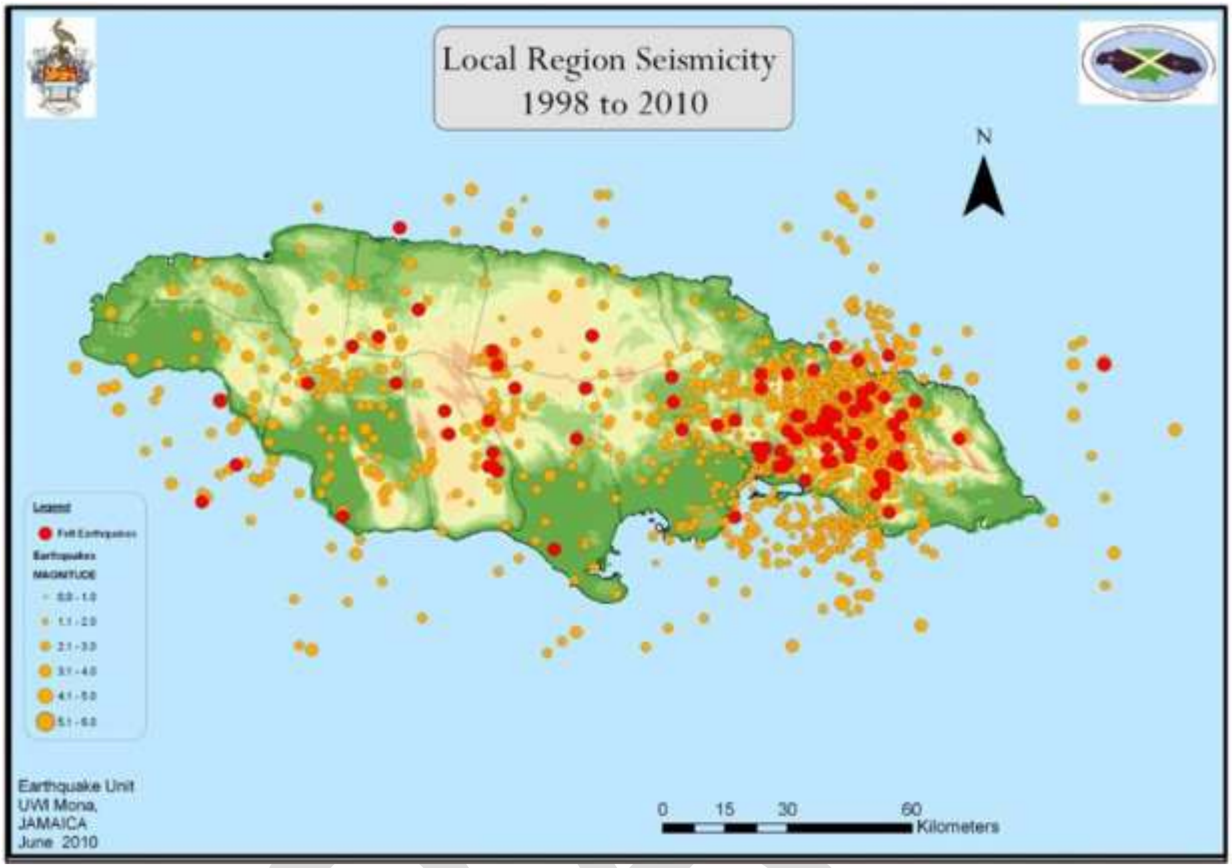

Figure 6.1-12. Local Region Seismicity 1998 to 2010.

Earthquake studies have shown earthquakes were not associated with surface rupture along the main fault. Consequently, it is estimated that these faults have accumulated at least 2m of slip deficit (Koehler et. al 2013). It is assumed that the deficit was released as a single event; this would amount to a magnitude 7 to 7.2 event. Underwater surveys in eastern Kingston Harbour (Hornbach et al 2011) indicate evidence of active faulting, recent slumping and liquefaction across the harbour (**Figure 6.1-13**). An active offshore fault was identified that continue on-land beneath Long Mountain.

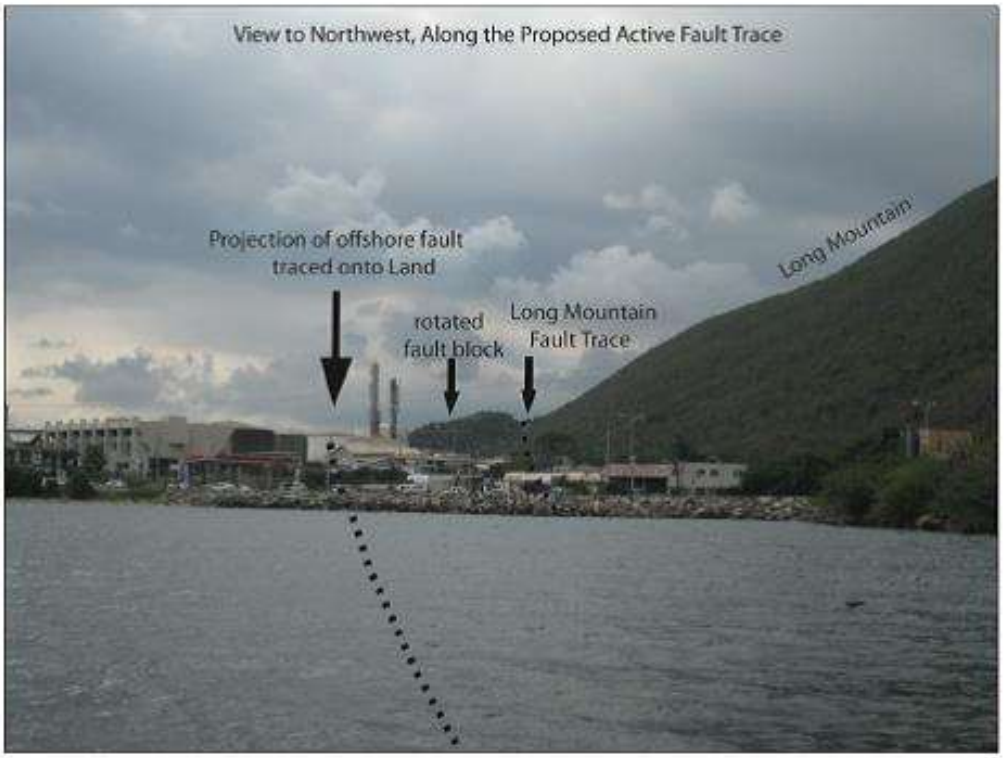

Figure 6.1-13. Photograph from Hornbach et al (2011) showing the trace of the identified offshore fault (black dashed line).

Table 6.1-10 lists earthquakes that have affected Port Royal and the Palisadoes up to 1993.

Table 6.1-10. From Ahmad & Masson, 2008 and Wiggins-Grandison, 2004, listing earthquakes that impacted Port Royal. MMII – Maximum Modified Mercalli Intensity; M= magnitude. Note MMII or magnitude of the pre-1993 events are based on historical descriptions in archives not actual measurements of ground motion.

Year	Date	MMI or M	Effects
1677		V	
1688	March 1	VII	Ships and houses in Port Royal were “much injured”.

1692	June 7	X	The “Great Port Royal Earthquakes”: significant damage, many buildings collapsed, roads inundated, about 2,000 people killed, widespread failure of water saturated unconsolidated sands.
1762	November 6	VI	
1766	June 11	VI	Felt in Port Royal.
1771	September 3	VII-VIII	Felt in Kingston and Port Royal, some damage to structures.
1787	Sept. or Oct.?	IV	
1814	May 12	V	
1824	April 13	V	
1907	August 14	M6 to 6.5	1,000 people killed, 85% of buildings destroyed or affected, significant liquefaction and lateral spreading in particular in Port Royal, widespread fires.
1914	August 3	VI-VII, M6	Felt all over the island, produced numerous landslides, buildings cracked.
1936	May 27	IV	
1941	November 6	III-IV	
1945	January 11	V	
1957	March 1	VII	Break off of a 180×2.5 m beach stretch into the sea at Port Royal
1965	August 20	IV	
1993	January 13	VII, M5.4	Woodford earthquake, two dead, weak building collapsed, reinforced engineering building suffered some damage, submarine landslide.

Due to the unconsolidated sediments and shallow groundwater table leading to saturated soils, ground motion will be amplified resulting in ground failure, liquefaction, mud/sand volcanoes, lateral spreading and soil slumping (potentially into the ocean), as shown in **Figure 6.1-14.**

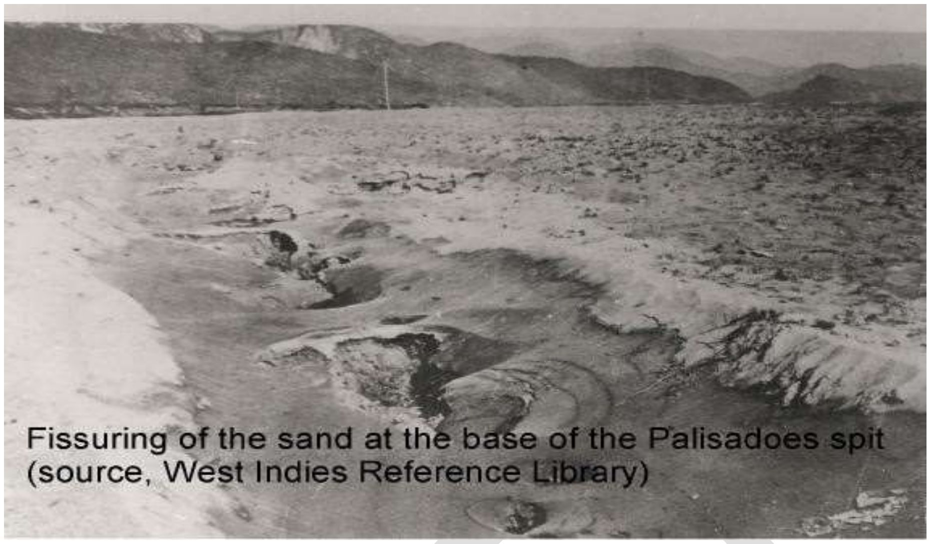

Figure 6.1-14. Sand fissures after 1907 earthquake due to liquefaction at the eastern end of the Palisadoes

The anticipated 0.2 and 1.0 second maximum ground acceleration for a seismic event that has a 2% probability of exceeding the limit in 50 years is shown in **Figure 6.1-15**. Microzonation maps are available from the Earthquake Unit.

Given the above, it is very likely that the proposed development will experience problems associated with seismicity in the future and appropriately designed earthquake-resistant structures, based on the site-specific soil conditions must be undertaken for the project.

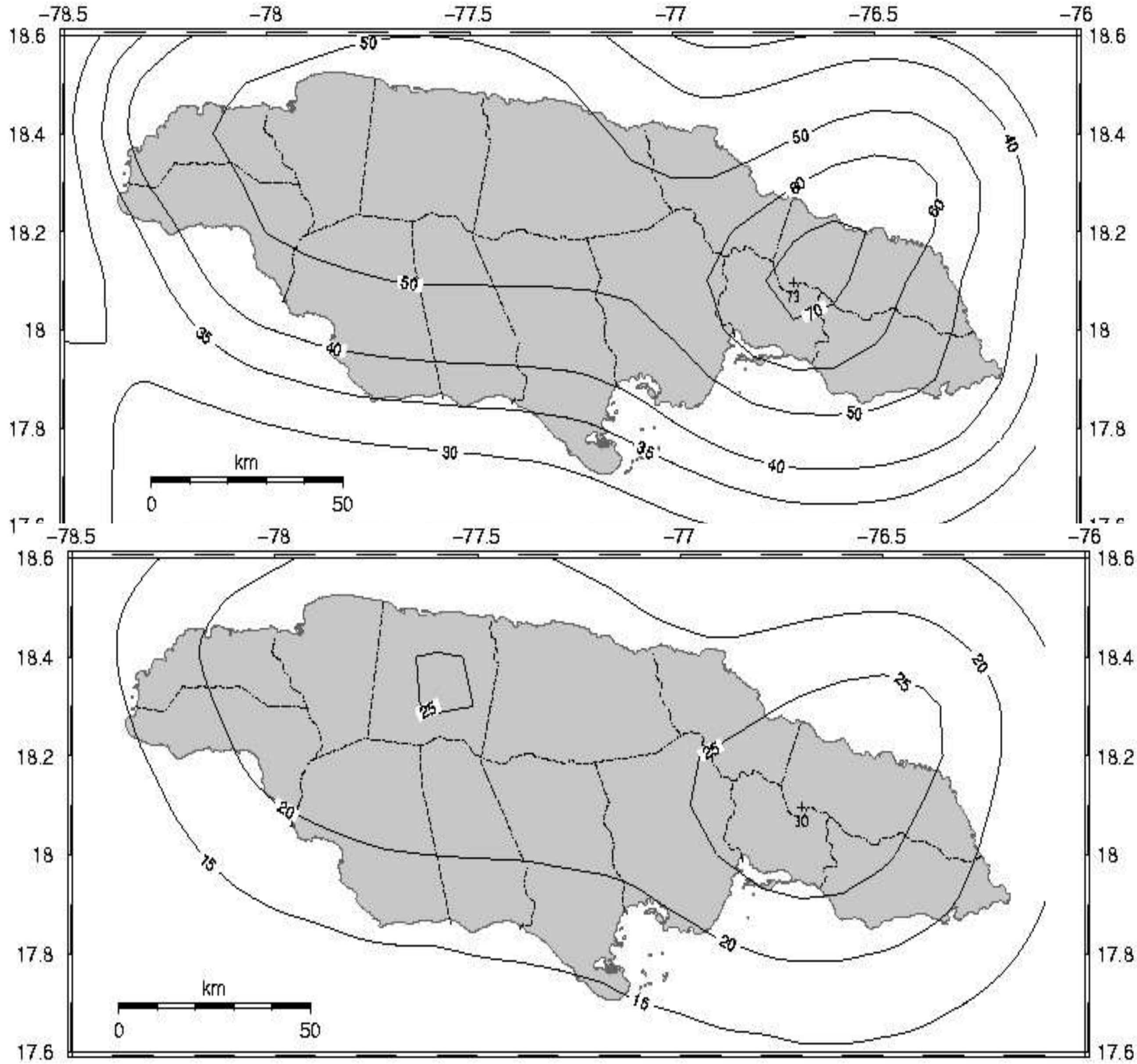

Figure 6.1-15. Seismic hazard map of Jamaica showing the anticipated acceleration in average rock with a 2,475 year return showing Spectral Response Acceleration of 0.2 second (top) and 1.0 second (bottom) expressed as a percentage of gravity.

6.1.6.2 Hurricane Hazard

The frequency of hurricanes is nearly an annual occurrence in Jamaica and the Caribbean. But despite this, its frequency of occurrence for Jamaica remains low, especially when considering catastrophic events.

In 2009 a hurricane risk assessment was undertaken for Jamaica using a probabilistic model (IDB Catastrophic Risk Profile: Jamaica, April 2009) the results of that study are reproduced in **Figure 6.1-16**. This image considers all historical trajectories and shows the maximum hurricane wind velocity maps for different return periods.

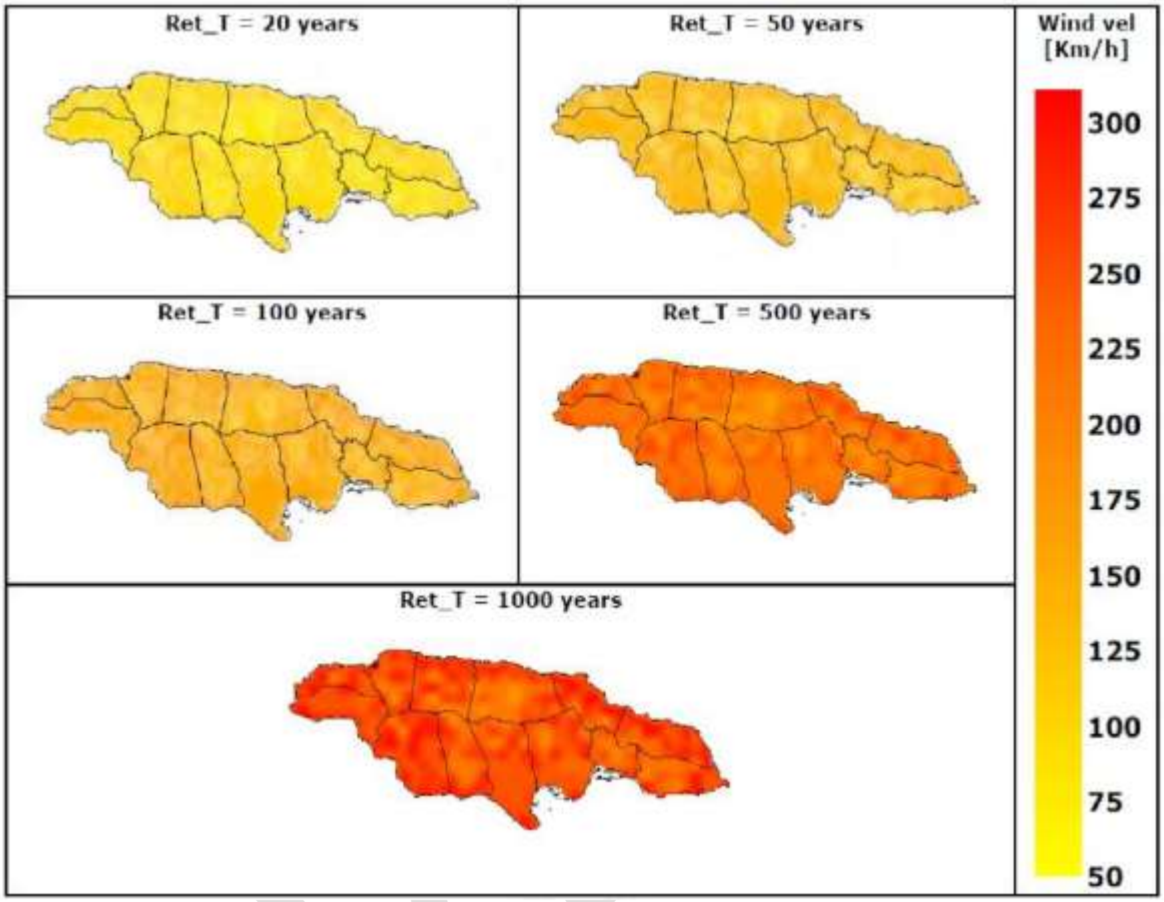

Figure 6.1-16. Maximum wind velocity maps (km/h) for different return periods (IDB 2009 Report).

In the recent past hurricane Ivan caused tremendous damage to the sand dunes and coastal vegetation on the Palisadoes. It is reported that storm surge was at least 2m above is daily maximum (Marine Geology Unit, Jan 2005). The storm also rendered the Palisadoes roadway impassable due to mounds of sand and debris transported by the storm surge. Historically the 1722 hurricane whose eye is reported to have passed over Port Royal caused severe damage with storm surges as high as 5m (16ft). It is also reported that this storm breached the Palisadoes tombolo, just north of the airport, making Port Royal an island again. It is reported that of the 50 vessels that were in port only four souls within those vessels were spared (History of Hurricanes and Floods in Jamaica, undated ODPEM report).

Designs for structures such as roofs will need to incorporate traditional West Indian hip roofs which have no overhangs and the rafters stop at the end of the walls and are appropriately anchored. This greatly reduces the potential for winds to get under eaves/overhangs and lift the roof off. The design philosophy to mitigate the hurricane hazard needs to be guided by local and Caribbean experience to ensure that all buildings have hurricane and storm damage reduction systems as integral to its design.

6.2 Biological Environment

6.2.1 Background

The project area is located within the Palisadoes-Port Royal Protected Area (P-PRPA) which is approximately 7,523 hectares (75.23 km^2) and consist both terrestrial and marine areas (NEPA 2013).

The Palisadoes - Port Royal area is a unique ecological area encompassing numerous cays, shoals, mangrove lagoons and islands, coral reefs, seagrass beds, sand dunes, and beaches. After being declared a Protected Area in 1998[11], it was also designated a 'Ramsar Site'[12] in 2005. The Port Royal area is known for its extensive mangrove stands, large expanses of seagrass and serves as a habitat to a number of endemic species some of which are listed as endangered on the IUCN Red List (2004) (See **Section 6.2.1-Ecosystem Functions).**

[11] Palisadoes Port Royal was designated a Protected Area under the Natural Resources Conservation Authority Act (NRCA)

[12] A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention on Wetlands, known as the Ramsar Convention, an intergovernmental environmental treaty established in 1971 by UNESCO.

6.2.1.1 Port Royal- Research Studies

Kingston Harbour waters, its mangroves, seagrass habitats, and associated benthic and pelagic fauna they support, have been studied extensively since the 1960s. Primary researchers (Wade 1976) documented the nutrient status of the harbour waters, which even at that time, were regarded as heavily polluted. Wade (1976) observed that in excess of 25 million gallons per day of raw sewage were entering the harbour from the various rivers and gullies that received input from light industry, business places, residential areas and sewage treatment plants on the northern and western sections of the harbour that in many instances produced highly polluting effluent. Solid waste in the Harbour waters remains a serious issue to this day.

The Port Royal mangrove complex covers >100 ha and is used primarily for fishing and as a shelter during hurricanes. One of the first known studies of fish communities in Kingston Harbour, in direct relation to turtle grass beds, was the work of Greenway (1973). Greenway produced the first studies on turtle grass productivity in Kingston harbour and commented on fish species associated with the seagrass areas near Port Royal. Aiken et al. (2008) found that a high percentage of fishes taken by the Harbour fishery were dominated by juveniles from the benthic herbivore and benthic carnivore feeding guilds. They originated from mangrove nurseries within the harbour that also functioned as refugia for invertebrates (crabs and urchins). They regard mangroves as critical in sustaining the stability and health of the food chains in the Port Royal area and possibly the entire harbor.

Authors, including Goodbody (2003), Warner (1967), and Creary (2003) have respectively done ground breaking work on the populations of ascidians, mangrove tree crabs and bryozoans in the areas mangroves. Goodbody also noted that with its small tidal range, wave and wind action are more important than tidal fluctuation as factors that affect sessile communities. He references the recovery of mangroves subsequent to annual, rainy season, deluges of freshwater from north shore point sources in the harbour as proof that its sessile community is still highly resilient, at least with respect to this impact.

The use of phyto- and zooplankton as indicators of pollution trends in Kingston has been put forth by Lui et al. (2014), Webber et al. (2003). Green and Webber (2003) suggested that being stationary, seagrass populations respond markedly and cumulatively to continued eutrophication over both time and space. Given a range of water quality conditions from the eutrophic to oligotrophic, *Thalassia testudinum* populations exhibit an increase in leaf productivity rates and leaf area in addition to a reduction in shoot density and total biomass, in response to increasing eutrophic conditions. Francis et al. (2014) found no significant improvement in the water quality of Kingston Harbour since the introduction of the treatment system at Soapberry.

Most recently Webber et al. (2019) have pointed to the association between the degradation of the harbour and the mangroves it contains, and the heavy load of solid waste entering the harbour. They include an examination of ways and means to use natural and human capital stock associated with the harbour to propel its recovery and the sustainable prosperity of which the area is capable of creating.

6.1.7 Water Quality

The water quality data are summarized in **Table 6.2-1** .

Turbidity was low at all sites (2NTU - 5NTU) with the lowest level determined in the mangrove lagoon (W4). At the development site (WQ2) and to the west of the development site (WQ1), turbidity was 5NTU at the surface and 3NTU at the bottom. East of the development site turbidity was 3NTU at the surface and 5NTU at the bottom of the water column. These values compare to a value of 29NTU that is frequently set by NEPA as a performance standard for during construction.

Biological Oxygen Demand (BOD) was in the range 0.11mg/l to 0.72mg/l. BOD was lowest in the mangrove lagoon (WQ4) and highest west of the proposed development site (WQ). In the vicinity of the Old Coal Wharf, BOD was 0.40mg/l and 0.29mg/l at WQ2 and WQ3 respectively.

Dissolved oxygen was in the range 2.5mg/l to 5.48mg/l at all sites. DO was lowest at WQ4 (mangrove lagoon) and highest in the vicinity of the proposed development site (WQ2). In an optimum situation, dissolved oxygen is at or close to its saturation value (100%) with a zero deficit. The introduction of organic load uses up oxygen, creating a deficit which increases as the organic load increases. The deficit at all marine sites was in the range 12.92% to 20.52% indicating a measurable organic load. DO nevertheless satisfied the USEPA criteria for salt water. In the mangrove lagoon (WQ4) DO was 2.5mg/l at the surface and 2.6mg/l at the bottom of the water column. These levels were well below the USEPA salt water standard and represented a significant deficit (61%).

Phosphate was below the test detection limit (<0.02mg/l) for the marine sites (WQ1 to WQ3) and .08mg/l at the site in the mangrove lagoon.

Table 6.2-1. Water Quality Data.

Sample ID	Top/ Bottom	TIME	DEPTH (m)	Location		SAL (ppt)	TURB (NTU)	TEMP. (C)	BOD	DO (mg/L)	DO Sat	DO Deficit	pH	NO3	o-PO4 (mg/L)	FC (MPN/ 100ml)	Oil and Grease (mg/L)	TPH (mg/L)	TSS
				N (180)	W (770)														
WQ1	T	10:19 AM	4.33	17.9412	-76.84050	40.0	5	27.6	0.72	5.37	6.31	14.84	8.0	0.6	0.02	<1.8	5.2	-	
	B					40.0	3	27.5		5.30	6.32	16.08	8.0						
WQ2	T	10:00 AM	4.30	17.9423	-76.8381	33.3	5	27.4	0.40	5.22	6.57	20.52	8.0	0.6	<0.02	<1.8	25.2	0.80 ± 0.1	
	B					34.4	3	27.5		5.48	6.55	16.37	8.0						
WQ3	T	9:33 AM	4.27	17.9432	-76.8358	40.0	3	27.3	0.29	5.30	6.34	16.36	8.0	0.6	<0.02	<1.8	59.3	0.70 ± 0.1	
	B					40.0	5	27.5		5.50	6.32	12.92	8.0						
WQ4	T	8:53 AM	0.58	17.9432	-76.8284	33.8	2	27.3	0.11	2.50	6.56	61.89	7.9	0.9	0.08	4.5	62.2	0.80 ± 0.1	
	B					33.7	2	26.9		2.60	6.61	60.65	7.9						
GW																		0.90 ± 0.1	
Standards (1)						(2) 32–38			1.16	(3) 4.8			8.0-8.4	.007 - .014	0.001 - 0.003	<2-13			

KEY FOR TABLE 6..2-1

(1) - Standards are NRCA/NEPA Ambient Marine Standards Unless Otherwise Noted

(2) - Canadian Council of Ministers of the Environment (CCME)

(3) - EPA November 2000 Ambient Aquatic Life Water Quality Criteriafor Dissolved Oxygen (Saltwater):

Cape Cod to Cape Hateras

T - Top of Water Column

B - Bottom of Water Column

Nitrate was in the range 0.6mg/l to 0.9mg/l. Nitrate was .6mg/l for all the marine sites while in the mangrove lagoon east of the development site it was .9mg/l. These levels were all in excess of the NEPA/NRCA ambient standard for marine water.

pH was relatively uniform at all sites, being in the range 7.9 to 8.0.pH was marginally lower in the mangrove lagoon (WQ4), quite likely due to humic acids produced naturally in the mangrove habitat.

Oil and grease levels reported by the Bureau of Standards were in the range 5.2mg/l to 62.2mg/l. These levels were inconsistent with the clear appearance of the samples and the low BODs at all sites. The results suggest that insufficient precaution was taken to guard against salt interference. These readings are therefore regarded as false positives and should not be relied on as a bench mark.

Total Petroleum Hydrocarbon (TPH)

Background total petroleum hydrocarbons (TPH) were in the range .8mg/l to .9 mg/l. These levels were considered to be insignificant.

Trace Metals

Results of analyses of trace metals are presented in Table 6.2-2. The following trace metals were detected at the parts per billion level to be within the USEPA criteria for wildlife: Arsenic, chromium, copper, lead, and zinc. Mercury and tin were undetected at <.1µg/L and <2.0µg/L respectively.

Arsenic (As) was in the narrow range .84 µg/m3 to 1.00 µg/m3. These levels were well below the USEPA criterion of wildlife which is 36 µg/m3. As was highest at the site just east of the Old Coal Wharf (WQ3). At the OCW site (WQ2) as was .91 µg/m3 while at the site to the west (WQ2) As was .97 µg/m3.

Cadmium (Cd) was below the test detection limit at all sites (<.02 µg/m3). This compares to the USEPA wildlife standard for this parameter which is 7.9 µg/m3.

Table 6.2-2. Trace Metals – Old Coal Wharf Marine Environment.

Sample ID	HEAVY METALS - PPB (µg/m3)							
	As	Cr	Cd	Cu	Hg	Pb	Sn	Zn
WQ1	0.97	3.44	0.020 U	1.34	<0.1	0.822	<2.0	1.55
WQ2	0.91	3.40	0.020 U	1.52	<0.1	0.796	<2.0	1.62
WQ3	1.00	0.94	0.020 U	1.51	<0.1	0.314	<2.0	0.91
WQ4	0.84	2.68	0.020 U	1.12	<0.1	0.543	<2.0	1.09
Standards	36 (1)	50 (1)	7.9 (1)	3.1	0.94 (1)	8.1 (1)	8 (2)	81 (1)

Copper (Cu) was in the range 1.12 µg/m3 to 1.52 µg/m3 for the sites monitored. These levels are well below the USEPA wildlife criterion value of 3.1 µg/m3. Cu was highest at the OCW sampling site (WQ2) while to the east (WQ3) and lowest in the mangrove lagoon (WQ4). At the site just east of the OCW (WQ3) Cu was 1.52 µg/m3 while to the west (WQ1) Cu was 1.34 µg/m3.

Mercury (Hg) was below the test detection level (<0.1 µg/m3) in all samples taken. This compares to the USEPA criterion level of 0.94 µg/m3.

Lead (Pb) concentrations were in the range 0.314 µg/m3 to .822 µg/m3 at all sites. Lead was lowest at the site just east of OCWW (WQ3) and highest at the site just west of the OCW (WQ1). At the OCW site, Pb was .796 µg/m3 while in the mangrove lagoon (WQ4) Pb was 0.534µg/m3. These levels are an order of magnitude lower than the USEPA criterion value for wildlife which is 8.1 µg/m3.

Total tin (Sn) was below the test detection limit (<2 µg/m3) in samples taken from all sites.

Zinc (Zn) was around two orders of magnitude below the USEPA criterion level for all sites monitored. The range of Zn concentration in all samples was 0.91 µg/m3 to 1.62 µg/m3. These levels compare to the USEPA sea water criterion value for salt water which is 81 µg/m3.

6.2.2 Coastal and Oceanographic Data

The study site is located along the southern coast of Kingston Harbour, just to the east of the wide and deep entrance (**Figure 6.2-1**). A large mangrove island and its surrounding shallow water are located to the north of the project site. The mangrove island is approximately 400 m to the north and east of the project site. As a matter of fact, the project site is located at the east entrance of a secondary embayment surrounded by mangrove islands (**Figure 6.2-2**). Rather extensive shallow water distributes to the west of the main mangrove island. These surrounding mangrove islands and the associated shallow water provide wave sheltering to the project site.

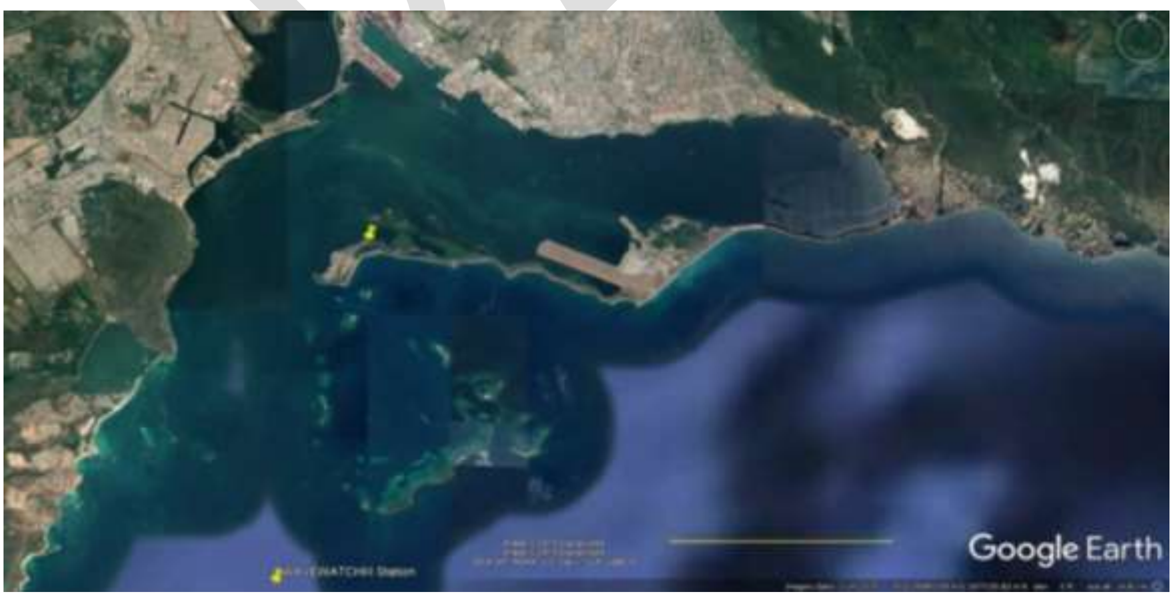

Figure 6.2-1. Port Royal study site within the Kingston Harbour. Numerical wave station is located at the bottom of the figure. Yellow line scale = 5 km.

Figure 6.2-2. Port Royal study site is located at the entrance to a secondary embayment surrounded by mangrove islands within the Kingston Harbour. Yellow line scale = 1 km.

The eastern end of the project site is bordered by mangrove trees (**Figure 6.2-3 and Figure 6.2-4**).

Figure 6.2-3. Shoreline conditions at the eastern end.

Figure 6.2-4. Shoreline conditions along the middle section.

Figure 6.2-5. Shoreline conditions along the western section.

This study examines the coastal dynamics at the Port Royal study site. Oceanographic conditions, particularly offshore wave conditions, are analysed based on computed waves by US NOAA WAVEWATCH III model. Nearshore wave conditions are investigated using the CMS-WAVE model developed by the US Army Corps of Engineers. Nearshore sediment processes are examined based on the modeled nearshore wave conditions and the analysis of present state of the shoreline. Impacts by historical tropical storms and hurricane over the past 100 years are analysed based on US NOAA's National Hurricane Center database.

6.2.2.1 Oceanographic Conditions Offshore Study Site

No long-term wave measurements are available in the greater study area. Reasonably accurate wave information can be obtained from US NOAA's WAVEWATCH III numerical model. WAVEWATCH III computes wave conditions based on meteorological data. In this study, the wave conditions computed from WAVEWATCH III are extracted from a numerical station slightly over 5 km south of the study area in deep water. The location of the WAVEWATCHIII station is shown in **Figure 6.2-1.** This is the closest numerical wave station to the study area.

Computed wave conditions by the WAVEWATCHIII model from the beginning of 2005 to the end of 2018, or 14 years, were extracted. Statistical analysis of this relatively long term wave conditions was conducted and summarized in **Table 6.2-3** and illustrated in **Figure 6.2-6** through to **Figure 6.2-12**. The waves were partitioned into 16 incident wave angle brackets, at 22.5 degrees for each bracket (**Table 6.2-3**). The average significant wave height and average peak wave period within each wave-angle bracket were calculated. The storm conditions are represented by the average of the top 2% and top 1% highest waves within a wave-angle bracket. This statistical wave information provides an overview of the wave conditions at the study site and is discussed below. Statistical wave conditions are also used as input for offshore wave conditions for the numerical wave modeling discussed in the following sections.

Table 6.2-3. Statistical wave conditions calculated from the 12-year wave data obtained from the WAVEWATCH III model. Yellow highlights indicate onshore-directed waves. The station location is shown in Figure 6.2-6.

Wave Statistics		% occur-rence	average sig H	average wave period	top 2% sig H	top 2% wave period	top 1% sig H	top 1% wave period
direction	direction		m	s	m	s		
N	348.75-11.249	0.01	0.72	2.96	1.09	2.58	1.09	2.58
NNE	11.25-33.749	0.01	0.42	2.67	0.56	3.23	0.56	3.23
NE	33.75-56.249	0.03	0.37	2.52	0.46	2.49	0.46	2.49
ENE	56.25-78.749	0.03	0.33	3.00	0.38	2.69	0.38	2.69
E	78.75-101.249	2.19	0.50	7.58	1.54	10.05	1.98	10.57
ESE	101.25-123.749	85.16	1.03	7.38	2.27	9.27	2.42	9.47
SE	123.75-146.249	10.78	1.09	7.27	2.19	9.69	2.40	10.39
SSE	146.25-168.749	0.41	0.76	5.79	4.03	10.44	5.18	10.81
S	168.75-191.249	0.56	0.89	5.74	2.57	6.76	2.70	7.12
SSW	191.25-213.749	0.52	0.64	5.46	2.16	6.88	2.25	7.03
SW	213.75-236.249	0.25	0.73	6.09	2.82	8.84	2.84	8.85
WSW	236.25-258.749	0.04	0.41	6.75	0.81	7.66	0.81	7.66
W	258.75-281.249	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	281.25-303.749	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	303.75-326.249	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	326.25-348.749	0.00	0.00	0.00	0.00	0.00	0.00	0.00

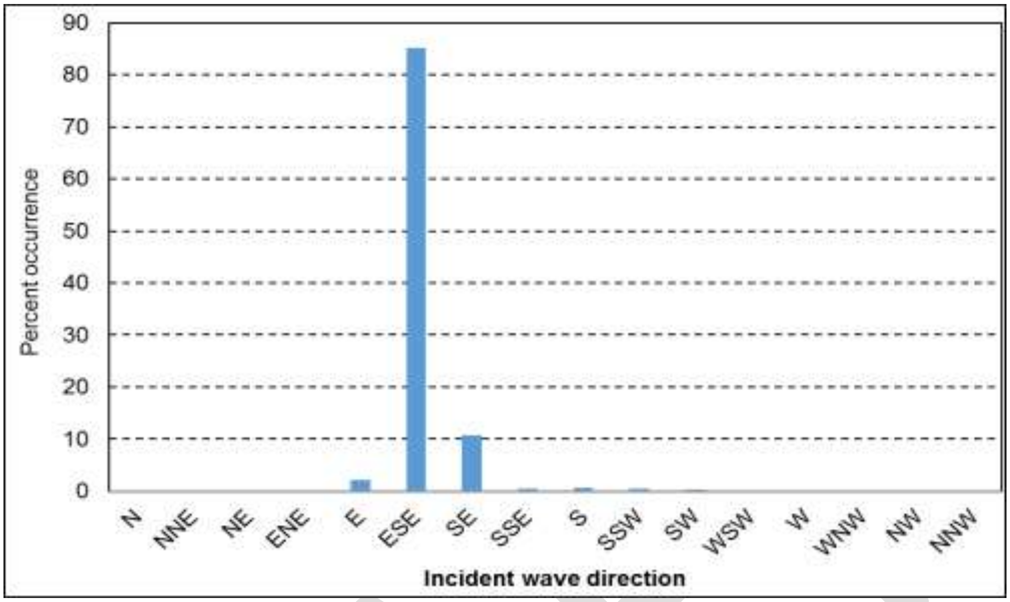

Figure 6.2-6. Frequency of occurrence of waves approaching from different directions.

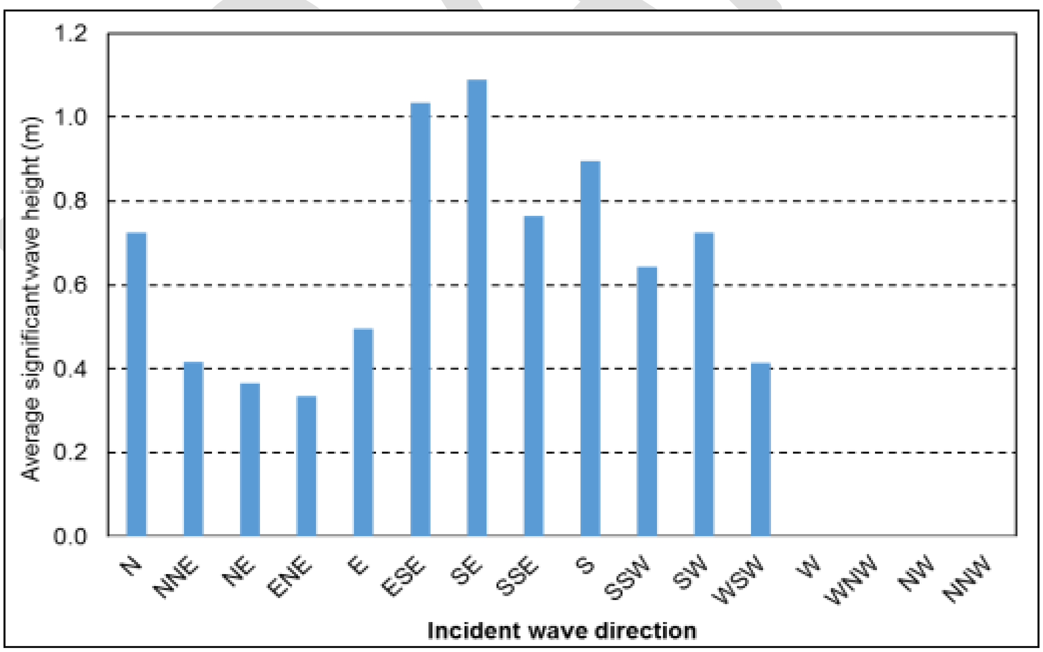

Figure 6.2-7. Average significant wave height waves approaching from different directions.

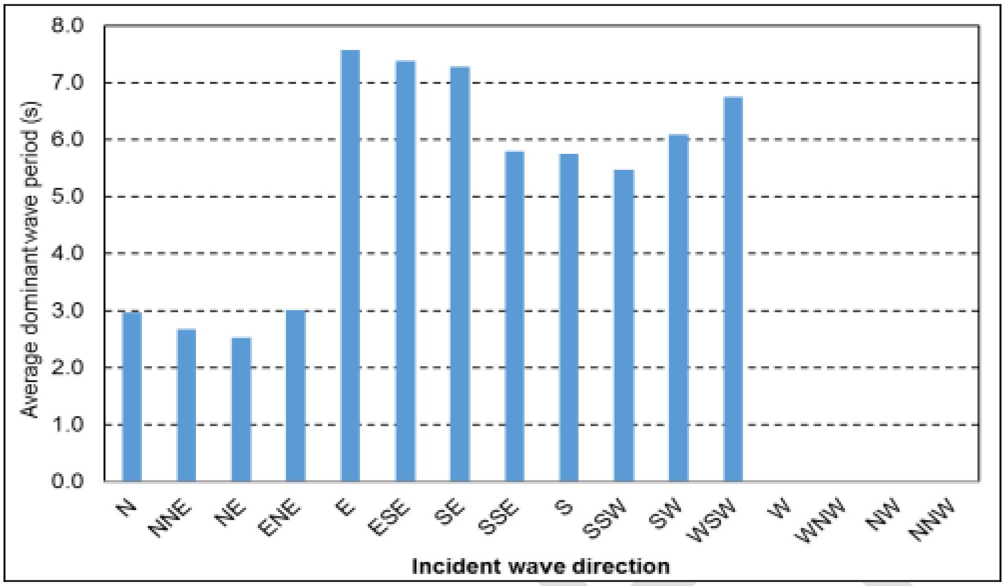

Figure 6.2-8. Average peak wave period waves approaching from different directions.

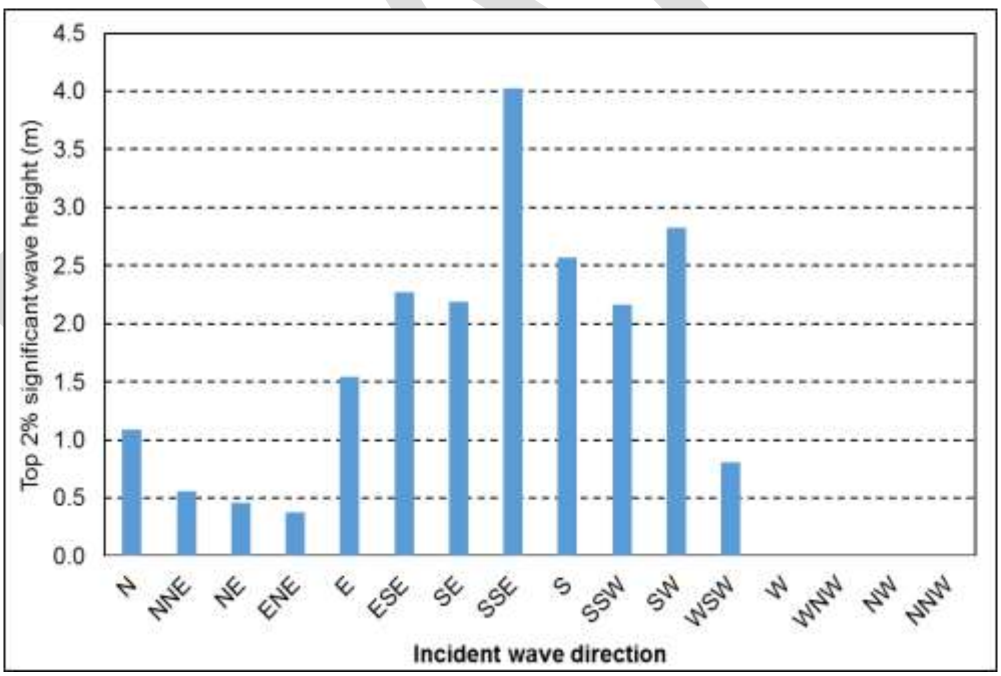

Figure 6.2-9. Average significant wave height of top 2% highest waves approaching from different directions.

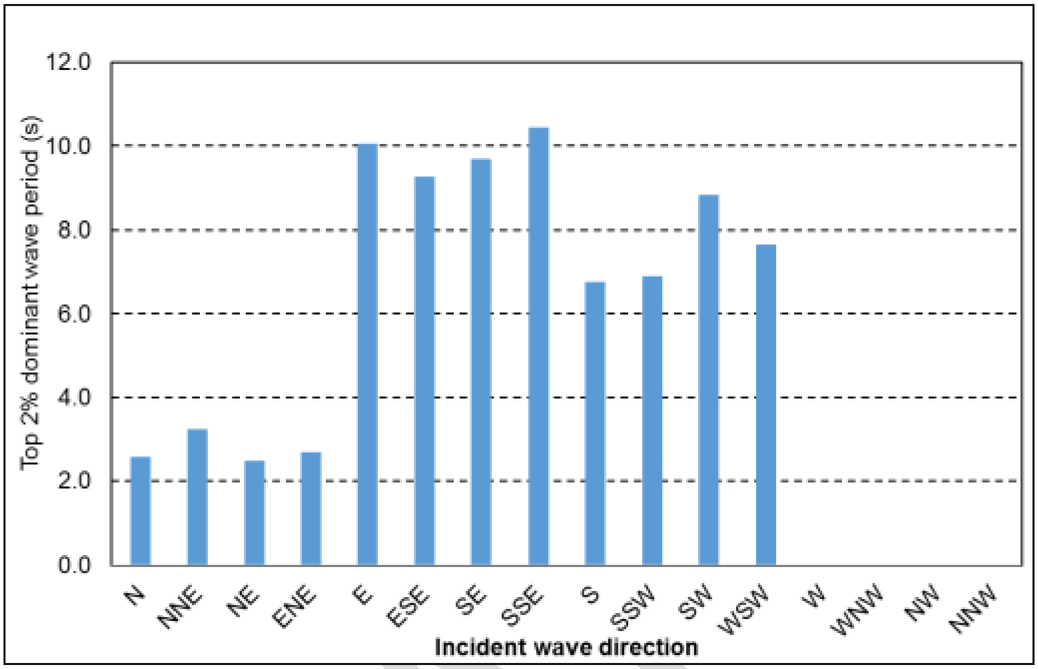

Figure 6.2-10. Average peak wave period of top 2% highest waves approaching from different directions.

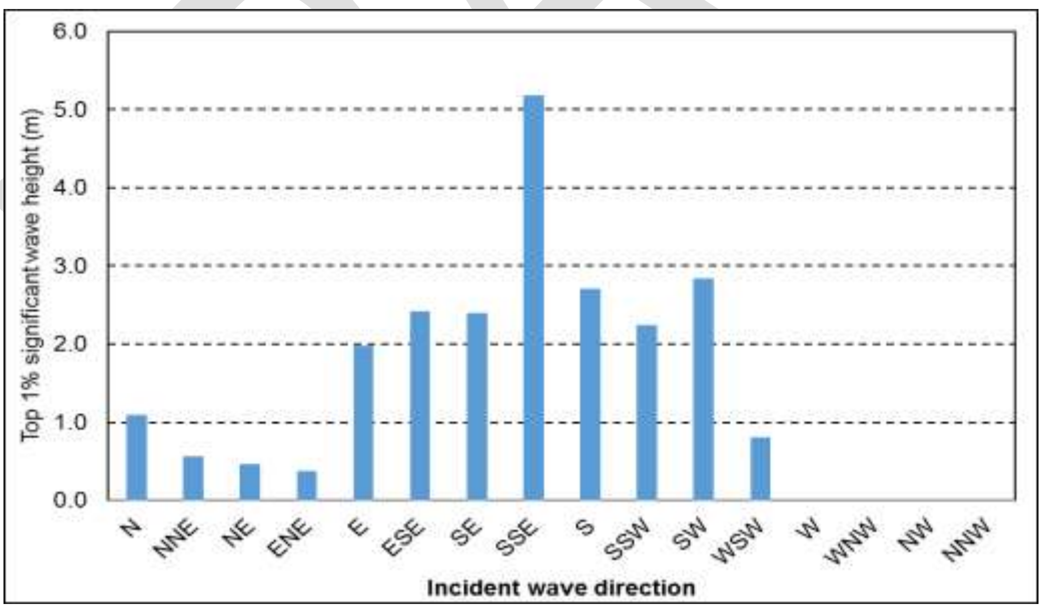

Figure 6.2-11. Average significant wave height of top 1% highest waves approaching from different directions.

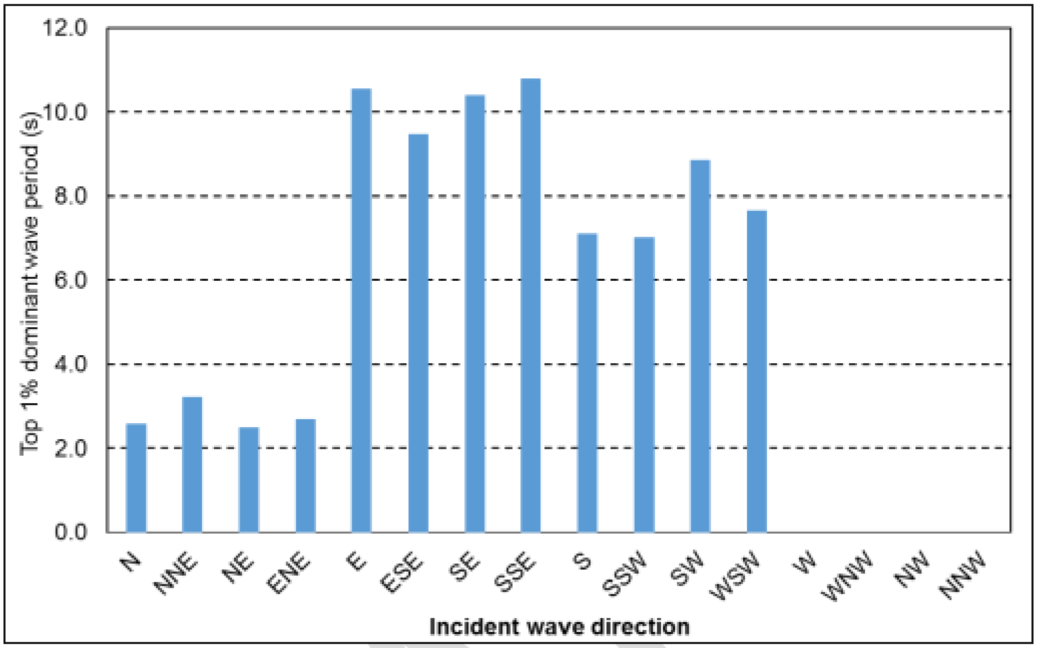

Figure 6.2-12. Average peak wave period of top 1% highest waves approaching from different directions.

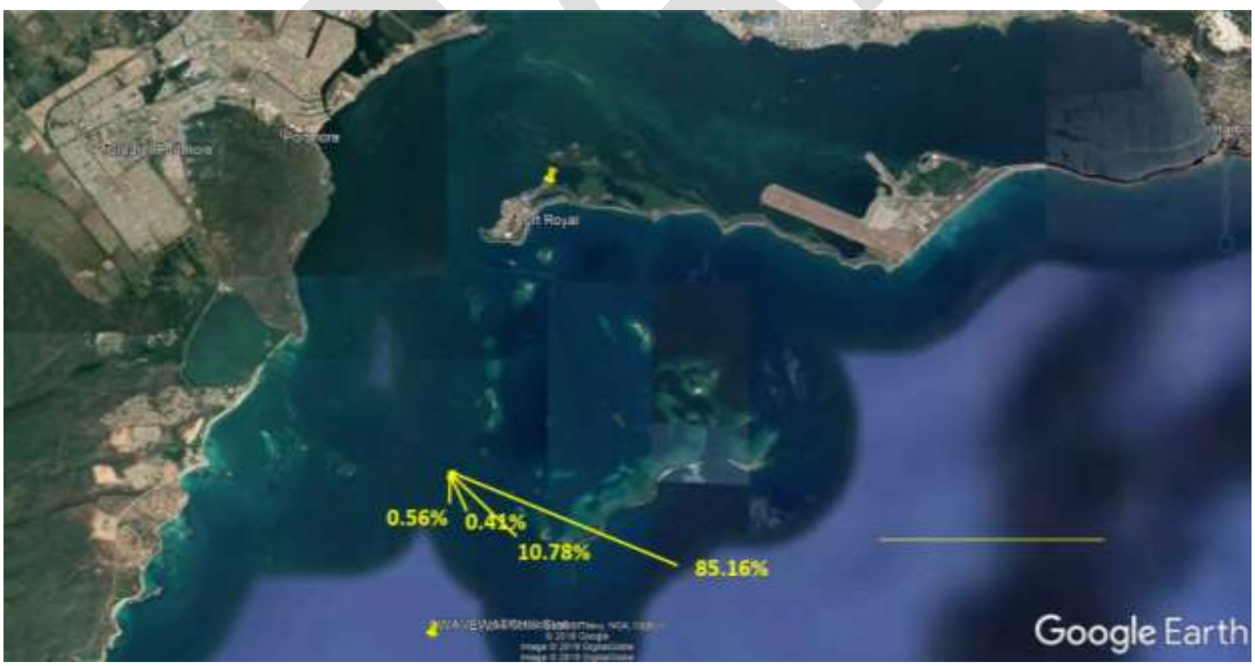

Figure 6.2-13. Most frequently occurring offshore incident wave directions.

6.2.2.2 Nearshore Wave Conditions Computed By the Cms-Wave Model

The wave fields in the project area were investigated using the numerical CMS-Wave model (http://cirp.usace.army.mil/wiki/CMS-Wave). The CMS-Wave is developed by the U.S. Army Corps of Engineers. The version that is used in this study is a Steady-state, half-plane, two-dimensional spectral transformation model using a finite-difference, forward-marching implicit scheme. Wave refraction, shoaling, reflection, diffraction, and breaking are computed. This makes the CMS-Wave an ideal model to investigate the project area with complicated bathymetry and highly oblique incident wave angle. The CMS-Wave model can use measured directional wave spectral or generate directional wave spectrum using statistical wave parameters such as significant wave height, wave period, and incident wave angle, spectral peakness, and directional spreading. Recently, wave setup and runup were added.

For this study, statistical wave conditions derived from the 14-year WAVEWATCH III data, are summarized in **Table 6.2-3** and **Figure 6.2-6** through **Figure 6.2-12**, and were used as the input to the CMS-Wave model. JONSWAP type wave spectra were generated based on statistical wave height and wave period (**Table 6.2-3**).

Wave propagation pattern in the nearshore area is significantly influenced by nearshore bathymetry (**Figure 6.2-14**).

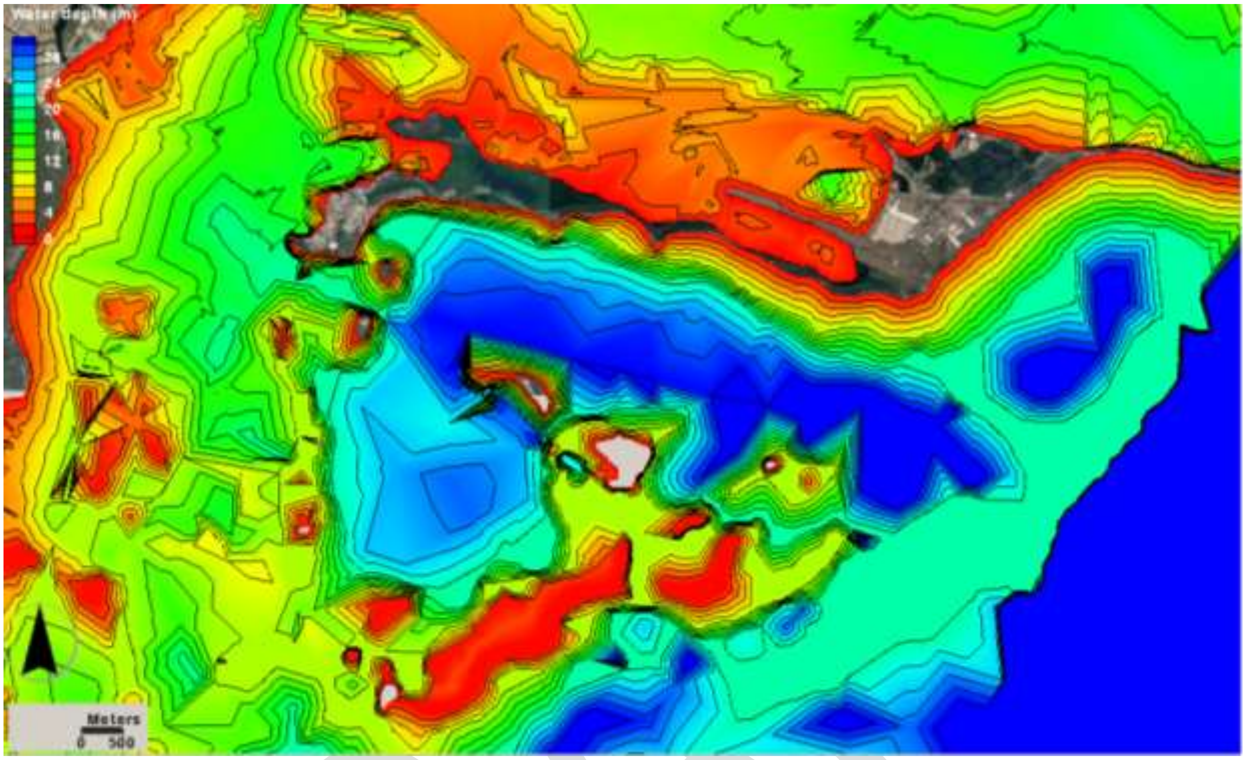

Figure 6.2-14. Nearshore bathymetry at the entrance to the Kingston Harbour and at the project site. The depth is referred to means sea level.

6.2.2.3 Protective Coastal Structures

The proposed coastal defence works is a rubble mound revetment along the shoreline north of Old Coal Wharf in Port Royal designed for a 100-year hurricane event as detailed in the Coastal Design Report (**Appendix 13.1.2**). The main features of the revetment are as follows:

- Revetment crest of 2.2 metres above sea level;
- A berm 2m in length and 1m above MSL;
- Recommended floor levels to be at least 2.2m above MSL;

- Armour stone sizes for the berm revetment ranges between 0.58 to 0.71m or 500 to 900kg stones with a slope of 1:1.5 and a crest width of at least $3D_{50}$ or 2m. The recommended armour thickness is $2D_{50}$ or 1.3m;
- The toe stones for the revetment range between 0.93 to 1.0m or 2000 to 2500kg.

6.2.1 Flora and Fauna

6.2.2.4 Terrestrial Flora and Fauna

The terrestrial study entailed an assessment of the flora and fauna assessment on the area for the proposed floating pier development at the Old Coal Warf site in Port Royal (**Figure 6.2-15**).

Figure 6.2-15. Location of fauna and flora assessment sites.

6.2.2.5 Flora

The plant species observed throughout the study area were categorized according to ecosystems in which they were found: wetland, beach/sand dune and shrub land/scrub forest.

- **Beach vegetation** (**Figure 6.2-16**) - Mainly sandy area between the – high and low water mark. The area varied from 2- 10 m within the project area. The beach was mainly black sand beach. Several salt and drought tolerant plant species are present in the area.

Figure 6.2-16. Beach vegetation.

- **Scrubland vegetation** (**Figure 6.2-17**) - A sparsely vegetated area that is mainly dominated by shrubs (2-8m high) including cactus. A range of plant communities is present, but large trees are restricted to sheltered areas. The main substrate is sand. Most of the plant species are adapted to flooding, wind and salinity. It should be noted that the scrubland areas in the proposed project have been impacted by human activity over the years.

Figure 6.2-17. Scrubland vegetation

- **Wetland- Mangroves and Salinas (Figure 6.2-18)**-. This includes the mangroves within the wetlands and herbaceous salt tolerant species at the Salinas.

Figure 6.2-18. The Salinas observed in the project area.

A total of seventy seven (79) species of plants from 48 different families were identified during the study. For each species, the name, perceived dominance and its growth form was noted (**Table 6.2-4**).

Table 6.2-4. The plant species identified during the Flora assessment for the proposed Port development.

Family	Scientific Name	Common Name	Status	Plant type	Wetland	Beach/sand dune	Shrub land
Acanthaceae	*Ruellia paniculata*		Native	Shrub			O
Aizoaceae	*Sesuvium portulacastrum*	Sesuvium	Native	Shrub	F	A	O
Amaranthaceae	*Alternanthera halimifolia*	Gray Crab Withe	Native	Herb	R	F	O
Amaranthaceae	*Amaranthus spinosus*	Wild Calaloo	Native	Shrub			O
Amaranthaceae	*Blutapharon vermiculare*	Beach Calalu.	Native	Herb	O	A	O
Apocynaceae	*Allamanda cathartica*	Yellow Allamanda	Native	Shrub			F
Apocynaceae	*Calotropis procera*	Dumb Cotton, French Cotton	Native	Shrub	R	O	F
Arecaceae	*Cocos nucifera*	Coconut	Native	Tree		R	R
Arecaceae	*Veitchia merrilli*	Christman Palm	Introduced	Tree			R
Asclepiadaceae	*Cryptostegia grandiflora*	Indian-rubber vine	Native	Climber		R	O
Asparagaceae	*Agave harrisii*		Native	Shrub		R	O
Asteraceae	*Bidens pilosa*	Spanish Needle	Native	Shrub	O		F
Asteraceae	*Gnaphalium americanum*	Wild Cotton	Native	Tree		R	O
Bataceae	*Batis maritima*	Jamaican Samphire	Native	Shrub		A	O
Bignoniaceae	*Pithecoctenium echinatum*	*Monkey Comb*	Native	Shrub			O
Bignoniaceae	*Crescentia cujete*	*Calabash Tree*	Native	Shrub			R
Boraginaceae	*Cordia humilis*	Wild Sage	Native	Shrub		R	O
Boraginaceae	*Cordia sebestena*	Scarlet Cordia	Native	Tree		O	O
Boraginaceae	*Heliotropium curassavicum*		Native	Shrub		O	R
Bromeliaceae	*Bromelia pinguin*	Pinguin	Native	Shrub			O

Family	Scientific Name	Common Name	Status	Plant type	Wetland	Beach/sand dune	Shrub land
Cactaceae	*Harrisia gracilis*	Torchwood Dildo	Native	Shrub		R	A
Cactaceae	*Hylocereus triangularis*	God Okra (endemic)	Endemic	Climber		R	O
Cactaceae	*Melocactus communis*	Turks Head	Endemic	Cactus			O
Cactaceae	*Opuntia dillenii*	Seaside tuna	Native	Cactus			O
Cactaceae	*Opuntia cochenillifera*	Seaside tuna	Native	Cactus			O
Cactaceae	*Opuntia Jamaicensis*		Endemic	Cactus			R
Cactaceae	*Stenocereus hystrix*	Dildo Cactus	Native	Cactus			O
Capparaceae	*Capparis ferruginea*	Mustard shrub	Native	Tree			F
Capparaceae	*Capparis flexuosa*	Capparis	Native	Tree		R	O
Caricaceae	*Carica papaya*	Papaw	Native	Tree			O
Casuarinaceae	*Casuarina equisetifolia*	Whistling Pine, Willow	Introduced	Tree			R
Combretaceae	*Conocarpus erectus*	Button Mangrove	Native	Tree	O		
Combretaceae	*Laguncularia racemosa*	White Mangrove	Native	Tree	A	R	
Combretaceae	*Terminalia catappa*	*West Indian Almond*	Native	Tree		R	O
Compositae	*Spilanthes urens*	Pigeon coop	Native	Shrub		R	O
Convolvulaceae	*Ipomoea pes-caprae*	Seaside Morning Glory	Native	Climber		A	O
Cyperaceae	*Cladium jamaicense*	Saw grass	Native	Grass	O		R
Cyperaceae	*Fimbristylis spathacea*		Native	Sedge	R	R	O
Cyperaceae	*Scleria secans*	Razor grass	Native	Grass			O
Euphorbiaceae	*Croton linearis*	Wild Rosemerry	Native	Shrub		R	O

Family	Scientific Name	Common Name	Status	Plant type	Wetland	Beach/sand dune	Shrub land
Euphorbiaceae	*Jatropha gossypifolia*	Belly Ache Bush	Native	Shrub	R		O
Euphorbiaceae	*Ricinus communis*	Castor Oil	Native	Shrub		R	F
Fabaceae	*Acacia mangium*	Acacia Mangium	Introduced	Tree			A
Fabaceae	*Acacia tortuosa*	Wild Poponax.	Native	Tree			O
Fabaceae	*Alysicarpus vaginalis*	Medina	Native	Herb	R		O
Fabaceae	*Caesalpinia bonduc*	Gray Nickal, Nicker Bean	Native	Shrub		A	O
Fabaceae	*Tephrosia cinerea*		Native	Shrub		O	O
Fabaceae, Mimosoidea	*Pithecellobium unguis-cati*	Bread-and-Cheese, Privet, Cat's Claw	Native	Tree		R	A
Goodeniaceae	*Scaevola plumieri*	Seaside Lobelia	Native	Shrub	R	A	O
Lauraceae	*Cassytha filiformis*		Native	Climber		R	O
Malvaceae	*Thespesia populnea*	Seaside Mahoe	Native	Tree	R	F	
Meliaceae	*Azadirachta indica*	Neem	Introduced	Tree			R
Mimosaceae	*Leucaena leucocephala*	Lead Tree	Native	Tree			O
Mimosaceae	*Prosopis juliflora*	Cashaw Macka	Native	Shrub			O
Mimosaceae	*Mimosa pudica*	*Shame Old Lady*	Native	Shrub		O	F
Moraceae	*Ficus benjamina*	Ficus	Native	Shrub			O
Moraceae	*Ficus microcarpa*	Green Island Ficus	Native	Tree			R
Nyctaginaceae	*Boerhavia sp.*	Hogweed	Native	Shrub			O
Paplionaceae	*Canavalia maritima*	Seaside Bean	Native	Shrub	O	A	R
Passifloraceae	*Passiflora foetida*		Native	Climber			O

Family	Scientific Name	Common Name	Status	Plant type	Wetland	Beach/sand dune	Shrub land
Phytolaccaceae	*Rivina humilis*	Dog Berry /Dog Blood	Native	Shrub			O
Poaceae	*Panicum maximum*	Guinea Grass	Invasive	Grass	R		O
Poaceae	*Sporobolus virginicus*	Beach Grass	Native	Grass		O	
Poaceae	*Stenotaphrum secundatum*	Crab Grass	Native	Grass		R	O
Poaceae	*Zoysia tenuifolia*	Zoyzia grass	Introduced	Grass	R		R
Polygalaceae	*Polygala jamaicensis*	White Lignum Viatae	Native	Tree			O
Polygonaceae	*Coccoloba uvifera*	*Sea Grape*	Native	Tree		O	R
Portulacaceae	*Portulaca oleracea*	Pussley	Native	Shrub	R	O	O
Rhizophoraceae	*Rhizophora mangle*	Red Mangrove	Native	Tree	D		
Rubiaceae	*Ixora spp.*	West Indian Jasmine	Introduced	Shrub			R
Sapindaceae	*Blighia sapida*	Ackee	Introduced	Tree			O
Scrophulariaceae	*Leucophyllum frutescens*	Texas Sage	Native	Shrub	R		O
Solanaceae	*Solanum erianthum*	*Wild Susumber*	Native	Shrub		R	O
Sterculiaceae	*Waltheria indica*	Raichie	Native	Shrub		R	O
Sterculiaceae	*Guazuma ulmifolia*	*Bastard Cedar*	Native	Tree			O
Tiliaceae	*Triumfetta semitriloba*	Wild Burr	Native	Shrub			O
Verbenaceae	*Avicennia germinans*	Black Mangrove	Native	Tree	F		
Verbenaceae	*Lantana camara*	Lantana	Native	Shrub		R	F
Zygophillacece	*Guaiacum officinale*	Lignum vitae	Native	Tree			O

Of the 78 plant species found within the study site, only 3 endemic species (*Hylocereus triangularis, Melocactus communis and Oputina jamaicensis*), all of which are cacti, were encountered (**Figure 6.2-19**).

Figure 6.2-19. *Melocactus communis* (endemic) observed on the property during the study.

All of the above mentioned endemic plant species are classified as locally common according to Adams (1972). None of the endemic species encountered during this study is deemed as endangered, or threatened or requiring any special conservation needs. It should be noted that *Oputina jamaicensis* which is locally common in St Catherine and Manchester, where they form pure stands near mangrove and Salinas, was observed in the scrub land habitat (Adams, 1972). It should be noted that only a few were observed.

Three species of mangroves were identified during the mangroves assessment, which include dominant Red Mangrove (*Rhizophora mangle*) *(***Figure 6.2-20***)*. White Mangrove (*Laguncularia* *racemose*) and Black Mangrove (*Avicennia germinans*) Button wood, *Conocarpus erectus* (Combretaceae) was identified in the fringe of the mangrove wetland. Mangroves provide structural complexity both above and below the water's surface. They serve as an important nursery habitat for juvenile fishes. Flora and fauna found in the mangrove included plants (climbers, epiphytes, and parasites), animals (insects, spiders, and vertebrates), borers, crustaceans (crabs, shrimp, lobster, isopods, and amphipods), mollusks, and fishes.

Figure 6.2-20. A stand of Red Mangroves within the survey area.

6.2.1.2 Terrestrial Fauna

6.2.2.5.1 Herpetofauna

Amphibian

There are approximately 27 species of amphibians found in Jamaica. However, only 2 species of amphibians were recorded during the terrestrial survey of the site; both species are introduced (**Table 6.2-5**). It should be noted that the low number of amphibians observed can be attributed to the drought conditions at the time of the survey. Most amphibians were encountered in the residential areas.

Reptiles

Five (5) species of reptiles were observed during the sur (**Table 6.2-5**); 1species is introduced while the others are endemic to Jamaica. It should be noted that no snakes were encountered during the assessment. Only a few Jamaican Galliwasp were seen on the property among the rock and wood piles. The status of *all* endemic reptilian and amphibian species are of concern primarily due to the distribution of their populations which are restricted only to Jamaica.

Table 6.2-5. Herpetofauna observed during the study area

Species	Common name	Species Status	IUCN Status	DAFOR
	AMPHIBIANS			
Rhinella marina	Cane Toad	Introduced	Least concern	O
Eleutherodactylus johnstonei	Lesser Antillean Frog	Introduced	Least concern	A
	REPTILES			
Celestus crusculus	Jamaican Galliwasp	Endemic	Near threatened	R
Anolis garmani	Jamaican Giant Anole	Endemic	Near threatened	R
Anolis grahami	Jamaican Turquoise Anole	Endemic	Near threatened	O
Anolis lineatopus	Jamaican Gray Anole	Endemic	Near threatened	D
Hemidactylus mabouia	Croaking lizard, Tropical House Gecko, Wood slave	Introduced	Least concern	F

Figure 6.2-21. Anolis observed on a twig on the scrubland

6.2.2.5.2 Avifauna

The project site is located near the eastern end of the town of Port Royal with its northern edge bounded by the waters of Kingston Harbour. The Port Royal main road separates the site from mangroves to the south with a small shallow coastal pond within those mangroves. Further south, beyond the mangroves is a sandy beach leading to the sea outside Kingston Harbour in the vicinity of the Port Royal Cays.

The Old Coal Wharf is a long abandoned port with several dilapidated buildings, possibly old warehouses and offices located around the site. The other parts of the site are overgrown with coastal scrub and coastal pioneer plant species such as Cashaw (*Prosopis juliflora*), *Acacia tortuosa* and cacti such as *Stenocereus hystrix* and *Harissia gracilis*. There are also shacks and shanty buildings that are currently being used as fishing gear storage sheds while others are occupied by squatters.

The site is located within the Palisadoes Port Royal Protected Area and is close to Refuge mangrove island that serves as the main nighttime roost and breeding area for seabirds that live and reproduce in the Kingston Harbour area. A total of thirty two (32) birds species were observed during the field visits, most of which were breeding residents (**Table 6.2-6**

Table 6.2-6). The number of species appears high given the level of disturbance and the small size of the site; however, nearly half of bird species observed (13) were seabirds and shorebirds which are commonly found in the area between the coastal scrub and the large mangrove wetland.

The only Jamaican endemic bird species observed was the Jamaican mango hummingbird (*Mangeo anthrocothorax)*. This hummingbird is widespread in Jamaica, and it is known to have an affinity for drier habitats where it feeds on the flowers of native cacti species. Three Jamaican endemic sub-species were detected: the bananaquit (*Coereba flaveola flaveola*), Commmon Ground Dove (*Columbina passerine jamaicensis)* and the Loggerhead Kingbird (*Tyrannus caudifasciatus jamaicensis*). All three species are common and widespread even in urbanised habitats.

The marine habitat located next to the site had several seabirds, some of which were high flying and could be seen from several counting points. Extra care was taken to avoid recounting the same individuals from more than one site.

The Seabirds included the Magnificent Frigate bird (*Fregata magnificens*), and the Brown Pelican (*Pelecanus occidentalis*) as well as the Royal Tern (*Thalasseus maximus*). The presence of water around the site also boosted the number of members of the Heron family, (Ardeidae), of which four members were observed, the Snowy Egret (*Egretta thula*), the Cattle Egret (*Bubulchus ibis*) the Green Heron (*Buteroides virescens*) and the Tricholoured Heron (*Egretta tricolor)*.

<u>Migratory Species</u>

There were seven winter (Neotropical) migrant species, five of which were Wood Warblers of the family Parulidae, and the remaining two were shorebirds from the family Scolopacidae. The Migrant warblers were the American Redstart (*Setophabga ruticilla*), the Black-throated Blue

Warbler (*Setophaga caerulencens)*, the Northern Parula (*Parula Americana*), the Palm Warbler (*Setophaga palmarum*) and the Prairie Warbler (*Setophaga discolor*). The shorebirds included the Spotted Sandpiper (*Actitis macularius*) which is commonly observed as a lone individual along the shore bobbing its tail vigorously as it feeds on tiny invertebrates on the beach, and the Ruddy Turnstone (*Arenaria interpes*) which is also often seen along the shore but is often in small groups strolling along the surf edge turning small stones and vegetation as it searches for food.

The migrant warblers are all fairly common in Jamaica in suitable habitats during the winter months, however, the Palm Warbler (*Setophaga palmarum*) is more common in coastal areas. The Yellow Warbler (*Setophaga petechial*) also known as the Mangrove Canary is generally a resident breeder which only occurs in coastal habitats particularly in mangroves. It is generally believed that there is a migratory cohort of Yellow Warblers that come to Jamaica in winter and combine with the resident group thus increasing the local population of Yellow Warblers during the winter season. Local studies have been unable to verify this assumption so it is likely that if there are migratory Yellow Warblers coming to Jamaica, they are probably vagrants and are few in number.

No summer migrants were detected because surveys are conducted prior to their arrival. The area, however, is known to have summer (austral) migrant warblers such as the Black Whickered Vireo (*Vireo altiloquus*) and the Grey Kingbird (*Tyrannus dominicensis*) which generally begin arriving in Jamaica in April and May each year.

<u>Endangered Species</u>

There were no endangered bird species observed during field visits to the Palisadoes area. The West Indian Whistling Duck (*Dendrocygna arborea*) is one endangered species that is a potential visitor to the area and is known to occur in coastal wetlands across the entrance to the Kingston Harbour in wetlands along the Hellshire coast. This is relatively nearby and although they are known to avoid highly disturbed areas they are highly adaptable and can adapt to human presence when necessary which suggest that they cannot be assumed to be absent from the Palisadoes wetlands and targeted surveys would be required to verify their absence.

Although night surveys were not conducted at the study site, Barn Owls (*Tyto alba*) have been observed at the nearby Norman Manley Airport. The Jamaican Owls (*Pseudoscops grammicus*) have also been previously observed in Port Royal, and are likely to frequent the open grounds around the Old Wharf where the owls can more easily spot potential prey such as rats and mice. The Antillean Nighthawk (*Chordeilles gundlachii*) is a nocturnal summer migrant that was not observed during the surveys but is known to occur all over Jamaica when they return to breed during the summer months.

Threats to Wildlife

<u>Habitat loss</u>: The site has historically been heavily used for commercial activities, and although it is presently derelict, the re-development of site area would remove some potential habitat and further exacerbate the effects of habitat fragmentation. The proposed development and the operation of the site represent a significant change to the ecological functioning of the area. Furthermore, any future expansion (e.g., railway, housing developments) may further encroach on the existing feeding and breeding grounds used by the birds, which could, over time, impact the high value habitats nearby such as the Refuge Cay Seabird colony.

<u>Alien Invasive species</u>: No cats, rats or mongooses were observed during the field visits, however, given the site's proximity to the town of Port Royal it can be assumed that they are present.

The Great-tailed Grackle (*Quiscalus mexicanus)* is a species that has recently been introduced to Jamaica and is currently reproducing and expanding its range along the coastal habitats east and west of the Palisadoes where it was first observed.

Table 6.2-6: Avian species observed in and around the Old Coal Wharf site.

Index	Family	Common Name	Scientific Name	Status	Points	Total	Index	DAFOR
1	**Alcedinidae**	Belted Kingfisher	*Megaceryle alcyon*	w	0		0.0	R
2	**Ardeidae**	Cattle Egret	*Bubulcus ibis*	b	0		0.0	R
3	**Ardeidae**	Green Heron	*Butorides virescens*	b	0		0.0	R
4	**Ardeidae**	Snowy Egret	*Egretta thula*	b	1	1	0.1	O
5	**Ardeidae**	Tricholored Heron	*Egretta tricolor*	b	0		0.0	R
6	**Cathartidae**	Turkey Vulture	Cathartes aura	b	1	1	0.1	O
7	**Columbidae**	Common Ground-Dove	*Columbina passerina jamaicensis*	bes	2	2	0.5	F
8	**Columbidae**	White-crowned Pigeon	*Patagioenas leucocephala*	b	2	3	0.8	F
9	**Columbidae**	White-winged Dove	*Zenaida asiatica*	b	6	14	10.5	D
10	**Columbidae**	Zenaida Dove	*Zenaida aurita*	b	0		0.0	R
11	**Falconidae**	American Kestrel	*Falco sparverius*	b	1	1	0.1	O
12	**Fregatidae**	Magnificent Frigatebird	*Fregata magnificens*	b	4	12	6.0	D
20	**Icteridae**	Great-tailed Grackle	*Quiscalus mexicanus*	i	1	1	0.1	O
13	**Laridae**	Laughing Gull	*Larus atricilla*	b	1	6	0.8	F
14	**Laridae**	Egretta caerulea	*Egretta caerulea*	b	0		0.0	R
15	**Laridae**	Royal Tern	*Thalasseus maximus*	b	5	10	6.3	D
16	**Laridae**	Sandwich Tern	*Thalasseus sandvicensis*	b	1	9	1.1	A
17	**Mimidae**	Northern Mockingbird	*Mimus polyglottos*	b	2	2	0.5	F
18	**Parulidae**	American Redstart	*Setophaga ruticilla*	w	2	2	0.5	F
19	**Parulidae**	Black-throated Blue Warbler	*Setophaga caerulescens*	w	2	3	0.8	F
21	**Parulidae**	Northern Parula	*Parula americana*	w	2	2	0.5	F
22	**Parulidae**	Palm Warbler	*Setophaga palmarum*	w	0		0.0	R
23	**Parulidae**	Prarie Warbler	*Setophaga discolor*	w	1	1	0.1	O
24	**Parulidae**	Yellow Warbler	*Setophaga petechia*	b	5	10	6.3	D
25	**Passeriformes**	Bananaquit	*Coereba flaveola faveola*	bes	1	1	0.1	O
26	**Pelecanidae**	Brown Pelican	*Pelecanus occidentalis*	b	3	12	4.5	D
27	**Rallidae**	Clapper Rail	*Rallus crepitans*	b	0		0.0	R
28	**Scolopacidae**	Ruddy Turnstone	*Arenaria interpes*	w	0		0.0	R
29	**Scolopacidae**	Spotted Sandpiper	*Actitis macularius*	w	1	1	0.1	O
30	**Threskionithidae**	White Ibis	*Eudocimus albus*	b	0		0.0	R
31	**Trochilidae**	Jamaican Mango	*Anthraothorax mango*	be	0		0.0	R
32	**Tyrannidae**	Loggerhead Kingbird	*Tyrannus caudifasciatus jamaicensis*	bes	0		0.0	R

	Index Ranges	Status Key
D - Dominant	**2.1 +**	b = breeding species
A - Abundant	**1.1 to 2**	be = Jamaican endemic species
		bes = Jamaican endemic sub-species
F - Frequent	**0.5 to 1**	
O - Occasional	**0.1 TO 0.5**	bs = summers and breeds
R - Rare	**0**	I = breeding introduced
		pm = passage migrant
		w= winters

Classification based on the American Ornithologists Union **AOU** current Checklist of species
Status in Jamaica according to Haynes-Sutton, Downer and Sutton "A Photographic Guide to the Birds of Jamaica."

6.2.2.5.1 Other Animals

Several crabs and their holes were observed in the mangrove wetland during the survey (**Table 6.2-7**).

Table 6.2-7: Other animals observed in the project area.

FAMILY	GENUS AND SPECIES	COMMON NAME	DAFOR RATING	COMMENTS
Gecarcinidae	*Cardisoma* sp.	Land crab	F	Hole of these crabs seen, some occupied, crabs not actually seen.

6.2.1.2.2 Insects

The insect fauna was very sparse (**Table 6.2-8)** and consisted of 9 species of butterflies, 3 species of wasps, 2 of bees, 3 species of ants and 4 dragonflies. One record, *Wallengrenia ortho vesuria,* is an endemic subspecies*;* it is widespread throughout the island. The dominant species was the Pygmy Blue butterfly, the smallest butterfly in the world; the larvae of this butterfly feed on *Batis maritima* and *Sesuvium portulacastrum*, which are common on most shore lines around Jamaica. The low number of insects is not surprising as the work was done during an intense dry period and most of the herbs and shrubs had either dried up or were in very poor condition. The number of species and number of individuals is likely to increase significantly during the rainy season.

Table 6.2-8. The insects observed during the site survey.

FAMILY	SPECIES	COMMON NAME	DAFOR	STATUS/COMMENTS
BUTTERFLIES (ORDER LEPIDOPTERA)				
Lycaenidae	*Leptotes cassius*	Cassius Blue	F	Wide spread locally and throughout the Americas
	Hemiargus hanno	Hanno Blue	O	Wide spread locally and throughout the Americas
	Brephredium exilis	Pygmy Blue	D	Wide spread locally and throughout the Americas. Smallest butterfly in the world. Restricted to coastal areas
Pieridae	*Ascia monuste*	Antillean great White; Cabbage White	O	Wide spread locally and throughout the Americas
	Eurema nise	Cramer's Little Sulphur	O	Wide spread locally and throughout the Americas
Nhmphalidae	*Euptoieta hegesia*	Tropical Fritillary	O	Wide spread locally and throughout the Americas
	Junonia evarete	Buckeye	O	Wide spread locally and throughout the Americas
Hesperidae	*Wallengrenia ortho vesuria*	Vesuria	O	Endemic sub-species. Widespread on Jamaica
Papilionidae	*Papilio andraemon*	The adreamon Swallotail	R	Widespread and common
WASPS (HYMENOPTERA)				
Vespidae	*Polisties crinitus*	Red wasp	F	Widespread
	Polisties hunter	Red wasp	O	Introduced & widespread
Megachilide	*Megachile concina*	Leaf cutter bee	O	
Formicidae	2 spp. ants		O	
Apidae	*Apis mellifera*	Common Honeybee	O	
DRAGONFLIES (ODONATA)				
	Erythemis simplicicollis		O	
	Tramea sp.		O	
	Erythrodiplax umbrata		O	
	Anisoptera sp		O	
HEMIPTERA				
Pyrrhocoridae	*Dysdercus mimulus*	Lovebugs	A	

6.2.2.5.2 Protected Fauna

6.2.2.5.2.1 Crocodile Assessment

The American crocodile (*Crocodylus acutus*), the largest reptile in Jamaica, is known to inhabit rivers, wetlands and coastal waters. It is listed as vulnerable by the International Union for the Conservation of Nature and Natural Resources (IUCN) and is protected under the Wildlife Protection Act (1945) in Jamaica. Crocodile populations across Jamaica have declined as a result of over-exploitation, continued illegal hunting, fear of the animal and habitat destruction. The decrease in available habitat has led to an increase in the number of human-crocodile interactions, as the animals seek to find alternative / new habitats (NEPA, 2011). Crocodiles have been sighted in the wetlands and surroundings waters of the Palisadoes- Port Royal Protected Area. They have been seen basking on the roadside in close proximity to the wetlands. In addition, nesting has been reported at the Royal Jamaica Yacht Club. Because of reported crocodile sightings in the area, a survey was carried out to confirm their presence and estimate their numbers.

During the crocodile assessment, two adult crocodiles were observed within the Rosie Hole area of Port Royal (adjacent to Morgan's Harbour). The size of these crocodiles could not be estimated. No signs of the crocodiles (tail drags, nests including egg shells) were encountered during a walkthrough of the area for the proposed cruise ship pier. It was noted that garbage (including plastic bags, plastic bottles, Styrofoam and an old fridge) was strewn on possible crocodile nesting areas along the beach and around the mangrove roots, likely discouraging crocodile nesting in the area.

American crocodiles inhabit brackish and saltwater habitats and are typically found in coastal mangrove wetlands. Only two crocodiles were observed during the study, suggesting that their density in the area is very low. In Jamaica, high density of crocodiles is usually found at the mouth of large rivers such as the Black river and the Rio Minho, or in manmade systems such as the Portmore Sewage Treatment Ponds. Crocodile numbers in coastal areas are usually low. Crocodile nesting usually occurs in late April and early May when they build their nest on land areas such as beaches above high tide marks. No crocodile nests or nestlings/ juveniles were observed in the area.

6.2.2.5.2.2 Sea Turtle

Seven species of sea turtles are found world-wide, six of which are found in the wider Caribbean: Hawksbill (*Eretmochelys imbricate*), Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Leatherback (*Dermochelys coriacea*), Kemp's Ridley (*Lepidochelys kempii*), and Olive Ridley (*Lepidochelys olivacea*). Historically, 4 of the 7 species of sea turtle are found and nest in Jamaica. This includes the Hawksbill, Green, Loggerhead, and Leatherback (Brown 2011). The most dominant species Hawksbill. However, the literature has suggested that the Green, Loggerhead, and Leatherback may be extirpated from Jamaica (Brown 2011).

While no sea turtle nest was observed on the beach during the assessment, it should be noted that the survey was not carried out during the peak nesting season for turtles. It is important to note that sea turtles are known to nest on the sand beaches in the Port Royal/ Palisadoes protected area. The National Environment and Protection Agency and the Jamaica Environmental Trust monitors sea turtle populations in the area.

6.2.1 Marine Survey Results

Surveys of marine resources at the study site were conducted from March 20-23, 2019. Twelve sites were selected, 4 in the immediate vicinity of the Old Coal Wharf area, and the remaining 8 extending to other locations within a 1km radius of the project site (**Figure 6.2-22**). The objective of the survey was to characterize the substrate and marine resources (coral, seagrass, and invertebrates) that may be affected by the landside and marine construction, the installation of the SeaWalk™, and the subsequent operation of the cruise ship berthing facility.

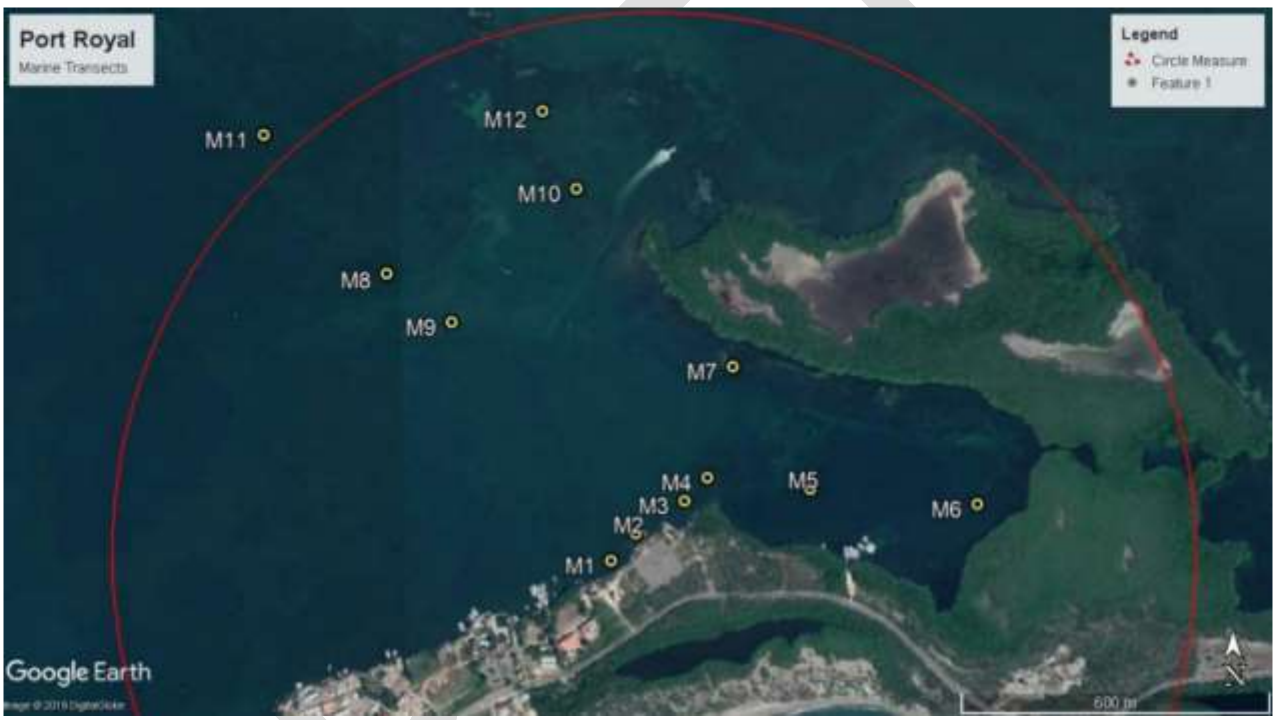

Figure 6.2-22. Marine survey sites in Port Royal.

6.2.1.1 Survey Site Description

M1

Site M1 (**Figure 6.2-22**) was located nearshore next to the remnant piles on the west side of the property. The water quality is generally turbid due to high levels of suspended solids in the water column. The substrate is heavily silted, with rubble, and debris including concrete blocks, as well as fragments of old boats and other discarded materials covered in a layer of silt and overgrown by algae.

The old wooden piles are encrusted with fauna typical of turbid environments, including a variety of sessile organisms such as oysters, sponges, ascidians, bryozoans, hydroids and macroalgae (**Figure 6.2-23**). Scleractinian corals and Alcyonaceans were scarce, and found mostly on hard surfaces closer to shore where the water is shallow enough (2-4m) to allow the light to penetrate the turbid water column. Seven Scleractinian coral species were observed during the survey, namely Siderastrea siderea, *Siderastrea radians, Solenastrea bournoni, Porites astreoides, Manicina areolata, Occulina diffusa* and *Phyllangia americana*.

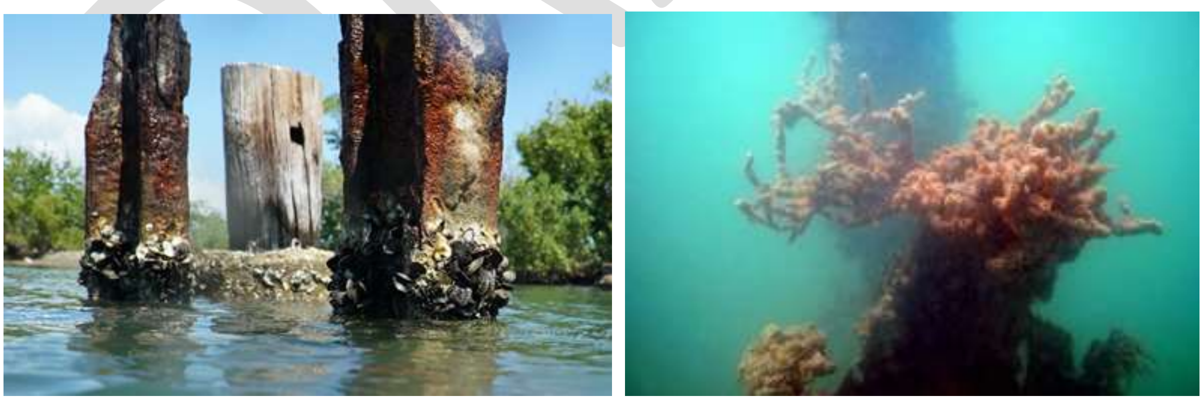

Figure 6.2-23. The old piles are overgrown with sessile organisms (e.g., oysters, sponges) and they also serve as a habitat for juvenile fish.

M2

At M2, located in front of the onshore concrete SeaWalk^{TM} anchor point, the muddy rubble zone gives way to a mixed seagrass bed (~10m offshore) comprised primarily of *Thalassia testudinum* interspersed with *Halodule wrightii* closer to shore. Seagrass density is variable, ranging from ~60 -100 shoots/$m^2$with shoot lengths ranging from10 -25cm (**Figure 6.2-24**). Associated fauna observed in the seagrass included the cushion starfish (*Oreaster sp.*), thorny sea star (*Echinaster* sp.), sea cucumbers (Holothuriidae), various bivalves, sea plumes (*Pseudopterogorgia sp.),* and urchins (*Tripneustes ventricosus*). The piles provide habitat for sessile organisms and for juvenile fish. Due to poor visibility, fish were mostly observed around piles, sunken debris, and in seagrass areas.

Figure 6.2-24. Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf.

M3

On the eastern side of the property, in the vicinity of the sunken vessel near the makeshift "cook-shop" on the shore, the substrate at M3 is a mixture of mud and coarse sand, with seagrass beds immediately north of the mangrove stand on shore. The barge is overgrown with encrusting gorgonians, sponges, ascidians and macroalgae. Fish (e.g., Yellowtail snapper (*Ocyurus chrysurus*) were observed around the barge (**Figure 6.2-25.**).

The small stand *Rhizophora mangle* (Red mangrove) on the eastern boundary of the project site should be protected during the construction of the landside facilities as it is one of the last remaining mangrove stands along the Port Royal shoreline (**Figure 6.2-26**). Destroying this mangrove area (~0.4 ha) would result in further habitat fragmentation and degradation, along with an increased edge effect[13] on the native flora (i.e., mangroves). Habitat destruction or alteration has the potential to change ecological processes such as seed dispersal, migration, pollination, flowering and fruiting periods among others. More importantly, habitat fragmentation increases the vulnerability of fragmented areas to invasion by exotic as well as native pest species (Primack 2000).

[13]Edge effects are defined as ecological alterations related to the development of sudden, artificial edges of forest fragments (Didham and Lawton, 1998). Edge effects are an important in the management of corridors and small habitat units as well as larger areas where long, narrow intrusions such as paths, fragment the otherwise continuous habitat and pave the way for the introduction of exotic/invasive species, disease and increased access to human activities (e.g. exploitation of resources).

Figure 6.2-25. The frame of the sunken barge at M3 is overgrown by various sponges, tunicates, bryozoans and macroalgae. Patchy seagrass beds can be found closer to shore, near a lush, healthy mangrove stand.

Figure 6.2-26. Mangrove stand on the eastern boundary of the project footprint.

M4

The second submerged vessel located northeast of the fishing beach, rests on a shallow muddy shoal. The wreck provides habitat for juvenile parrot fish which were observed schooling around the wooden remains. The framework of the vessel is entirely overgrown with sponges, tunicates, hydroids and macroalgae (**Figure 6.2-27**).

Figure 6.2-27. Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Basin to the east of the project site - M5, M6 and M7

Sites M5 and M6 were located to the east of the project site, in the basin near the Rosey Hole. At a depth of 10 m, the substrate at M5 was primarily mud. Closer to the edge of the mangrove stands, at M6, the substrate was shallower (5-6m) with a dense expanse of mature *Thalassia testudinum (*>100 shoots/m^2) with occasional *Lytechinus variegatus and Tripneustes ventricosus (1-2/m^2)* urchins found hiding amongst the lush seagrass blades (15-20cm long).

Along the undisturbed mangrove-seagrass habitat on the northern side of the basin (M7), across from the Old Coal Wharf, the shallow substrate (2m) is a mix of sand and mud, with dense patches of *Thalassia testudinum (>100 shoots/m^2).* The density of *Lytechinus variegatus* and *Tripneustes ventricosus* was estimated at *1-2/m^2.* The mangrove-seagrass habitat remains undisturbed but will be exposed to increased turbidity resulting from the resuspension of sediments from the cruise ship's prop wash and bow waves, especially with the use of thrusters during arrival and departure maneuvers. (See **Mitigating effects of cruise ship traffic**)

Northwest of the project site - M8, M9 and M11

Northwest of the project site, the substrate in the basin leading toward the main ship channel is a mosaic of mixed mud, rubble, rocks, and *Thalassia testudinum* beds. At M9 (depth ~4-5m), the dense seagrass areas with >150 shoots/m^2, are intermingled with mixed coarse sand and rubble substrate that is heavily overgrown with macroalgae. Solitary coral colonies (*Solenastrea*) and Alcyonaceans (sea fans and sea plumes) were observed, along with other fauna typically associated with seagrass beds (i.e., urchins and sea stars) (**Figure 6.2-28**).

At site M8 (depth ~7 m), the mixed coarse sand and rubble seafloor is barren. The only fauna observed in the transect were tunicates, star fish (*Oreaster reticulatus*), and jellyfish (*Cassiopea xamachana*).

The seafloor near the eastern edge of the main shipping channel (M11 – depth 4-5m) is heavily impacted by maritime traffic. The silty/sandy substrate is mostly barren except for patches of algal cover and sparse seagrass. The condition of the site represents the likely outcome for the seagrass areas that are located in or near the approach channel (e.g., T7, T9) for the cruise ships docking at the Old Coal Wharf pier.

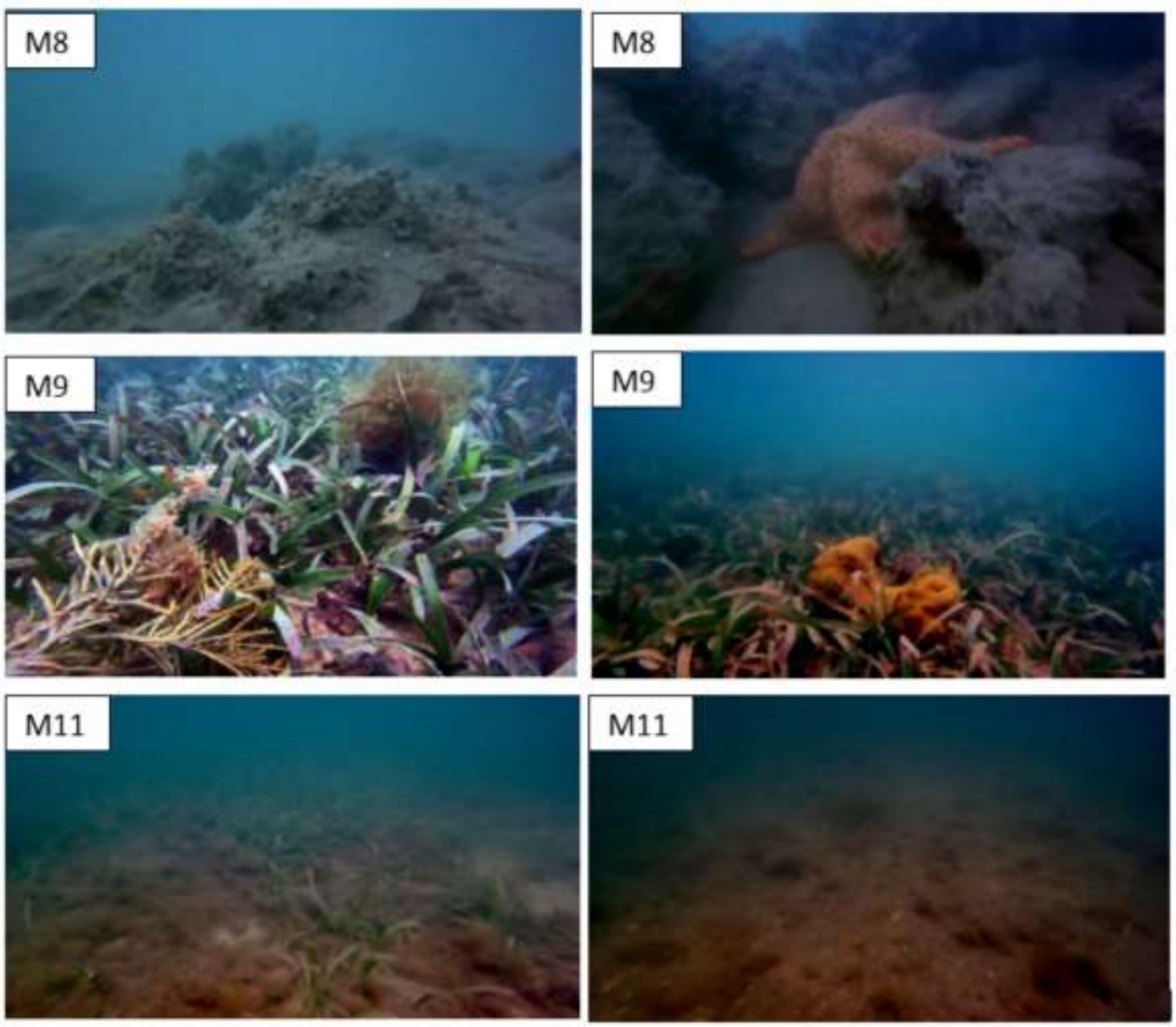

Figure 6.2-28. Substrate types at survey sites M8, M9 and M11.

M10 and M12

The substrate near the mangrove stand on the eastern side of '5ft navigation channel' (site M10) is primary coarse sand with seagrass beds of variable density (~50-100 shoots/m^2). The fauna in the area is sparse, with sea stars (*Oreaster sp.*), urchins (*Tripneustes ventricosus*) and fish from the nearby mangrove area. A small school of mid-sized (20-30 cm) snappers (Lutjanidae) was observed foraging in the seagrass.

Similar conditions were observed on the western side of the '5ft navigation channel' near the 'NEPA Restricted' Area buoy. The site is characterised by variable density seagrass (~50 shoots/m^2 interspersed with Dictyota and *Halimeda sp.,* urchins (*Tripneustes ventricosus*) and jellyfish (*Cassiopea xamachana*).

6.2.1.2 Species Assemblage

The Port Royal marine ecosystem is dominated by a mangrove-seagrass complex which not only shapes the community assemblages but is also essential for maintaining the biodiversity of the area. Fauna observed in various areas during the survey of Port Royal are summarized in (

). Seven Scleractinian coral species were observed during the survey, namely Siderastrea siderea, *Siderastrea radians, Solenastrea bournoni, Porites astreoides, Manicina areolata, Occulina diffusa* and *Phyllangia americana* **(Figure 6.2-29**). None of the coral species are considered endangered according to the **IUCN Red List (2004)**.

Sites M1- M4 support a diverse number of sessile organism including oysters, sponges (**Figure 6.2-30**) and bryozoans found on piles, sunken vessels and other solid surfaces. Sites M5-M12 are primarily seagrass habitats with *Thalassia testudinum* as the dominant seagrass species. The distribution and shoot densities are highly variable (**Table 6.2-10**), with high densities near mangrove stands (M6, M7) and sparser densities in disturbed areas (M8, M10, M11, M12).

Table 6.2-9. Faunal species identified at sampling sites M1-M12 during the marine survey at Port Royal.

CORAL	COMMON NAME	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Siderastrea radians	Lesser Starlet Coral	●		●									
Siderastrea siderea	Massive Starlet Coral		●										
Solenastrea bournoni	Smooth Star Coral	●	●							●			
Porites astreoides	Mustard Hill Coral	●	●										
Manicina areolata	Rose Coral		●										
Occulina diffusa	Diffuse Ivory Bush Coral		●										
Phyllangia americana	Hidden Cup Coral		●		●				●				
Millipora sp.	Fire Coral	●	●	●	●								
ALCYONACEANS													
Gorgonia sp.	*Sea fan*												
Pseudopterogorgia sp.	Sea plume	●	●							●			
Erythropodium	Encrusting gorgonian			●									
SPONGES													
Various		●	●	●	●				●				
Cliona delitrix	Red boring sponge	●	●										
Neopetrosia carbonaria	Black pinnacle sponge	●			●								
TUNICATES													
Didemnidae (purple)	Overgrowing tunicates				●				●				
Trididemum	Overgrowing tunicates	●		●									
Phallusia nigra	Black tunicate	●	●		●								
			●		●								
URCHINS													
Tripneustes ventricosus	West Indian Sea Egg	●	●				●	●		●	●		
Lytechinus veriegatus	Veriegated urchin		●				●				●	●	
			●				●						
OTHER													
Oreaster sp.	Cushion starfish		●	●					●				
Echinaster echinophorus	Thorny seastar		●		●								
	Sea cucumbers								●				
Aiptasia sp.	Pale clumping anemone	●	●		●								
Sobellastarte magnifica	Magnificent feather duster												
Stenorhynchus seticornis	Arrowhead crab												
Atrina rigida	Pen shell		●								●		
Bryozoans		●			●								
Ascidians				●									
	Oysters	●			●								

Table 6.2-10: Variable *Thalassia testudinum* shoot densities at the survey sites M1-M12.

Survey Sites	# Shoots/m^2	Blade length (cm)
M1	60	10
M2	>100	10-30
M3	50-100	15
M4	50-100	15-30
M5	-	-
M6	>100	10-30
M7	>100	20
M8	-	-
M9	100-150	15
M10	50-100	10-30
M11	<50	15
M12	50	10-15

Figure 6.2-29.Five (of seven) Scleractinian species found at the sites M1 and M2 (from top to bottom): *Solenastrea bournoni, Siderastrea siderea, Manicina areolata, Siderastrea radians,* and *Occulina diffusa*.

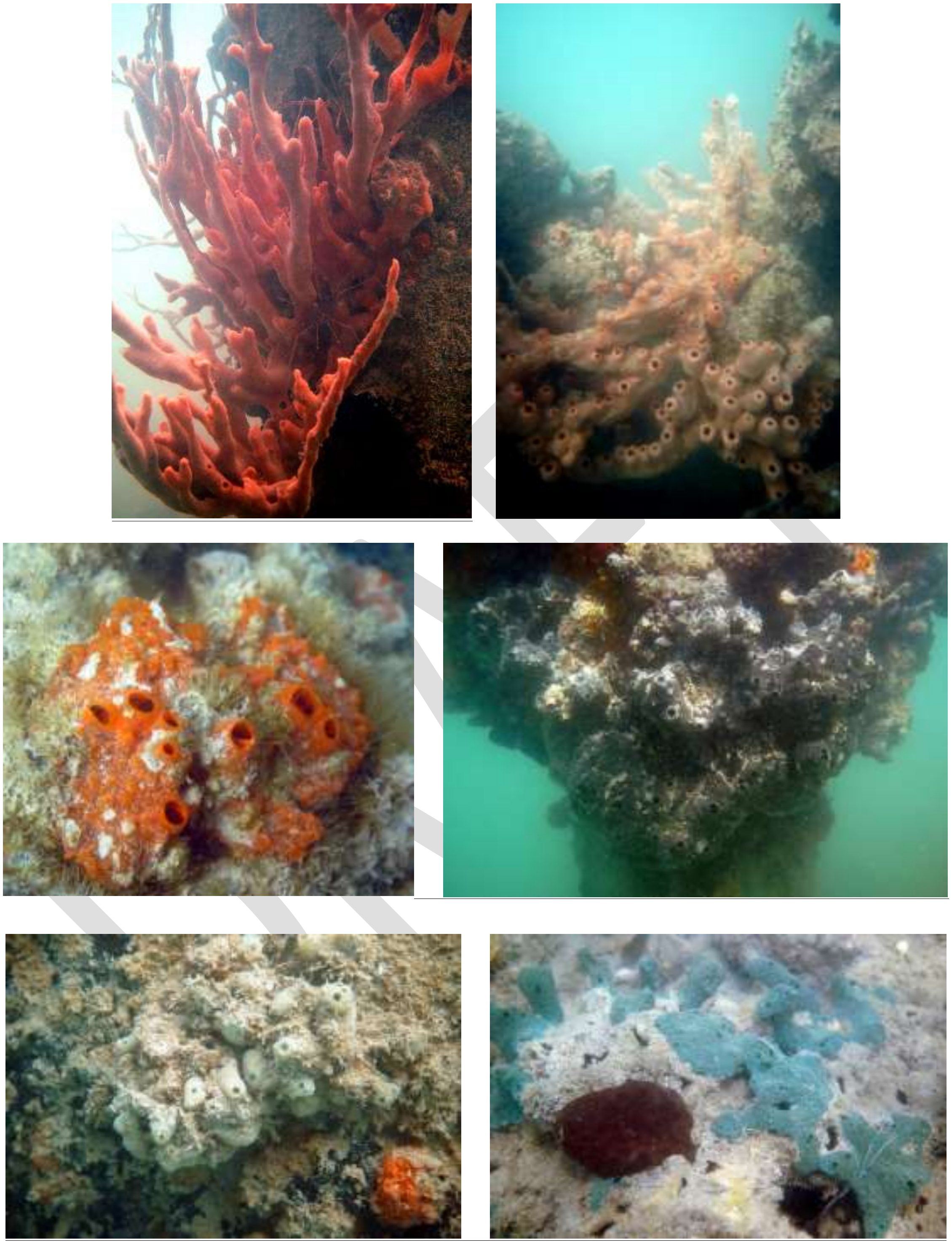

Figure 6.2-30. Diversity of sponges found throughout the survey sites located in the immediate vicinity of the project site (M1-M4).

6.2.2 Ecosystem Functions

Despite being a multi-use area (i.e., harbour, fisheries, mooring/water-sport recreational area, Protected Area, etc.) the marine ecosystems at Port Royal, specifically the mangrove stands and seagrass communities, show remarkable resilience.

The Palisadoes tombolo forms the southern boundary to the harbor, separating it from the Caribbean Sea to the south. The densest portion of the mangrove forested coastline lies on the southern part of the harbour (Goodbody 2003), east of Port Royal, the site of the proposed SeaWalk™ cruise ship pier.

The Palisadoes Port Royal Protected Area provides many ecosystem functions. Known for its extensive mangrove stands and large expanses of seagrass, the area serves as a habitat to a number of endemic species some of which are listed as endangered on the IUCN Red List (2004)[14], including: *Crocodylus acutus* (American Crocodile - Vulnerable), *Chelonia mydas* (Green Turtle - Endangered), *Eretmochelys imbricata* (Hawksbill Turtle - Critically endangered), *Trichechus manatus* (West Indian Manatee - Vulnerable), *Tursiops truncatus* (Bottlenose Dolphin – CITES Appendix II), *Hippocampus erectus* (Lined Seahorse CITES Appendix II) and *Hippocampus reidii* (Longsnout– DD, CITES Appendix II) (Mason 2007).

Mangroves and seagrasses complexes, are extremely productive ecosystems, not only in terms of the biodiversity they support but also because they provide a myriad of other valuable ecosystem functions:

1. **Coastal Protection (*Regulation and Maintenance)***: Mangrove forests serve as a natural barrier providing coastal protection against recurrent storms (e.g., Hurricane Ivan) and

[14] IUCN Red List https://www.iucnredlist.org/

other natural hazards that can cause great destruction to coastlines and communities (Das and Crépin 2013). This ecosystem function is of importance in the context of climate change and its inherent impacts, including rising sea levels and more frequent and severe storm events (Giri et al 2011).

2. **Protection from sedimentation (*Regulation and Maintenance)***: Mangroves create a dense network of roots that bind the soil and facilitate the accretion of sediment and suspended particulate matter at the land-sea interface, a service that is especially important in terms of filtering coastal runoff (Short and Short 1984). Seagrass beds also play an important role in sediment trapping and coastal stabilization (Hemminga and Duarte 2000). In addition to the deposition of fine sediments, seagrass beds act as carbon and nutrient sinks, contributing to the chemical and biological processes attributed to seagrass communities (Mellors et al. 2002).

3. **Habitat, nursery grounds and refugia (Provisioning/*Regulation and Maintenance*):** The site serves as a refuge for many terrestrial (e.g., avifauna) and marine animals during various stages in their lifecycle, and provides shelter during adverse weather conditions (Mason, 2007).

4. **Fisheries**: One of the key provisioning services provided by mangroves and seagrass beds relates to local fisheries (subsistence and commercial). The area provides an essential habitat for numerous commercially important fish species including Atlantic thread herring *(Opisthonema oglinum),* and Redear herring *(Harengula humeralis)*, as well as various species of oysters as well as shrimp and lobster (Mason, 2007).

5. **Regulation and Maintenance**: In terms of regulation and maintenance, the mangrove – seagrass complexes contribute to the maintenance of physical, chemical and biological

conditions, specifically: lifecycle maintenance, habitat and genepool protection (Mukherjee et al. 2014). Both, mangroves and seagrasses support local nursery populations and serve as refugia for invertebrates including crabs, urchins, and conch.

6. A study of the Port Royal red mangrove-seagrass complex and the associated fish communities (Aiken et al 2008), found that these unique habitats served as important nursery grounds to 21 fish species found the area. In addition to serving as nursery grounds, the habitats also functioned in regulating the stability and health of the food web in the harbor near Port Royal, with a spillover effect to other areas within the greater harbour area. The study emphasised the need to protect the Port Royal mangroves and associated seagrass areas from future developments.

7. **Biodiversity (*Regulation and Maintenance*):** Biodiversity, defined hierarchically, refers to species, populations and ecosystems (Ray and Grassle 1991). This definition is especially relevant in the context of the Port Royal mangroves, where biodiversity encompasses an assemblage of terrestrial and aquatic species (See **Section 6.2.1.2**), life histories (nursery grounds and refugia), habitats (mangroves and seagrass beds), and the complex food webs, and nutrient cycles that exist between terrestrial and marine ecosystems at the land-sea interface.

8. **Carbon sequestration (*Regulation and Maintenance*)**: Referred to as Blue Forests, mangroves are known to be the most carbon rich forests in the tropics, reported to have 1023 Mg C per hectare of forest including soil carbon (Donato et al. 2011).

9. **Functional connectivity (*Regulation and Maintenance*):** Functional connectivity refers to the degree to which the seascape configuration enables or hinders movement of individuals between habitats (Turgeon et al. 2010). The spatial configuration and the

quality of the habitat, as well as species specific characteristics such as mobility, habitat range, sex, life stage, all influence how a species behaves in and responds to its habitat (Taylor et al. 1993). The nursery function of mangroves varies with spatio-temporal accessibility, in that it depends on unimpeded connectivity to nearby habitats. Connectivity to adjacent seagrass beds and reefs enhances the functional value of mangroves as nurseries through trophic interactions and ontogenetic migrations (Nagelkerken et al. 2015). The mangrove-seagrass ecosystem in Port Royal covers an estimated 100 ha (Aiken et al. 2008), serving as important nursery areas that provide a spillover effects to adjacent areas in the harbour and nearby cays. Functional connectivity has important implications for the functioning of the mangroves and sea grass areas in Port Royal. Spatially clustered expanses provided by mangroves and seagrasses allow for ecological linkages including migration of individuals during developmental stages as well as during diurnal migration of fauna between habitats (Mumby 2006).

10. **Existence and cultural function.** While mangroves, seagrass meadows, and salt marshes, are considered among the most valuable and productive coastal ecosystems on the planet (Himes-Corenell 2018), their cultural, spiritual and aesthetic values are systematically overlooked especially in attributing valuation to the ecosystem services provided. In cases where ecosystems services cannot easily be ascribed a monetary valuation based on benefit transfer values that can easily be translated to market values, it is important to consider the importance of the ecosystem to local communities. The existence value of Port Royal mangroves and associated habitats is reflected in its Protected Status, designation as a Ramsar Site, and also in the importance they hold for local communities.

6.3 Socio-Economic and Cultural Environment

6.3.1 Demography and Housing

This section presents the demographic and housing characteristics of the parishes of Kingston and St. Andrew and the communities of Port Royal and Harbour View which fall within the impact zone designated for the proposed Kingston Cruise Shipping Pier. The demographic and housing data presented in this section of the report were obtained mainly from the Statistical Institute of Jamaica (STATIN) and the Planning Institute of Jamaica (PIOJ).

6.3.1.1 Population

The recent population figures released for Jamaica by the Statistical Institute of Jamaica (STATIN) indicates that at the end of 2018, the parish of Kingston and St. Andrew had a combined population of 669,773 persons (**Table 6.3-1**), a decline of 0.06 per cent over 2017 levels. The decline is due in part to the declining population growth rate of the parish of Kingston, which recorded a 7% decline in the size of its population between 2001 and 2011.

Disaggregation of the latest population data by parish, showed Kingston had 89,980 persons and St. Andrew 579, 793 at the end of 2018. The current population figure for Kingston is 1% higher than the 89,057 figure recorded in the 2011 census; giving the parish an annual growth rate of 0.15% since the 2011 census. This rate resulted in the parish having the third smallest population size in Jamaica and also one of the slowest growth rates in the island. The parish presently accounts for 3.3% of Jamaica's total population (STATIN, 2018). This figure has remained fairly consistent since 2001, though there has been a noted decline of 8% when compared with 2001 figures. In 2011, 3.3% of Jamaica's population resided in Kingston, compared to 3.6% in 2001.

Table 6.3-1. Post 2011 Census Population at National and Parish Level 2014-2018.

Parish	2014	2015	2016	2017	2018	% of country population (2017)
Jamaica	2,723,246	2,727,329	2,728,969	2,728,864	2,726,667	**100.0**
Kingston & St. Andrew	668,932	669,935	670,338	670,183	669,773	24.6
Kingston	89,867	90,001	90,056	90,052	89,980	3.3
St. Andrew	579,065	579,934	580,282	580,131	579,793	21.3
p –preliminary						

Source: PIOJ, 2018 and STATIN, 2018

The parish of St. Andrew has an estimated population of 579,793 persons. The figure represents an estimated 0.99% growth over 2011 census figures. According to the 2011 Census the parish of St. Andrew had 573,369 persons. The parish which accounts for 21% of the total population of Jamaica, is the most populous parish.

Kingston and St. Andrew is the largest urban centre in Jamaica. In 2011, 93% of the population of the combined parishes resided in urban areas. The entire parish of Kingston is considered urban, while 86% of St. Andrew is deemed urban. The parish of St. Andrew along with Kingston and sections of St. Catherine forms the Kingston Metropolitan Area (KMA), which is the largest urban centre in Jamaica (Table 6.3-2).

Table 6.3-2. Population at Parish Level 2001 and 2011.

Parish	2011			2001		
	Total	% of country population	% of population in urban areas	Total	% of country population	% of population in urban areas
Kingston	89,057	3.3	100	96,052	3.6	100
St. Andrew	573,369	21.25	86	555,828	21.32	87

Source: STATIN, 2013

6.3.1.2 Sex Distribution

Sex disaggregation data for Kingston shows the parish had a male to female population ratio of 1:1, i.e. for every 101.64 males there were 100 females (**Table 6.3-3**). According to the 2011 Census, males accounted for 50.4% of the total population of the parish, a 2 percentage point increase over 2001 levels. This percentage increase resulted in males accounting for the majority of the population in the parish, a noticeable sex change over 2001 baseline levels, when females accounted for 51% of the total population of the parish. The sex distribution pattern in the parish is currently not in line with national trends, where women account for the majority of the population in Jamaica, but is consistent with sex patterns observed in nine (9) other parishes.

Table 6.3-3. Sex Distribution Population for the Parish 2011.

Parish		Total	Male	Female	Sex Ratio (males per female 100)
Jamaica		2,697,983	1,334,533	1,363,450	97.9
Kingston		89,057	44,891	44,166	101.64
St. Andrew		573,369	274,320	299,049	91.73

Source: STATIN, 2013

In St. Andrew the proportion of females in the parish has remained consistently higher than their male counterparts over the last two intercensal periods. Disaggregation data for St. Andrew from the 2011 Census, shows the parish had a male to female population ratio of 1:1, i.e. for every 97.7 males there were 100 females (**Table 6.3-3**). The sex ratio of the parish is consistent with national patterns. The data shows that the percentage of males in the parish has grown since the last census in 2001 by 14%. In 2001 males accounted for 47.17% of the total population of the parish and in 2011, the figure stood at 47.84%. The sex distribution data for 2011, shows similarity to national trends, where the growth rate for the male population is higher than that for females.

6.3.1.3 Age Distribution

The age distribution trends observed at the parish level for Kingston are similar to those observed nationally. Approximately twenty-eight percent (28%) of the total population is under the age of 15; sixty-six percent (66%) between the age of 15 and 64 and; six percent (6%) 65 and over. Approximately fifty-six percent (56%) of the population is 29 years and younger, 2 percentage points higher when compared to the population at the national level. The age group 30-64 constitutes the largest segment of the population and accounts for approximately thirty seven percent (37%) of the total parish population (**Table 6.3-4**).

Table 6.3-4. Age Distribution of Population at Parish Level 2011.

Parish	Total	Under 15	15-29	30-64	65 and over
Jamaica	**2,697,983**	**702,835**	**751,489**	**1,026,053**	**217,606**
St. Andrew	573,369	129,412	167,227	233,457	43,273
Kingston	89,057	24,860	25,451	33,326	5,420

Source: STATIN, 2013

In the parish of St. Andrew, twenty-two point five percent (22.5%) of the total population is under the age of 15; sixty-nine point eight percent (69.8%) between the age of 15 and 64 and; seven point five percent (7.5%) being 65 and over. Approximately fifty-two percent (52%) of the population is 29 years and younger, 2 percentage points lower when compared to the population at the national level. The age group 30-64 constitutes the largest segment of the population and accounts for approximately forty point seven percent (40.7%) of the total parish population.

6.3.1.4 Age Dependency Ratio

The age dependency ratio[15] for Jamaica has continued to decline steadily since 1991. The figure, which stood at 73.34 in 1991, witnessed an estimated eight percent (8%) decline in 2001. The 2001 census showed that for every 100 working persons there were close to 67 dependents. By 2011, the national dependency ratio figure witnessed an even larger decline, falling by an estimated twenty-two point six percent (22.6%) to 51.84 dependents for every 100 working persons within the ten year period between 2001 and 2011. The PIOJ (2018) estimated the 2017 dependency ratio at 43.6 dependents per 100 persons, a further decline over 2016 and 2015 figures which stood at 45.2 and 46.0 respectively.

The parish of Kingston had an overall dependency ratio of 51.5 in 2011, in line with the national dependency ratio of 51.78 recorded in the 2011 census (STATIN, 2013). The parish of St. Andrew has a total dependency ratio of 48.09, lower than the national ratio.

6.3.1.5 6.3.2 Community Level: Impact Zone Demographics

Port Royal and Harbour View are the two (2) communities found within the designated Impact Zone of the proposed Cruise Pier. The communities combine for a total population of 10,046 persons (STATIN, 2013). Harbour View is the most populous community within the impact zone,

[15]Dependency Ratio - is an age-population ratio of those typically not in the labour force (the *dependent* part) and those typically in the labour force (the *productive* part). It is used to measure the pressure on productive population

accounting for an estimated 88% of the total population (**Table 6.3-5**). Though the national 2011 census estimates the population of Harbour View to be below 9,000, a community profile by the Social Development Commission estimates the overall population of the community to be approximately 13,400.

Port Royal's population declined by approximately 24% between the intercensal period 2001 to 2011. In 2011, the town's total population was 1,251, compared to 1,651 total recorded in 2001. Both Port Royal and Harbour View are considered as urban areas, with the latter divided into five districts.

Table 6.3-5. Population of Communities by Sex and Enumeration District, 2011.

Communities	ED	Female	Male	Total
Port Royal	E87	365	347	**712**
	E88	268	272	**540**
Harbour View (Kingston)	E86	411	334	**745**
Harbour View (St. Andrew)	ER64-81	4,434	3,615	**8,049**
Total		**5,478**	**4,568**	**10,046**
Sex Percent Total		**54.5%**	**45.5%**	**100%**

Source: STATIN, 2013

6.3.1.5.1 Population Density

Port Royal and Harbour View have some of the highest population densities in the parish of Kingston and Jamaica. The historic town of Port Royal in 2011 had an overall density of 5,957 persons per km^2, compared to the 7,861.9 recorded in 2001. The town's density is twenty-four times higher than the population density of Jamaica and a third more than the population density recorded for the parish of Kingston. Harbour View's population density in 2011 was

11,725.3, close to, forty-eight times higher than the national population density figure, ten times higher than the figure for St. Andrew and three times higher than the density figure for Kingston (**Table 6.3-6**).

The impact area has a population density of 1,004 persons per square kilometre.

Table 6.3-6. Impact Zone Population Density.

	Port Royal	Harbour View	Impact Zone
Land Area (km^2)	0.21	0.75	10*
Population	1,251	8,794	10,046
Population Density	5,957.1	11,725.3	1,004
*estimated			

6.3.1.5.2 Sex Disaggregation

Aggregation of the population data by sex, shows that females account for an estimated 54.5% of the total population living within the designated impact zone. Examination of the data by community level showed females accounted for 55% of the total population in Harbour View and 50.5% in Port Royal. Analysis of the sex data showed that for every 83.3 males, there were 100 females. The sex distribution pattern largely reflected existing parish trends in St. Andrew, but not Kingston, where males account for the largest segment of the population **(Table 6.3-3**).

6.3.1.5.3 Age Distribution

An estimated twenty percent (20%) of the total population in the impact zone is under the age of 15; seventy percent (70%) between the age of 15 and 64 and; nine percent (9%) 65 and over. Approximately forty-five (45%) of the population is 29 years and younger, which is largely consistent with the patterns observed for this age group category at the national level. The age group 30-64 constitutes the largest segment of the population and accounts for close to forty-five percent (45%) of the total population of the communities (**Table 6.3-7**). The impact zone has a dependency ratio of 41.7.

Table 6.3-7. Age Distribution of Impact Zone by Community.

Community	ED*	Age Group Category				
		Total	Under 15	15-29	30-64	65 & over
Port Royal	E87-88	1,252	310	334	524	84
Harbour View	E86, ER64-81	8,793	1,696	2,246	3,983	868
Total		**10,045**	**2,006**	**2,580**	**4,507**	**952**
*- Enumeration District						

Source: STATIN, 2013

6.3.2 Housing

The housing information from the 2011 census shows that nationally there has been an increase in the total number of housing and dwelling units and households. The number of housing units increased in 2011 by approximately nineteen point seven percent (19.7%) over 2001 baseline figures. For dwelling units, the 2011 census shows that nationally the total number of dwelling units increased by nineteen percent (19%) over 2001 baseline figures. Similar to the observed changes in the number of housing and dwelling units, notable increases in the number of households at the parish and national levels were observed in 2011. Nationally there has been a seventeen percent (17%) increase in the number of households over 2001 figures (**Table 6.3-8**).

Table 6.3-8. Housing Parish Data 2001 and 2011.

Parish	Number of Dwelling Units		Number of Households		Household Size	
	2011	2001	2011	2001	2011	2001
Jamaica	853,668	723,041	881,089	748,326	3.1	3.5
Kingston	28,834	27,204	29,518	28,199	3.0	3.4
St. Andrew	184,831	156,137	192,112	164,513	3.0	3.4
Port Royal	331	437	338	473	3.7	3.5
Harbour View (Kingston)	194	132	205	136	3.6	4.1
Harbour View (St. Andrew)	2,604	2,440	2,732	2,634	2.9	3.2

Source: STATIN, 2013

6.3.2.1 Housing Units and Households

Data from the 2011 Census indicated that the parish of St. Andrew recorded an 18% increase in the total number of dwelling units in the parish. Dwelling units recorded in 2011, totalled 184,831 compared to 156,137 in the 2001 census. A change in the number of households was also noted, with a recorded growth of 16.7% in total household numbers from 191,112 recorded in 2011, from the 164,513 recorded in 2001. Similar to national trends, there was an 11.7% decline in household size (**Table 6.3-10**).

For the parish of Kingston, there was a 6% increase in the number of dwelling units and 4.6% increase in the number of households. Similar to national trends, there was an overall decline in household size by 11.7% over 2001 levels.

6.3.2.2 Cruise Pier Impact Zone Housing

There are a total of 3,129 dwelling units and 3,275 households in the communities identified within the Impact Zone (STATIN, 2013). The household size within the impact zone ranges between 2.9 and 3.7 persons per household (**Table 6.3-9).**

Table 6.3-9. Housing Data for Communities in the Impact Zone.

Parish	Number of Dwelling Units		Number of Households		Household Size	
	2011	**2001**	**2011**	**2001**	**2011**	**2001**
Port Royal	331	437	338	473	3.7	3.5
Harbour View (Kingston)	194	132	205	136	3.6	4.1
Harbour View (St. Andrew)	2,604	2,440	2,732	2,634	2.9	3.2
Total	**3,129**	**3,009**	**3,275**	**3,243**	-	-

Source: STATIN, 2013

Disaggregation of housing data showed that the number of dwelling units in Port Royal declined by 24%, while the number of households declined by 28%. The number of persons per household increased by approximately 6%. This housing trend is incongruent to parish and national patterns.

6.3.3 Housing Tenure

Housing tenure patterns have shown that housing ownership has increased nationally since the last census in 2001. An estimated 60.3% of households owned the dwelling they occupied in 2011, compared to 58.3% in 2001. The data presented in **Table 6.3-10** also shows that 'rent' is the second leading tenure status amongst households nationally. In the parish of St. Andrew, forty-eight percent (48%) of households owned the dwelling they occupy. The overall percentage is the second lowest in Jamaica, after Kingston, which has only thirty percent (30%) of households owning their dwellings. Both parishes are also the only parishes where less than fifty percent (50%) of dwellings are owned by households. Rent is the dominant tenure status in Kingston and St. Andrew. In St. Andrew, sixty-two percent of all housing is rented, while for Kingston, the overall percentage stands at approximately 32%.

Table 6.3-10. Housing Tenure Status by Parish and National Level, 2011.

Parish	***Number Households***	***Tenure***					
		Own	***Leased***	***Rent***	***Rent Free***	***Squatted***	***Other****
Jamaica	881,089	534,353	15,069	176,871	136,835	8,823	9,138
St. Andrew	192,112	93,761	4,934	58,225	29,265	2,911	3,016
Kingston	29,513	8,931	375	9,409	9,095	954	749
****- Includes Other tenure status and the category of "not reported"***							

Source: STATIN, 2013

Approximately 47% of households own the dwelling they occupy within the impact zone. The figures are largely in line with ownership figures for St. Andrew and above the level recorded for Kingston. Disaggregation of the data by community shows 40% of households own the dwelling they occupied in Port Royal, compared to 48% of households that indicated owning the dwelling they occupied in Harbour View (**Table 6.3-11**).

Table 6.3-11. Housing Tenure Status in Impact Zone, 2011.

Community	Number of Households	Tenure					
		Own	Leased	Rent	Rent Free	Squatted	Other*
Port Royal	338	136	2	160	25	9	6
Harbour View	2,935	1,428	16	1,045	344	4	39
Total	**3,273**	**1,564**	**18**	**1,205**	**369**	**13**	**45**
*- Includes Other tenure status and the category of "not reported"							

6.3.4 Utilities

6.3.4.1 Water

The National Water Commission (NWC) is the major supplier of water across Jamaica, producing more than ninety percent (90%) of Jamaica's potable water. More than seventy percent (70%) of water is supplied via house connections and the remaining is supplied using standpipes, water trucks, wayside tanks etc. Small providers, including the Four Rivers Development Company (FRDC) produce and supply less than one percent (1%) of the nation's water. The 2016 ESSJ (PIOJ, 2017) estimates seventy-seven point four percent (77.4%) of Jamaica's total population had access to safe potable water and 69.0% having access to water via a piped source.

The NWC supplies water to Kingston and St. Andrew (KSA) from rivers, deep alluvial and limestone wells and springs. Surface Water Some 75% of the water obtained for use in KSA is abstracted from surface sources. The main river sources in the parish are the Morsham, Wag Water and Hope Rivers. Water sources in the KSA are inadequate to meet demands and as such water from Yallahs and Negro River in St. Thomas and the Rio Cobre (through the Ferry and Forest Hills etc. system) in St. Catherine are imported into the KSA to satisfy demands. There are four main treatment facilities which supply water to the KSA, these are Constant Spring Treatment Plant (CSTP), Mona Treatment Plant (MTP) Hope Filter Plant) and Seaview Treatment Plant. These are supplied by several other water supply distribution systems (tanks) in the KSA. Under the Jamaica Water Supply Improvement Project (JWSIP), the NWC has undertaken the improvement and upgrading of existing water supply systems (pipelines, treatments plants, water infrastructure fixtures etc.) across the Kingston Metropolitan Area, which includes the parishes of Kingston and St. Andrew.

Approximately 75% of households in the KSA main source of domestic water was water piped directly into their dwelling from either a public or private source.

6.3.4.2 Electricity

According to the 2011 Census an estimated ninety-six percent (96%) of households in both St. Andrew and Kingston had access to electricity; five percent (5%) below the national level. In the impact zone, 91% of households use electricity as their main lighting source (**Table 6.3-12)**.

Table 6.3-12. Number of Household with Electricity at National and Parish Level, 2011.

Parish/Community	Number of Households	Electricity	Electricity (%)
Jamaica	881,089	809,746	91.9
St. Andrew	192,112	185,006	96.3%
Kingston	29,513	28,298	95.8%
Port Royal	338	325	96.1%
Harbour View	3,273	2,832	86.5%

Source: STATIN, 2013

6.3.4.3 Sewage

The NWC operates sixty-eight (68) sewage treatment plants island wide, collecting wastewater from approximately twenty-five percent (25%) of the Jamaican population. The NWC currently operates fourteen (14) sewage treatment facilities in the parishes of Kingston and St. Andrew (**Figure 6.3-1**). Port Royal is not connected to any of the existing treatment plants in the parishes. Septic tanks and absorption pits are used as the main systems for the collection, treatment and disposal of sewage from dwellings in the community.

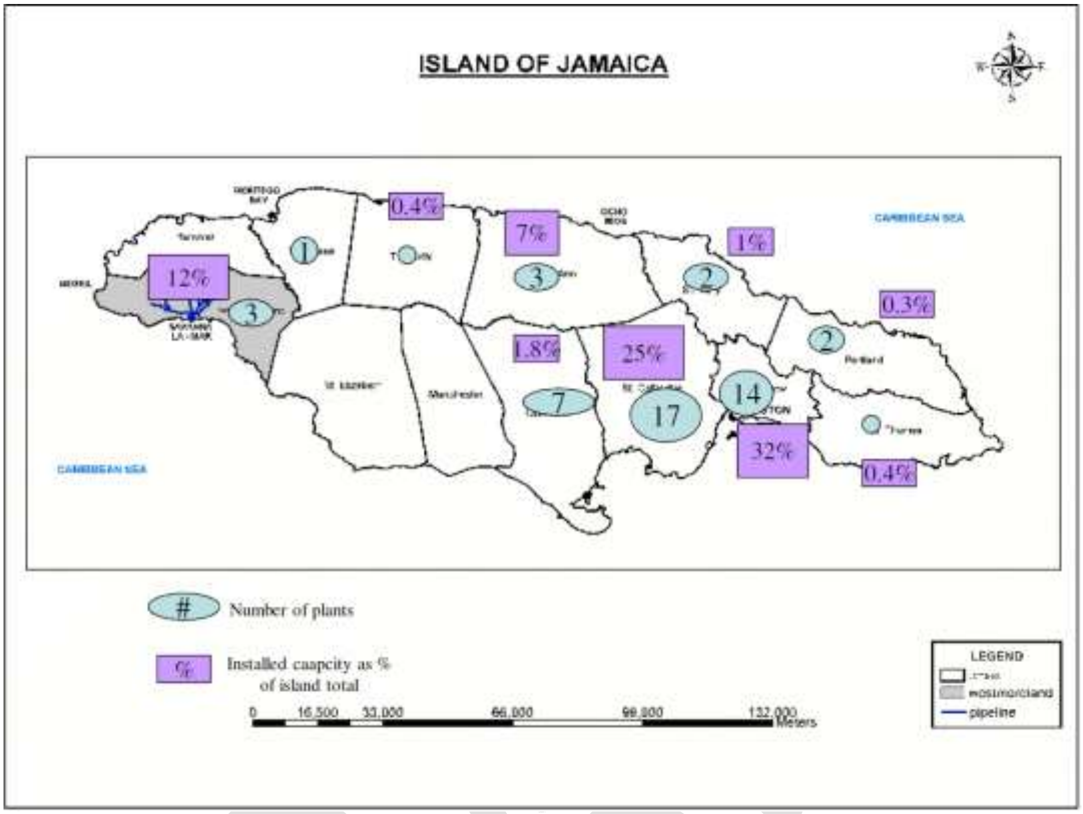

Figure 6.3-1. National Water Commission Sewage Treatment Plants in Jamaica.

Source: National Water Commission, 2013

6.3.4.4 Solid Waste

MPM Waste Management Ltd. (MPM) is responsible for the collection and disposal of solid waste in the communities found in impact zone of the project. The MPM serves the parishes of Kingston and St. Andrew, St. Catherine, Clarendon and St. Thomas and is responsible for the management of the Riverton (Kingston) and Church Corner (St. Thomas) disposal sites.

Jamaican households generate on average 2.7 million kilograms (kg) of solid waste on a daily basis.[16] The parish of St. Andrew generates 573,369 kilograms (kg) daily, while the parish of Kingston generates 89,057 kilograms daily. St. Andrew accounts for the highest daily generation of solid waste in Jamaica.

In the local impact zone, approximately 10,046 kilograms (kg) of solid waste is generated daily based on average waste generation rates for Jamaica.

6.3.5 Municipal and Social Services

6.3.5.1 Health Services

The parishes of Kingston and St. Andrew are served by forty-eight (48) health centres and five hospitals, including the Kingston Public Hospital and the University of the West Hospital. Health care in the parishes is managed by the South East Regional Health Authority (SEHRA). Port Royal and Harbour View are served primarily by the:

- Port Royal Health Centre
- Harbour View Health Centre
- Kingston Public Hospital
- University of the West Indies Hospital

[16]Domestic garbage generation is calculated at the average waste generation rate of 1kg/person/day identified in the 2013 waste composition study by the National Solid Waste Management Authority.

6.3.5.2 Educational Institutions

According to the Ministry of Education School Statistics 2015-2016 (MOE, 2017) the parishes of Kingston and St. Andrew have one hundred and fifty nine (159) public education institutions, beginning at the early childhood/infant level through to the tertiary level. There are three (3) public schools found in the impact zone in the MOE's database, Port Royal Primary and Infant, Harbour View Primary and Donald Quarrie High School.

There are several privately operated schools in the zone, mainly early childhood institutions. **Table 6.3-13** provides information on the characteristics of the public schools located within the impact zone.

Table 6.3-13. Listing of Schools within Impact Zone Communities.

Educational Institutions						
School Name	**Class**	**Percent Attendance**	**Capacity**	**Enrolment**	**Number of Teachers**	**Pupil Teacher ratio**
Port Royal Primary and Infant	I	85	175	72	7	14:1
Harbour View Primary	IV	85	830	1,162	42	34:1
Donald Quarrie High	III	67	640	1,132	18	16:1
NB: Class refers to the classification assigned based on the school type (infant, primary or secondary) and number of students. Class goes from I-IV and covers number of students from 500 to above 5500						

Source: MOE, Jamaica 2017

6.3.5.3 Emergency Protection Services

Kingston and St. Andrew is served by more than forty (40) police stations and eight (8) fire stations. Port Royal and Harbour View are served by the Port Royal Fire Station and the Port Royal and Harbour View Police Stations.

6.3.5.4 Communication Technology

Flow and Digicel are the major providers of telecommunication services across Jamaica. Both telecommunication companies provide cellular services to the communities within the social impact zone. Internet services are also provided via these two major communication companies.

6.3.5.5 Cultural and Heritage Resources

There are thirty-eight (38) officially recognised national heritage and cultural sites in the parish of Kingston. The sites consist of churches, forts, public buildings, art sculptures, and entertainment spaces based on information sourced from the Jamaica National Heritage Trust (JNHT). The parish of St. Andrew has thirty-two (32) officially recognised national heritage and cultural sites.

- **Port Royal** is recognised as one of the most important heritage and cultural areas in Jamaica by the Jamaica National Heritage Trust. In 1996, the town of Port Royal was designated as a protected national heritage site by the JNHT. The community's heritage and cultural resources include Forts, churches, underwater artefacts, lighthouse, historic naval hospital, naval dockyard and the lopsided giddy house. Fort Charles in the community is the oldest fort in Jamaica and is one of six located in Port Royal.
- **Fort Charles:** Fort Charles was the first of six forts constructed by the British in Port Royal to guard the city and entrance to the Kingston Harbour. It was used by pirates as a hideout to plunder passing ships. Built in 1656, the fort, the oldest fort in Jamaica was originally known as Fort Cromwell, before being renamed Fort Charles in 1662 to honour Charles II, restored King of England. The Fort underwent several changes between 1656 and 1765. Built originally with 10 guns, the number was increased to 36 by 1667, and 1765 an additional 68 guns were added, along with a barrack able to house 500 persons. The Fort was one of the only to survive the 1692 earthquake and was reconstructed in 1699 due to damages.

- **Giddy House:** The 'Giddy House' was built in 1888 and used as an artillery store by the British. The house was known as the Royal Artillery Store and in the 1907 earthquake event, the building shifted to its present 45o angle, giving it its famous slant appearance.
- **Dockyard and Coaling Wharf:** The British constructed a naval dockyard in 1715 to house its fleets. By 1775, the facilities at the dockyard were updated to handle trans-Atlantic voyages and expanded to accommodate large navy ships. The dockyard was fitted with a coaling station to support steam-powered vessels which became the vessels of choice by the mid-nineteenth century. In 1815, a new wharf was built and continued to support naval operations until 1905 when the dockyard ceased operations. The cultural and heritage attributes of the Old Coal Wharf are documented in detail in the Archaeological Impact Assessment done by the JNHT (JNHT 2019). The AIA includes preparation of a site specific inventory of all cultural heritage resources to be affected by the development and forms part of the Port Royal Heritage Asset Inventory to be incorporated into the National Inventory of Heritage Sites. The area where artefacts assemblages were identified, samples were collected, studied, conserved and stored for future references, and where necessary, displayed as part of the site's heritage assets.
- **Naval Hospital:** The Naval Hospital was built around 1818 using the labour of enslaved Africans. The building was constructed on the foundation of a previous hospital which was erected in 1743, but destroyed by fire in 1812. The architecture of the building boasted the use of cast iron, which were imported from England and bricks made from local clay. Today the building is a multipurpose facility.
- **St. Peter's Church:** Originally constructed in the late 1600s, the original St. Peter's Church building was destroyed by the 1692 earthquake and after being rebuilt destroyed by fire in 1703. The existing church, which has undergone numerous restoration, was built between 1725 and 1726. The original tiles of the church floor and its organ loft still exists today. Constructed in 1725, St. Peter's Church is located in the

centre of the town of Port Royal. The original tiled floor and organ loft of the Church still exists today.

- **Plumb Point Lighthouse:** Plumb Point Lighthouse was built in 1853, 11 years after the construction of the Morant Point Lighthouse. It is located the Palisadoes Peninsula at Great Plumb Point near the entrance of the Kingston Harbour. The Tower stands at 21m.

6.3.6 Artifacts, Archaeological and Cultural Features

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6.3.7 Economic Baseline

Kingston and St. Andrew (KSA) is the main financial, transportation, manufacturing and commercial centre of Jamaica.

6.3.7.1 Macro-Economy

The information presented in this section is from the Economic and Social Survey of Jamaica 2017, published by the Planning Institute of Jamaica (2018). The figures presented below are a revision of the preliminary figures first published by the PIOJ in its preliminary economic summary. Overall the Jamaican economy achieved a 0.5 per cent increase in Real Value Added (GDP) in 2017. The economic industry performance for Jamaica has shown that the Service Industry continues to out-perform the Goods Producing Industry. The Goods Producing Industry contracted by 0.7 per cent, while the Services Industry grew by 0.9 per cent (**Table 6.3-14**).

The Service Industry constitutes the following industries:

1) Electricity and Water Supply
2) Transport, Storage and Communication
3) Wholesale, Retail, Trade Repair and Installation of Machinery
4) Finance and Insurance Services
5) Real Estate, Renting and Business Activities
6) Producers of Government Services

7) Hotels and Restaurants

The Goods Producing sector includes the following industries:

- Agriculture, forestry and fishing
- Manufacturing
- Mining and quarrying
- Construction

The Goods producing sectors account for 24.8% of total GDP in 2017. The Manufacturing industry is the main earner for the goods producing sector, averaging total GDP contribution of 8.5% annually over the last 5 years. In 2016, goods production sectors earned an estimated $189 billion, a 3.2% increase relative to 2015 earnings.

Table 6.3-14. Gross Domestic Product Contribution by Industry.

	Unit	2013	2014	2015	2016	2017
Goods Production	**%**	**24.6**	**24.5**	**24.5**	**25.1**	**24.8**
Agriculture, Forestry & Fishing	%	6.7	6.6	6.6	7.3	7.0
Mining & Quarrying	%	2.3	2.3	2.3	2.2	2.1
Manufacturing	%	8.5	8.4	8.5	8.5	8.6
Construction	%	7.1	7.2	7.2	7.2	7.2
Services	**%**	**79.5**	**79.5**	**79.4**	**78.9**	**79.2**
Basic	%	14.2	14.2	14.2	14.2	14.2
Electricity & Water	%	3.2	3.1	3.1	3.2	3.2
Transport, Storage & Communication	%	11.0	11.1	11.1	11.0	11.0
Other Services	%	65.3	65.3	65.2	64.7	64.9

Source: PIOJ, various years

The Wholesale & Retail Trade; Repair and Installation of Machinery industry is the main earner for the services sector, averaging total GDP contribution above 17% annually over the last 5 years. In 2016, services sectors earned an estimated $593 billion, a 0.6% increase relative to 2015 earnings.

6.3.7.2 Manufacturing

Real value added for the Manufacture industry grew by 1.5 percent for 2017, a continuation of trends observed in 2016 which saw growth of 0.2 percent in that economic year. This resulted from growth in Food, Beverages & Tobacco and the Other Manufacturing sub-industries. The sub-industry of Food, Beverages & Tobacco grew by 2.3 per cent relative to 2016.

The value of manufactured exports was US$574.2 million, an 18.5 per cent increase over 2016 earnings. Average employment in the Manufacture industry increased to 79, 675 persons compared with 77, 450 persons in 2016. The share of employment in the Manufacture industry of the total employed labour force remained steady at 6.6 per cent, similar to the output for 2016 and since 2013. The higher average employment reflected increases in the number of males and females employed. The average number of males employed in the industry was 52,225 compared with 51,525 for 2016. The average number of females employed was 27,450, an increase of 6 per cent relative to 2016.

6.3.7.3 Tourism Sector

In 2016, the Hotel and Restaurant Industry accounted for 5.8% of Jamaica's Gross Domestic Product (PIOJ, 2017) (**Table 6.3-15**). The sector earned in excess of US$2,552 million, an increase of US$157.9 million relative to 2015 and employed an estimated 94,850 persons; 8.1% of Jamaica's total labour force. The sector has continued to grow over the last four years. In 2016, the sector increased its earnings by 28% over 2013 levels and also increased the number of persons employed.

Table 6.3-15. Tourism Sector Economic Performance 2013-2016.

	Direct GDP (%)	Earnings (US$)	Employment	% of total labour force
2016	5.8	2.56bn	94,850	8.1
2015	5.8	2.34bn	88,250	7.8
2014	5.7	2.24bn	80,500	7.1
2013	5.6	2.0bn	75,750	6.8

Source: Planning Institute of Jamaica, various years

When additional tourism products are considered in the statistical analysis of the tourism sectors overall impact e.g. entertainment and transport, the contribution of the sector to the Jamaican economy is even greater, both in terms of direct and indirect contributions.

The World Travel and Tourism Council (2017) tourism data showed in 2016, the tourism sector's direct contribution accounted for 9.6% of Jamaica's Gross Domestic Product (GDP); earning an estimated US$1.4 billion (bn). The sector's total contribution however, showed tourism accounting for approximately 30% of Jamaica's GDP and having total earnings in excess of US$5.2bn. The sector employs 97,000 persons, 8.4% of Jamaica's labour force directly. Indirectly, it is estimated that close to 320,000 persons are employed due to the sector, representing approximately 27% of the total labour force (**Table 6.3-16**).

Table 6.3-16. Tourism Sector Direct and Indirect Economic Performance 2014-2016.

	Direct GDP (%)	Direct Earnings	Total GDP	Total Earnings	Direct Employment	% of labour	Total Employment	% of labour

		(JMD)	(%)	(JMD)		force (direct)		force
2016	9.6	162.6bn	30.3	529.2bn	97,000	8.4	318,500	27.5
2015	8.9	145.5bn	29.3	481.6bn	91,500	8.0	306,000	26.6
2014	8.1	128.3bn	27.2	428.4	82500	7.3	277,000	24.7

Source: WTTC, various years

Jamaica had an approximate room capacity (accommodation) of 28,400 rooms in 2015/2016 and an average hotel room occupancy rate of 69 per cent. The resort town of Montego Bay accounts for 25% of total room capacity in Jamaica, with approximately 7,304 rooms.

6.3.7.3.1 Tourist Arrivals

In 2017, approximately 4.2 million tourist visited Jamaica. Stopover visitors accounted for the majority of total visitors to the island, with a 55% majority of total visitors. Examination of tourist arrival data covering the period 2010-2017, showed on average, that the total number of tourists arriving in Jamaica has increased by 5.7% annually. Tourist arrivals in 2017, accounted for the largest increase over a one year period from 2010-2017, with an 11.4% increase in visitor numbers over 2016 levels.

Stopover visitors account for the majority of tourist arrivals in Jamaica. The group accounted, on average, for 60% of total tourist visitors annually to the island from 2007-2017. The number of visitors in this group has increased annually, with average per annum growth recorded at 3.3% for the same period. Since 2013, however, there has been a noticeable annual decline in the percentage majority proportion of stopover tourists. In 2013, 61.3% of visitors were stopover visitors, by 2015 the percentage distribution fell to 57.4% and in 2017 the distribution figure stood at 55% (Table 6.3-17).

Table 6.3-17. Tourist Arrivals Jamaica 2007-2017.

Year	Cruise Passenger	Stopover	Total	% change
2007	1,180,733	1,700,785	**2,881,518**	**-4.4**
2008	1,093,273	1,767,271	**2,860,544**	**-7**
2009	923,234	1,831,097	**2,754,331**	**-3**
2010	909,976	1,921,678	**2,831,654**	**2.8**
2011	1,127,012	1951,752	**3,078,764**	**8.7**
2012	1,320,547	1,986,085	**3,306,632**	**7.4**
2013	1,265,693	2,008,409	**3,274,102**	**-0.9**
2014	1,424,047	2,080,181	**3,504,228**	**7.0**
2015	1,569,342	2,123,042	**3,692,384**	**5.3**
2016	1,656,151	2,181,684	**3,837,835**	**3.9**
2017	1,923,274	2,352,915	**4,276,189**	**11.4**

Source: JTB, various years

In 2017, an estimated 1.9 million cruise passengers visited the island. The figure represented a 16% increase over 2016 levels and a 111% increase over 2010 figures.

6.3.7.3.2 Tourist Spending

Over the last five years gross visitor expenditure has totaled more than US$2 billion. In 2016, visitors spent an estimated US$2.6 billion; an 8.6% increase over 2015 spending and a 23% increase over 2012 figures. Stopover tourists have accounted for approximately 91% of gross visitor spending over the last five years (2012-2016). Stopover visitors have increased their spending on average by 5% per annum over the period (**Table 6.3-18**).

While cruise passengers do not account for a significant portion of gross visitor expenditure, the group has increased their average per annum spending by 14% over the 5 year period. Additionally the average daily spending per person by cruise passengers increased by an estimated 19% in 2016 against 2012 levels, compared to a 14% increase in the average daily spending by stopover tourists.

Table 6.3-18. Tourist Expenditure 2012-2016.

	Tourist Expenditure (US$)				
	All tourist	**Stopover**	**Cruise Passengers**	**Stopover (avg. per person)***	**Cruise passenger (avg. per person)***
2016	$2.609bn	$2.372bn	$0.150bn	$134	$90
2015	$2.402bn	$2.188bn	$0.137bn	$126	$87
2014	$2.248bn	$2.053bn	$0.118bn	$122	$82
2013	$2.113	$1.936bn	$0.102bn	$117.22	$75.67
2012	$2.070	$1.890bn	$0.102bn	$117.22	$75.67
*average per person per night			bn-billion		

Source: JTB, various years

6.3.7.3.3 Excursions

In 2016, City/Town tours, beach parties, falls climbing/visit, transportation tours (bus/fly cruise pax) and adventure tours were ranked as the top five attractions/excursions for cruise passengers visiting Jamaica. Transportation tours were favoured by an estimated 22% of all passengers, while City/Town tours, beach parties, falls climbing/visit attractions had an almost even percentage distribution, with approximately 13% of passengers favouring each one. An estimated 8% opted for adventure tour attractions (**Table 6.3-19**).

Examination of the data by Port revealed the following:

- Beach party was the top attraction for passengers arriving at the Falmouth Port. This option was chosen by an estimated 27% of passengers
- Transportation tours were the top attraction for passengers arriving at the Montego Bay Port. This option was chosen by an estimated 51% of passengers
- Falls climb/visit was the top attraction for passengers arriving at the Ocho Rios Port. This option was chosen by an estimated 26% of passengers

Table 6.3-19. Cruise Passenger Excursions by Type and Port, 2016.

Attractions/Tours	Cruise Passenger Arrival Excursions by Type and Port 2016							
	Falmouth	% Share	Montego Bay	% Share	Ocho Rios	% Share	Total	% Share
Adventure Tour	10,432	2.9%	37,953	10.2%	31,459	12.1%	79,844	8.1%
Animal Sanctuary	27,123	7.7%	11,286	3.0%	11,230	4.3%	49,639	5.0%
Beach Party	95,350	26.9%	11,271	3.0%	29,517	11.4%	136,138	13.8%
Boat Tour	10,711	3.0%	6,865	1.8%	365	0.1%	17,941	1.8%
Cave Tour	2,463	0.7%	106	0.0%	6,073	2.3%	8,642	0.9%
City\Town Tour	34,659	9.8%	46,808	12.5%	50,237	19.4%	131,704	13.4%
Falls	48,131	13.6%	19,691	5.3%	67,567	26.0%	135,389	13.7%
Gardens	-		-		6,063	2.3%	6,063	0.6%
Greathouse \ Plantation Tour	31,391	8.9%	19,710	5.3%	1,827	0.7%	52,928	5.4%
Helicopter Tour	24	0.0%	-		-		24	0.0%
Horsback Riding	5,198	1.5%	-		6,402	2.5%	11,600	1.2%
Hospital	5	0.0%	5	0.0%	1	0.0%	11	0.0%
Hotel Day Pass	5,946	1.7%	11	0.0%	1,256	0.5%	7,213	0.7%
Independent Tours	29,926	8.5%	16,721	4.5%	20,240	7.8%	66,887	6.8%
Museum	1,810	0.5%	865	0.2%	1,505	0.6%	4,180	0.4%
OTHERS	-		-		2,433	0.9%	2,433	0.2%
Rafting & River Tour	18,094	5.1%	9,567	2.6%	6,558	2.5%	34,219	3.5%
Restaurant	1,375	0.4%	334	0.1%	1,486	0.6%	3,195	0.3%
Shopping Tour	3,275	0.9%	-		5,329	2.1%	8,604	0.9%
Sport	674	0.2%	240	0.1%	141	0.1%	1,055	0.1%
Transfers	38	0.0%	-		19	0.0%	57	0.0%
Transportation*	24,457	6.9%	190,642	51.1%	1,063	0.4%	216,162	21.9%
Unique Experience	2,682	0.8%	130	0.0%	2,851	1.1%	5,663	0.6%
Watersports	128	0.0%	898	0.2%	5,846	2.3%	6,872	0.7%
	353,892	100.0%	373,103	100.0%	259,468	100.0%	986,463	100.0%
% of Cruise Passengers	50.0%		82.3%		52.8%		59.7%	
Cruise Passenger Arrivals 2016	707,883		453,563		491,506		1,652,952	

* Includes Transportation of Intransit Fly Cruise Pax in Montego Bay

Source: Jamaica Tourist Board, 2018

6.3.7.3.4 Fishing

In 2016 fish production improved by 1.9 percent relative to 2015. The improvement was as a result of improved aquaculture production, which saw a 58% growth in production. The Fishing industry, according to 2014 data from the Fisheries Department, accounted for approximately 0.3% of total GDP and earned approximately $2,212 million through fish production.

The industry employs more than 20,000 fishers. In 2016, the industry had 23,687 registered fishers and 7,622 registered boats operating from 187 fishing beaches and two cays located at the Pedro Bank. This compared with 23,631 registered fishers and 7,133 registered boats operating from the same locations during 2015 (**Table 6.3-20**). The parishes of Kingston & St. Andrew account for the majority of fishers, averaging 18 per cent of total fishers island wide over the four year period covering 2012-2015.

Table 6.3-20. Number of Fishers per Parish 2012 – 2015.

	YEAR			
PARISH	**2012**	**2013**	**2014**	**2015**
Clarendon	2,130	2,156	2,186	2,226
Hanover	678	681	689	707
Kingston & St. Andrew	4,032	4,137	4,187	4,317
Manchester	472	478	503	521
Offshore Banks	980	981	981	981
Portland	1,478	1,501	1,527	1,577
St. Ann	1,148	1,165	1,183	1,223
St. Catherine	2,448	2,519	2,564	2,651
St. Elizabeth	1,194	1,233	1,254	1,301
St. James	1,002	1,015	1,034	1,083
St. Mary	1,025	1,030	1,054	1,078
St. Thomas	1,379	1,390	1,417	1,461
Trelawny	594	595	598	601
Unknown	1,109	1,109	1,109	1,109
Westmoreland	2,541	2,571	2,597	2,687
TOTAL	**22,210**	**22,561**	**22,883**	**23,523**

Source: Government of Jamaica, MOAF

6.3.7.4 Project Location Economy

Fishing is the main economic sector in Port Royal. The Port Royal Fishing Beach is located on the south-western margin of the Kingston Harbour. This beach accounts for a large number of resgistered fishers within the Habour. The landing site also accounts for some of the largest proportion of active vessels as indicated by Aiken (2015) with 18% at the Port Royal Fishing Beach (**Table 6.3-21**).

Table 6.3-21. Number of Registered Fisherfolks at the Landing Sites within the Kingston Harbour.

PARISH	LANDING SITE	2012	2013	2014	2015
KINGSTON &ST.ANDREW	GT - GREENWICH TOWN	695	703	708	725
KINGSTON &ST.ANDREW	HB - HUNTS BAY(JAM WORLD/CAUSE WAY)	984	992	998	1013
KINGSTON &ST.ANDREW	HH - HARBOUR HEAD	134	138	138	153
KINGSTON &ST.ANDREW	K - KINGSTON	597	620	625	644
KINGSTON &ST.ANDREW	PR - PORT ROYAL	843	868	882	929
KINGSTON &ST.ANDREW	ROCK FORT	75	76	76	77
KINGSTON &ST.ANDREW	RT - RAE TOWN	461	481	488	504
TOTAL		**3789**	**3878**	**3915**	**4045**

Source: Government of Jamaica, MOAF

6.3.7.5 Labour Market

The labour force consists of persons 14 years and over. In 2016, the labour force had 1,360,300 persons, an increase of 0.4% relative to 2015 figures. The labour force participation rate stood at 65.1%, up 0.4 per cent over 2015 levels. Males account for 53.7 per cent of the total labour force and have a participation rate of 71.3 percent. The number of females joining the labour force increased by 0.8% over 2015 levels, while for males the figure was 0.04% (**Table 6.3-22**).

In terms of actual employment, 55% of the labour force currently employed is males. However the number of females gaining employment increased at a faster rate when compared to males. Female employment increased by approximately 3.3%, while males increased by 1% in 2016. Overall employment grew locally by 2.2 percent in 2016 compared to 2015. In 2016, 88.3% of the total labour force was employed, resulting in an 11% decline in the unemployment rate between 2015 and 2016.

Table 6.3-22. Labour Force Data Jamaica 2012-2016.

	2012	2013	2014	2015	2016
Labour Force	1,308,500	1,307,500	1,316,600	1,353,700	1,360,300
Male	713,500	715,000	719,000	730,500	730,800
Female	591,100	592,500	597,600	624,100	629,500
Participation rate	63.0	62.8	63.1	64.8	65.1
Male	70.0	70.0	70.3	71.2	71.3
Female	56.3	55.9	56.3	58.9	59.1
Total Employment	1,109,100	1,127,800	1,138,700	1,175,200	1,201,800
Male	633,400	642,900	647,800	662,400	669,100
Female	475,600	485,000	490,900	515,500	532,700
Total Unemployment rate (%)	15.2	13.7	13.5	13.2	11.7
Male (%)	11.0	10.1	9.9	9.3	8.4
Female (%)	20.0	18.1	17.8	17.6	15.4

Source: PIOJ, various years

At the end of 2017, the unemployment rate stood at 11.7%, similar to 2016 figures. The unemployment rate for males stood at 8.4% at the end of 2016, compared to 9.3% in 2015; a

0.9% decline over the one year period. The female unemployment rate saw a much higher decline when compared to their male counterparts over the same period, recording a decline of 12.5%. At the end of 2016 the female unemployment rate was 15.4%, compared to 17.6% in 2015.

6.3.7.6 Formal Educational Level

According to the 2011 census on educational attainment, only point five percent (0.5%) of the population over 15 years had no formal schooling. The vast majority of the population, i.e., fifty-two point seven percent (52.7%) have been educated at the secondary level, while an estimated thirteen percent (13%) have received tertiary level schooling (**Table 6.3-23)**.

Table 6.3-23. Highest Level of Education for Population 15 Years and Over, 2011 and 2001.

Highest Level of Educational Attainment	Percentage	
Population 15 years and over	2011	2001
No Schooling	0.5	0.6
Pre-primary	0.1	0.3
Primary	28.5	25.5
Secondary	52.7	55.5
University	6.1	4.2
Other Tertiary	6.7	8.1
Other	0.8	3.5
Not Reported	4.6	2.3

Source: STATIN, 2013

6.3.7.7 Poverty

According to figures released by the Planning Institute of Jamaica (PIOJ) as of 2012, 19.9% of Jamaicans live in poverty.[17] The figure represented a two point three percent (2.3%) increase over 2008 figures (**Table 6.3-24**). The parish of St. Thomas had the highest poverty rate at thirty-two point five percent (32.5%), while St. Mary had the lowest at nine point four percent (9.4%).

The parish of Kingston has the second highest poverty rate in Jamaica. The parish has a poverty rate of 28.6%; almost doubling its poverty rate in the four year period between 2008 and 2012. The parish of St. Andrew had one of the lower poverty rates in the country at 17.7%/ The parish rate increased by 103% over 2008 levels.

[17]Poverty in Jamaica is defined using a consumption based methodology. The poverty line is calculated on the value of the basic food basket which includes food and non-food items e.g. education, transportation etc. The value of the food basket changes each year. In 2012 the food basket had an adult equivalent per year value of $143,686.90. The approach is different from that of the World Bank which uses an income based approach and defines poverty line as the number of persons earning less than US$2.50 per day.

Table 6.3-24. Poverty Rate by Parish in Jamaica, 2008 and 2012.

Parish	2008	2012
Hanover	**15.5**	**10.8**
Westmoreland	**10.7**	**18.9**
St. James	**8.5**	**11.2**
St. Elizabeth	**30.6**	**23.8**
Trelawny	**19**	**13.2**
Manchester	**15.3**	**22.5**
Clarendon	15	19.3
St. Ann	12.5	18.4
St. Mary	**21.3**	**9.4**
St. Catherine	7.5	24
St. Andrew	**8.7**	**17.7**
Portland	**17.3**	**21.5**
Kingston	**14.5**	**28.6**
St. Thomas	**14.4**	**32.5**

Source: PIOJ, 2015

6.3.8 Land Use

6.3.8.1 Historical

The town of Port Royal originated in the 1650s by the first British settlers who came to Jamaica. The town developed around Fort Charles and soon became packed with traders, shopkeepers, innkeepers, soldiers, buccaneers and pirates. There were also craftsmen including carpenters, bricklayers, tailors, goldsmiths and silversmiths (JNHT, 2013 cited in NEPA, 2013).

By 1690, there were between 8,000 and 10,000 permanent inhabitants at Port Royal. On June 7, 1692, an earthquake struck Port Royal. Many of the buildings were destroyed and most of the city disappeared into the sea, thus the emergence of the Sunken City. Over 2,000 people died and more than 3,000 had serious injuries. After the earthquake, the survivors went across the harbour and many settled in Kingston. In 1703, Port Royal was impacted by a fire and in 1722 by a devastating hurricane, which further contributed to the decline of the town (JNHT, 2013 cited in NEPA, 2013).

The town of Port Royal today is a mixture of modern and historic structures, some of which are in disrepair (NRCA, 1997 cited in NEPA, 2013). Its historic sites and monuments however prominently illustrate the cultural/heritage values of the P-PRPA which are valuable for public understanding and popular among visitors.

6.3.8.2 The Natural Environment

The lands forming the Port Royal community is not only very environmentally sensitive but also of significant historic importance; it represents a section of the Palisadoes-Port Royal Protected Area. According to the National Environment and Planning Agency (2013), the Palisadoes-Port Royal Protected Area (P-PRPA) is approximately 7,523 hectares (75.23 km2) and encompasses both terrestrial and marine areas. On September 18, 1998 the area was declared a Protected Area under the Natural Resources Conservation Authority (NRCA) Act. Prior to this declaration, the Port Royal Protected Area was declared on May 8, 1967 under the Beach Control Act. Internationally, on April 22, 2005 the area was designated as Jamaica's second Wetland of International Importance (Ramsar Site) under the Convention on Wetlands of International Importance, especially as a Waterfowl Habitat. The Port Royal and the Palisades area is one of five (5) heritage districts in the island, designated by the Jamaica National Heritage Trust (JNHT).

There are various zones within the P-PRPA, ranging from strictly conservation areas to those within which development, economic and recreational activities are permitted, but with some amount of restriction (See Appendix 1 – adopted from NEPA, 2013).

6.3.8.3 Land Uses Within Impact Zones

6.3.8.3.1 Land Use within the Wider Area – Palisadoes and Port Royal

The land uses within the study area included but was not limited to residential (formal and informal), commercial, historic site, industrial, public assembly and recreation. The major land uses within the wider area (Palisadoes, Port Royal and sections of Harbour View) are outlined in **Table 6.3-25**. The majority of the land parcels within this area were used for residential purposes including single and multi-family uses. A significant number of the land parcels were illegally occupied by households (squatters); the most significant squatted site was the informal settlement at Michelin Avenue (Port Royal). A Socio-economic Survey conducted by the Ministry with responsibility for Housing in 2011 identified a total of 31 dwelling units occupied by 81 persons at Michelin Avenue; 60.5% of these persons were female. Other noteworthy land uses included commercial, historic sites, conservation, vacant lot and residential mixed with commercial **(Table 6.3-25**; **Figure 6.3-2)**.

Table 6.3-25. Major Land use Categories – Port Royal and the Palisadoes.

Land use Category	Number of Land Parcels
Residential (Single-family)	2,111
Residential – Informal	89
Commercial	28
Residential (Multi-family)	19
Residential/Commercial	16
Conservation (Natural)	13
Historic Site	12
Vacant Lot	12

6.3.6.3.2 Land Use within 0.5 Kilometer Radius of the Project Site

Residential (single family) land use was also the most dominant within 0.5 kilometer (km) of the project site (Old Coaling Wharf). This was followed by vacant lot, open space (public), historic site, residential (informal) and resort (hotel) **(Table 6.3-26; Figure 6.3-3, Figure 6.3-4)**.

Table 6.3-26. Major Land use Categories – 0.5 km of the Old Coaling Wharf.

Land use Category	Number of Land Parcels
Residential (Single-family)	8
Vacant Lot	6
Open Space (Public)	5
Historic Site	3
Residential (Informal)	3
Resort (Hotel)	3

6.3.8.3.2 Land Use within 1 Kilometer Radius of the Project Site

Similarly to the previous zones, residential (single and multi-family) was the most prevalent land use identified. Residential (single family) accounted for 176 of the land parcels within this zone (1 km of the Project Site) while residential (multi-family) accounted for 19 land parcels. This was followed by open space (public), commercial and historic site **(Table 6.3-27)**.

Table 6.3-27. Major Land use Categories – 1 km of the Old Coaling Wharf.

Land use Category	Number of Land Parcels
Residential (Single-family)	169
Residential (Multi-family)	19
Open Space (Public)	16
Commercial	12
Historic Site	10
Vacant Lot	9

6.3.8.3.3 Land Use within 2 Kilometers of the Project Site

The land uses identified within 2 km of the Project Site were very similar to that within the 1 km zone, with only a few exceptions **(Table 6.3-28; Figure 6.3-4*).***

Table 6.3-28. Major Land use Categories – 2 km of the Old Coaling Wharf.

Land use Category	Number of Land Parcels
Residential (Single-family)	176
Residential (Multi-family)	19
Open Space (Public)	16
Commercial	12
Historic Site	11
Vacant Lot	10

Examples of land use in the Port Royal area are shown in **Figure 6.3-5, Figure 6.3-6, Figure 6.3-7, Figure 6.3-8, Figure 6.3-9 and Figure 6.3-11.**

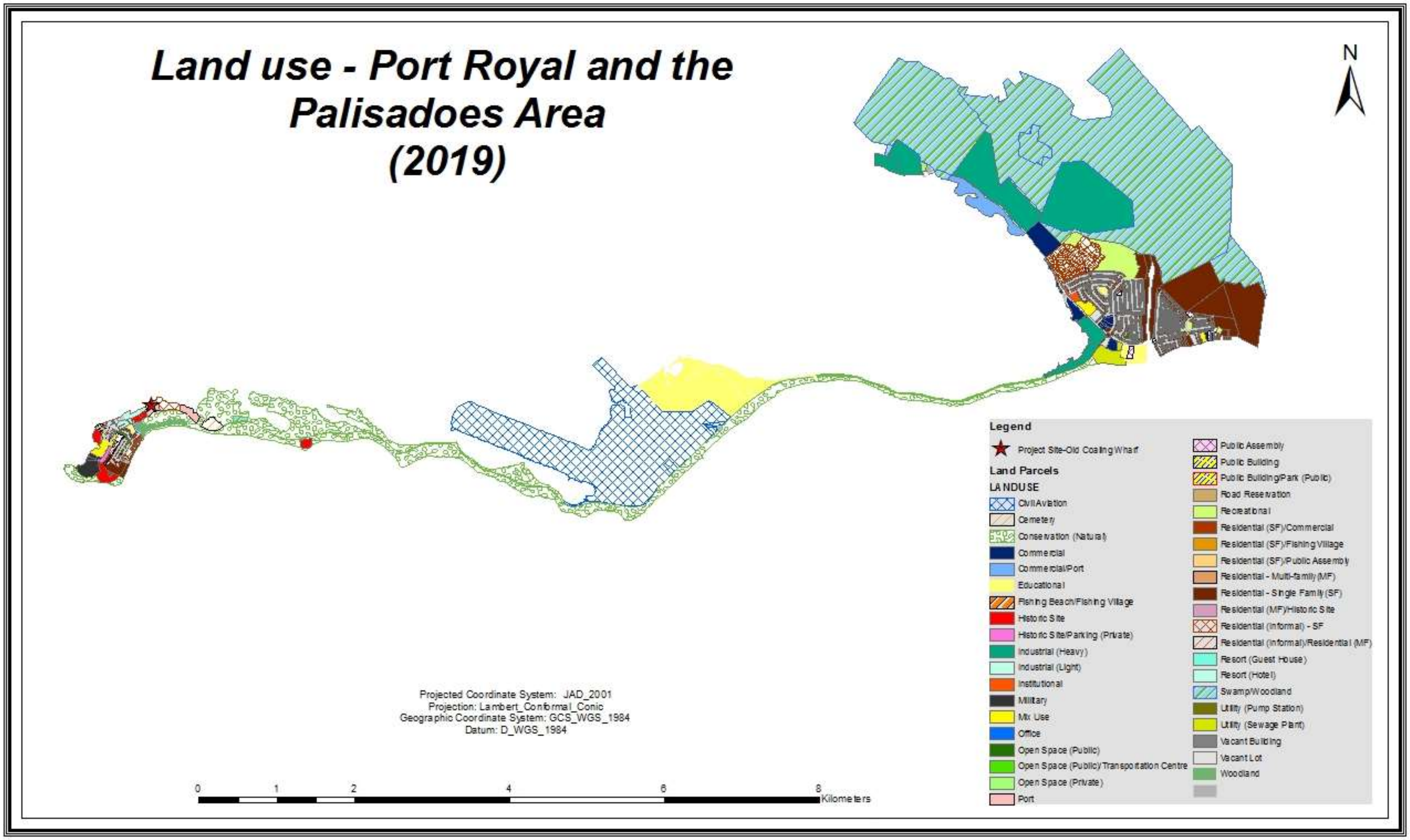


Figure 6.3-2. Land uses – Port Royal and the Palisadoes.

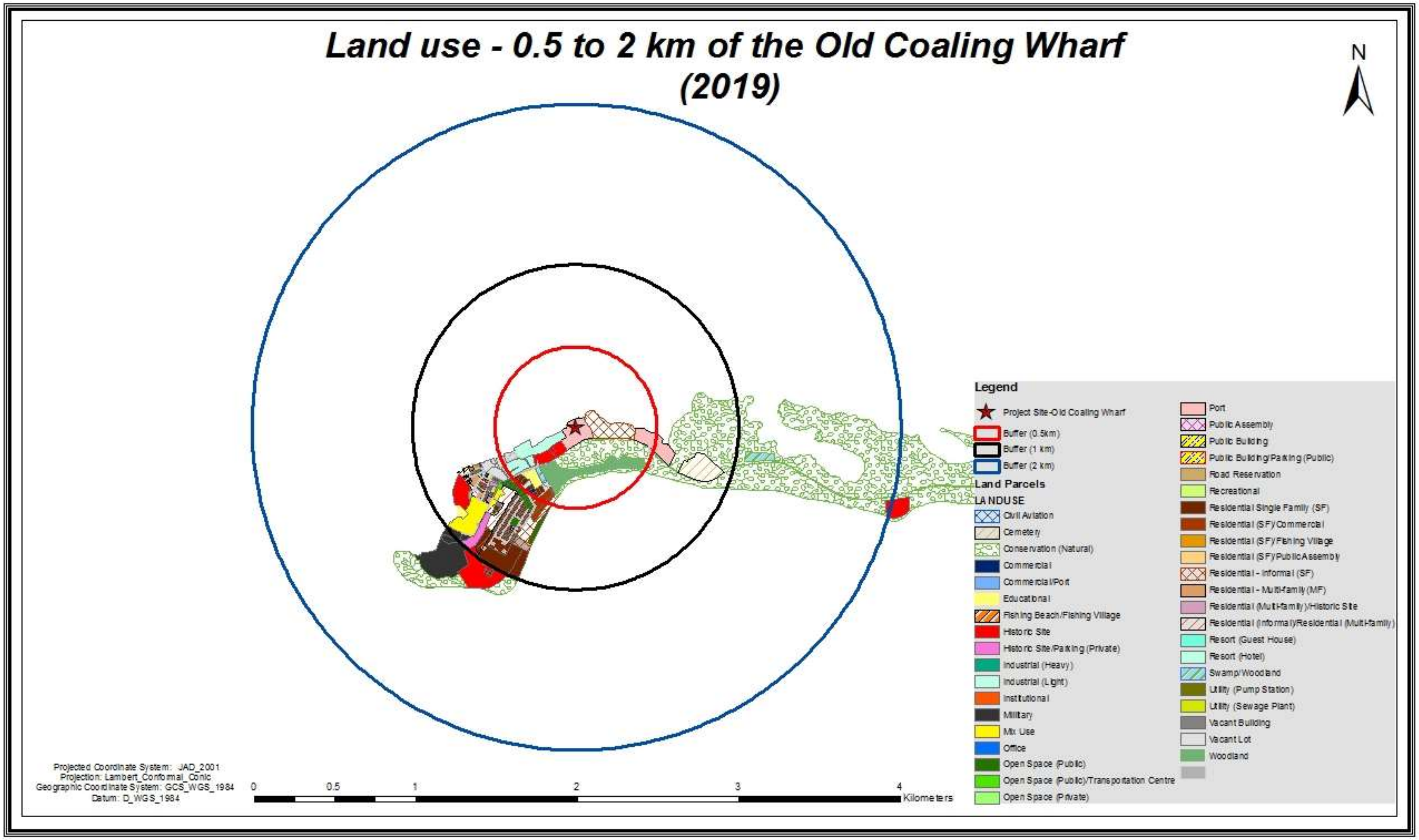


Figure 6.3-3. Land uses within 0.5 to 2 km of the Old Coaling Wharf.

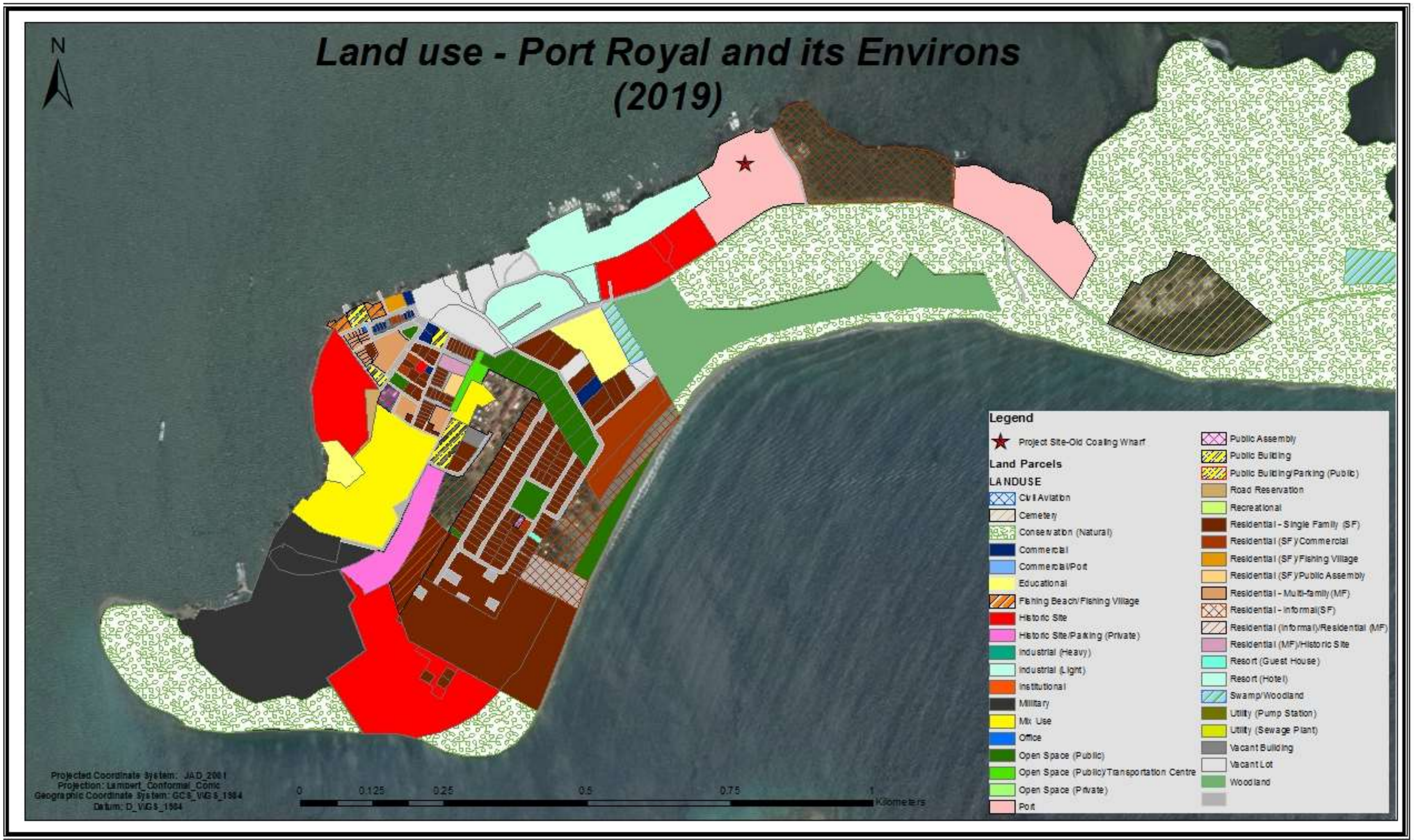


Figure 6.3-4. Land uses within Port Royal and its Environs.

PHOTOGRAPHS OF LAND USES

A

B

Figure 6.3-5. (A) Residential – Multi-family (L) and (B) Single family (R).

Figure 6.3-6. Institutional (Caribbean Maritime University).

Figure 6.3-7. Institutional Uses and Emergency Services (A) Jamaica Defence Force Coast Guard (B) and the Jamaica Constabulary Force (C) Jamaica Fire Brigade.

A. Fort Charles

B. Old Naval Hospital

C. St. Peters Church

D. Old Coaling Wharf

Figure 6.3-8. ***Heritage Sites.***

A. Fishing Pier

B. Boats Docked at Fishing Beach

C. Gloria's Restaurant Entrance

D. Gloria's Restaurant

Figure 6.3-9. Commercial and Recreational land Uses.

A. Welcome Sign

A. Public Park

C. Housing Project Area Abandon by HAJL

D. **Open Space used for parking by Gloria's Customers**

Figure 6.3-10. Open Spaces in Port Royal.

Residential land use was the most prevailing identified across all impact zones. The lack of adequate housing solutions for the populace of Port Royal has been a perennial problem for years. This is exacerbated by the fact that the residents are not amenable to living elsewhere, due to the revered sense of community and peaceful nature of the settlement. The lack of suitable and safe lands for housing development further compounds the challenge. Not only is there a limited supply of open lands within the area but there are issues related to vulnerability to hazards, limited load-bearing capacity of the soil and the historic nature of many of the properties within the area. In an attempt to increase the supply of housing solutions to the community, the Housing Agency of Jamaica sought to develop services lots contiguous to the formal housing scheme within Port Royal. Most of the requisite infrastructure (roads, drains etc.) were implemented however, the project was halted because of vulnerability issues identified post the initiative.

The proposed development will warrant the identification of measures to address the prevailing housing situation at Port Royal. Apart from the squatting at Michelin Avenue, sections of the beachfront and the project site are occupied by illegal settlers, especially the former. This situation will worsen if the housing needs of these residents are not addressed.

6.3.8.4 Proposed Future Land Use

Terminal Building which exits onto a Main Plaza surrounding a marketplace; taxi coaster and future tram loading area rounded by Bus loading and retail facility; and a restaurant. Other structures on the master plan include a staff office/maintenance and service building; and several bus loading buildings (**Figure 6.3-11**)

Proposed land use for a future development in the downtown Port Royal include restoration and development of an old Laboratory (F+B); Morgan's Aisle; Museum and Archaeological Centre; Morgan's Landing; Forts; etc. (**Figure 6.3-12** through **Figure 6.3-14**).

Figure 6.3-11. Proposed Master Plan of the Immediate Project Impact Zone (Port Royal).

Figure 6.3-12. Proposed Land Use of the Project Site.

Figure 6.3-13. Port Royal Cruise Terminal Development at Old Coal Wharf: Perspective of Revised Design.

Figure 6.3-14. Proposed Future Development in the Port Royal Historic District, Promenade and Entry Plaza.

7 Public Participation

As a means of gathering information from the public on the potential impacts of the proposed project, perception surveys were administered using a questionnaire instrument (**Appendix 13.7**). Questionnaires were administered to a representative sample in each community within the study area/ zone of influence.

7.1 Sample Method and Size

The representative sample for questionnaire administration was determined using a margin of error of 5.5%, a confidence level of 95% and a response distribution of 50%. Sample size was calculated using the total number of the population in the Port Royal and Harbour View, Kingston. With a total population of 1,997, a sample size of 308 persons was used to administer the perception survey. Sample size for each community was determined based on their proportion of the total population of Portmore. Data gathered from the survey was collated and analysed using SPSS data packaging software and the quantitative and qualitative results presented in graphical and written form.

The total sample size was distributed among communities and interest groups active within the immediate study area (**Table 7.1-1**).

Table 7.1-1. Sample Size and Response Rate by Target Group.

Target Group	Households / Residents	Visitors	Fishermen/ Excursionists	Businesses	Total
Target Sample Size	140	98	50	20	308
Responses	132	91	40	16	279
Response Rate	94%	93%	80%	80%	91%

Total response rate for the total sample size was 91%. Among the 140 persons targeted at the household level, an overall response rate of 94% was achieved. Response rate among visitors to Port Royal was 93%; fishermen/excursionist was 80% and among local businesses, 80%. The main limiting factors which prevented the achievement of the targeted 100% response rate were time and the reluctance of persons to participate during the Easter Holy weekend. Surveys were administered April 14-28, 2019.

7.2 Perception Survey Results

7.2.1 Fisherman/ Excursionist Participants Profile

7.2.1.1 General Profile

A total of 40 persons participated in the Fisherman/ Excursionist perception survey, 39 males and one female. The 40-49 age group category accounted for the largest proportion of respondents at 37.5% (**Table 7.2-1**). The second largest age group is 50-59 925.0%). A combined 85.0% of participants are aged 40 years or older. Five percent are under age 20 while 7.5% are in the 20-29 group. Approximately 95% are heads of households with the average household size being 3 persons.

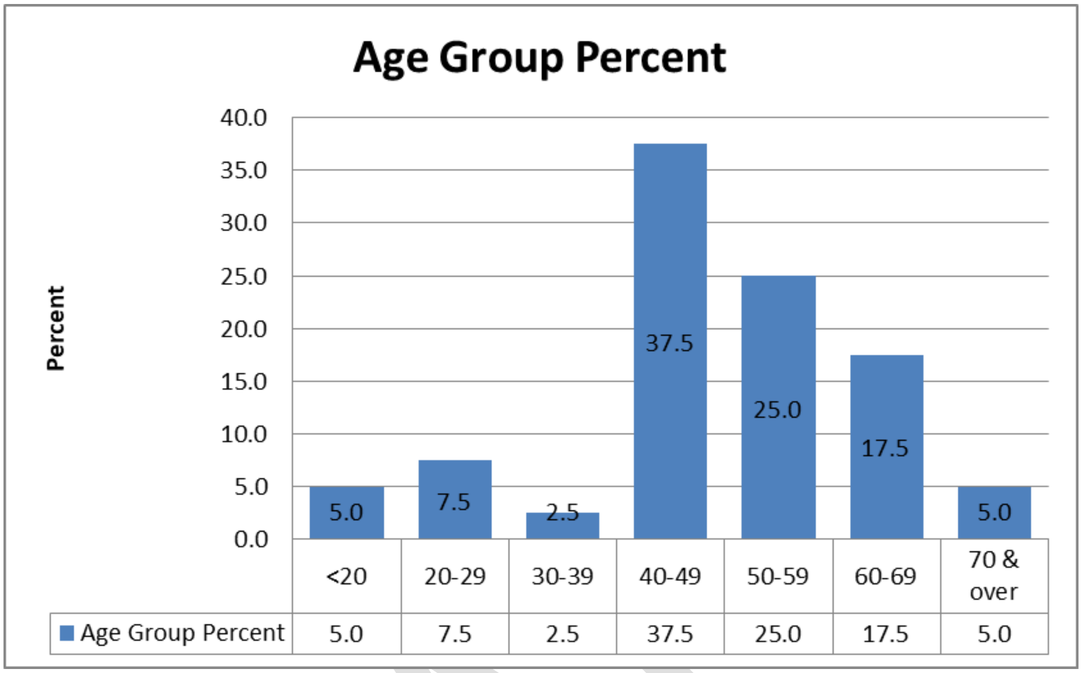


Table 7.2-1. Age Group of Fishing Community Participants.

Fishers were interviewed on location at the Rae Town fishing beach and multiple fishing locations in Port Royal. The main community of residence for the fishers are Port Royal (52.5%) and Rae Town (40%) with the remaining 7.5% residing elsewhere (**Table 7.2-2**).

Table 7.2-2. Community of Residence for Fishers.

Community of Residence	Frequency	Percent
No Response	1	2.5
Port Royal	21	52.5
Rae Town	16	40.0
Stony Hill, St. Andrew	1	2.5
Windward Road	1	2.5
Total	**40**	**100.0**

7.2.1.2 Fisherfolk Characteristics

Some 82% are fisherman; 10% facilitate sightseeing/ diving excursions. Three percent fish as well as facilitate recreational fishing excursions; another 3% fished and facilitate sightseeing/diving excursions, while one person was an employee on a fishing boat (**Figure 7.2-1**). Some 60% of participants operated on a full-time basis while 30 % operated on a part-time basis (**Figure 7.2-2)**. Participants have been fishing and/or facilitating excursion for an average of 22 years, ranging from 2 to 47 years. Sixty three percent reported being licensed with the Fisheries Division of the Ministry of Industry, Commerce, Agriculture and Fisheries (MICAF).

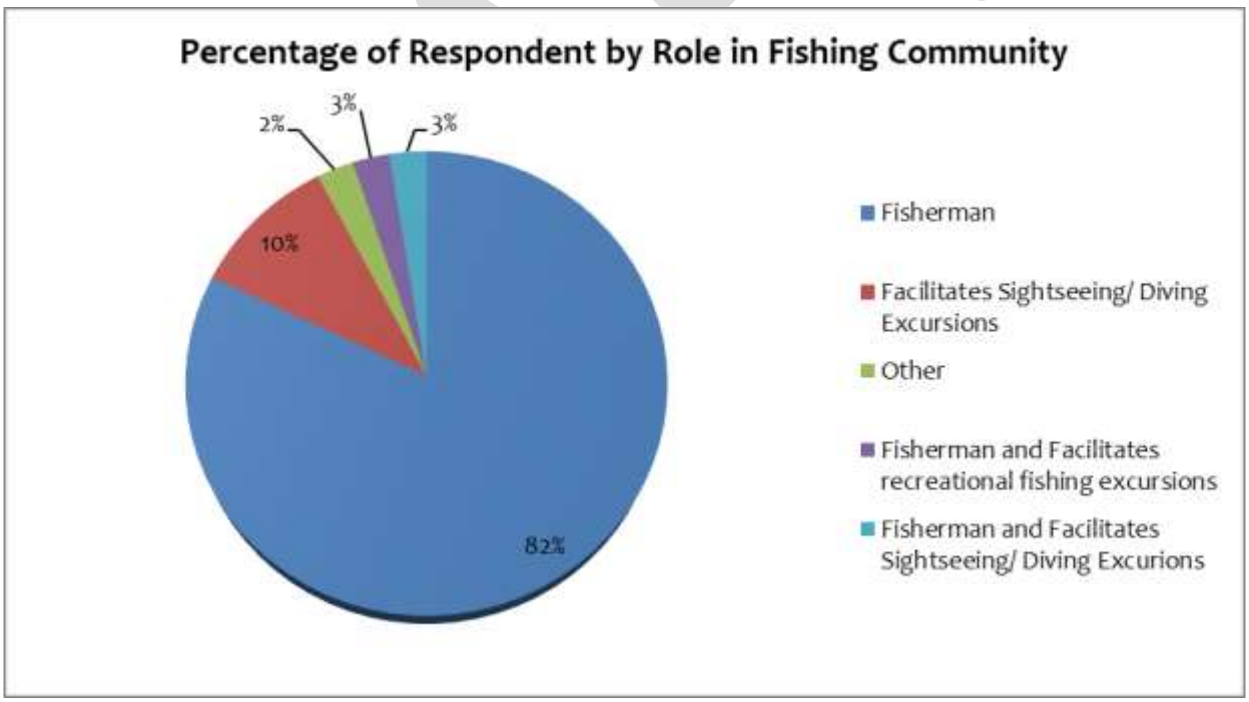


Figure 7.2-1. Percent of Respondent by Role in the Fishing Community.

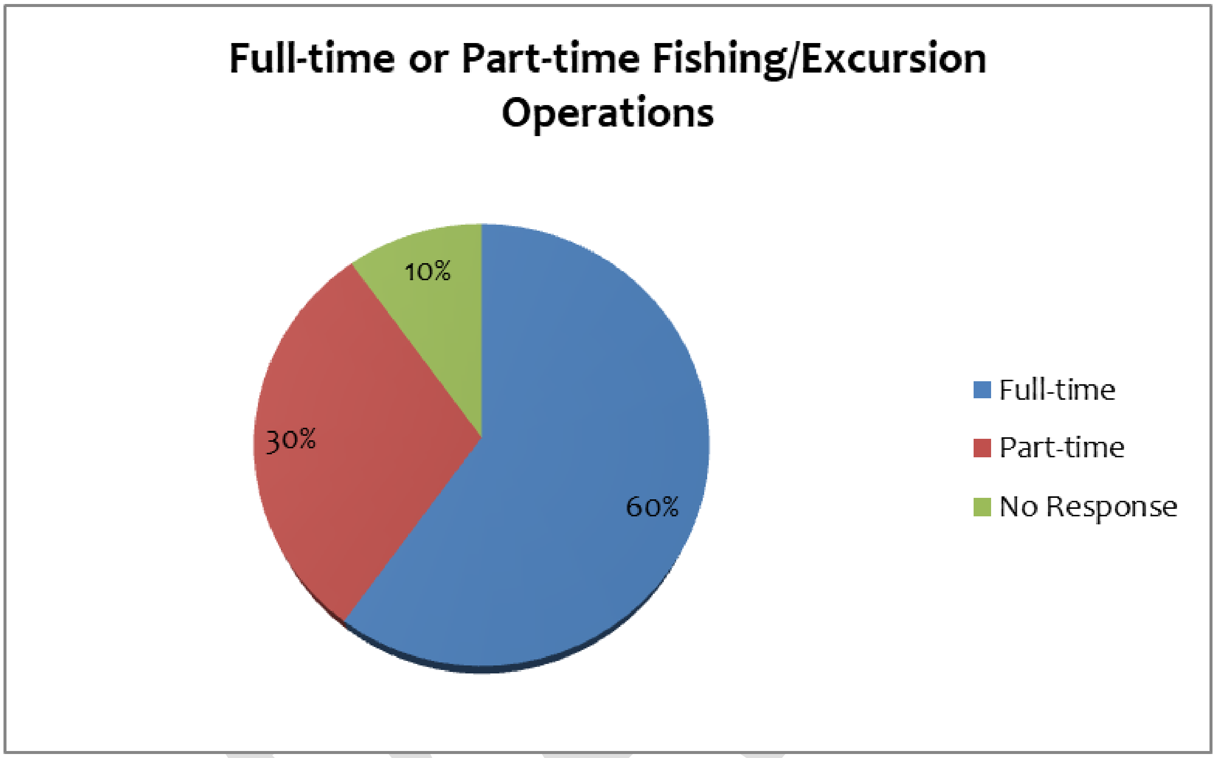


Figure 7.2-2. Percent of Part-time vs. Full-time Fishing Operations.

7.2.1.2.1 Landing Docks, Distance Travelled and Frequency of Fishing Activities

Some 47.5% of respondents indicated that they only use docks/ landing areas in Port Royal for their fishing activities. Local names for dock/landing areas in Port Royal include Beach/Sea Side, Big Wharf, Queen's Street; Maritime/ Gun Boat area' Port Royal Fishing Village. Other landing areas used include the cays and banks (Pedro and Lime Cays; and Bodles and Outer Banks); fishing beaches including Fort Clarence, Greenwich Town, Hellshire, Harbour View, Rocky Point, Old Harbour Bay; and the reefs.

Participants travel between 4.8Km and 300 Km to fishing grounds up to 7 days per week. Approximately 27.5% undertake their fishing and excursion activities 5-6 days or 3-4 days per week 3-4days per week (**Table 7.2-3**). Nights are the most common time for fishing accounting for 42.5% of respondents followed by mornings (10.0%) and daytime (10.0%) (**Table 7.2-4)**.

Table 7.2-3. Frequency of Fishing Activities.

Frequency of Fishing Activities	Frequency	Percent
1-2 days	6	15.0
2-3 days	1	2.5
3-4 days	11	27.5
4-5 days	1	2.5
5-6 days	11	27.5
7 days	6	15.0
No Response	4	10.0
Total	**40**	**100.0**

Table 7.2-4. Time of Day Fishing Activities are conducted.

Time of Day Fishing Activities are conducted		
Time of Day	**Frequency**	**Percent**
No Response	4	10.0
Afternoons and Early Mornings	1	2.5
Afternoon	3	7.5
Daytime	4	10.0
Evening	3	7.5
Morning	4	10.0

Time of Day Fishing Activities are conducted		
Time of Day	**Frequency**	**Percent**
Morning and Night	3	7.5
Night	17	42.5
Night and Day	1	2.5
Total	**40**	**100.0**

Some 87.5% of participants fish from boats with fiberglass boats being the most popular, used by 70% of respondents. Other types of boats used are wooden boat and one person reportedly uses a sports fishing boat. Just over half (52.5%) of participants own their boats, while 15.0% rent (**Table 7.2-5**).

Table 7.2-5. Boat Ownership.

Boat Ownership		
	Frequency	Percent
Own	21	52.5
Rent	6	15.0
Other	9	22.5
No Response	4	10.0
Total	**40**	**100.0**

7.2.1.2.2 Fishing Grounds

There are a number of fishing grounds used by fishers with many using multiple locations. A list of fishing grounds is provided in **Table 7.2-6**. Approximately 22.5% of fishers reported fishing in the Port Royal area including Morgan's Harbour and Maritime Institute/Gun Boat areas. Approximately 62.5% of fishers are satisfied (47.5%) or very satisfied (15.0%) with their main fishing/excursion grounds.

Table 7.2-6. Main Fishing Ground by Number and Percent of Fishers.

Main Fishing Ground by Number and Percent of Fishers					
Main Fishing Grounds	**#**	**%**	**Main Fishing Grounds**	**#**	**%**
No Response	4	10	Morgan's Harbour; Pedro Cays	1	2.5
All over - Morgan's Harbour; Pedro Cays	1	2.5	Not Applicable	1	2.5
All over including Kingston Harbour	1	2.5	Old Harbour; Hellshire; Harbour View	1	2.5
Along Airport Road and Kingston Harbour	1	2.5	Open Sea	1	2.5
Bodles Bank	1	2.5	Pedro Cay	1	2.5
Bodles Bank; Port Royal Bushy Cay	1	2.5	Pedro Cays, Lagos Bank	1	2.5
California Bank	2	5	Port Royal Harbour	1	2.5
Fort Clarence	1	2.5	Port Royal Harbour; Mackerrel Bank	1	2.5
Kingston Harbour	3	7.5	Port Royal, Pedro Cay	1	2.5
Lime Cay	1	2.5	Port Royal; Harbour View	1	2.5
Lime Cay; Window Ledge, Bull Bay	1	2.5	Rae Town	3	7.5
Mackerel Bank	1	2.5	Reefs; Port Royal Harbour	1	2.5
Mackerel Bank, Lagos, California Bank, South Shelf	1	2.5	Seaside	1	2.5
Maritime/ Gun Boat area	1	2.5	South Shelf	3	7.5
Moran and Pedro Cays	1	2.5	South; Drunken Man Cay	1	2.5
			Total	**40**	**100**

7.2.1.2.3 Excursion Activities

The main activities offered on excursions boat rides to Lime and Maiden Cays; snorkeling; glass bottom boat tour; jet skis; scuba diving; swimming and in the past wind surf.

7.2.1.2.4 Community Value

The characteristics that the fishing community value most about the Port Royal community include its history and heritage, its peaceful and quiet nature, the sense of community a (**Table 7.2-7**).

Table 7.2-7. Most Valued Characteristics of Port Royal (Fishers).

Community Value	# Respondents	Percent
History/ Heritage	17	43%
Business / Ability to fish and Work	5	13%
Peaceful/ Quiet/ Crime-free/ Safe	17	43%
Sense of Community/ Togetherness/ People	7	18%

7.2.1.2.5 Awareness of Project

Approximately 77.5% of respondents were aware of the Port Authority's plan to develop a cruise ship pier and terminal in Port Royal prior to being interviewed during the public consultation process. The most popular source of project information was community members with 40% of fishers learning about the project from that source (**Figure 7.2-3**). The second most popular source of project information is television (17.5%). Other sources of information reported was community meeting and meeting with Port Authority representatives.

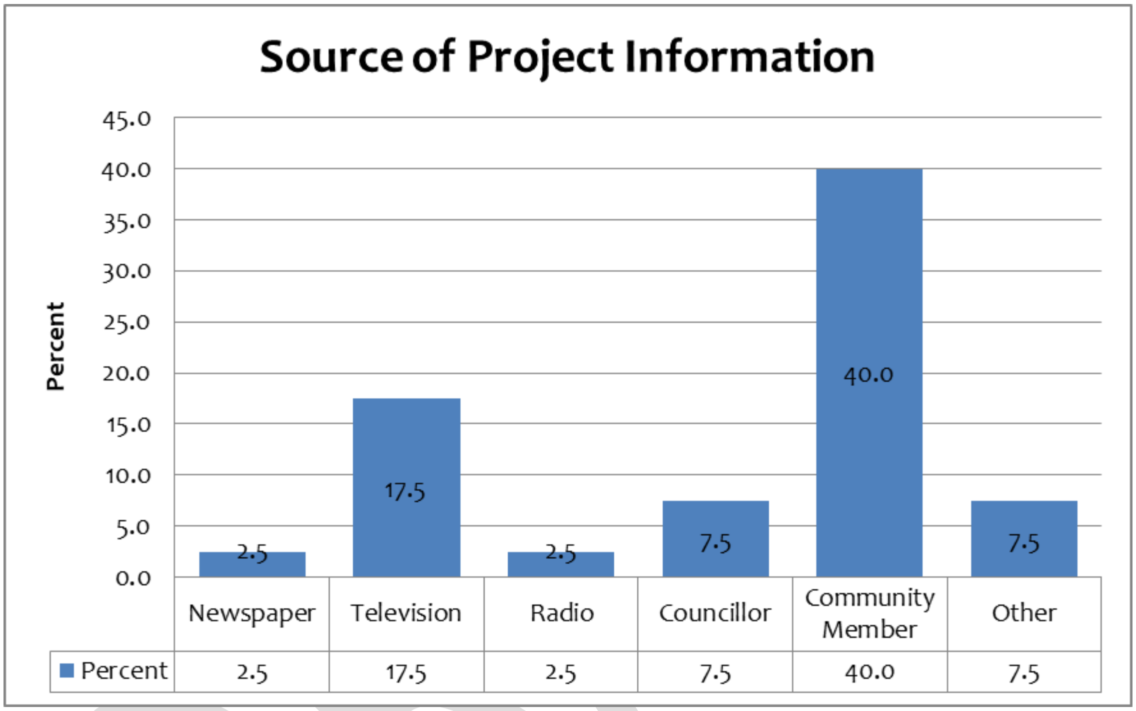


Figure 7.2-3. Source of Project Information (Fishers).

7.2.1.2.6 Project Importance

Fifty nine percent (~60%) of participants believe that the project is very important to Jamaica's Tourism and Cruise industries, while 35.0% believe that the project is important **Figure 7.2-4**. In regards to its importance to Port Royal and its environs, 62.5% believe the project is very important and another 27.5% believe it is important to Port Royal and its environs.

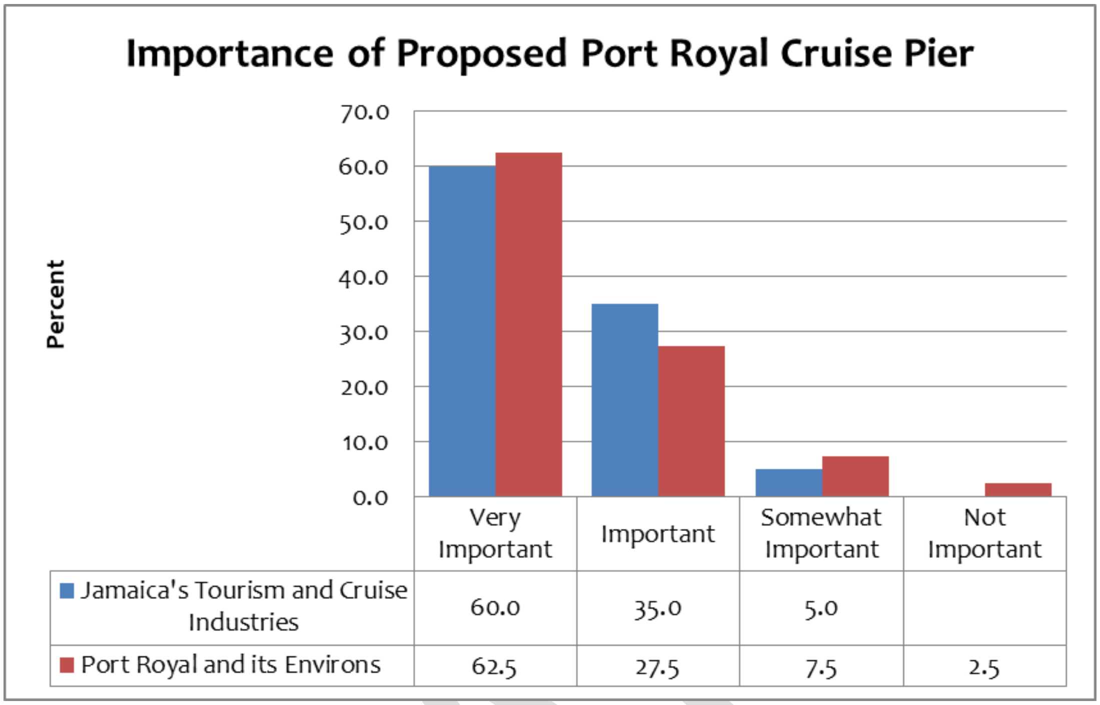


Figure 7.2-4. Importance the Project (Fishers).

Reasons for the importance rating were based on the perception that the project will contribute to the following:

- Economic growth and development
- Foreign exchange/ Income earnings
- Job opportunities
- Promote Jamaica and add to the country's global image as a top destination
- Boost the industry

The project was thought to be important to Port Royal and its environs because it is believed that it will contribute to the following:

- Increase visibility of Port Royal to international and local visitors
- New business opportunities
- Employment/ job opportunities
- Infrastructural development
- Increased customer base for fishers and other sectors
- Boost the local economy

Concerns expressed included:

- Worry about safety due to threat of violence
- Opportunities going to persons who do not reside in Port Royal and none or not enough local residents made available to local residents

7.2.1.2.7 Importance of Cultural and Heritage Resources

The project impact zone is a designated Heritage site nationally and internationally. Participants were asked to rate the importance of selected heritage resources and the level of significance any damage or loss to these resources would be to the communities within the project impact zone and beyond. As shown in **Table 7.2-8**, at least 80% of participating fishers believe that the Forts, Giddy House, Historic Naval Hospital and St. Peter's Church, and the terrestrial and underwater archeological resources of Port Royal are important or very important. At least 70% also believe that any loss of damage to these resources would be a significant or very significant loss to the community (**Table 7.2-9**).

Table 7.2-8. Importance of Cultural Heritage Resources.

Heritage Resource	Importance Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)	2.5	15.0	40.0	42.5		100.0
Giddy House		12.5	40.0	47.5		100.0
Historic Naval Hospital	2.5	12.5	37.5	42.5	5.0	100.0
St. Peter's Church		15.0	37.5	42.5	5.0	100.0
Port Royal Terrestrial Archaeology		12.5	42.5	42.5	2.5	100.0
Port Royal Underwater Archaeology		15.0	37.5	45.0	2.5	100.0

Table 7.2-9. Significance of Damage or Loss to Selected Port Royal Heritage Resources.

Heritage Resource	Significance Of Loss or Damage					
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)	5.1	15.4	41.0	35.9	2.6	100.0
Giddy House	5.1	15.4	41.0	33.3	5.1	100.0
Historic Naval Hospital	5.1	15.4	38.5	30.8	10.3	100.0
St. Peter's Church		15.4	38.5	41.0	5.1	100.0
Port Royal Terrestrial Archaeology	5.1	15.4	43.6	30.8	5.1	100.0
Port Royal Underwater	5.1	15.4	43.6	30.8	5.1	100.0

Heritage Resource	Significance Of Loss or Damage					
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know	Total
Archaeology						

7.2.1.2.8 Importance of Port Royal's Natural Resources

Approximately 97.5% of respondents use the resources of Port Royal for various purposes. The resources identified most were the cays (65.0%) and fisheries (20.0%). It is therefore not surprising that when asked to rate the importance of selected natural resources, the majority of respondents thought that the cays, marine wildlife and resources, coastal resources and terrestrial wildlife were all believed to be important or very important to the community (**Table 7.2-10**). The cays and marine wildlife and resources were rated important or very important by the largest proportion of respondents (87.5% each).

Table 7.2-10. Importance of Port Royal Natural Resources.

Natural Resource	Importance Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Terrestrial Wildlife e.g. birds, crocodiles	2.5	15.0	32.5	45.0	5.0	100.

Natural Resource	Importance Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
						0
Coastal resources e.g. mangroves, beaches, spawning grounds		12.5	32.5	52.5	2.5	100.0
Marine wildlife and resources e.g. Fisheries, turtles, seagrass		12.5	32.5	55.0		100.0
Nearby Cays		10.0	30.0	57.5	2.5	100.0

All fishing community participants use and depend on these natural resources for their livelihoods (**Table 7.2-11**). The Cays are the resources identified by the largest proportion of respondents (65%) followed by coastal and marine resources including fisheries and mangroves (20%). Ten percent noted that they used all the resources while 2.5% used both the beach and the Giddy House.

Table 7.2-11. Natural Resources Used by Fishers.

Resource Used	# Respondents	Percent
All	4	10.0
Cays	25	65.0

Resource Used	# Respondents	Percent
Coastal/ Marine Resources/ Fisheries/ Mangroves	14	20.0
Beach	1	2.5
Giddy House	1	2.5

Respondents use resources and for multiple purposes including, entertainment/leisure /relaxation (47.5%); their livelihoods (37.5%) and facilitating visitors use of these resources (5%). Some 30% used the resources for fishing, as their job or "trade", as well as for leisure (**Table 7.2-12**).

Table 7.2-12. Purpose for which Port Royal natural Resources are used (Fishers).

Purpose for Use of Resource	# Respondents	Percent
Fishing	12	30.0%
Entertainment/ Leisure/ Relaxation	19	47.5%
Livelihood/ Economics/ Work	13	37.5%
Water Transportation/ Transport Visitors to the Cays	2	5.0%

Half (50%) of fishing community participants indicated that they are aware of pollution and stress factors affecting the natural resources of Port Royal and its environs. The types of pollution identified are garbage/ solid waste, industrial waste and sewage, smelly gutters; polluted waters. Fishers believe that the main source of these pollutants and stressors are dredging activities in the harbour, improper waste disposal including illegal dumping in gullies which wash into the harbour especially after heavy rains; oil from ships, waste from ships, prison and factories; and humans.

7.2.1.2.9 Perceived Project Impacts (Fishing Community)

7.2.1.2.9.1 During Construction

Perception among fishing community participants is that project impacts during the construction phase will be positive for economic variables. This is evident in the large proportion of respondents that noted project impacts will be positive for variables such as Job Opportunities for locals (64.1%), Local Businesses / local economy (61.5%), and the Jamaican Economy (56%). Almost half of respondents (48.7%) believe the fishing community will be negatively impacted while 30.8% thought it there would be no impact. Another 20.5% believes the fishing community will be positively impacted. In comparison, a large proportion believes that environmental variables such as water quality, marine resources, noise pollution and visual aesthetics will not be impacted by the project during construction (**Table 7.2-13**). The main reasons given were that there was reportedly no dredging involved and that the construction will be outside of the hub of the town.

Table 7.2-13. Perceived Project Impacts during Construction (Fishers).

Perceived Impacts during Construction				
	Positively	**Negatively**	**No Effect/ Do Not Know**	**Total**
Water quality	5.0	40.0	55.0	100.0
Coastal and marine resources	5.0	37.5	57.5	100.0
Noise Levels in Port Royal	5.0	22.5	72.5	100.0
Water Sports (Fishing, Diving, etc.)	15.0	30.0	55.0	100.0
Fishing community (Fishers, fishing areas, etc.)	20.0	47.5	32.5	100.0
Job Opportunities (locals)	65.0	7.5	27.5	100.0
Local Businesses (local economy)	62.5	10.0	27.5	100.0
Jamaican Economy	57.5	12.5	30.0	100.0
Residents	45.0	15.0	40.0	100.0
Visual aesthetics of the area	25.0	22.5	52.5	100.0
Traffic	5.0	27.5	67.5	100.0
Heritage Sites (monuments, buildings)	17.5	7.5	75.0	100.0
Average	**27.3**	**23.3**	**49.4**	

Specific **Construction Phase** impacts identified during the surveys included:

Negative

- Fish migration
- Loss of livelihood
- Pollution and damaged roads during construction
- Heavy traffic
- Destruction of the beauty of area
- Dirty water; dredging may damage sensitive resources
- Damage fisheries; fish kill
- Divers will have to stay far from the project site affecting fishing activities
- Loud noise from machinery
- Far from heritage sites
- Outside of town and traffic zone

Post Construction (**Operational Phase**) impacts identified included:

Perception of post construction impacts showed similar trends to construction phase impacts responses in that the economic impacts were the believed to be mainly positive by the majority of respondents. A larger proportion of respondents believe that water sports, the fishing community, cruise and stay over tourism, residents and visual aesthetics will be positively impacted by the project during the operational phase (compared to the construction phase). For example, 61.5% of respondents believe that residents will be positively impacted during the operations phase of the project compared to 43.7% during construction (**Table 7.2-14**). Similarly, 35.9% of respondents believe that water sports and the fishing community will be positively impacted compared to 20.5% and 15.4% respectively during construction. Despite the change in perception by some, a large proportion of respondents still believe that the project will have no impact on the environment and heritage sites.

Table 7.2-14. Perceived Impacts during Post Construction (Operations) (Fishers).

Perceived Impacts during Post Construction (Operations)					
	Positively	**Negatively**	**Mixed (Both Positive and Negative)**	**No Effect/ Do Not Know**	**Total**
Water quality	10.0	32.5	55.0	2.5	100.0
Coastal and marine resources	7.5	25.0	65.0	2.5	100.0
Noise Levels in Port Royal	2.5	12.5	82.5	2.5	100.0
Water Sports (Fishing, Diving, etc.)	35.0	5.0	57.5	2.5	100.0
Fishing community (Fishers, fishing areas, etc.)	35.0	32.5	30.0	2.5	100.0
Cruise Tourism	37.5	12.5	50.0		100.0
Stay-over Tourism	62.5	5.0	30.0	2.5	100.0
Job Opportunities (locals)	75.0	5.0	17.5	2.5	100.0
Local Businesses (local economy)	72.5	5.0	20.0	2.5	100.0
Jamaican Economy	70.0	2.5	25.0	2.5	100.0
Residents	62.5	30.0	7.5		100.0
Visual aesthetics of the area	57.5	2.5	37.5	2.5	100.0
Traffic	20.0	20.0	57.5	2.5	100.0
Heritage Sites (monuments, buildings)	32.5	2.5	62.5	2.5	100.0
Average	**41.4**	**13.8**	**42.7**	**2.5**	

The main positive impacts were employment opportunities, boost in the local and national economy. It is believed that "development is a good thing as people and businesses grow and expand to cater to visitors." Post construction impacts identified include:

- Very good development to uplift the city so all areas will be positively affected
- More jobs
- More shops to supply fish
- Boost in Jamaican economy
- Better roads
- More attractions for visitors
- Muddy waters
- Development is a good thing as people and businesses grow and expand to cater to visitors
- Jobs for people to make money
- Potential for negative water quality impact depending on the number of ships and whether or not they follow standards for dumpling waste
- Positive impact on the fishing community expected as fishing community as they were given the first preference on choice of spots to fish, etc. by the PAJ
- Boost cruise industry
- More business and sales; more profits
- More foreign currency earnings; people will "live a little better" (improved living standards)
- Place will look better aesthetically. Buildings fixed; more people in and out of the town.
- Due to the location of development outside of the town center, no impacts on certain items

Other negative impacts and comments submitted are listed in **Table 7.2-15**. Crime, the fear of locals being" left out" or not able to access opportunities were among the sentiments expressed.

Table 7.2-15. Other Negative Impacts during Construction.

Other Negative Impacts/ Comments		
	Frequency	**Percent**
Control of port by private investors	1	2.5
Crime; drugs; scamming	1	2.5
Cruise ships and tourist will be separated from residents so it will be hard for fishermen	1	2.5
Dumping of food	1	2.5
Economic Boost	1	2.5
Increase dumping; crime from Ghettos/ Inner City communities in close proximity	1	2.5
Locals may not benefit	1	2.5
Locals might be displaced for the more privileged in society to take over	1	2.5
More work for the coast guard	1	2.5
None	25	62.5
Oil from ships causing death and migration of fish in the Harbour	1	2.5
People element- improvement in the treatment of the community needed; Place will need to be cleaned; crime	1	2.5
People with good integrity needed to deal with visitors	1	2.5
Power used to oppress locals. Bigger industries vs local fishermen. Need fair and just treatment	1	2.5
Relocating local residents	1	2.5
Rezoning of the area may occur restricting locals from certain areas designated for tourists	1	2.5
Total	**40**	**100.0**

Other positive impacts or benefits of the project identified are listed in **Table 7.2-16**.

Table 7.2-16. Other Positive Impacts/ Benefits and Comments.

Other Benefits of the Project		
	Frequency	Percent
Foreign exchange	1	2.5
General feeling of upliftment because of development	1	2.5
Individuals can earn from tourist spend; e.g. skilled craftsmen	1	2.5
More fishing to cater to the new needs of restaurants as more tourist come to dine	1	2.5
Negative effects of construction	1	2.5
None	28	70.0
Not a benefit - more money, more crime	1	2.5
Not sure	3	7.5
No response	1	2.5
opportunity for operating speed boats when not fishing in the harbour	1	2.5
Welcome the project conditionally	1	2.5
Total	40	100.0

It was noted by one respondent that PAJ had a meeting in the community to discuss the project and “to give them the preference to choose a location that will be designated to them for fishing activities and sales for a potential fee of 2000.” He also noted that the Fisherman Cooperation was operational a few years ago and went on a break. They are currently trying to revamp it, administrative measures are put in place and in about 4 weeks they should be in operation.

7.2.1.2.10 Fishers' General Comments

General comments of participating fishers were:

- Concerned that the impact on fishermen will be dependent on restrictions placed on their operations
- Good project; it will create jobs
- I support the project
- Need to see the impacts and changes that the project will bring to comment
- Opposed to development of pier as it opens the community to undesirable elements
- People of Rae Town will not benefit from the development
- The development is a great idea that will cause investment
- Would like to see employment opportunities from the project

7.2.1.3 Local Businesses

7.2.1.3.1 Local Business Operator Profile

Ten male and six female business operators (Operators) with establishments in the Port Royal community participated in the perception survey. Approximately 31.3% of Operators belongs to 30-39 age group and 12.5% to the 60-69 age group (**Figure 7.2-5**). The remaining age groups each had 18.8% of participants. Some 68.8% were head of household with average household size of 3 persons.

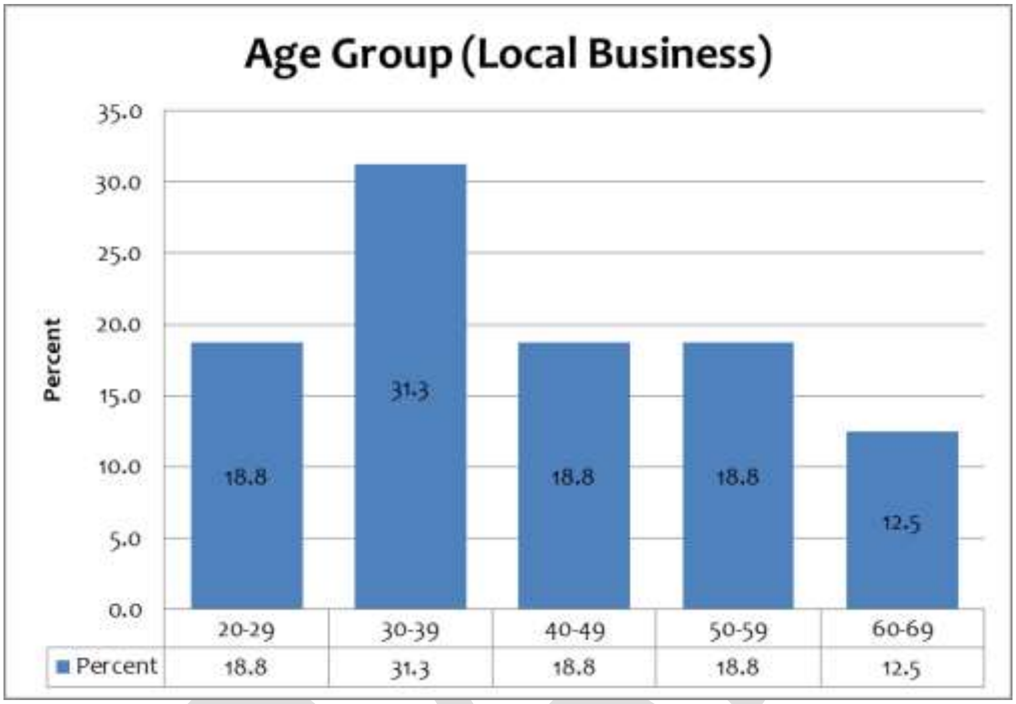


Figure 7.2-5. Age Group of Business Operators.

The characteristics that Operators value most about the Port Royal community include its history and heritage, its peaceful and quiet nature, the sense of community among others (**Table 7.2-17**).

Table 7.2-17. Most Valued Characteristics of Port Royal.

Characteristic	Number of Respondent	Percent
History and Heritage	7.0	43.8
Peaceful (very low crime rate) and Quiet	9.0	56.3
Sense of Community	3	18.8
Fishing Industry	1	6.3
Attractions/ Restaurants	2	12.5

7.2.1.3.2 Operator Characteristics

The type of businesses operated by respondents included retail shops/stalls (43.8%), restaurants (31.3%), a fish vendor and other vendors (**Figure 7.2-6**). Fourteen (87.5%) of respondents owned their businesses, one was a relative of the owner and the other an employee. Half of respondents reported owning the facility in which their business is located. One person reported owning the shipping container structure but not the land, while others reported squatting, operating on a relative's property and "walking and selling." The businesses have been operating in the community for an average of 9 years, ranging from less than 1 year 20 years.

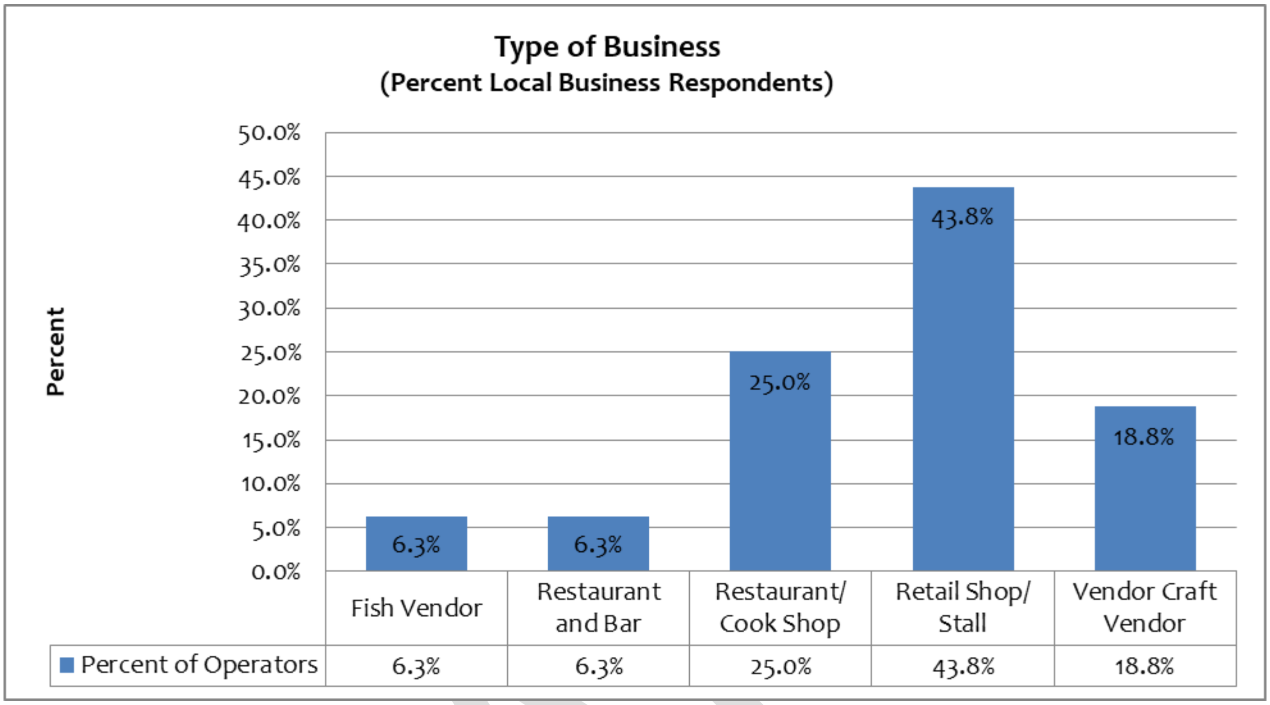


Figure 7.2-6. Type of Business.

Operators varied widely in the size of their businesses evident in the wide range in reported monthly sales ranged from $15,000 to $2,000,000. Monthly operating expenses ranged from a minimum of $5,000 to a maximum of $1,600,000. A wide variety of goods are sold including cooked food, groceries, snacks, fruits, fresh fish, alcoholic and non-alcoholic drinks, crafts (natural beads, jewellery, bags, hats) and one operator sell boat oils and materials.

Issues facing the business community in Port Royal include:

- Businesses basically selling the same goods to the same customer base

- Inconsistent supply of customers; everything dependent on fishing; sales good on holidays
- Slow sales after tourist season ends
- Lack of external linkages
- Lack of necessary infrastructure
- Overcrowded fishing industry; small catch which cause prices to increase
- Poor maintenance of sewage system; smell affects customers
- Having to relocate because of the development
- Unemployment, fishing is single source of earning

Improvements the business operators would like to see in the community include:

- Development needs to be more frequent to push more sales
- Diversify sector
- Fishing village with small shops for fish vendors
- Improve sewage system
- Improvement in stalls; training and support; financing
- Improvement to infrastructure
- Locating a financial institution or ATM in Port Royal
- More sales to grow income and business
- More support from tourist industry and locals
- Need more customers; more people to purchase items to boost business
- Not a lot of business in the area
- Opportunity to purchase or lease land on which container is situated

7.2.1.3.3 Awareness of Project

Fourteen (87.5%) of the 16 Operators interviewed were aware of the proposed project prior to their interviews. The main source of information about the project was from other community members (**Figure 7.2-7**). Other sources were community stakeholder meeting, social media and directly from the PAJ.

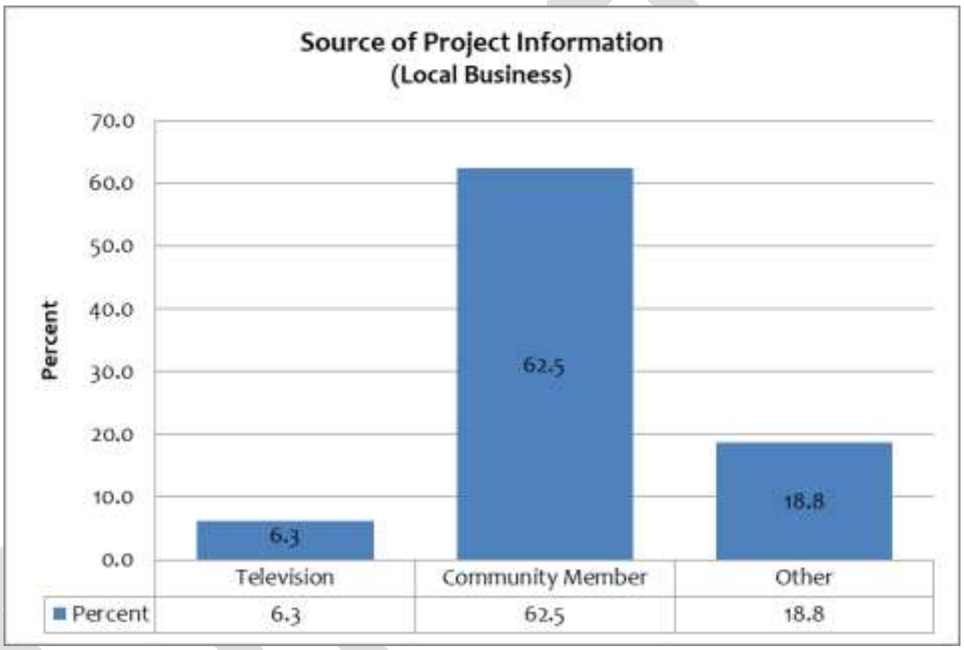


Figure 7.2-7. Source of Project Information.

7.2.1.3.4 Project Importance to Jamaica and Port Royal (Business)

The majority of Operators think that the project is very important or important to Jamaica's tourism and cruise industries as well as to Port Royal and its environs. Some 62.5% believe the project is very important to Jamaica's tourism and cruise industries while another 31.3 % believe the project is important (**Figure 7.2-8**). In terms of its importance to Port Royal and its environs, 56.3% believe the project is very important and 25% believe it is important. One person believes the project is not important to the local community.

The main reasons for rating of importance to Jamaica included the potential for the project to:

- Boost the tourism product economy,
- Boost the economy
- Generate more money to circulate island wide
- Create jobs
- Increase tourist arrivals, more foreign exchange earnings

Reasons for importance to Port Royal were:

- Boost local economy; job creation
- Improve infrastructure
- Opportunity to establish a better community organisation and development
- Potential to develop the town to an extent, as the location site is outside the main town
- Provide jobs and employ young people
- Failed promises; focus is mainly on the pier, Port Royal may not benefit. Built to accommodate tourism, passengers will be bussed to locations outside of Port Royal so residents won't benefit

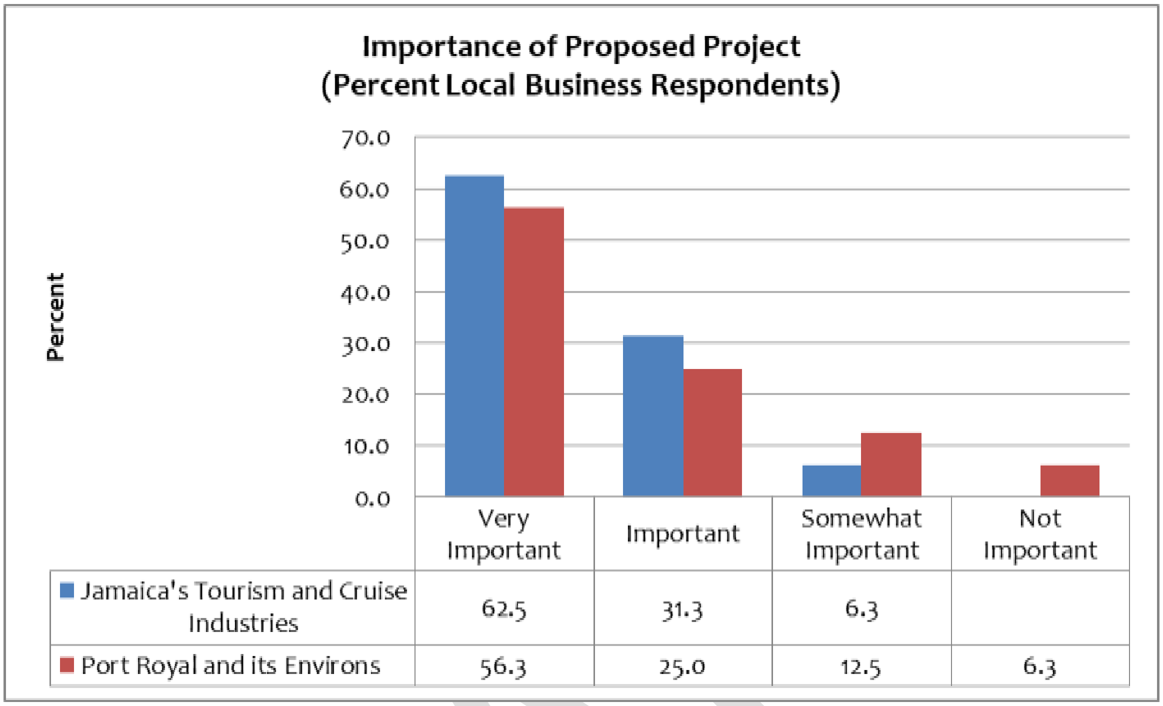


Figure 7.2-8. Importance of Project to Jamaica and Port Royal.

7.2.1.3.5 Importance of Cultural Heritage Resources (Business)

Operators were asked to rate the importance of selected heritage resources and the level of significance any damage or loss to these resources would be to the communities within the project impact zone and beyond. The majority of Operators believe the cultural heritage resources of Port Royal are important to very important. All participants believe that the Giddy House, St. Peter's Church and Port Royal's terrestrial archaeology are important to very important. Approximately 93.8% believed the Forts, Historic naval hospital and underwater archaeology are important to very important (**Table 7.2-18**). Only 1 operator thought that the naval hospital is not important. At least

75% of Operators believe that any loss of damage to these resources would be a significant to very significant loss to the community (**Table 7.2-19**).

Table 7.2-18. Business Operators Importance rating of Cultural and Heritage Resources

Heritage Resource	Importance Rating					
	Not Important	**Somewhat Important**	**Important**	**Very Important**	**Do not know**	**Total**
Port Royal Forts (Fort Charles, Fort Morgan, etc.)		6.3	50.0	43.8		100.0
Giddy House			43.8	56.3		100.0
Historic Naval Hospital	6.3		50.0	43.8		100.0
St. Peter's Church			56.3	43.8		100.0
Port Royal Terrestrial Archaeology			50.0	50.0		100.0
Port Royal Underwater Archaeology			50.0	43.8	6.3	100.0

Table 7.2-19. Significance of Loss or Damage to Cultural Heritage Resources.

Resource	Significance Rating					
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)		6.3	31.3	43.8	18.8	100
Giddy House			31.3	50.0	18.8	100
Historic Naval Hospital	6.3		31.3	43.8	18.8	100
St. Peter's Church			31.3	50.0	18.8	100
Port Royal Terrestrial Archaeology			31.3	50.0	18.8	100
Port Royal Underwater Archaeology			31.3	43.8	25.0	100

7.2.1.3.6 Importance of Port Royal's Natural Resources

Operators were asked to rate the importance of the natural resources of Port Royal. All Operators believe the l coastal and marine resources, marine wildlife and the nearby cays are important to very important (**Table 7.2-20**). All but one Operator believe the terrestrial wildlife is important to very important. For all selected resources the highest proportion of Operators believed them to be very important (62.5-75%).

Table 7.2-20. Business Operator Importance rating of Port Royal Natural Resources.

Resource	Ranking

	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Terrestrial Wildlife e.g. birds, crocodiles			31.3	62.5	6.3	100
Coastal resources e.g. mangroves, beaches, spawning grounds			25.0	75.0		100
Marine wildlife and resources e.g. Fisheries, turtles, seagrass			25.0	75.0		100
Nearby Cays			25.0	75.0		100

The importance ratings are not surprising given that 15 of the 16 participants use these natural resources for various reasons. Operators reported using the beach, cays, coast, mangroves, fisheries, Giddy house and marine resources. These resources are used for fishing, swimming, tourism, recreation, leisure and relaxation on family outings and to sell fish.

Participants were asked if they had knowledge of pollution of stress factors affecting the natural resources of Pot Royal and environs. Six (37.5%) of the 16 Operators said there were pollution and stress factors. Sources identified were debris from the harbour, land and water pollution such as debris from the harbour, polluted gullies ad beaches, and sewage. Poor garbage disposal, sewage and gullies were identified as the main sources of these pollutants/ stress factors.

7.2.1.3.7 Perceived Project Impacts (Business)

7.2.1.3.7.1 During Construction

Perception among business participants is that project impacts during the construction phase will be positive for economic variables. This is evident in the large proportion of respondents that believe the project impacts will be positive for Job Opportunities for locals (81.3%), Local Businesses / local economy (81.3%), and the Jamaican Economy (75%). Some 43.8% of respondents believe the fishing community will be negatively impacted while 37.5% thought it there would be no impact (**Table 7.2-21).** Another 18.8% believes the fishing community will be positively impacted. In comparison, a large proportion believes that environmental variables such as water quality, marine resources, noise pollution and visual aesthetics will not be impacted by the project during construction. Approximately 44% believe there will be negative impacts to Heritage sites during construction.

Table 7.2-21. Perceived Impacts during Construction (Business).

Perceived Impacts during Construction				
	Percent Respondents			
	Positively	**Negatively**	**No Effect/ Do Not Know**	**Total**
Water quality		31.3	68.8	100.0
Coastal and marine resources	6.3	37.5	56.3	100.0
Noise Levels in Port Royal	6.3	18.8	75.0	100.0
Water Sports (Fishing, Diving, etc.)	12.5	18.8	68.8	100.0
Fishing community (Fishers, fishing areas, etc.)	18.8	43.8	37.5	100.0
Stay-over Tourism	43.8	6.3	50.0	100.0
Job Opportunities (locals)	81.3		18.8	100.0
Local Businesses (local economy)	81.3		18.8	100.0
Jamaican Economy	75.0		25.0	100.0
Residents	62.5	6.3	31.3	100.0
Visual aesthetics of the area	18.8	18.8	62.5	100.0
Traffic	12.5	25.0	62.5	100.0
Heritage Sites (monuments, buildings)	43.8		56.3	100.0
Average	**38.1**	**25.0**	**48.4**	

Specific project impacts identified include:

- Waste from site will contribute to pollute coastal waters
- Construction dust will negatively impact coastal and marine resources
- Use of floating pier will reduce negative impact on coastal and marine resources

- Heavy equipment will cause noise; location of project outside of town
- Dislocation of fishermen; Pier location is in fertile fishing ground
- Fish will relocate which will lead to less catch or fishers have to go further to fish
- Jobs for residents
- Prospective increase in sales
- Tourism currently drives the economy
- Growth in various sectors - construction and employment
- Foreign exchange earnings
- Evidence of construction activities will impact aesthetics
- Concerns expressed at community meeting that nothing will be done regarding housing
- Increased road usage; delays
- Refurbish heritage sites

Post Construction (Operations) Impacts

All Operators believe that local businesses will be positively impacted by the project, while over 80% believe cruise tourism, job opportunities for locals, the Jamaican economy and residents will be impacted positively (**Table 7.2-22**). Some 68.8% believe project impacts on visual aesthetics and heritage sites will be positive during the operations while 31.3% believed they will not be impacted. Negative impacts were believed to be associated with water quality (43.8%), coastal and marine resources (31.3%), traffic (18.8%), noise (12.5%), water sports (6.3%) and the fishing community (6.3%).

Table 7.2-22. Perceived Impacts during Post-Construction (Operations) (Business).

Perceived Impacts during Post-Construction (Operations)	**Percent Respondents**			
	Positively	**Negatively**	**No Effect/ Do Not Know**	**Total**
Water quality	25.0	43.8	31.3	100.0
Coastal and marine resources	25.0	31.3	43.8	100.0
Noise Levels in Port Royal	25.0	12.5	62.5	100.0
Water Sports (Fishing, Diving, etc.)	43.8	6.3	50.0	100.0
Fishing community (Fishers, fishing areas, etc.)	6.3	6.3	87.5	100.0
Stay-over Tourism	81.3		18.8	100.0
Cruise Tourism	87.5		12.5	100.0
Job Opportunities (locals)	87.5		12.5	100.0
Local Businesses (local economy)	100.0			100.0
Jamaican Economy	87.5		12.5	100.0
Residents	81.3		18.8	100.0
Visual aesthetics of the area	68.8		31.3	100.0
Traffic	43.8	18.8	37.5	100.0
Heritage Sites (monuments, buildings)	68.8		31.3	100.0
Average	**59.4**	**19.8**	**34.6**	

Specific Post-Construction impacts identified by respondents included:

- Pollution from ships will negatively impact water quality
- Coastal and marine resources may be depleted due to pollution from the development and ships
- Town will come alive
- Town will no longer be peaceful and quiet
- More persons going out on excursions to the cays
- Fishers might have to leave the area and go further out which will cost more
- Increased cost to venture out and catch fish
- Boost the industry; growth in the sector
- New destinations for tourists and cruise ships
- Job opportunities (with necessary training)
- Increased sales; expand business
- Live more comfortably in the community
- Improve in appearance (more pleasing to the eyes)
- Place will look more welcoming
- Better roads
- Delays on roads
- More people in town
- More attention will be placed on heritage sites
- Profits generation and improved durability of heritage sites

When asked to identify any other negative impact, one person indicated “business will go to external persons (non- community members)” which would be a negative impact on residents. Another noted that “crime may escalate due to the project”.

Another positive impact identified not listed above is the potential for job creation and guest houses.

Business Operators are of the opinion that the following groups will be disadvantaged by the project:

1. Business and persons that occupy the space they need
2. Fishermen
3. Squatters - eviction of squatters close to the project area
4. Squatters on the wharf
5. Young residents

All but one of the Operators believes that they will have direct benefits from the project in the form of increased visitors and sales as well as the “opportunity to operate better business and generate more income.”

7.2.1.3.8 Business Operators’ General Comments

General comments from Operators were:

- As long as the businesses are not relocated, project is supported
- Project would be good for boosting sales and create jobs
- Show more interest in the concerns of the people
    - The development of the pier and terminal is a great idea to facilitate economic growth

7.2.1.4 Resident Survey Results

7.2.1.4.1 Resident Profile

7.2.1.4.1.1 Age and Sex

Of the 132 participants in the resident/household survey, 52% are male and 49% female (**Table 7.2-23**). The percentage share is the reverse of the sex distribution of the population of the study area which is 55% female to 45% male.

Table 7.2-23. Sex Distribution of Resident Participants.

	Frequency	Percent
Male	68	51.5
Female	64	48.5
Total	132	100.0

Seventy three percent of participants head their households. Average household size is 4 persons with a minimum of 1 and maximum size of 16. This average household size is higher the average for Port Royal which was 3.7 at the 2011 census.

The age group category 50-59 accounted for the largest proportion of respondents. Approximately 24% of respondents belong to this age group (**Figure 7.2-9**). The second largest category is the 40-49 age group which accounted for 22% of respondents, while the 16% belong to the 60-69 category. The youngest and oldest age group categories each accounted for 5.3% of respondents.

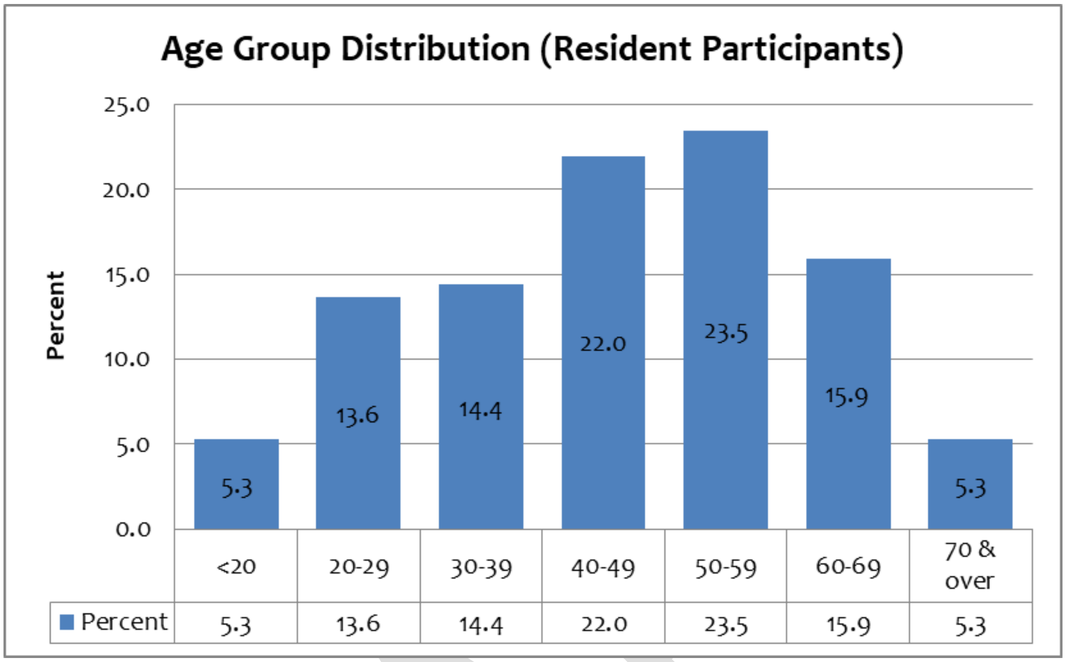


Figure 7.2-9. Age Group Distribution of Resident Survey Participants.

7.2.1.4.1.2 Education

An estimated 94% of participants provided information about their education (**Table 7.2-24**). Forty six percent (46.2%) of participants reported training up to the High School level while 25.8% had specialised skills training. Approximately 12.9% had training at the Primary level and 7.6% had University training. The percentage of persons in the Port Royal educated at the Secondary level is lower than 52.7% national average. The percentage of persons with tertiary /university training is also higher than the national average of 6.1%.

Table 7.2-24. Educational Level Attained by Residents.

Education Level Attainment of Residents			
	Frequency	**Percent**	**Cumulative Percent**
None	1	0.8	0.8
Primary	17	12.9	13.6
High School	61	46.2	59.8
Training/ Skills Institution	34	25.8	85.6
University	10	7.6	93.2
Other	1	0.8	93.9
No Response	8	6.1	100.0
Total	**132**	**100.0**	

7.2.1.4.1.3 Occupation and Income

An estimated 28.8% of participants identified with the *Skilled/trade/technical/clerical/sales* occupational category while 19.7% belong to the *Unskilled/labourer/domestic category. Another* 15.9% are in the *Unemployed/Housewife/Student* category. Four percent of participants did not respond the question.

Forty one percent of participants have full-time employment; 24.2% are self-employed and 9.1% have part-time employment. Occupations include chefs, construction workers including mason, contractor, carpenter, fishermen, fish vendors and musician, among others.

Participants are generally unwilling to provide information on income. Sixty five percent of participants responded to the income question. Approximately 50% of participants earn $56,000 or less per month, while a 6.0% earn over $112,000 per month **(Table 7.2-25**). Some 27.3% earn less than the national minimum wage of $7,000 per week (an estimated $28,000 per month).

Table 7.2-25. Resident Income (JMD).

Resident Income (JMD)			
	Frequency	**Percent**	**Cumulative Percent**
<$28,000	36	27.3	27.3
$28,001-$56,000	30	22.7	50.0
$56,001-$84,000	8	6.1	56.1
$84,001-$112,000	4	3.0	59.1
$112,001-$140,000	4	3.0	62.1
>$140,000	4	3.0	65.2
Not stated	46	34.8	100.0
Total	132	100.0	

Participants resided in the communities of Port Royal (85%) and Harbour View (15%). Residents have lived in their communities for an average of 32 years ranging from 1 to 73 years. Their place of employment vary in location from local to their community, across the Kingston and St. Andrew area (New Kingston, Cross Road, Down Town, etc.) and, and St. Catherine. The main mode of transportation for residents is the bus. An estimate 61% of participants uses the bus to travel for work, school and shopping etc. (**Table 7.2-26**). Bus services in the study are provided by the JUTC. Private vehicle was the main mode of transport for 14.4% of participants while 10% walked or cycled.

Table 7.2-26. Main Mode of Transportation.

	Frequency	Percent
Private Vehicle	19	14.4
Bus	81	61.4
Taxi	16	12.1
Walk	12	9.1
Cycle	1	0.8
No Response	3	2.3
Total	132	100.0

7.2.1.4.1.4 Housing

Fifty two percent (52%) of residents reported owning the house in which they reside while 42% rent or lease (**Table 7.2-27**). Six percent reported living rent-free or were occupying the home without permission. These percentages exceed those of the study area. As stated earlier, 47% of households in the project impact zone own their homes; 37% rent; 11% live rent-free while 0.4% squatted (live without permission).

While persons may own their homes, they may not own the land on which it is situated. This is evident when land tenure is examined for residents. Forty percent of participants own the land on which their home is situated, an 11.4% difference compared to the percentage owning their homes. Forty six percent rent or lease land while another 13% occupy the land rent-free or without permission.

This is indicative of the squatting problem in the community including on/near the project site.

Table 7.2-27. House and Land Tenure.

Tenure				
	House		**Land**	
	Frequency	Percent	Frequency	Percent
Own	68	51.5	53	40.2
Lease	2	1.5	6	4.5
Rent	53	40.2	50	37.9
Rent-free	6	4.5	10	7.6
Occupy without permission	2	1.5	7	5.3
Other	1	0.8	6	4.5
Total	**132**	**100.0**	**132**	**100.0**

7.2.1.4.2 Awareness of Project

Of the 132 participants, 88.6% were aware of the PAJ proposed plan to develop a cruise pier and terminal at the old coal wharf in Port Royal. As expected, project awareness was higher among residence of Port Royal than Harbour View. Ninety five percent of Port Royal residents were aware of the project while 52% of those who reside in Harbour view were aware. Community members were the main source of information for 36.4% or participants while 16.7% learned of the project from television (**Figure 7.2-10**). Other sources of information included community meetings; citizen Association meetings and meetings with representatives from the Port Authority of Jamaica (project owners).

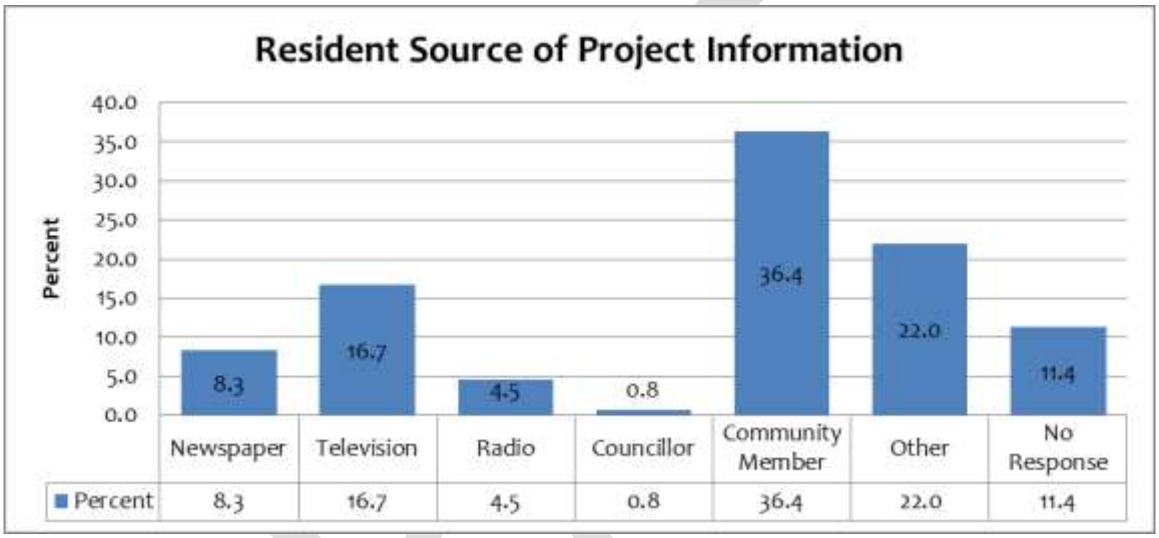


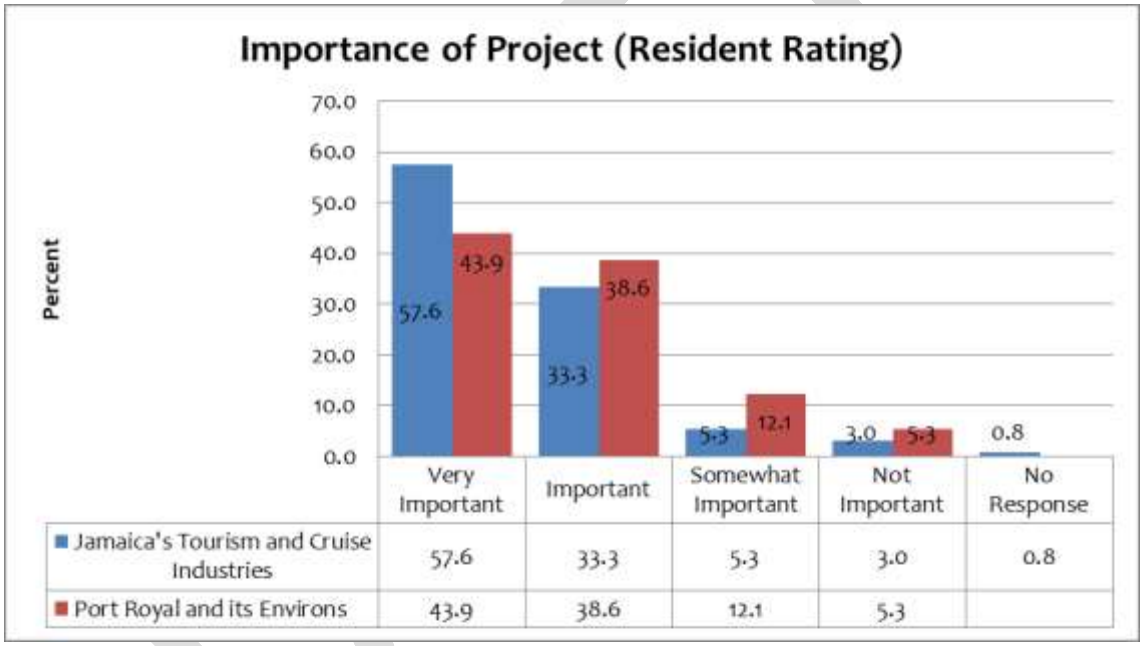
Figure 7.2-10. Resident Source of Project Information.

7.2.1.4.3 Project Importance

A large majority of participants believe the project is important to very important to Jamaica's tourism and cruise industries and to Port Royal and its environs (**Figure 7.2-11**). Approximately 58% of participants believe that the project is very important to Jamaica's tourism and cruise industries, while another 44% believe the project in important. Three percent is of the opinion that the project is not important to the tourism or cruise industries.

The main reasons given for the importance of the project was centred on its potential to:

- Generate foreign exchange earnings
- Boost the economy and the tourism sector
- Create employment opportunities
- Provide an opportunity for tourist to witness Jamaican history, and culture
- Add value to Kingston; attract more visitors to the island and capital city



	Very Important	Important	Somewhat Important	Not Important	No Response
Jamaica's Tourism and Cruise Industries	57.6	33.3	5.3	3.0	0.8
Port Royal and its Environs	43.9	38.6	12.1	5.3	

Figure 7.2-11. Importance of Project to Jamaica and Pot Royal.

The perceived level of importance was lower at the local level. A combined 82.6 percent of participants believe the project is very important (43.9%) or important (38.6%) to Port Royal. Reasons why the project is important to Port Royal include:

- Grow the local economy; development

- Job opportunities for residents and income generation
- infrastructure development; increased attractiveness of the community
- “Generates jobs, income, training opportunities, will fix up the area, too much history to be run-down”
- “New development will bring back relevance to Port Royal : the real capital city"

Several participants noted that the local people may not benefit if external parties are used and as such is not deemed important.

7.2.1.4.4 Importance of Cultural Heritage Resources

One of the characteristics of Port Royal that residents value most is its rich history and cultural heritage. In fact, 37.9% of participants indicated that this in the survey. The history was second only the peaceful nature of the community. The value of the cultural heritage resources is also reflected in residents rating of the importance of a selection of these resources and to assess the level of significance any damage or loss to these resources would be to the community. The majority of Residents believe the cultural heritage resources of Port Royal are important to very important. Approximately 71% of residents believe that the Port Royal’s Forts are very important resources while an additional 24% think they are important (**Table 7.2-28**). Similarly, the Giddy House was rated as very important resource by 70% of residents and important by another 25%. Less than 1.0% of residents were of the opinion that the Historic Naval Hospital and St. Peter’s Church are not important cultural heritage resources.

The importance of the cultural heritage of Port Royal is recognised at the national and global levels with the entire town designated as a National and Global Heritage site.

Table 7.2-28. Importance of Cultural Heritage Resources to Residents.

Heritage Resource	Importance Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)		3.0	23.5	70.5	3.0	100.0
Giddy House		3.0	25.0	69.7	3.0	100.0
Historic Naval Hospital	0.8	6.1	22.0	67.4	3.8	100.0
St. Peter's Church	0.8	2.3	27.3	67.4	2.3	100.0
Port Royal Terrestrial Archaeology		3.0	26.5	64.4	6.1	100.0
Port Royal Underwater Archaeology	1.5	3.8	25.0	64.4	5.3	100.0

For all resources assessed, the highest percentage of residents believes that any loss or damage would be a very significant loss to the community. For each resource over 65% of residents believe that damage or loss would be significant or very significant (**Table 7.2-29**). The Giddy House and Forts received this ranking by the largest proportion of participants, 71% and 70%, respectively. On the lower end of the spectrum, only 5-6% of residents believe that any loss or damage to any one resource would not be significant to the community.

Table 7.2-29. Significance of Damage or Loss to Selected Port Royal Heritage Resources to Residents.

Heritage Resource	Significance Of Loss or Damage					
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)	4.5	5.3	15.2	54.5	20.5	100.0
Giddy House	5.3	4.5	16.7	53.8	19.7	100.0
Historic Naval Hospital	6.1	4.5	17.4	49.2	22.7	100.0
St. Peter's Church	5.3	5.3	19.7	50.0	19.7	100.0
Port Royal Terrestrial Archaeology	5.3	6.1	17.4	48.5	22.7	100.0
Port Royal Underwater Archaeology	5.3	7.6	15.2	50.0	22.0	100.0

7.2.1.4.5 Importance of Port Royal's Natural Resources

Another important aspect of the project impact zone is its natural resources. With fishing and leisure tourism being the economic base for the community, it is highly dependent on its natural resources. Approximately 84% of participants indicated that the use the natural resources of Port Royal and its environs, oftentimes for multiple purposes (**Table 7.2-30**).

In lieu of this residents were asked to assess the importance of selected natural resources identified in the project impact zone. Not surprising all natural resources were rated as important to very important by the majority of residents. However, the coastal and marine resources received these ratings by a higher percentage of participants. Coastal resources are considered important to very important by 96% of participants, marine wildlife and the cays each were rated the important to very important by 93% of participants, while 81% rated terrestrial (land) wildlife the same (**Table 7.2-31**).

Table 7.2-30. Resident Use of Port Royal's Natural Resources.

Do Respondent Use Port Royal Natural Resources?		
	Frequency	**Percent**
Yes	111	84.1
No	21	15.9
Total	132	100.0

Table 7.2-31. Importance rating of Port Royal Natural Resources to Residents.

Resource	**Ranking**					
	Not Important	**Somewhat Important**	**Important**	**Very Important**	**Do not know**	**Total**
Terrestrial Wildlife e.g. birds, crocodiles	3.8	8.3	25.8	55.3	6.8	100.0
Coastal resources e.g. mangroves, beaches, spawning grounds	0.8		24.2	72.0	3.0	100.0
Marine wildlife and resources e.g. Fisheries, turtles, seagrass	0.8	3.0	25.8	67.4	3.0	100.0
Nearby Cays	2.3	1.5	22.0	71.2	3.0	100.0

Specific natural resources identified as being used by residents include the cays, beach, fisheries and the sea, with the Cays being resource used by the highest proportion of participants. Approximately 67% of participants identified the Cays as one of the natural resources they use (**Table 7.2-32**). The beach was the used by the second highest proportion of participants (16%) while fisheries were used by 7% of participants.

Table 7.2-32. Natural Resources used by Residents.

Resource	Frequency	Percent
All	4	3.0
Cays	88	66.7
Beach	21	15.9
Fisheries/ Mangroves	9	6.8
Sea	3	2.3

Persons used multiple resources and varied purposes. Four clear themes emerged from the individual or group of purposes for which participants used resources. These are provided in **Table 7.2-33**. The data show that 75% of respondents utilise natural resources for recreational purposes. This ranges from relaxing and meditating to parties on the cays. Approximately 6% of participants used resources for swimming. Some 7% indicated that they used the resources for economic purposes and livelihoods while 2.3% used them for domestic purposes, likely food supply.

Table 7.2-33. Purpose for Natural Resource Use (Residents).

Purpose for Use	Frequency	Percent
Recreation/ Relaxation/ Meditation/ Party	99	75.0
Swim	8	6.1
Economic/ Livelihood (Fishing; Excursions, etc.)	13	9.8
Domestic Purposes	3	2.3

Forty three percent (43%) of residents indicated awareness of pollution or stress factors affecting the natural resources of Port Royal. The most common type of pollution identified was garbage and other solid wastes. In addition to improper waste disposal within the project impact zone, this practice in the areas across the harbour in Kingston and St. Andrew contributes to the issue. Illegally dumped wasted into the gullies that drain into the harbour (which one respondent noted was 31) gets washed into the harbour and along the coasts of Port Royal and the Palisadoes. Sewage and waste water are other pollutants/stressors identified by residents. They noted that the sea, beaches, water, drains and gutters around the community are polluted. Some are having more difficulty catching bait and fish.

Sources of the pollution/stressors are human's illegal and "indiscriminate" dumping of garbage; poor infrastructure and maintenance and ship and manufacturing wastes.

7.2.1.4.6 Perceived Project Impacts

7.2.1.4.6.1 During Construction

Perception among resident participants is that project impacts during the construction phase will be positive for economic variables. This is evident in the large proportion of respondents that believe the project impacts will be positive for Job Opportunities for locals (75%), Local Businesses / local economy (72%), and the Jamaican Economy (72%). Some 54.5% of respondents believe that impacts on the residents or Port Royal will be positive. In comparison, a large proportion or participants believe that environmental variables such as water quality, marine resources, noise pollution and visual aesthetics will not be impacted by the project during construction. Some 29.5% believe that the fishing community will be negatively impacted while 13.6% thought it would be positively impacted (**Table 7.2-34**). Another 46.2% believes the fishing community will be not be impacted by the project. Approximately 34.8% believe there will be negative impacts to Heritage sites during construction; however 56.8% believe they will not be impacted.

Table 7.2-34. Resident Perceived Impacts of Selected Social, Environmental, Cultural Variables during Construction.

Perceived Project Impacts During Construction						
	Positive	Negative	No Effect	Positive & Negative	No Response	Total
Water quality	9.8	32.6	55.3		2.3	100.0
Coastal and marine resources	5.3	32.6	60.6		1.5	100.0
Noise Levels in Port Royal	4.5	22.0	67.4		6.1	100.0
Water Sports (Fishing, Diving, etc.)	12.1	14.4	66.7		6.8	100.0
Fishing community (Fishers, fishing areas, etc.)	13.6	29.5	46.2		10.6	100.0
Job Opportunities (locals)	75.0	5.3	17.4		2.3	100.0
Local Businesses (local economy)	72.0	4.5	19.7		3.8	100.0
Jamaican Economy	72.0	3.0	22.7	0.8	2.3	100.0
Residents	54.5	9.8	26.5		8.4	100.0
Visual aesthetics of the area	38.6	8.3	49.2		3.8	100.0
Traffic	15.9	18.9	62.9		2.3	100.0
Heritage Sites (monuments, buildings)	34.8	7.6	56.8		0.8	100.0
Average Rating	**34.0**	**15.7**	**46.0**	**0.8**	**4.2**	

7.2.1.4.6.2 Post- Construction (Operations)

Perceived impacts in the post-construction/ operations phase of the project indicate positive economic impacts by an even larger proportion of participating residents (

Table 7.2-35). An average of 75% of participants believes that impacts on the cruise tourism, job opportunities of locals, local businesses and the Jamaican economy will be positive. Approximately 28.8% believe impact to the fishing community will be positive compared to 19.7% who believe they will be negative. In general, the proportion of respondents who believe that environmental variables such as water quality, coastal and marine resources will be negatively impacted was less than negative impacts during the const.

Table 7.2-35. Resident Perceived Impacts of Selected Social, Environmental, Cultural Variables during Operations.

Perceived Project Impacts During Post-Construction (Operations)						
	Positive	Negative	No Effect	Positive & Negative	No Response/ Do Not Know	Total
Water quality	16.7	21.2	60.6		1.5	100.0
Coastal and marine resources	11.4	27.3	60.6		0.8	100.0
Noise Levels in Port Royal	10.6	15.9	68.9		4.5	100.0
Water Sports (Fishing, Diving, etc.)	22.7	7.6	63.6		6.1	100.0
Fishing community (Fishers, fishing areas, etc.)	28.8	19.7	47.0		4.5	100.0
Cruise Tourism	75.0	1.5	21.2		2.3	100.0
Job Opportunities (locals)	73.5	3.0	22.0		1.6	100.0
Local Businesses (local economy)	74.2	2.3	20.5		3.0	100.0
Jamaican Economy	76.5	1.5	20.5		1.5	100.0
Residents	59.8	9.1	28.0	1.5	1.5	100.0
Visual aesthetics of the area	47.7	4.5	47.0		0.8	100.0
Traffic	26.5	18.9	53.0	0.8	0.8	100.0
Heritage Sites (monuments, buildings)	45.5	3.8	48.5		2.3	100.0
Average Rating	**43.8**	**10.5**	**43.2**	**1.1**	**2.4**	

7.2.1.4.6.3 Other Negative Impacts

When asked if there are any other positive benefits of the project, there were 28 unique responses (**Table 7.2-36**).

Table 7.2-36. Other Negative Project Impacts.

Other Negative Impacts of The Project		
	Frequency	**Percent**
Corruption; inadequate management; Need better police station to cover tourist for the sake of Jamaica's reputation	1	0.8
Crime	2	1.5
Crime and theft	1	0.8
Crime as criminals may target tourists	1	0.8
Crime may come with tourism; increased traffic	1	0.8
Crime may increase as criminal try to prey on tourists	1	0.8
Crime may increase as Port Royal get more visitors	1	0.8
Crime rate may increase as more people enter Port Royal	1	0.8
Crime,	1	0.8
Criminal activities	1	0.8
Damage to sea; criminal activities	1	0.8
Destruction of beach	1	0.8
Destruction of some natural resources such as mangroves	1	0.8
Dust, sewage control, toxic stuff from sewage	1	0.8
Fear that it will be taken away from local people; fear of relocation to facilitate government economic interest	1	0.8
Foreigners will benefit more than locals	1	0.8
Housing condition is poor	1	0.8
If the jobs are awarded to persons outside of the community	1	0.8
Increased crime	1	0.8
Introduction of cruise ships will attract thieves and other criminal activities to the area. Crime will increase as the area is currently low crime	1	0.8
it is affects fishery, or disappoint where job are concerned	1	0.8

Other Negative Impacts of The Project		
	Frequency	**Percent**
Lack of housing and focus on tourists	1	0.8
Lack of job opportunity, use a local representative	1	0.8
May affect shoreline	1	0.8
May become more crowed	1	0.8
May cause increase in strange persons and crime rate	1	0.8
More persons in the area will generate more waste that will be uncontrollable	1	0.8
Negative if not properly managed without corruption	1	0.8
None	2	1.5
Not providing employment opportunities for residents	1	0.8
No Response	86	65.2
outside non- natives migrate into Port Royal to benefit from tourism but disrupting the peace	1	0.8
Positive impacts will outweigh the negative ones	1	0.8
Possibility of ... returning corruption in the administration; etc.	1	0.8
Relocation may occur	1	0.8
Relocation of households (pushed off land with children and nowhere to go	1	0.8
Relocation of people	1	0.8
Relocation of residents will break up the closeness of the community	1	0.8
Relocation of housing and businesses	1	0.8
Ships may hinder fishermen's access to resources	1	0.8
Spoil the culture, more criminals and murderers may come in	1	0.8
Squatters will be displaced	2	1.5
The government is not thinking about the implementation of housing for the people of Port Royal	1	0.8
Tourist harassment like in Ocho Rios	1	0.8

7.2.1.4.6.4 Other Positive Impacts

When asked if there are any other positive benefits of the project, there were 28 unique responses (**Table 7.2-37**).

Table 7.2-37. Other Project Benefits.

Other Benefits of the Project		
	Frequency	**Percent**
Boost economy	1	0.8
Development of infrastructure	1	0.8
Earn more money	1	0.8
Employment	1	0.8
Exposure, ...	1	0.8
Financial benefits to community residents	1	0.8
Financial boost, improve livelihood	1	0.8
Financial gain if people provide what tourist demand	1	0.8
Greater nightlife and vibrancy to the area; People can visit more frequently	1	0.8
Income; promote Jamaica’s tourism industry; increase exposure	1	0.8
Increase business for residents through tourism	1	0.8
Increased awareness of Port Royal, new development for the area	1	0.8
Job creation	1	0.8
Job creation, infrastructure development	1	0.8
Job opportunity	1	0.8
Job opportunities for young people	1	0.8
Jobs, more money in the community	1	0.8
Jobs, revenue development	1	0.8
May be Port Royal will get a facelift and restore its glory	1	0.8
More investment and business development	1	0.8
More vibrancy in the area as more activities to attract visitors	1	0.8
New business may open up in Port Royal or even close to benefit from the pier	1	0.8

Other Benefits of the Project		
	Frequency	Percent
None/ No Response	104	78.9
Opportunity to meet other people/ network	1	0.8
Road network and reconfiguration of the town	1	0.8
To create more jobs for the people within Harbour View	1	0.8
Will better community by providing more opportunity for the youth	1	0.8
Will look nicer; Port Royal will be more developed	1	0.8
Work, Community involvement	1	0.8
Total	**132**	**100.0**

7.2.1.4.6.5 Disadvantaged Groups

Residents were asked if they think any particular group in their community will be placed at a disadvantage because of the project. Their explanations are provided in **Table 7.2-38**.

Table 7.2-38. Groups Disadvantaged by the Project.

Groups that many be at a Disadvantage by Project		
Group	Frequency	Percent
Fishermen	2	1.5
Fishermen and local businesses, the cost of stuff	1	0.8
Fishermen May be displaced	1	0.8
Fishermen may be restricted from certain areas; persons living near the pier; divers	1	0.8
Fishermen Relocation	1	0.8
Fishermen will be affected	1	0.8

Groups that many be at a Disadvantage by Project		
Fishermen, some areas will be restricted	1	0.8
Fishing bans with be placed on areas affecting livelihoods	1	0.8
Local business operators, when other businesses come they will have to share the profits	1	0.8
Local residents, increase garbage, traffic, etc.	1	0.8
Locals	2	1.5
Locals, sometimes Chinese companies get most of the construction jobs	1	0.8
No open opportunity	1	0.8
No, Because I don't think any particular group will be put at a disadvantage	1	0.8
Outsiders may get jobs instead of local residents	1	0.8
People living on project site - coal wharf property- will have to move	1	0.8
People without skills or education	1	0.8
Persons squatting close to the coal wharf will have to move	2	1.5
Persons squatting on the coal wharf site	1	0.8
Persons with disabilities and those who may oppose the project	1	0.8
Residents	1	0.8
Squatters	1	0.8
Squatters and Fishermen	1	0.8
The community may not benefit as expected	1	0.8
Untrained residents	1	0.8
Vendors/ Shopkeepers may not benefit	1	0.8
Yes fishermen will be restricted from certain areas	1	0.8
Yes the vendors will be related	1	0.8
Yes they gave us notice to relocate before the 28/04/19	1	0.8
Yes, I think the fishermen will be affected	1	0.8

Groups that many be at a Disadvantage by Project		
Yes, illiterate persons	1	0.8
Yes, major players ...	1	0.8
Yes, small business people might be asked to move	1	0.8
yes, the development will attract criminals to the community putting the community at a disadvantage	1	0.8
Yes, the ignorant	1	0.8
Yes, the small people who are squatting	1	0.8

7.2.1.4.6.6 Perception of Direct Impact to Respondent

Over half of participants believe that they may directly benefit from the project. The benefits stated are listed in **Table 7.2-39**. The main benefits include employment opportunity, growth in business from increased customer base and sales; opportunity to start new businesses such as craft making for sale as souvenirs. Some participants noted that as squatters their impact is that they will have to relocate from the project site, and have received notice to that effect.

Seventy five percent (75%) of residents believe that the necessary skills for construction and operational phases of the project can be found within the community. However, many noted that training will be needed. According to some residents, the Port Royal Citizen's Association has started training in craft making in anticipation of the potential for new business ventures.

Table 7.2-39. Perceived Direct Project Benefits to Residents.

Direct Benefits Reason		

	Frequency	Percent
(fish sells better) job opportunity	1	0.8
As a squatter, I have to move off the land	1	0.8
Because I am in the entertainment industry as a musician	1	0.8
Better housing opportunity	1	0.8
Better roads	1	0.8
Build a shop	1	0.8
business	1	0.8
Business opportunity	1	0.8
But the government of Jamaica will benefit from the project	1	0.8
Community level benefits	1	0.8
Craft sales to tourists and other visitors will increase	1	0.8
Currently studying cruise ship management at CMU; once the project is complete I hope to gain Employment	1	0.8
Different skill set	1	0.8
Don not visit the area	1	0.8
Don’t see how I will benefit	1	0.8
Employment	2	1.5
Employment during construction	1	0.8
Employment for young people in my family	1	0.8
Employment opportunities	1	0.8
Employment opportunities	1	0.8
Employment opportunities during construction stage	1	0.8
Employment opportunity	2	1.5
Employment opportunity by offering services to tourists	1	0.8

Direct Benefits Reason		
	Frequency	Percent
Employment opportunity for my children	1	0.8
Experienced Mason so may get a job	1	0.8
Family member can no longer work	1	0.8
I am a small business owner	1	0.8
I am too old	1	0.8
I will not benefit from the development of the community	1	0.8
If I have required qualifications	1	0.8
Increase sales	1	0.8
Increased salary with increased profits for my employer- Gloria's	1	0.8
Increased sales	1	0.8
Job and earning opportunity	1	0.8
Job creation; currently learning craft through the Citizen's Association	1	0.8
Job opportunities (carpentry)	1	0.8
Job opportunities but only after construction	1	0.8
Job opportunities to grow my business	1	0.8
Job opportunity	4	3.0
Job opportunity as a Mason	1	0.8
Job security	1	0.8
Jobs	1	0.8
Just live here but want community to be protected	1	0.8
Make robes for sale to tourists	1	0.8
Might be able to have a stall/ concessionary stand to sell	1	0.8

Direct Benefits Reason		
	Frequency	Percent
souvenirs		
More customers to my place of work which will increase my financial	1	0.8
More sales	2	1.5
More sales for local businesses	1	0.8
More visitor, more customers	1	0.8
Not directly, only on a wider scale	1	0.8
only if trained	1	0.8
Operate shop at Fort Charles	1	0.8
Opportunity for jobs	1	0.8
Opportunity to get work etc.	1	0.8
Opportunity to provide entertainment for tourists on newly developed attraction sites	1	0.8
Possible job	1	0.8
Potential growth personally and for business	1	0.8
Potential increase in sales	1	0.8
Potential job	1	0.8
Potential job opportunity	2	1.5
Pre-determined contraction and workers	1	0.8
Presently learning to make craft items because of the proposed development	1	0.8
retired	1	0.8
Retired	1	0.8

Direct Benefits Reason		
	Frequency	Percent
Sales for potential rum cake business	1	0.8
Sells in yard	1	0.8
They gave us notice to relocate from Port Royal, there will be no benefit for me	1	0.8
Through family members employment	1	0.8
Tour guide - increase of visitors will benefit from business	1	0.8
Tourist may visit community and purchase good from my shop	1	0.8
Tourist won’t come to this section	1	0.8
unless apply self to business opportunity	1	0.8
Yes because I am self-employed	1	0.8
Yes because I can go and enjoy myself over there	1	0.8
Yes, benefit from an improved Port Royal	1	0.8
Yes, breakfast businesses in the community will be better	1	0.8

7.2.1.4.7 Resident General Comments

General comments provided by respondents are listed in **Table 7.2-40**.

Table 7.2-40. Residents General Comments on Project.

Comments		
	Frequency	**Percent**
31 gullies empty into the Kingston Harbour impacting the Coast Guard. Need to clean up the harbour before investment. Pollution is rampant. Quality of fish declining; Area does not have anything to offer tourists. Most visitors will be bused to the Bob Marley Museum	1	0.8
Benefits of project will improve quality of life; increased opportunities and profits during operations	1	0.8
Benefits should first go to Port Royal residents	1	0.8
Brilliant project, it will increase visitors to Port Royal and Jamaica at large which will boost our	1	0.8
Bring back ferry service	1	0.8
Crime rate will increase	1	0.8
Ensure that the people in the community benefit from job opportunities, improve transportation system	1	0.8
Floating pier should be placed in Kingston Harbour instead	1	0.8
Freshly paved road	1	0.8
Great community	1	0.8
Great project	1	0.8
Hope benefits are felt in the community and the community is developed	1	0.8
Hope it happens so people get opportunities	1	0.8
Hope it's done in a satisfactory manner	1	0.8
Hope the citizens of Port Royal will benefit from the development	1	0.8
Hope the residents are not related	1	0.8
Hope the town really develops	1	0.8
Hoping that all goes well	1	0.8

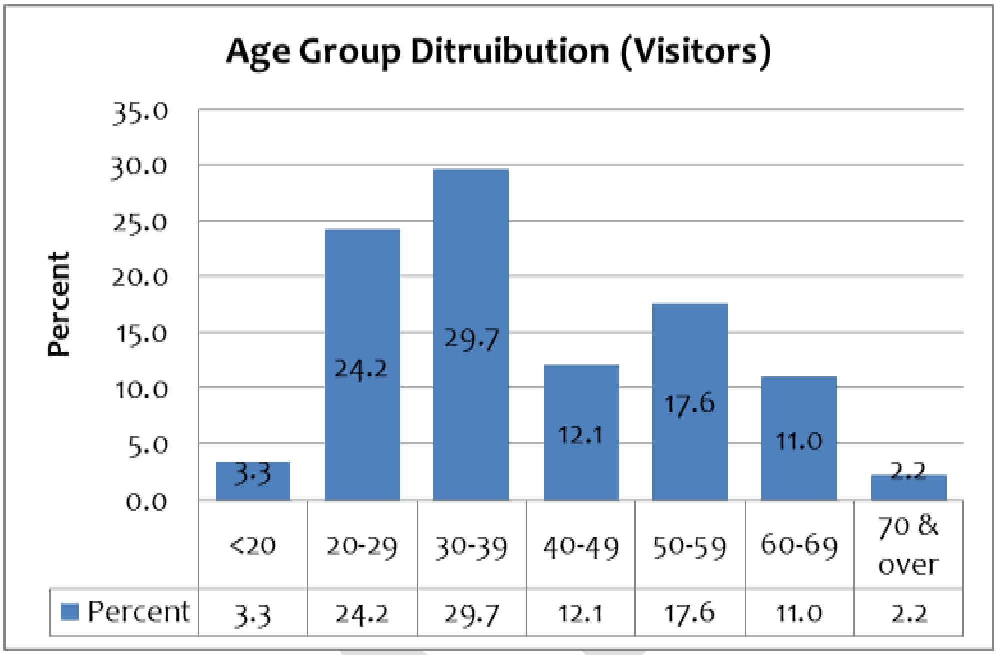
Comments		
	Frequency	**Percent**
Housing is a major issue in the community	1	0.8
I hope the residents of Port Royal will not be ask to relocated to another community	1	0.8
I want to see the beauty of Port Royal when the implementation is finish	1	0.8
Implement boundaries so that fishermen are not negatively affected. Should regulate the market so that larger companies don't come in and ruin the market/ livelihood of the small man	1	0.8
Know people from Port Royal to housing	1	0.8
Need a trade center	1	0.8
Need better representation	1	0.8
Need better understanding of how the project will be implemented and livelihood impacts	1	0.8
Need locals to be a part of the project, so they can benefit	1	0.8
Need more housing	1	0.8
None/ Nor Response	91	68.9
People of Port Royal need to help clean beach and do things to generate income and boost the local economy	1	0.8
Project is good as long as it brings employment	1	0.8
The authorities to give back to the local primary/basic schools in the community	1	0.8
The development of the pier and terminal is a great idea as it facilitates economic growth	1	0.8
The Port Royal Citizen's Association implemented a Craft training Programme to generate craft makers to supply demand when the project comes on stream	1	0.8
Training for young people needed for them to get jobs and assistance in starting new businesses	1	0.8
Training programs for persons in the area	1	0.8
Wants Port Royalists to be engaged in the process	1	0.8
What is the starting point	1	0.8
Will need better security and protection of historic sites	1	0.8
Would love the project, but hate the threat that is presented by	1	0.8

Comments	Frequency	Percent
kind of people		
Yes hope residents of Port Royal will not be relocated	1	0.8
Yes, basically I need to see the benefit to Port Royal ad the changes	1	0.8
Total	**132**	**100.0**

7.2.1.5 Visitors to Port Royal

7.2.1.5.1 Visitor Profile

A total of 91 visitors agreed to participate in the survey. Persons were interviewed while visiting several popular recreation spots across the Port Royal community including Gloria's, Bar on the Beach, Seaside Bar and Restaurant, on the beach, among others. Some 62.6% of participating visitors (visitors) were male and 36.3% female (**Figure 7.2-12**). They vary in age with the 30-30 age group category being most represented, accounting for 30% of visitors. Twenty four percent (24%) belonged to the 20-29 age group category while 18% were in the 50-59 group. The under 20 and 70 and over age group categories were the least represented accounting for 3.3 and 2.2% respectively.



	<20	20-29	30-39	40-49	50-59	60-69	70 & over
Percent	3.3	24.2	29.7	12.1	17.6	11.0	2.2

Figure 7.2-12. Visitor Age Group.

Visitors were from various communities across Kingston and St. Andrew, St. Catherine, St. Thomas, Clarendon, St. Ann, St. James, Hanover. Approximately 11% were visiting from the United States, Canada, the United Kingdom, France and Germany.

Twenty tow percent were visiting Port Royal for the first time, while 73% were repeat visitors. Repeat visitors reported visiting an average of 8 times, ranging from as low as once to 30 times. There were various reasons given for visiting Port Royal, including various recreational purposes (beach, restaurants, and cays), visiting the historic sites, visiting family and friends, work and to conduct business. Points of interest noted include:

- Gloria’s
- Bars and Restaurants (including Gloria’s which was named by 29% of visitors)

- Heritage sites - Fort Charles, Giddy House, St. Peter's Church
- Giddy House
- Beach and scenic areas

7.2.1.5.2 Awareness of Project

Approximately 41% of visitors were aware of the project prior to their interview while 59% were not aware of the proposal. The main source of information on the project was television which was the source for 51% of respondents (**Table 7.2-41**).

Table 7.2-41. Visitor Main Source of Project Awareness.

Source of Project Information		
	Frequency	**Percent**
Newspaper	4	11%
Television	19	51%
Radio	3	8%
Community Member	6	16%
Other	4	11%
No Response	1	3%
Total	**37**	**100%**

7.2.1.5.3 Project Importance

The level of importance ascribed to the project was high among visitors. Approximately 70% of visitors believe that the project is very important to Jamaica's tourism and cruise industries, and to Port Royal and its environs **(Figure 7.2-13)**. An additional 20-21% considers the project important, while 9% consider it somewhat important to Jamaica's tourism and cruise industry, and to Port Royal (7%). Only 2% of visitors consider the project not important to Port Royal and 1.1% to Jamaica.

Key reasons for thinking the level of importance ascribed to the project include its potential to:

- Generate business opportunities
- Boost the local economy
- Earn foreign exchange
- Create Job opportunities and more income, increase wealth
- Transform the atmosphere and culture of the town
- Increased standard of living for residents
- Benefit the country thorough tourist arrivals, increase in revenues
- Add value to the tourism product of Jamaica; more than sand and sea.

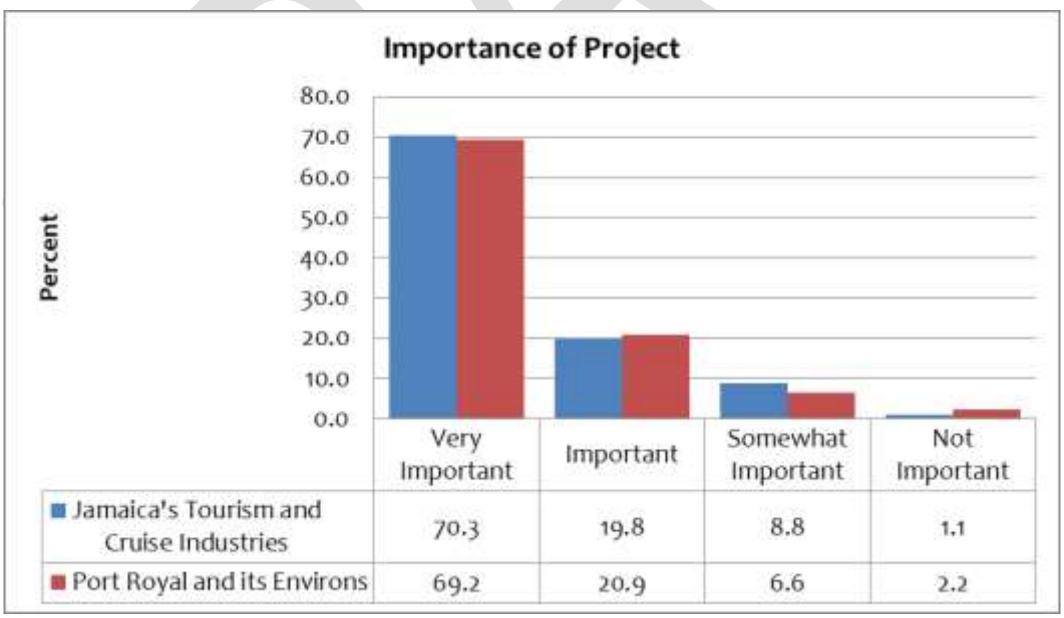


Figure 7.2-13. Importance of Project (Visitor Rating).

7.2.1.5.4 Importance of Cultural Heritage Resources

Survey data show that the cultural heritage resources of Port Royal are important to very important. For the Forts, Giddy House and the Historic Naval Hospital and St. Peter's Church, over 80 percent of visitors rate the resources as important to very important. The terrestrial and under water archaeology was considered important to very important by a smaller proportion (approximately 60% of visitors (**Table 7.2-42**).

Visitors also indicated that any damage of loss to these cultural heritage resources would be significant to very significant. A combined 80% considered damage or loss as significant (28.4%) to very significant (52.0%) (**Table 7.2-43**).

Table 7.2-42. Importance of Selected Port Royal's Cultural Heritage Resources (Visitor).

Heritage Resource	Importance Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)	1.1	3.3	33.0	60.4	2.2	100.0
Giddy House	2.2	4.4	26.4	63.7	3.3	100.0
Historic Naval Hospital	2.2	7.7	26.4	57.1	6.6	100.0
St. Peter's Church	3.3	6.6	25.3	60.4	4.4	100.0
Port Royal Terrestrial Archaeology	9.9	28.6	56.0	4.4	1.1	100.0
Port Royal Underwater Archaeology	8.8	30.8	56.0	4.4		100.0

Table 7.2-43. Significance of any Damage of Loss to Selected Port Royal's Cultural Heritage Resources.

Heritage Resource	Significance Of Loss or Damage					
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know	Total
Port Royal Forts (Fort Charles, Fort Morgan, etc.)	1.1	6.6	29.7	52.7	9.9	100.0
Giddy House	1.1	4.4	29.7	54.9	9.9	100.0
Historic Naval Hospital	2.2	7.7	25.3	49.5	15.4	100.0
St. Peter's Church	3.3	5.5	27.5	51.6	12.1	100.0
Port Royal Terrestrial Archaeology	2.2	6.6	28.6	51.6	11.0	100.0
Port Royal Underwater Archaeology	1.1	6.6	29.7	51.6	11.0	100.0

7.2.1.5.5 Importance of Port Royal's Natural Resources

The majority of visitors also consider the natural resources of Port Royal to be very important. Ranking for selected resources by percentage of participants are presented in **Table 7.2-44**.

Table 7.2-44. Importance of Port Royal's Natural Resources (Visitor).

Resource	Ranking					
	Not Important	Somewhat Important	Important	Very Important	Do not know	Total
Terrestrial Wildlife e.g. birds, crocodiles	2.2	2.2	29.7	62.6	3.3	100.0
Coastal resources e.g. mangroves, beaches, spawning grounds	2.2	29.7	65.9	1.1	1.1	100.0
Marine wildlife and resources e.g. Fisheries, turtles, seagrass	2.2		26.4	69.2	2.2	100.0
Nearby Cays		1.1	25.3	71.4	2.2	100.0

7.2.1.5.6 Perceived Project Impacts

7.2.1.5.6.1 During Construction

When asked if they thought certain environmental and socio-economic variables will be impacted in a positive of negative way, economic variables related to jobs, business and the Jamaican economy were identified as mostly likely to be impacted in a positive way (**Table 7.2-45**).

Table 7.2-45. Project Impacts during Construction (Visitor).

Perceived Project Impacts During Construction

	Positive	Negative	No Effect	Positive & Negative	No Response	Total
Water quality	11.0	38.5	41.8	1.1	7.7	100.0
Coastal and marine resources	12.1	38.5	41.8	1.1	6.6	100.0
Noise Levels in Port Royal	5.5	26.4	54.9	2.2	11.0	100.0
Water Sports (Fishing, Diving, etc.)	17.6	25.3	41.8	1.1	14.3	100.0
Fishing community (Fishers, fishing areas, etc.)	20.9	39.6	30.8	1.1	7.7	100.0
Job Opportunities (locals)	79.1	2.2	11.0	1.1	6.6	100.0
Local Businesses (local economy)	78.0	2.2	13.2	1.1	5.5	100.0
Jamaican Economy	70.3	4.4	18.7		6.6	100.0
Residents	59.3	14.3	18.7		7.7	100.0
Visual aesthetics of the area	35.2	24.2	30.8		9.9	100.0
Traffic	16.5	29.7	44.0		9.9	100.0
Heritage Sites (monuments, buildings)	38.5	9.9	45.1		6.6	100.0
Average Rating	**37.0**	**21.2**	**32.7**	**1.3**	**8.3**	

7.2.1.5.6.2 Post-Construction (during Operations)

Some 54% of visitors believe that project impacts will be positive in the post-construction/ operations phase of the project, 17 percentage points higher than the proportion of visitors that thought there would be positive impacts during construction. Economic variables will continue to see positive impacts. A higher percentage of visitors also believe that impact on Water sports, the fishing community, the visual aesthetic of the community and cultural heritage site will be positive during the operations phase of the project (**Table 7.2-46**).

Table 7.2-46. Project Impacts during Operations (Visitor).

Perceived Project Impacts During Post-Construction (Operations)						
	Positive	**Negative**	**No Effect**	**Positive & Negative**	**No Response/ Do Not Know**	**Total**
Water quality	20.9	27.5	44.0	7.7	100.0	20.9
Coastal and marine resources	22.0	29.7	42.9	5.5	100.0	22.0
Noise Levels in Port Royal	15.4	24.2	53.8	6.6	100.0	15.4
Water Sports (Fishing, Diving, etc.)	38.5	17.6	34.1	9.9	100.0	38.5
Fishing community (Fishers, fishing areas, etc.)	40.7	29.7	26.4	3.3	100.0	40.).7
Cruise Tourism	75.8	2.2	15.4	6.6	100.0	75.8
Job Opportunities (locals)	81.3	2.2	11.0	5.5	100.0	81.3
Local Businesses (local economy)	84.6	1.1	11.0	3.3	100.0	84.6
Jamaican Economy	82.4	1.1	13.2	3.3	100.0	82.4
Residents	72.5	5.5	17.6	4.4	100.0	72.5
Visual aesthetics of the area	71.4	3.3	18.7	6.6	100.0	71.4
Traffic	28.6	27.5	38.5	5.5	100.0	28.6
Heritage Sites (monuments, buildings)	63.7	5.5	26.4	4.4	100.0	63.7
Average Rating	**53.7**	**13.6**	**27.1**	**5.6**	**100.0**	**53.7**

7.2.1.5.6.3 Other Negative Impacts

Other negative impacts identified by visitors are listed in **Table 7.2-47**.

Table 7.2-47. Other Negative Project Impacts (Visitor).

Other Negative Impacts of The Project		

	Frequency	Percent
being bought out by large institution may lower its authenticity	1	1.1
Crime	1	1.1
Crime may increase, criminals may prey upon tourist or businesses	1	1.1
Criminal activities	1	1.1
Crowds	1	1.1
Damage of fishing nets- to turtles, dolphins etc.	1	1.1
Delays in job opportunities for local residents	1	1.1
Dredging, erosion from large tides	1	1.1
IF the crime rate goes up	1	1.1
Increased crime, pollution, and traffic, may also strain the economy	1	1.1
May add more waste to the harbour	1	1.1
May attract criminals	1	1.1
Monopolized trade, limit trade for locals	1	1.1
More restrictions in terms of where people can traverse	1	1.1
Project may restrict fishermen that fish close to project site	1	1.1
Scamming, crime, and dredging	1	1.1
Sense of family broken up	1	1.1
Technologies available to address environmental issues	1	1.1
Too many people	1	1.1

7.2.1.5.6.4 Other Positive Impacts

Visitors identified a number of other positive impacts they think the project will have. As seen in **Table 7.2-48**, income generation and infrastructural development are benefits visitors foresee as a result of the project.

Table 7.2-48. Other Benefits of the Project (Visitor).

Other Benefits of the Project		
	Frequency	**Percent**
Better infrastructure, more investments	1	1.1
Better infrastructure, more investments, exposure	1	1.1
Better infrastructure, more investments, more beautiful beach plus community, job training, exposure	1	1.1
Better roads leading into the town	1	1.1
Boost in overall economy	1	1.1
Businesses	1	1.1
Community development	1	1.1
Create opportunities for housing	1	1.1
Craft vendors will benefit from more stop-over tourists	1	1.1
Economic spinoffs	1	1.1
Government will benefit	1	1.1
Impound attraction	1	1.1
Improvements to infrastructure	1	1.1
Income generation	1	1.1
Increase local tourists	1	1.1
Investment in Jamaica; tourism industry growth	1	1.1
Job, growth in the economy, expansion for business	1	1.1
Local venders will benefit from sales of goods	1	1.1
More indirect revenue	1	1.1
More money	1	1.1
More opportunities and profits	1	1.1
Opportunity for locals	1	1.1

7.2.1.5.7 Visitor Comments

A number of visitors also made general comments on the project. These comments are provided in **Table 7.2-49**.

Table 7.2-49. Visitors General Comments.

Comments		
	Frequency	Percent
	55	60.4
Any lost by the development of a terminal or pier should be should be paid for dearly, because all these are a part of Port Royal's rich history which I pay keen attention to	1	1.1
As long as they are conscious of the community that already exist then everyone can benefit equal bur if it is only tourists oriented then it is one to look out for the negative impacts it has	1	1.1
Concerned about how the dust will affect residents	1	1.1
Concerned that prices will go up and it will become a tourist attraction away from local benefit	1	1.1
Developers should actively involve local persons in the development process	1	1.1
Development of Port Royal is taking too long	1	1.1
Do not ruin it by poor maintenance or allow it to lose its original flair by changing it too much	1	1.1
Don't forget the people	1	1.1
Don't interfere with residents	1	1.1
donate an aspect of the income to environmental fund	1	1.1
Excited about the development	1	1.1
Foreign investor means foreign owners which means no monopoly, government does not decide the levels of control early	1	1.1
Good project for Kingston and people of Port Royal	1	1.1
Hope people will benefit from the project and not be pushed aside	1	1.1
Hope the residents will be able to keep this sense of closeness they seem to have	1	1.1
Implementation is a very brilliant idea	1	1.1
Improve infrastructure	1	1.1
It is a good thing as long as it is not affecting the residents in a negative way	1	1.1
Looking forward to the project and there should be transparency	2	2.2
More information can be given to the public	1	1.1
More public awareness needed	1	1.1
Must be properly monitored and protect the coast	1	1.1
Must be reasonably priced for locals	1	1.1

Comments		
	Frequency	Percent
Need more creativity	1	1.1
Poor development of questionnaire	1	1.1
Port Royal Beach needs to be developed in order to accommodate tourists as well as locals	1	1.1
Road needs fixing as well as housing infrastructure	1	1.1
Scared of scamming and crime and money not filtering down to locals, similar situation to Montego Bay	1	1.1
Should bring back ferry	1	1.1
The project could really do the town some good	1	1.1
They need to do renovations to the bars and the beach, crafts, etc.	1	1.1
Think the historical site in its current stage is a trick	1	1.1
Tourism Ministry should host town hall meeting to discuss with the residents of Port Royal so that persons can voice their concerns as some are saying they will be evicted	1	1.1
Very good idea; believe that the locals will enjoy the inflow or tourists into Port Royal	1	1.1
Very good project, should have come before now	1	1.1

8 Impact Identification and Assessment/ Analysis of Potential Impacts

The marine habitat at the Old Coal Wharf has been impacted by various forms of exploitation and uses over the years, yet the nearshore area within the project footprint and its immediate surroundings support a surprising diversity of marine flora and fauna.

The floating, articulating, Seawalk™ cruise ship pier represents a lower impact alternative to conventional cruise ship piers, the construction of which, often comes with extensive habitat destruction due to dredging requirements, land reclamation, installation of pilings and other infrastructure required for accommodating ever larger cruise ship vessels. While the installation of the floating Seawalk™ does not require direct destruction of the benthic substrate, it still represents an alteration to the habitat that may result in indirect impacts to the ecosystem functions within the protected area. Given the ecological and environmental significance of Port Royal, it is important to consider how habitat alterations may affect the ecological processes within the project's broader area of influence.

The extent of habitat alteration and the severity of the impacts resulting from the construction of cruise ship berthing facilities and the placement of the floating cruise pier at Old Coal Wharf are determined by the location and scale of the project, the nature of the resources within the project footprint, the capacity of the environment to absorb and recover from these impacts, construction techniques, and the mitigation measures implemented throughout the various phases of the project (PIANC 2010). In accordance with the Terms of Reference, anticipated impacts to the marine and terrestrial resources within the project footprint are discussed for the two phases of the project’s life cycle including the:

1. Construction phase
2. Operational phase

Other impacts, specifically impacts of climate change are also discussed.

8.1 Site Preparation and Construction Stage

8.1.1 Physical/Chemical Environment

8.1.1.1 Air Quality

Potential Impacts during construction will be temporary and mainly related to the influx of heavy duty vehicles to the area most of which will be diesel powered. Specific impacts include:

- Increased PM10 especially from inadequately maintained diesel engines;
- Increased PM10 from soils spilled on the roadway.

Mitigation measures include:

- Ensuring all vehicles working at the site are properly maintained to minimize emission of soot/smoke;
- Ensure all vehicles are covered effectively to prevent spillage of material to the roadways.

8.1.1.2 Noise and Vibration

Impacts to noise and vibration during construction will be mainly due to heavy duty equipment entering and leaving the site and operating on the roadways. Specific impacts include:

- Indiscriminate use of Jake brake (Engine brake);
- Unnecessary revving of engines;
- Defective silencers/mufflers.

Mitigation measures could include:

- Erect signage onsite and on roadway restricting use of engine brake;
- Enforcing speed limit;
- Checking vehicles for roadworthiness especially with regard to effective silencer/muffler. This could be a condition for selection of trucking providers.

8.1.1.3 Geology/Soils/Landscape

Impacts: As indicated above the site is located on an old coal wharf and was used for a marine terminal. Although the site has not operated as a marine terminal for coal for some decades, the site has continued to be used as an industrial estate for events. The construction of the new onshore facilities will be erected on already developed lands and as such the proposed construction will not affect any "natural" topographic or geological features in the area. During the constructions phase there will be temporary changes to the landscape and upper soils. Alternations will occur during excavation and demolition of old foundations. Following demolition, backfilling of the excavated areas will restore the site surface profile. Care will need to be taken to not disturb the coal dust layer so that it forms dust as mobilization by wind could result in dispersal over a wide area and affect adjacent properties. For any areas that have elevated organics, then care must be taken to ensure these areas are not remobilized and that during construction they are covered with hardstanding to separate contact with these areas and the surface, reducing any possibility of interaction with persons using the facilities.

Marine dredging will lead to lowering of the sea bed levels through the removal of sea-bed sediments. This could result in the permanent alterations of the seabed and sediment composition.

Mitigation: Ensure coal dust layer is not remobilized or areas with organics contamination (e.g. Coal tar storage areas. Coal tar was used to waterproof ships in the past. Coal tar has a distinctive 'organic' odour and can appear as a black/brown viscous liquid). Such areas will need to be covered with hardstanding or removed and appropriately disposed of at a landfill. Zones of peat may also be within the site footprint.

It is essential that dredging works are carried out in accordance with appropriate standards and within dredging tolerances developed so as to reduce damage to the surrounding areas.

8.1.1.4 Hydrology

Impacts: Potential contamination of groundwater from oil, fuel and chemical spills and runoff from waste is the main impact during construction. Vehicles and machinery taking part in the construction/demolition activities are potential sources of fuel leaks and oil leaks. If construction material piles, demolition debris (excavated coal dust) and other waste are not stored, transported and disposed of properly, contaminants may be released to the aqueous environment (both groundwater, surface runoff and marine water)/

Coal dust and other construction dust may also be transported into water by wind. Similarly, as the geology at the site comprises high permeability sands and gravels, liquid waste or fuels or oils may contaminate groundwater and marine water through rapid infiltration and movement to the sea.

Excavating soil contaminated with any historically material (e.g. coal tar) used for ship maintenance may also mobilize contaminants and eventually facilitate their release to the hydrologic environment.

Mitigation: Regular maintenance checks should be carried out on all vehicles/equipment to minimize the risk of leaks. All repairs should be carried out on hardstanding and away from water resources and local drainage flow paths.

All none-natural construction materials, oils, fuel and other chemicals kept on site should be appropriately stored and monitored to prevent leaks or spillage. Any excavated coal dust must be covered and kept away from any natural drainage flowpaths to avoid marine contamination via runoff.

Mitigation: The implementation of an agreed waste management plan as well as appropriate waste transportation, handling and disposal methods will effectively mitigate the majority of the potential adverse impacts outlined.

Impacts: Pollution from in-water construction works for the SeaWalk and other terminal works and breakwaters are possible. Work vessels taking part in the construction works will all be possible sources of contaminant leaks and spills to the marine environment.

In addition any activity such as pile driving, deposition of rubble, the dumping of boulders/rocks for breakwaters, sand compaction and diffusion from in-water concrete works and the escape of fine sediments from material used in filling will also result in re-suspension of sediments with impacts similar to dredging.

Mitigation: Adverse effects of in-water construction works can in general be reduced through the selection of appropriate, globally-accepted equipment and techniques for undertaking marine/coastal pile driving works and in-water/near-water construction.

Rocks, machines and other material containing fine sediments should be washed before being used/deposited into the sea to avoid the potential release of pollutants into the marine environment.

8.1.1.5 Coastal Dynamics

Impacts to coastal dynamics during the construction stage will be nil.

8.1.2 Coastal/Terrestrial

Likely impacts to the embayment NE of the project site include “Changes in water currents and sediment fluxes (due to construction and subsequent ship traffic) that can result in increased sedimentation rates on nearby seagrass beds and mangroves that may affect the marine flora and fauna in the area.” This impact is likely during both the construction and operational phases.

On the terrestrial side, the increased traffic to the area from visitors leaving in buses and other vehicles may impact the air quality, and contribute to increased noise levels which may impact certain fauna (e.g., avifauna), light pollution and solid waste if not dealt with properly. Any foot tours (i.e., hiking) through the area can also negatively impact the flora and fauna (i.e., trampling).

8.1.2.1 Marine Impacts and Mitigation During Construction

Impacts to coastal marine habitats during construction include the following:

Impact: Habitat destruction/alteration

The shoreline at the Old Coal Wharf bears marks of long term, heavy use of the area. Despite the degraded state, there are corals, seagrass beds and other marine flora and fauna found in the shallow water immediately in front of the Wharf. The construction of the infrastructure required for the anchoring of the Seawalk^{TM}, while minimal, will result in destroying/altering the habitat and displacing the flora and fauna, thereby reducing biodiversity in the area.

Impacts of habitat alteration/loss include:

- **Loss of habitat.** Habitat alteration/destructions is associated with decreased abundance and biodiversity of marine organisms associated with a particular area. Generally, environmental changes resulting from the alteration or destruction of habitats increase the edge effect and promote the colonisation or proliferation of opportunistic species that benefit from disturbed conditions.

- **Loss of ecosystem functions.** Coastal habitats such as seagrasses and mangroves provide a wide range of ecosystem functions including nursery grounds, food and refuge provision for other species (fish and marine invertebrates), sediment trapping, light and hydrodynamic conditions, all of which act synergistically to influence the resilience of the systems. Habitat loss or alteration can result in the reduction or loss of site-specific ecosystem functions, which in turn, can negatively impact on the productivity of individual species or communities, and possibly the survival of other species. The capacity of seagrass beds and mangroves to continue providing key ecosystem functions (e.g., refuge and nursery provision, shoreline consolidation/protection) in the vicinity of the cruise ship pier and shoreline facilities will depend on the measures taken during construction to minimize damage to nearby habitats and associated biota.

- **Loss of biodiversity.** Ecosystem degradation (elevated turbidity and sedimentation) and loss of biodiversity can weaken ecosystem functioning and resilience, thereby compromising the ability of the ecosystem to continue providing ecosystem-related goods and services for present and future generations (de Groot et al. 2012).

Mitigation: Based on the NEPA directive, "all possible corals that can be relocated, particularly those 5cm and above" found within the project footprint are to be harvested and transplanted to a designated site within the Harbour. As outlined in the Old Coal Wharf Coral Relocation Site Selection Report (Trench, 2019), an estimated 200 coral colonies that were enumerated and identified in the nearshore waters at the site, will be transplanted to recipient sites located in the vicinity of the UWI Port Royal Marine Lab.

Impact: Turbidity and Sediment Dispersal

The sedimentation and turbidity impacts resulting from the removal of old piles and the installation of new piles and dolphins or moorings required for the attachment of the SeaWalk™ are expected to have both short and long term impacts on nearby marine habitats (i.e., seagrasses, mangroves). Specific environmental impacts during the construction phase may include:

- Increased turbidity causing decreased light penetration and smothering of nearby seagrass beds;
- Short-term decreases in dissolved oxygen levels due to excessive sedimentation;
- Dispersal of sediment from the construction site (i.e., run-off) onto nearby seagrass beds and coastal mangrove stands;
- Release of contaminants from sediment and the ensuing uptake by fish and other biota;
- Accidental leaks or spills from barges carrying heavy equipment (e.g. crane, pile drivers)
- Ship grounding.

While turbidity and sedimentation can be contained to a certain extent, consideration must also be given to the current regimes, which could disperse the fine sediments over nearby seagrass beds resulting in smothering and shading, both of which can impact on the health and resilience of established seagrass beds.

Mitigation: The removal of old pilings, old vessels and debris from the seafloor, along with the installation of new pilings will increase turbidity and contribute to dispersal of sediments. The recommended mitigation calls for use of berms and silt curtains to minimize the dispersal of suspended sediments to nearby marine habitats, especially into the basin to the east of the project. The efficacy of silt curtains depends on proper deployment, specifically by ensuring that the lower edge of the curtain extends deep enough into the water column to effectively minimize sediment dispersal. An alternative solution to be considered is the use of air bubble screens.

Impact: Installation of piles, dolphins

- Damage from the placement of the anchors/spuds of the barge that holds the pile driver. Given the proximity of the project footprint to adjacent seagrass beds, improper anchorage and the risk of grounding by the barge pose potential risks to the marine environment.
- Potential negative effects of the sound/vibration produced during pile driving[18] on people and on marine fauna. Exposure to low levels of sound for a relatively long period of time, or exposure to higher levels of sound for shorter periods of time, may result in auditory tissue damage in fish, though recovery is generally possible

[18] Un-attenuated pile strikes can produce a sound pressure level around 180 dB RMS at a distance of 650-1,000 ft. (200-300 m) (California Department of Transportation 2009)

within 24 hours (Popper et al. 2005). Oscillations induced by high sound pressure levels can cause swim bladders in fishes to rupture (Hastings and Popper 2005). It is likely that most species of fish would swim away from an intense sound source, thereby decreasing exposure to sound; however, larvae and fish eggs are often at the mercy of currents or move very slowly.

- Structures constructed in the ocean may alter localized currents, resulting in settling out of sediments carried by currents. Water currents and sediment fluxes can change resulting in increased sedimentation rates on nearby seagrass beds and mangroves which may affect the marine flora and fauna in the area.

Mitigation: Any construction materials near the water's edge, or where debris can be washed or blown into the water, should be surrounded by silt screens, which must be installed before the work starts. Screens should also be placed around storage areas to prevent waste from blowing away, and bunds used to prevent sediment run-off into the sea. In addition to silt screens, it is recommended that storage areas for sand and soil, and all work areas, should be at least 20 m away from the high water mark, and construction equipment must not be cleaned or washed within 50m of the high water mark.

8.1.2.2 Terrestrial Impacts and Mitigation During Construction

Any construction activities near water, especially the pouring of concrete and placement of scaffolding, where the debris can be washed or swept into the water, can contribute to the degradation of adjacent seagrass beds.

Impact: Change in drainage patterns and resulting impacts on marine ecology

The development of port facilities and the onsite storage of building materials as well as modified drainage patterns have the potential to release larger volumes of sediment laden water into sensitive near shore habitats during heavy rains, especially during the construction phase. The resulting turbidity and sedimentation would negatively impact the inshore water quality and the associated flora and fauna.

Mitigation: Creating and maintaining storm water drainage systems/areas free of debris is required to minimize surface runoff into coastal waters. Proper storage and cover of construction materials within enclosures or containment berms is needed to prevent or limit sedimentation and blockage of drainage channels. Appropriate use of sediment traps/silt curtains should be used along the foreshore, along with regularly-scheduled removal and disposal of construction debris.

Selection of paving materials for the landside development should favor pervious systems over traditional impervious materials for the car park, sidewalks and other pedestrian areas at the site. Whether it is pervious concrete, porous asphalt, paving stones or concrete or plastic-based pavers, all these permeable paving systems allow storm water to percolate and infiltrate the surface areas instead of draining directly into coastal waters.

Impact: Transportation and storage of construction materials

Transportation of heavy machinery and building supplies/materials implies heavy traffic on the roads, and this carries possible negative impacts including dust, spillage and emissions. Use of uncovered trucks for transporting construction materials as well as improper storage of materials, especially gravel, sand and cement at the construction site could cause inadvertent dispersal of materials during heavy rains or high wind conditions. Further, improper storage or handling of hazardous or flammable materials, including fuel, paints and solvents, could result in contamination and eventual leaching (or direct runoff) of these substances into the harbour waters.

Mitigation: Steps should be taken to ensure that the vehicles used for transporting building materials/debris to and from the site are appropriately covered to minimize dust. Dust producing building materials such as sand or cement should be stockpiled in low enclosures and covered, away from drainage areas where they could easily be dispersed by wind or washed into coastal waters during heavy rains.

Impact: Disposal of construction debris

Each phase of the development will produce solid waste, the disposal of which, if not managed properly could have negative impacts on the site and the surrounding area. Construction materials including concrete waste, wood, steel and packaging plastics could be dispersed and end up blocking drainage channels or creating direct damage to near-shore flora/fauna if not disposed of at an approved disposal site. Construction wastes are of particular concern in the absence of adequate waste management facilities, as it is difficult to monitor discharges and ensure that hazardous materials do not end up in sewers or as runoff draining into the harbour.

Mitigation: Development and implementation of a site waste management plan is required to ensure appropriate waste storage areas on the site, including the timely collection and removal of construction debris to an approved dump site. Furthermore, appropriate provisions must be made for the collection, storage and removal of hazardous waste.

Providing an adequate number of portable restrooms (chemical toilets or dry composting toilets) and dumpsters, combined with regular garbage collection and removal of sewage from the construction site is essential to keeping the construction site clean and pest free. All measures must be taken to ensure that untreated sewage is not directed into the harbour waters.

Impact: Sewage and garbage disposal

Inadequate provision of portable restrooms and garbage dumpsters at the construction site can lead to unsanitary conditions. Resulting impacts would vary from unsightly littering of the site, fly and vermin infestations to increased nutrient loading of coastal areas. It is essential for development plans to examine the carrying capacity of the existing infrastructure in Port Royal to ensure that they can meet local demands as well as increased demands during peak tourist season.

Mitigation: The main objective is to ensure that the sewage treatment, garbage disposal facilities and associated services are capable of handling increases in capacity and that there is no direct discharge of untreated effluent into the harbour.

Impact: Destruction of local flora and the introduction of invasive species

Landscaping of public places such as the cruise ship terminal often introduces exotic floral species which can become invasive or are not ideal for the fauna (e.g., avifauna) within the Port Royal Protected Area.

Mitigation: Use only native flora for landscaping the cruise ship terminal grounds.

Impact: Destruction of the shoreline mangrove stand

Mangroves along the coastline in the vicinity of the project site have already been heavily impacted by previous “development” activities; the effects of bad weather and heavy wave action from passing ships that refuse to slow down and abide by the “no-wake” speed restrictions within the harbour.

The mangrove area on the shore (M3 eastern boundary of the project site) is the last remaining stand of old Red Mangrove (*Rhizophora mangle)* growth on the shoreline at Port Royal. The revetment of the shoreline (riprap) will further alter the coastal habitat by destroying the mangrove strip to the east and west of the anchor point. Destroying the mangrove area (~0.4 ha) in particular, would result in further habitat fragmentation and degradation, along with the increased edge effect on the native flora (i.e., mangroves).

Mitigation:

The proposed placement of shoreline revetment provides an opportunity for incorporating mangroves into the site landscaping plan, with the end goal of restoring mangroves along the shoreline. The riprap-like substrate can serve as a framework (i.e., a 'planter') in which mangrove seedlings can be planted with a high likelihood of survival. Resorting mangroves along the shoreline would be in keeping with the character of the area and would, in addition to providing shoreline protection, establish a habitat 'corridor' along the otherwise barren shoreline.

8.1.3 Socio-Economic and Cultural Environment

8.1.3.1 Impacts during Construction (Positive)

Impact: There will be positive impacts to employment during the construction phase. It is anticipated that jobs will be created during construction of the pier and terminal facilities. Job categories will include but not be limited engineers, architects, skilled and semi-skilled construction workers and casual labourers. To the extent where local expertise is available, the labour force will benefit. Employment impacts will be temporary during the construction phase of the project.

Impact: Materials including aggregates and concrete work will be required for the construction of buildings, parking lots and other paved surfaces. There will be direct benefits to the mining and quarrying sector and local contractors and subcontractors transporting the materials.

Impact: The capital investment required for the project and employment opportunities generated will contribute to the gross domestic product (GDP) of Jamaica and reduce employments rates. This will be reflected in the construction and mining and quarrying sectors of the national accounting statistics. Indirect or secondary benefits will be in other sectors such as wholesale& retail and employment rates. Construction macro-economic impacts will be temporary though cumulative.

Impact: Local businesses within the immediate vicinity of the project will also benefit from increase purchasing power and potential spending by construction workers in the area. Food and beverage services and retail and wholesale will benefit. There will also be spin-off benefits associated with increased purchasing power of the workers' household. This may be local to Port Royal or spread to other areas depending on where construction workers reside. Spin-off benefits from temporary employment are short-term and minor to moderate (based on numbers employed).

Impact: Public perception of positive impacts during construction include employment opportunities, increase customer base and sales for local businesses.

8.1.3.2 Impacts during Construction (Negative)

Impact: The project site is a designated Heritage site as is the community of Port Royal. There is the potential for terrestrial and underwater archeological resources of cultural value to be damaged or destroyed during site preparation and construction.

Other heritage sites are located outside of the immediate construction zone with low potential for negative impacts. Future development involving these sites may cause damage during renovations and restoration activities.

Mitigation: To mitigate any negative impacts to heritage sites and archaeological artifacts of value, an archaeological impact assessment should be done to fully assess the condition, integrity of any cultural assets within the direct project footprint. This should be undertaken by an archaeologist prior to disturbing these artefacts and sites and should identify optimum ways of moving them. Additionally, the project must be approved by the Jamaica National Heritage Trust given the heritage designation of Port Royal.

Impact: Land use impacts during construction will be limited to activities at the project site. The beachfront of the project site are occupied by illegal settlers. The project will displace these persons as they will be required to relocate. Survey results indicate that housing is a need in the community and there are several areas of squatting. This has the potential to have long term negative impacts. Additionally, any potential new workers will require housing during construction. This may result in further squatter.

While Port Royal is a part of a protected zone, the project site is situated just outside the boundaries of the conservation zone and is therefore not in conflict with associated zoning ordinances. There will be no significant land use impacts during construction.

The visual impact will be directly proportional to the visibility of the construction site. Areas from which he project site is totally visible will experience the greatest impacts.

Mitigation: A relocation plan should be developed and implemented.

Impact: The public perception of negative impacts is related to the potential displacement of fishers who will no longer be able to use or traverse the project site (land and sea). There is also belief that increased economic activities will increase crime to the area. Other impacts include destruction and dislocation of fisheries; reduced water quality, noise and dust pollution.

Mitigation: Mitigating any negative perceptions of the public involves communication and transparency. A communication strategy that informs the public and groups that will be impacted such as fishers and squatters, of the potential positive and negative impacts of the project; construction activities and schedules on an ongoing basis throughout construction is very important. Engaging the community in activities where feasible such as employment, etc. will also mitigate their fear of being left out. Increased security.

Impact: Transportation of heavy machinery and building supplies/materials implies heavy traffic on the roads, and this carries possible negative impact including dust, spillage and emissions.

Impact: Construction actives will potentially disrupt marine vessels especially smaller fishing vessels traversing the harbour and vessels on excursions to the cays for recreational and business purposes. There is also the increased potential for accidents and injuries. This impact is expected to be short-term and minor.

Mitigation: Mitigation of road and marine traffic impacts should be done through scheduling activities when it will be the least disruptive. Communication with stakeholders is also necessary for coordination. Strict adherence to traffic regulations especially regarding, road worthiness, covering of loads and speeding.

Impact: The use of heavy equipment for excavation and other construction activities will increase noise levels in the study area. There is also the potential for vibration impacts from the use of heavy equipment on site.

Greenhouse gas emissions are also likely to increase with increase in construction equipment emissions and dust particulates. Air pollution represents health threats to people in the area, especially respiratory illnesses. Noise and air pollution impacts are expected to be minor to moderate and short-term.

Mitigation: Dust suppression e.g. sprinkling; establish no jake brake policy and speed control to minimize noise; Communicate with neighbouring school regarding construction activities and put in place additional safety measures as necessary; establish noise barriers as necessary.

Impact: Increased demand for social services such as emergency services, water consumption, electricity; increased pressure on infrastructure.

Mitigation: Communication with local emergency services and utilities providers to accommodate increase demand and avoid disruptions to the community.

8.2 Operation Stage

8.2.1 Coastal/Terrestrial Impacts and Mitigation During Operations

8.2.1.1 Marine Impacts and Mitigation

Impacts during the operation of the facility will arise mostly from cruise ship traffic and increased use of the new port facilities.

Mitigating Impacts Arising from Cruise Ship Traffic

The International Maritime Organization (IMO) is an established United Nations agency that sets standards and adopts regulations that apply to all vessels that operate internationally. IMO's most important objectives are to improve vessel safety and to prevent marine pollution (www.imo.org). The MARPOL Convention - The International Convention for the Prevention of Pollution from Ships (MARPOL) sets strict regulatory guidelines for the protection of the marine environment. Regulations covering the various sources of ship-generated pollution are contained in five annexes of the Convention. The annexes that govern cruise industry operations set standards to prevent pollution by oil, garbage and waste and should be used as minimal guidelines for minimizing the impact of cruise tourism at this destination. The efficacy of proposed mitigation measures is directly linked to the capacity to monitor and enforce the international (IMO) and local laws and regulations pertaining to cruise ship waste management and operation while in Jamaican waters. It is common practice for the cruise industry to rely on Memoranda of Understanding (MOU) or "Environmental Guidelines" established between the cruise ship industry and the government of countries to be visited to define specific environmental practices to be adopted, however MOUs and guidelines do not include provisions for monitoring or for effective enforcement. Enforcement presents its own challenges however there are certain measures which ports can take to mitigate cruise related environmental impacts by establishing regulations and enforceable laws, including regular monitoring for compliance and significant penalties for non-compliance. This will be especially important given the location of the SeaWalk™ in the Port Royal Protected Area.

Other impacts may include:

Impact: Increased turbidity and sedimentation

In contrast to the short-term impacts associated with the installation of piles, sedimentation and turbidity created by ship propellers and thrusters, as well as bow waves, represent a chronic impact which could affect the water quality in the long term due to the repeated resuspension of sediments. Flora and fauna, particularly seagrasses and sessile organisms would be negatively impacted (i.e., degraded) under conditions that promote chronic re-suspension of sediments.

Areas in close proximity to maritime traffic are often degraded or barren due to repeated exposure to propeller wash, and smothering from the resuspension of sediments. It is likely that the approach channel used by the cruise ship may contribute to create a barren zone in areas that now have seagrass cover. Ship propeller wash and resuspension of sediments may pose a direct threat to nearshore seagrass beds and mangroves on the northern side of the basin (T7, T10).

Mitigation: Use of tugboats is recommended, over the use of thrusters for all docking/departure maneuvers, to reduce resuspension and the dispersion of the sediments within the Port Royal Protected Area, specifically in the mangrove and seagrass areas.

The spread of resuspended sediments/turbid waters can be further constrained by the use of silt curtains particularly on the eastern side of final approach to the moorings. Given that weekly visits are anticipated over many years, the use of “air bubble curtains” should be investigated with a view to minimizing the time, effort and infrastructure required to repeatedly deploy this protective feature each time a ship visits. In between transits the bubble curtain would be secured to allow free movement of water and foraging fauna into and out of the nearshore channels servicing the inner lagoons. Seagrass beds in the shallow water along the shoreline are likely to be subjected to the erosive action of repeated bow waves. The use of tugs to execute nearshore maneuvers would minimize this impact. Seagrass beds likely to be eroded should be relocated and used to stabilize existing blow out areas on either side of the 5ft channel to the north. Locations such as

i) 17°56'58.06"N ; 076°50'22.59"W

ii) 17°56'52.65"N ; 076°50'8.06"W

are suggested.

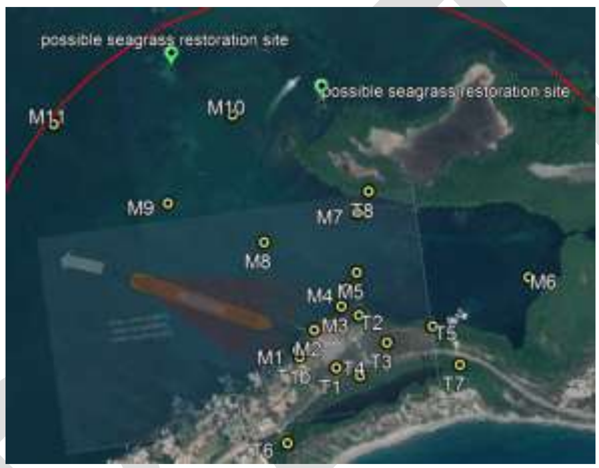


Figure 8.2-1. Possible seagrass relocation / restoration sites.

Stabilization of the shoreline on either side of the anchorage point of the floating dock can be achieved with the use of low profile rip-rap in which mangrove trees can be planted. Rehabilitation of this shoreline would therefore be achieved by improving the aesthetics and habitat connectivity in the area.

Stemming further loss and degradation of mangroves and seagrass meadows is urgent and requires better management, including the systematic removal of solid marine debris that accumulates throughout Port Royal and Kingston Harbour, and restoration of damaged mangrove and seagrass areas as required. It also calls for systematic assessments and monitoring to ensure the sustainable use of these resources.

Impact: Ballast water and invasive species

Cruise ships rely on quantities of ballast water for vessel stabilization. Ballast water discharge is the leading source of non-native or invasive species that enter shallow marine waters.

Mitigation: Reducing the risk of introducing invasive species into coastal waters calls for strict compliance with regulations (Cruise Control, 20025) which specifically prohibit dumping ballast water inside the Exclusive Economic Zone (200 miles from shore).

Impact: Cruise ship sewage – black and grey water discharges and accidental pollution events

Cruise ship black water is typically more concentrated than land based sewage and may contain bacteria, pathogens, diseases and viruses requiring treatment prior to its release. Grey water, which represents the largest proportion of liquid waste generated by cruise ships, includes drainage from dishwashers, showers, laundry, baths, galleys, and washbasins. It can contain pollutants such as faecal coliform, food waste, oil and grease, detergents, shampoos, cleaners, pesticides, heavy metals, and, on some vessels, medical and dental wastes. It is estimated that a typical cruise ship carrying 3,000 passengers and crew produces up to 10 gallons of black water per person per day, or 15,000 to 30,000 gallons per day, and 30 to 85 gallons of grey water per passenger per day per person, or 90,000 to 255,000 gallons per day. International Regulations prohibit the discharge of untreated or inadequately treated sewage with a faecal coliform bacterial count greater than 200 MPN per 100 ml, or total suspended solids exceeding 150 mg/100 ml within three nautical miles of shore. According to the cruise line industry, black and grey waters are discharged only when underway and not while in ports. These practices are difficult to monitor, thus making it challenging to confirm whether the companies are in compliance with stated industry policies or international regulations.

Bilge water may contain oil or petroleum substances resulting from oil spills and leaks occurring during the use and maintenance of on-board mechanical systems. Illegal discharge of bilge/ballast water by cruise vessels in international or coastal waters, as well as oil spills resulting from collisions and groundings have been documented extensively because they represent a serious threat to pelagic and coastal marine life. Petroleum pollution is known to have adverse effects on coastal ecosystems and their associated inhabitants including marine mammals, sea birds, fish, and plankton and other invertebrates. Juvenile and larval forms of many species are especially vulnerable to even extremely small quantities of hydrocarbons at low concentrations. Exposure of marine flora and fauna to oil and contaminated bilge products, poses a serious threat to the seagrass and mangroves in Port Royal.

Mitigation: Enforcement of international and/or Jamaican rules and regulations which require that filtered oily wastes (< 15 ppm oil content) are discharged at least 12 nautical miles off shore along with "No discharge zones" 3 to 12 miles from the coast line, and the explicit prohibition of the discharge of untreated wastewater by cruise ships in Jamaican waters is essential.

Impact: Potential for vessel grounding during ship berthing

The operation of vessels closer inshore, especially during high wind conditions, presents a risks of ship collision or grounding (e.g. due to power or steering failure, mooring line breakage or pilot error). Ship groundings can potentially result in destroying the benthic flora fauna in the impact area. The inherent risk of future accidents (i.e., damage from cruise ship groundings) represents a long-term threat with potential for direct impacts to the seagrass beds.

Mitigation: It is recommended that tug boats be used for all docking/departure maneuvers. Restrict access to the port during high wind conditions (25 knot maximum).Regular update of inshore bathymetry to detect possible changes resulting from continued sediment (gully) inputs to harbour. Ensure proper navigational buoyage.

Impact: Damage to marine ecosystems

Degradation of coastal marine ecosystems due to increased maritime traffic.

Mitigation: Given that the berthing facility is located within the bounds of the Port Royal Protected Area and is a Ramsar Site, consideration must be given to environmental compensation where a designated percentage of profits generated by the cruise industry are directed specifically to the support of mangrove and seagrass restoration projects in the area. Instituting a nominal 'environmental clean-up fee' to be paid by cruise ship visitors could provide the funds to help support the harbour clean-up initiatives currently underway as well as habitat restoration projects. The funds could also be directed toward creating "environmental warden" jobs for locals.

8.2.1.2 Terrestrial Impacts and Mitigation During Operations

Impacts of increased tourism

Potential impacts from increased tourism on coastal ecosystems include:

- Inadequate landside facilities to deal with the sewage and solid waste generated by increased tourist traffic;
- Additional demands on potable water;

- Associated wear and tear on the surrounding environment;
- Increased nutrient loading in and contamination of coastal waters (e.g. hydrocarbon pollution, spills). Exceeding the carrying capacities of marine sites has the potential to further degrade the marine environment.
- Increased solid waste and improper waste disposal

Impact: Solid Waste Accumulation

Inadequate landside facilities to deal with solid waste generated by cruise ships and increased tourist traffic.

Mitigation: Solid waste generated by the cruise ship terminal will require a robust and comprehensive waste management program. Where possible, infrastructure should be set up to facilitate separation of waste into biodegradable, recyclable and general waste, to be removed on a regular basis. Reducing the use of single use plastics (i.e., plastic bottles, plastic bags, Styrofoam food containers, straws, plastic cups) in favor of biodegradable food containers (e.g., bamboo, hemp) and utensils is recommended. Using panels sensitizing visitors and locals to the clean-up efforts underway, installing water bottle re-filling stations (**Figure 8.2-2**), and generally promoting waste free products would contribute significantly to reducing the accumulation of solid waste.

Requirements for cruise line companies to adopt and comply with MARPOL guidelines pertaining to solid waste disposal regulations should be continued while ensuring that portside waste reception facilities and waste management strategies are adequate to accommodate the waste generated by passengers while onshore. The provision of fee-based waste disposal services (i.e., services not covered by dockage fees) would assist in ensuring proper waste disposal.

Figure 8.2-2. Water bottle refilling station with counter informs patrons how many bottles were kept out of the landfill by refilling re-usable bottles.

Impact: Increased demand on the sewage treatment

Primary impacts associated with human waste and domestic effluents include: eutrophication or nutrient-enrichment of coastal waters, increased risks of pathogenic diseases, and increases in Total Suspended Solids (TSS).

Mitigation: It is essential that a proper sewage treatment plan and infrastructure are implemented (**See 8.2.2.6**) to reduce macro-nutrient and suspended solid concentrations in the effluent to levels where they do not constitute a threat to human health, or a risk to the integrity of the environment.

Impact: Introduction of invasive floral species.

Mitigation: Landscape management plan to ensure only native floral species, specifically flowers/trees that attract avifauna.

Cumulative effects

Impacts from the construction phase of the pier construction and the impacts from operations will permanently alter the ecological landscape of the area. While it is difficult to provide a full assessment of the magnitude of all potential impact, it is important to note the significant potential for long-term negative cumulative effects.

Some of these may include:

- Impact of severe storm events on the SeaWalk™. Destruction of all or part of the proposed facility during storms (i.e., high category hurricanes) could potentially generate large amounts of debris to nearby marine and coastal environments.
- Increased potential for pollution and nutrient loading of the marine environment from debris generated by increased number of tourists using the facility; debris may end up in the harbour waters where they pose a threat to marine fauna (e.g. birds and turtles ingesting or become entangled in plastic debris), or of being dispersed by currents to seagrass, mangrove and reef communities farther away.

Influence of Climate Change on Marine Ecology

Predictions of continued increase in sea surface temperatures (SSTs), in combination with rising sea level, and increased frequency of severe storm events have the potential to amplify the impacts of localized anthropogenic stressors (e.g., coastal development, coastal runoff), and can combine synergistically, to reduce local biodiversity and alter or eliminate important ecosystem functions. Mitigating impacts of climate change is a challenge that calls on cooperation of the international community, but much can be done at the local scale through imperative conservation of coastal habitats, and implementation of sustainable coastal development strategies which minimize damage to these ecosystems.

8.2.2 Physical/Chemical Environment

8.2.2.1 Noise and Vibration

Impact: Noise and vibration levels during the operational phase are expected from sources at the cruise terminal (delivery traffic, pier equipment) and onboard the cruise ships (engines, ventilation, HVAC, ship horn, and PA-system.

Ships noise has been identified as a serious problem for various species of cetaceans (Veirs et al, 2016). While low-frequency noises have been known to affect some whale spp., the high-frequency din (20,000Hz) from vessels affects their ability to communicate, echolocate prey) and navigate. Dolphins and porpoises, which also operate at medium and higher frequencies, may be suffering the same problems.

A wide range of cetacean impacts result from noise stress such as stranding, behavioural changes such as reduced communication or increased vocalizations when exposed to sound sources in their vocal range - in effect, they need to 'shout' to allow themselves to be heard. Some whale species have been have been shown to avoid important habitats (key breeding and/or feeding grounds) as they intentionally evade areas of high noise. They can also experience lower respiration rates resulting in shorter dive periods.

Although only seen once during the current field exercises, a population of dolphins is known to spend much time in Kingston Harbour. Concerns have been expressed that underwater noise may disturb dolphins, however, there is little research available to support or disprove these assumptions in relation to noise from commercial shipping and recreational craft at any location worldwide.

Other animals are also affected. Short exposure to low-frequency, low-intensity sounds have disturbed the balance systems of squid, octopuses and cuttlefish. Fish and invertebrate larvae are also affected with several species moving away from their traditional habitats to settle instead in places that have (low-frequency) noise caused by shipping. This movement has flow-on effects for the ecosystems that depend on these larvae. Other species, such as hermit crabs, have been shown to be less responsive to visual predators when in high-noise environments. This 'distracted prey hypothesis' demonstrates the potential for noise pollution to affect behaviours that are stimulated by non-auditory information. Noise from shipping traffic can also lead to 'acoustic masking' which reduces the ability of many marine animals to detect and use sound for communication, foraging, avoiding predators, reproduction, and navigation. These factors have unknown implications for fauna in a major, protected, wetland system immediately adjacent the proposed mooring.

Noise travels faster in the water (approximately 1,500 meters per second - around five times faster than on land) and attenuates less per unit of distance from the source (Parris & McCauley, 2019). The effective range and intensity of the noise produced by a vessel of this size entering a confined port space is unknown at present.

Mitigation to reduce noise could include:

- Encourage public transport rather than private cars for moving passengers would minimize volume of vehicles and thus decrease noise emission from traffic;

- Driver training to enable the terminal operator to reduce noise emissions from cargo handling and pier operations. Slower driving and foresighted acceleration/braking can reduce the typical roaring noise of forklifts;
- If the noise emitting equipment on the pier and at the terminal area cannot be attenuated sufficiently, noise barriers can be installed – this may be necessary to protect the CMU/Admiralty House from noise exposure;
- Restrict berthing of cruise ships to daytimes, which would also restrict terminal activities to daytimes.
- Apart from technological advances in hull and propeller design to reduce friction of the vessel as it moves through the water and reduce cavitation, one of the best ways to reduce noise is to slow down. Decreasing speed by only six knots could decrease noise intensity by 50%."

8.2.2.2 Air Quality

The model runs predicted the cruise ships expected to dock at the new pier will not create a significant impact on the local air quality or the Kingston and St. Andrew Airshed. The predicted fallout concentrations of criteria air` pollutants from the proposed ships were predicted to be compliant with the Jamaica National Ambient Air Quality Standards (JNAAQS).

8.2.2.3 Geology/Soils/Landscape

Impacts: The development will be a major improvement to the area and the regeneration will significantly upgrade the aesthetic profile of the landscape. Positive impacts will transcend the boundaries of the site and enhance the micro and macro views of the development from the road as well as the Palisadoes coastline. The buildings should complement the architecture of the wider Port Royal and be low-rise.

Mitigation: While the proposed terminal will establish itself as a local landmark, all buildings and facilities should be designed in such a way that does not conflict with the existing Port Royal architecture and landscape. Suitable construction materials, appropriate colours and the use of indigenous vegetation should be used to improve site scenery.

Once the recommendation and designs of the marine consultants are followed there should be no impact on the coastal hydraulics and as such no mitigation measures should be necessary.

8.2.2.4 Hydrology

Impacts: Potential contamination of groundwater from oil, fuel and chemical spills and runoff from operational material/processes is the main impact during operation. The terminal may act as a point source of pollutant discharge to the hydrologic environment as pollutants could be introduced into the aqueous environment (groundwater and marine) from the various uses of material in the operation of the facility.

Mitigation: All materials and waste on site should be handled, transported or disposed of using best practice techniques and monitored regularly. Implementation of a waste management plan and the implementation of a sustainable urban drainage system will effectively mitigate the majority of impacts.

In addition, some general measures outlined below should be enforced:

- Provide oil/water separators on areas such as the public parking areas;
- Pave areas around storage tanks to prevent seepages into soil and groundwater;
- Provide liners under any storage for tank wash down and cleaning waters, to prevent them from entering any drainage network;

- Provide adequate space for example sumps to capture spills and leaks and clean the area regularly;
- Conduct inspections to handling and storage areas for leaks and maintain them regularly.

Ensure that any landside sewerage systems are located over the thickest soil cover above static groundwater which is located at the east of the site.

Impacts: Discharges and leaks/spills from ships and other vessels can potentially impact the aquatic environment. Several international ship-source pollution regulations/standards prohibit the discharge of contaminants from ships to marine waters. Increased shipping activity will probably result in higher marine pollution levels from accidental oil and fuel leaks/spills as well as illegal discharge of pollutants such as oil, garbage, bilge water, ballast water, tank washing and sewage regardless of the regulations governing operations.

Impacts: Maintenance dredging may become necessary because of the natural accretion of material or because of a build-up of material over time. However, the volume of dredged material at this stage will be considerably less and therefore impacts from increased turbidity and potential sediment plumes will be more moderate.

Mitigation: Use of silt curtains.

8.2.2.5 Coastal Dynamics

Waves and currents at the project site are very weak, and therefore, will not induce significant sediment transport and lead to infilling the ship basin. Currents and wave action will not significantly affect normal berthing operations.

8.2.2.6 Water Quality

Possible impacts to water quality include:

- Discharge of effluent from sewage treatment plant
- Release of chemicals used in maintenance of the facility including the sewage treatment plant
- Release of oil to the environment due to shipping accidents spills
- Increased release of storm water runoff

Mitigation of water quality impacts should include:

- Tertiary treatment of sewage to include effective removal of nutrients (nitrogen and phosphorous);
- Containment and treatment onsite of hazardous chemicals where possible;
- Offsite disposal of any hazardous chemicals in keeping with NRCA/NEPA regulations;
- Effective contingency planning to minimize or prevent release of oil to the environment and to respond quickly to spill incidents large or small.

8.2.3 Socioeconomic Impacts and Mitigation (Operation)

8.2.3.1 Impacts during Operations (Positive)

Impact: The macro-economic impact during the operations phase of the proposed project is one of the main driving forces of the project. The introduction of cruise ships to the area expected to potentially result in increased revenue stream from cruise tourism. Direct and indirect benefits will also result across the economy which is largely dependent on tourism. There will be employment and income opportunities, higher and/or larger proportion of the population with disposable incomes and higher standard of living. There will be increased business opportunities for attractions such the Giddy House, Forts, excursions to the cays and enjoying the beach and food of Port Royal. There will be opportunities for attractions across Kingston and St. Andrew and other areas. Tour companies and the transportation sector will also benefit.

Macro-economic impacts during operations are expected to be significant, long-term and positive.

Impact: There will be an influx in cruise visitors to the area once the pier and terminal are operational. This will result is increase in customer base and earning potential for local businesses and increased opportunities to provide additional jobs. The project will directly create employment opportunities. Increased employment will result in income, purchasing power and the potential for spin-offs benefits to the residents and the community.

Impact: Land use impacts during operations will be positive, significant and long-term. The project site will be transformed into the pier with a terminal, commercial shops, services, parking infrastructure, etc. This will increase the value of the property and add to the infrastructure of the area. The national capacity for cruise tourism will be increased.

Impact: Operations of the cruise pier and terminal facility will require employees of varying skill sets. Jobs will be provided on the local and regional level (KSA) and contribute to the reducing the national unemployment rates.

Impact: Community development impacts will be both negative and positive. Positive impacts include planned improvement in infrastructure. The master plan which include the current project and future development options show an extensive amount of investment in new infrastructure as well as upgrading existing infrastructure.

Impact: Renovation and restoration of heritage sites and monuments to serve as attractions for visitors will improve these resources. Survey participants also noted that it will highlight an important history of Port Royal.

8.2.3.2 Impacts during Operations (Negative)

Impact: During operations there will be significant increase in pedestrian and vehicular traffic especially on days when ships call. Existing road infrastructure is inadequate to accommodate this. This will be a negative, long-term and significant impact.

Mitigation: Improve roads (surface and network); install sufficient signage and traffic signals as necessary.

Impact: Community development impacts will be both negative and positive. During operations, increased resources will be required to cope with increased visitor volume. Funding will be required to upgrade necessary infrastructure and social services such as the road infrastructure, insurance for the new facility, emergency services including health care and fire, in order to accommodate cruise visitor and ships.

Mitigation: Investment in training emergency services, expand services and upgrade/develop new infrastructure.

9 Risk Analysis and Emergency Response

9.1 Risk Analysis

General Risks

Catastrophic events affecting Jamaica such as hurricanes and earthquakes could impact generally on economic activity and the operations of the cruise pier. Equipment, buildings, and fixtures are susceptible to loss or damage by fire, hurricane, earthquake, flood, lightning strikes, and other perils.

Operational Risks

Potential areas of operational risk include:

i. errors by employees in the technical operation of Company's business causing
ii. breakdown and possible equipment damage;
iii. key equipment failure;
iv. acts of God (including but not limited to fire, flooding, earthquake);
v. data entry errors, accounting errors;
vi. criminal activity;
vii. labour unrest/strikes
viii. shipping accidents (collision, ship grounding, oil spills)
ix. personal injury

Emergency Management /response

The Emergency Preparedness and Continuity of Operations Planning Manual for Best Practices (Saathoff 2006) is a useful guide for emergency planning at port facilities. The local legal framework for emergency planning and response in Jamaica is the Disaster Preparedness and Emergency Management Act and executing agency, the Office of Disaster Planning and Emergency Management (ODPEM). In addition, there are two main plans to be considered in international law or rules about possible contingency plans that should be available at ports:

- Oil pollution emergency plan in accordance with IMO’s Article 3.3 of International
- Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC 1990).
- Pollution incident emergency plan in accordance with IMO’s Article 3.2 of Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (OPRC - HNS protocol 2000).

The centerpiece of comprehensive emergency management will be the Emergency Operation Plan (EOP). The EOP must be designed to:

- define the scope of preparedness activity;
- facilitate response and short-term recovery (which set the stage for successful long-term recovery);
- provide an emergency management "bottom line." From which the entity can proceed confidently with long-term mitigation efforts directed at specific hazards or devote more resources to risk-based preparedness measures (e.g. specialized training, equipment, and planning).

10 Analysis of Project Alternatives

Environmental Impacts are assessed for the following alternatives (**Table 10.1-2**):

Alternative 1: Do Nothing

Alternative 2: Develop cruise pier using Sea Walk™

Alternative 3: Develop cruise pier using fixed jetty

10.1 Application of Rapid Impact Assessment Matrix (RIAM)

An assessment of the overall project alternatives and analyses of the potential environmental and social impacts during construction and after the upgrade are presented in this section.

The environmental impacts specified in the Terms of Reference are grouped into four components (study disciplines), namely:

- Physical/Chemical,
- Biological/ecological,
- Sociological and
- Economic/Macroeconomic.

The definitions for these are as follows:

Physical/chemical Covering all physical and chemical aspects of the environment, including finite (non-biological) natural resources, and degradation of the physical environment

Biological / ecological Covering all biological aspects of the environment, including renewable natural resources, conservation of biodiversity, species interactions pollution of the biosphere

Socioeconomic Covering all human aspects of the environment, including social issues affecting individuals and communities; together with cultural aspects, including conservation of heritage, and human development

Macroeconomic Covering macroeconomic consequences of environmental change, both temporary and permanent within the context of the project activities

Sensitive parameters in all the study disciplines that describe the impacts for the current situation, during construction of the cruise pier, and after construction are assessed for their overall impact using the rapid impact assessment matrix (RIAM) method (Jensen, 1998).

The RIAM method provides an overall assessment where there are multi-disciplinary factors since the method allows data from different disciplines to be analysed against common important criteria within a common matrix, thereby providing a clear assessment of the major impacts. The assessment is done for each project alternative and in the present case is done for the “do nothing” case and for the preferred alternative (during construction and operation).

The RIAM is based on two groups of assessment criteria and the means by which semi-quantitative values for each of these criteria can be assigned for the impacts in the four environmental components and then consolidated to give an overall assessment. The impacts of project activities in the environmental components are assessed against the two groups of criteria, and for each component, a score (using the defined criteria) is determined, which provides a measure of the impact expected from the component.

Assessment criteria

The criteria, together with their appropriate judgement scores are as follows:

Group (A) criteria

Spatial Importance of condition (A1)

A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.

The scales are defined as follows:

4 = important to national/international interests

3 = important to regional/national interests

2 = important to areas immediately outside the local condition (aspect-specific study areas)

1 = important only to the local condition (Petrojam plant site)

0 = no importance.

Magnitude of change/effect (A2)

Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition:

+3 = major positive benefit

+2 = significant improvement in status quo

+1 = improvement in status quo

0 = no change/status quo

-1 = negative change to status quo

-2 = significant negative dis-benefit or change

-3 = major dis-benefit or change.

Group (B) criteria

Permanence (B1)

This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g., an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).

1 = no change/not applicable

2 = temporary

3 = permanent

Reversibility (B2)

This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence.

1 = no change/not applicable

2 = reversible

3 = irreversible

Cumulative (B3)

This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent/irreversible situation.

1 = no change/not applicable

2 = non-cumulative/single

3 = cumulative/synergistic

It is possible to change the cumulative component to one of synergism, if the condition warrants consideration of additive effects.

Overall Assessment

The various ES values are grouped into ranges and assigned alphabetic or numeric codes (**Table 10.1-1**) so they may be more easily compared.

The assessments that follow are in respect of the following scenarios:

- No action/Do nothing
- Construction of a fixed jetty
- Construction of the sea Walk
- Operational phase without mitigation
- Operational phase with mitigation

Table 10.1-1. Environmental scores and range value interpretation.

Environmental Score (ES)	Range value (RV) (Numeric)	Description of Range Value
> 71	5	Major positive change/impact
36 to 71	4	Significant positive change/impact
19 to 35	3	Moderate positive change/impact
10 to 18	2	Positive change/impact
1 to 9	1	Slight positive change/impact
0	0	No change/status quo/not applicable
-1 to -9	-1	Slight negative change/impact
-10 to -18	-2	Negative change/impact
-19 to -35	-3	Moderate negative change/impact
-36 to -71	-4	Significant negative change/impact
< -71	-5	Major negative change/impact

The impact summary of the 5 scenarios assessed is presented in **Table 10.1-2** while the detailed matrices are presented in **Appendix 13.11 (RIAM Detailed Matrix).**The project as proposed with mitigation scores highly positive overall compared to the other scenarios considered. The main impacts are associated with ecological impact while the positive impacts are socioeconomic.

Table 10.1-2. Impact Assessment Summary.

Activity/Discipline	Alternative 1 No Project		Alternative 2 Sea Walk		Alternative 3 Fixed Jetty		Operation (No Mitigation)		Operation (With Mitigation)	
Parameter	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**
Physical/Chemical:	**0**	0	**-216**	-5	**-238**	-5	**-238**	-5	**-214**	-5
Water Quality - Marine and Stormwater	0	0	-121	-5	-121	-5	-133	-5	-133	-5
GasseousEmmissions - Ambient/Occupational	0	0	-45	-4	-45	-4	-39	-4	-39	-4
Noise and Vibration	0	0	-16	-2	-16	-2	-36	-4	-36	-4
Solid Waste Management	0	0	-20	-3	-20	-3	-16	-2	-16	-2
Hydrodynamics and Dredge Plumes	0	0	0	0	0	0	0	0	0	0
Waves and Sediments	0	0	-14	-2	-36	-4	-14	-2	10	2
Natural Hazards	0	0	0	0	0	0	0	0	0	0
Biological/Ecological	**-56**	-4	**-205**	-5	**-269**	-5	**-223**	-5	**-128**	-5
Terrestrial	0	0	-27	-3	-27	-3	-27	-3	-19	-3
Marine Ecology	-56	-4	-178	-5	-242	-5	-196	-5	-109	-5
Socio-Economic and Cultural	**0**	0	**-124**	-5	-176	-5	**397**	5	**770**	5
Sociological/Cultural	0	0	-94	-5	-130	-5	49	4	306	5
Traffic and Pedestrian	0	0	-12	-2	-24	-3	-72	-5	-83	-5
Cruise and Cargo	0	0	0	0	0	0	72	5	72	5
Economic and Operational	0	0	-18	-2	-22	-3	348	5	475	5
Overall Scores	**-56**	**-4**	**-545**	**-5**	**-683**	**-5**	**-64**	**-4**	**428**	**5**

11 Environmental Monitoring and Management

A monitoring plan is required for each phase of the project to ensure compliance with relevant legislation, implementation of the adaptive/mitigation measures and long-term reduction of negative environmental impacts at the project site and its surroundings. The principle underlying environmental monitoring is to observe changes over time that may be direct or indirect consequences of construction activities.

11.1 Coastal/Terrestrial - Monitoring During Construction

Monitoring for turbidity and sedimentation should be conducted during the construction phase to ensure that there is no seepage from landside construction site, and to ensure proper application of mitigation measures, including containment bunds and silt curtains. Implementing a regular schedule for sampling (twice per week) at the Old Coal Wharf area during the various phases of the development to identify any negative impacts and address them at their onset, thus preventing further deterioration of the environment. A monitoring program designed for the construction phase of the project should include but not be limited to:

- Ongoing monitoring of turbidity and sedimentation;
- Monitoring for signs of run-off especially after significant rainfall;
- Monitoring the marine community for unusual signs of morbidity;
- Monitoring the construction site for waste management and disposal.

11.2 Coastal/ Terrestrial - Monitoring During Operations

Long-term monitoring of the mangrove and seagrass communities

The protocol for monitoring long-term changes Old Coal Wharf is essential for the ongoing management of the environment. The monitoring program should include water quality, sedimentation rates, as well as semi-annual assessments of nearby seagrass and mangrove communities to detect any deleterious effects related to the operation of the cruise ship pier. Monitoring is essential to detecting long-term impacts related to the operation of the cruise ship pier on mangrove and seagrass habitats. The results can be used to inform adaptive management strategies or mitigation for minimizing any deleterious impacts to the ecosystem (e.g., imposing regulations for minimizing propeller wash, use of tugboats for incoming/departing ships, minimizing coastal runoff, etc.).

Monitoring cruise ship operations

Monitoring cruise ships for compliance with international and Jamaican rules and regulations pertaining to discharge effluents, waste disposal, air quality, and other pertinent indicators is essential for protecting the habitat in the Port Royal Protected Area. If not already implemented, monitoring should include:

- Compliance with specific mitigation measures as outlined in Section **8.2.1.2**. Mitigating Operational Impacts;
- Compliance inspections for illegal ballast/effluent discharge within harbour waters;
- Compliance inspections pertaining to cruise ships waste management practices while in Jamaican waters;
- Requirement for cruise ship vessels to keep and make available to port authorities logs documenting the discharge or disposal of all oily waste, including bilge water.

12 CONCLUSION AND RECOMMENDATION

We conclude that the project would have a positive impact on, not only, the community/economy of Port Royal but on the economy of Jamaica. Based on surveys conducted the majority of individuals who participated believe that the project is very important to Jamaica's Tourism and Cruise industries as well as Port Royal and its environs.

As indicated, the site is located on an old coal wharf and was used as a marine terminal. Although the site has not operated as a marine terminal for coal for decades, the site has continued to be used for importing aggregate and for events. The construction of the new onshore facilities will be erected on already developed lands and as such the proposed construction will not affect any "natural" topographic or geological features within the project footprint.

During the construction phase there will be temporary changes to the landscape and upper soils. Care will need to be taken to not disturb the coal dust layer to prevent dispersal by wind over adjacent properties. The construction of the terminal will result in the loss of some coastal resources, primarily seagrass beds and mangrove stands, the loss of which can be mitigated through seagrass relocation and mangrove restoration by incorporating mangrove replanting in the coastal revetment design.

RECOMMENDATIONS

Operations will result in significant increase in pedestrian and vehicular traffic, especially on days when ships call. Existing road infrastructure is inadequate to accommodate the increase in traffic; it is highly recommended that priority be given to improve roads (surface and network) along with the installation of signage and traffic signals as necessary.

Community development impacts will be both negative and positive, and as such, additional resources will be required to properly manage increased visitor arrivals once the facility becomes operational. Funding will be required to upgrade necessary infrastructure and social services including roads, emergency services including police, health care and fire, in order to accommodate cruise visitors and local communities alike. Investment will be required for training emergency services, and for expanded services and upgrades/development of new infrastructure. Implementation of an effective waste management plan as well as appropriate waste transportation, handling and disposal methods will be essential to effectively mitigate majority of the potential adverse impacts.

Creating and maintaining storm water drainage systems/areas free of debris is required to minimize surface runoff into coastal waters. Proper storage and cover of construction materials within enclosures or containment berms is needed to prevent or limit sedimentation and blockage of drainage channels. Appropriate use of sediment traps/silt curtains should be used along the foreshore, along with regularly-scheduled removal and disposal of construction debris.

Selection of paving materials for the landside development should favour pervious systems over traditional impervious materials for the car park, sidewalks and other pedestrian areas at the site. Permeable paving systems allow storm water to percolate and infiltrate the surface areas instead of draining directly into coastal waters.

Replanting of mangroves along with the relocation of corals and seagrass within the footprint of the project is highly recommended.

Monitoring of the construction should focus on evaluating the effectiveness of turbidity screens.

13 Appendices

13.1 Reference Documents

13.1.1 Soil Investigation (Geotechnical) Report – Old Coal Wharf

SOIL INVESTIGATION REPORT

PROPOSED CRUISE TERMINAL DEVELOPMENT PROJECT

Port Royal, Kingston, Jamaica.

Prepared for:

Port Authority of Jamaica
15-17 Duke Street
Kingston, Jamaica

Prepared by:

NHL Engineering Limited
29 Munroe Road
Kingston 6, Jamaica

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1.0 INTRODUCTION

1.1 Authority

NHL Engineering Ltd. was invited by Mr. Christopher Hamilton of the Port Authority of Jamaica to submit a proposal for a soil investigation for the proposed Cruise Terminal expansion and development to be located in Port Royal, St. Andrew. Our proposal was accepted and authorization to proceed with the fieldwork was issued.

This report contains the results of the work done, the conclusions drawn, and the recommendations made regarding the main areas of engineering concerns.

1.2 Scope of Work

The Area under investigation is as shown in the Site Plan (Appendix I). NHL

Engineering Ltd., was to arrange:-

i) The field exploration based on the proposed test location points and

ii) The laboratory testing programme, which in our judgment, is necessary to provide a satisfactory basis for evaluating the site for the design of the building foundations and other infrastructural elements on site.

On completion, a report presenting the results obtained, together with our recommendations for the appropriate design parameters will be submitted to the Client.

1.3 Project Description

1. <u>SITE LOCATION:</u>

The general location of the sites can be seen in Appendix I of the report Appendices. One site is located at the existing JDF Coast Guard Base Facility (Boreholes 1 to 3 and the other on adjacent lands at the existing Morgan's Harbour Restaurant (Boreholes 4 & 5). The area is relatively flat with accessway and surface infrastructure; however the site presented little or no access problems to the drilling equipment.

The area forms part of an Alluvium overlying possibly the Coastal White Limestone Group at depths. The insitu soils are therefore likely to be a mixture of Clay, Silts, Sands and gravels in varying mixed proportion overlying weathered limestone/rocks. The soil however is expected to be predominantly granular with the majority of the coarse grained aggregate in the Gravel/Sand fraction.

A high water table is likely to be encountered during the data collection process.

2. SUPERSTRCTURES:

According to the information obtained from the client, it is proposed to construct, 300 ton Bollard, Landside Floating Bridge foundation, General Bus Loading area and other facilities. This could also require the construction of a small buildings, transmission line, sub-station structure and equipment foundations.

PLATE 1 – Picture showing general site conditions in the vicinity of **BH # 1**

PLATE 2 – Picture showing general site conditions in the vicinity of **BH # 4**

PLATE 3 – Picture showing general site conditions in the vicinity of **BH # 5**

2.0 DATA BASE

2.1 Proposed programme

It was proposed by the client to drill a total of five (5) boreholes, distributed across the site as shown in Figure 5.2. The boreholes were to be taken to a depth of 30m (100') or to refusal on the spoon/auger.

The boreholes were to be used to recover representative samples of the soil for examination by the soils engineer for carrying out of a laboratory testing programme. It was envisaged that no more elaborate testing than the conventional Classification and Index Test would be required.

2.2. Anticipated Design Approach

The possible existence soft/loose soils, previously dumped or backfilled areas and abandoned pits on site could result in;

a) Swell/shrinkage problems
b) Total and differential settlement problems,
c) Possibility of Liquefaction in the loose sands

Given the above site concerns, it is important that during scarification and site clearance that efforts are made to identify if present the affected areas by proof rolling using a vibratory roller.

In general shallow foundation may not be appropriate for the site under steady load condition.

2.3. Soil Boring & Sampling

1. Methodology:

The borings were made by NHL Drillers using a truck mounted CME Drill Rig, with a 160 mm hollow stem auger string. Sampling was done with a Split Spoon in accordance with Standard Penetration Testing specifications, using an Automatic Hammer (N_{70} values). In general, S.S samples were taken at 0.76 metre intervals of depth to the first 3 metres and thereafter at 1.5 metre interval to the maximum depth. The office logs of the boreholes are shown in Appendix II.

2. Discussion of results:

The soils penetrated were generally a mixture of loose to Compact Silty Sands overlying compact to dense C-F Sands/Gravels and stratified layers of Stiff Clays and overlying a compact to dense weathered limestone (calcareous Sands and Gravels) throughout the depth explored. See Figures 4.1 and 4.2.

The Ground Water Table was encountered at about 1.3m below existing ground.

3.0. LABORATORY TEST RESULTS

The soils encountered were predominantly granular (sandy). Twenty three samples were selected for testing, all grainsize distribution tests. The chosen samples are, to the best of the engineer's judgment, representative of the samples recovered from the boreholes. The Gradation curves and Casagrande Chart of the samples tested are shown in Figures 3.1 and 3.2 respectively.

3.1 Classification & Index Testing:

1. Grainsize Distribution:

Figure 3.1 shows the grainsize distribution envelope of the samples tested. The figure indicates that the samples have gradation that falls essentially into three groups. The groups can be described as follows:

Group A - the Coarse to Fine Sands + Some Gravels & Clays/Silts (10)

Group B - the Sands & Silts/Clays + Little Gravels (8)

Group C - the Sandy Gravels + Some Clays/Silts (5)

2. Soil Plasticity:

No Index Tests were done, the soils were predominantly non-plastic.

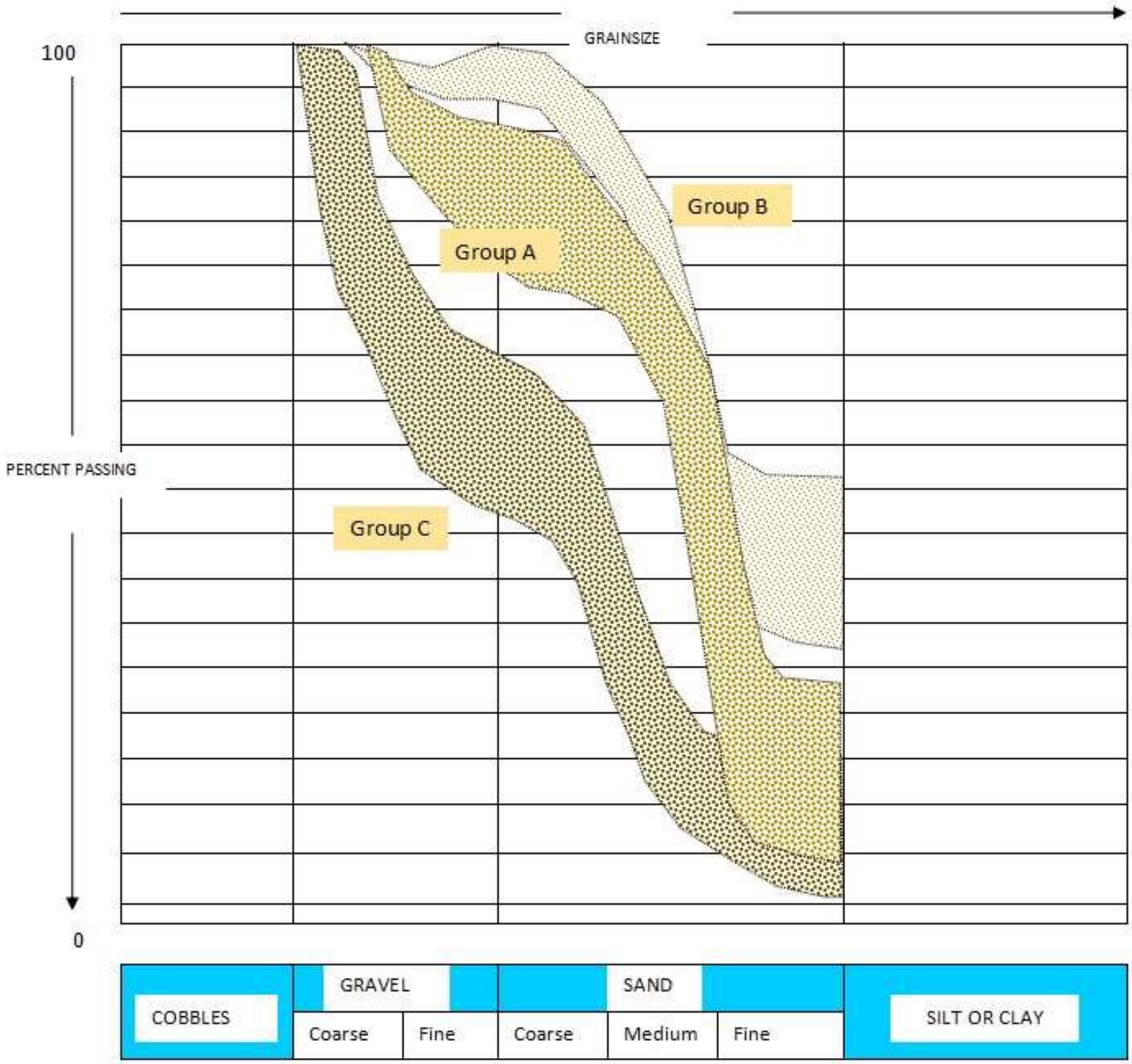


FIGURE 3.1 - GRADATION ENVELOPE – Port Royal Cruise Terminal Development

4.0. GEOTECHNICAL DISCUSSION

4.1. Presumptive Soil Profile

The Presumptive profile shown in Figure 4.1 is an extrapolation of the borehole information along with an understanding of the deposition history of the soils in the area. The profile boundaries shown are presumptive and should be viewed only as approximate representations of the insitu soil condition on site.

The following soil types are presumed to be applicable for evaluating engineering behavior and construction concerns:-

A) TYPE 1

1) The Compact to Dense C - F SANDS + Some Gravels & Clays

Depth Range; Variable 0 – 25m

Average N_{55} = 18

All Boreholes

B) TYPE 2

2) The Loose to Very Loose Sands + Some Clays/Silts & Little Gravels

Depth Range; Variable; 1.2 – 15m

Range N_{55} = 4

Boreholes 1, 2, 3 & 4

C) TYPE 3

4) The Compact to Very Dense Calcareous C-F SANDS plus Some Gravels & Clays/Silts

Depth Range ; Variable, 15m+

Average N_{55} = 20

All Boreholes

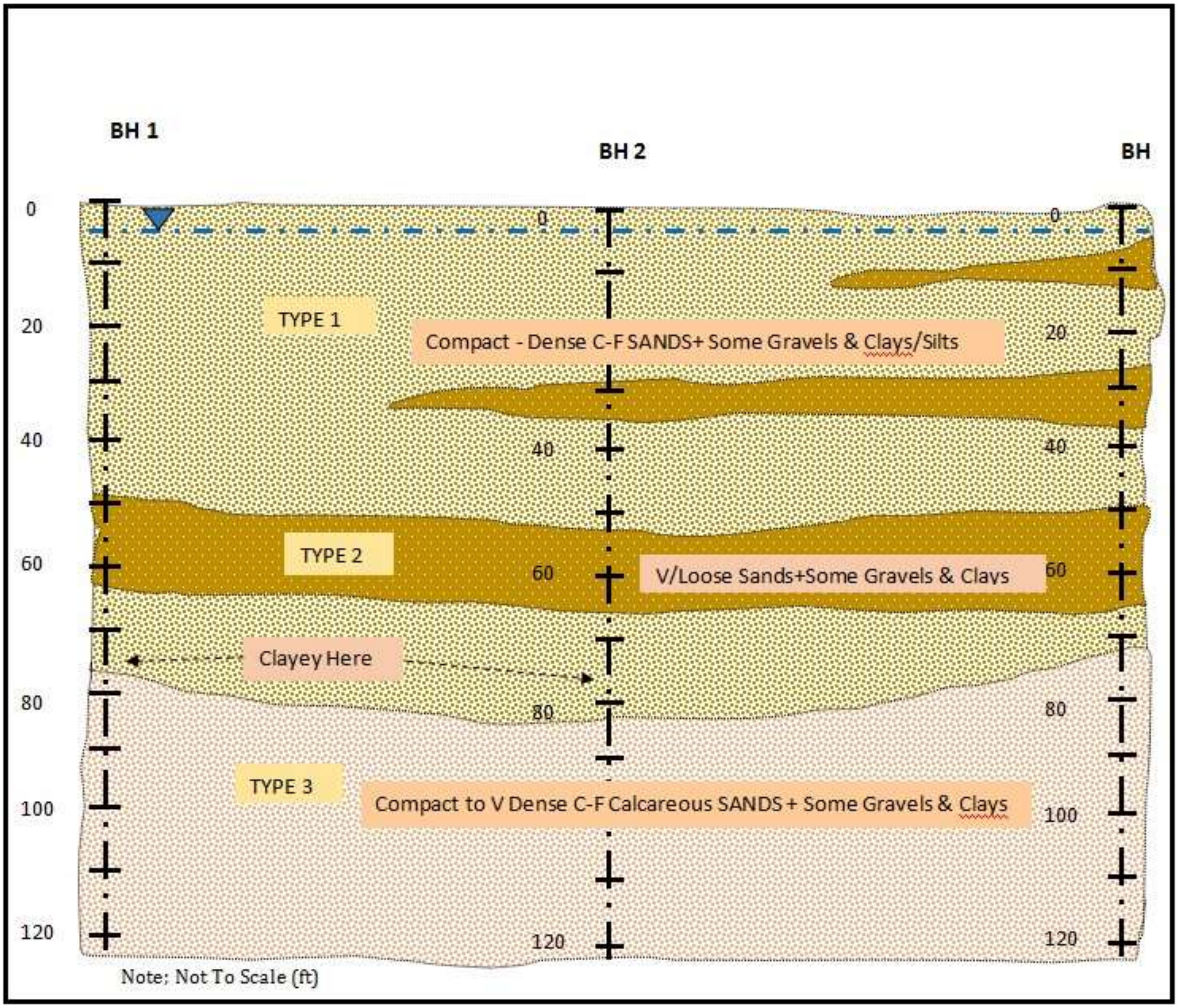


FIGURE. 4.1 - PRESUMPTIVE PROFILE – Showing BHs 1, 2 & 3 Profile across Site

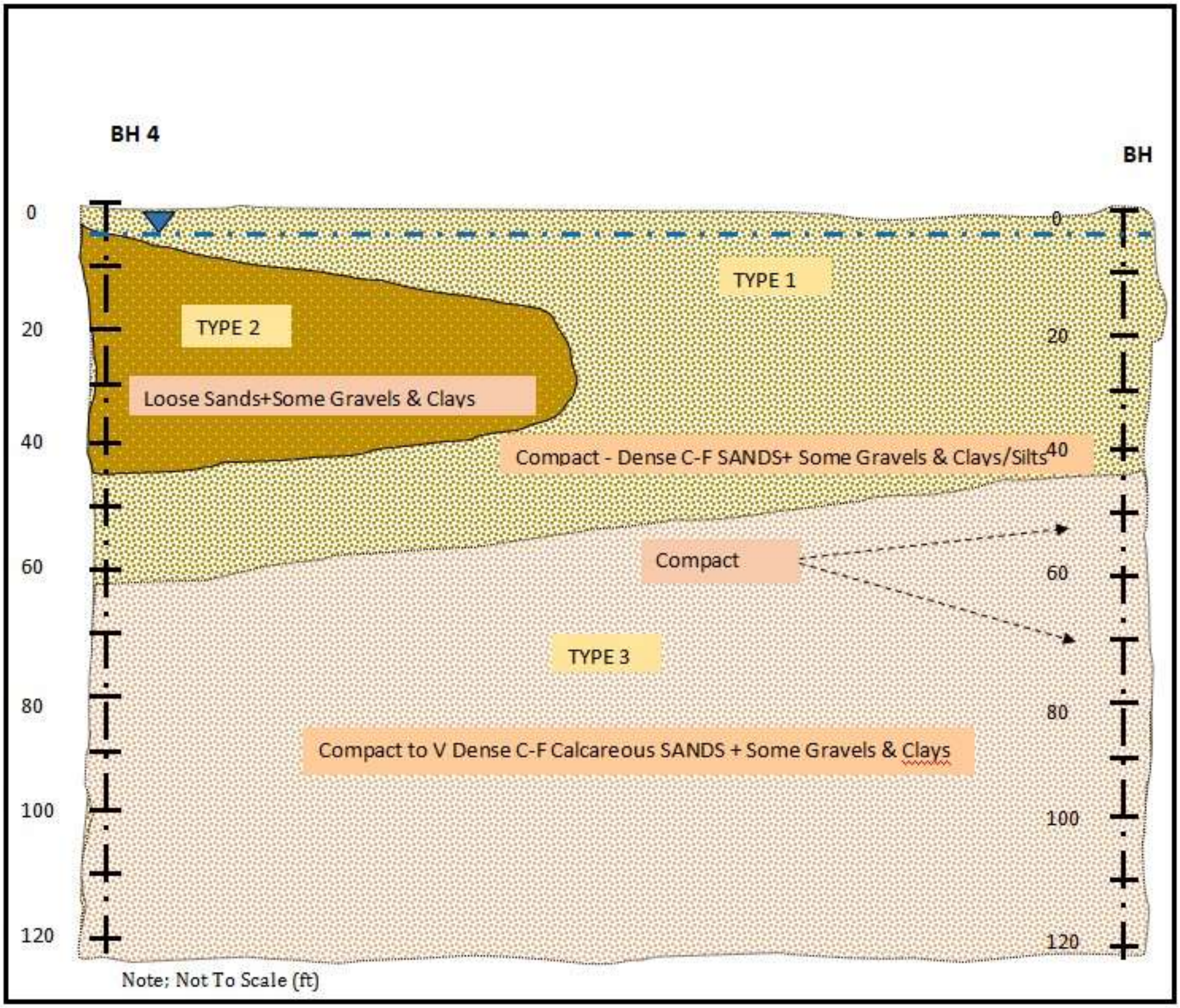


FIGURE. 4.2 - PRESUMPTIVE PROFILE – Showing BHs 4 & 5 Profile Across Site

4.2 Depth and Type of Foundations

Based on the above information, some level of foundation deformation problems are envisaged across the site. The water table level is high (1.3m), the insitu densities in the upper Type 2 soils are relatively low and the soils (gravels/sands) are not well graded. All of these characteristics indicate that these soils are likely to respond significantly (liquefy) to seismic activities.

The use of conventional shallow foundation is therefore not recommended. Based on the deposition history and information from the locations tested, predictions of trends in the soil profile across the site appears to be fairly accurate even though the possibility of encountering the Type 2 Soils in unexplored locations is possible and could lead to further deformation problems.

The information obtained from our client indicates that the main substructures, the 300 ton Bollards and the land side floating bridge foundation are not anticipated to have critical impose loading that could lead to significant deformation problems. The critical loading for this structure is lateral load resistance and uplift capacity. These could be achieved from a heavy slab shallow foundation and or deep foundation. The liquefaction potential of the soils in that area however would render shallow slab foundation unsuitable unless they are modified using for example, stone columns densification/mitigation techniques.

Consequently, for the loading conditions described above, a foundation that mitigates the effects of the following is recommended:

a) Settlement in the Type 2 Soils below the foot print of the proposed structures under static and seismic/cyclic loading
b) Subsidence due to liquefaction effects during seismic/cyclic loading
c) Foundation uplift and passive resistance failure from unbalanced overturning loads and large lateral impact loads respectively.

The above possibilities can be rectified economically by the use of the following solutions in combination:

i) Use soil modification techniques such as stone columns and use shallow slab foundation. Macro-stability to be accounted for.
ii) Use deep foundation such as bored piles to prevent uplift and overturning and to transfer loads below liquefiable soils

4.3 Bearing Capacity

4.3.1. Shear Considerations:

Recommended to use a Factor of Safety of 2.5 for allowable load determinations.

1. Type 1 & 3 Soils:

Raft Foundation:

For this alternative, the Modulus of Subgrade Reaction (Ks) is the parameter of relevance for design. The recommended value for this parameter is :-

i) Ks = 10,112*(1-0.4*B/L)*B KN/m^3

Shallow Spread/Strip/Beam:

For this alternative, the maximum **Ultimate Bearing Capacity** and other relevant parameters recommended for this soil material is :- ii) Q_{ult}. = 384.12*(1+0.35*B/L)*(1+0.19*D/B) KPa

2. Type 2 Soils:

Raft Foundation:

For this alternative, the Modulus of Subgrade Reaction (Ks) is the parameter of relevance for design. The recommended value for this parameter is :-

i) Ks = 7,104*(1-0.4*B/L)*B KN/m^3

Shallow Spread/Strip/Beam:

For this alternative, the maximum **Ultimate Bearing Capacity** and other relevant parameters recommended for this soil material is :-

ii) Q_{ult}. = 228.06*(1+0.34*B/L)*(1+0.17*D/B) KPa

Where,

Q_{ult} is the Ultimate Bearing Capacity

Ks is the Vertical Modulus

D is the Depth of footing,

B is the Width of footing or width of smallest span,

L is the Length of footing

TABLE 4.1 - SUMMARY OF SOIL PARAMETERS

LAYER IDENTIFICATION	**TYPES 1 &3 SOILS**	**TYPES 2 SOILS**
	Sands& Gravels	**Silty Sands**
Bulk Unit Weight	16.9 KN/m^3	16.2 KN/m^3
Submerged Unit Weight	9.7 KN/m^3	9.2 KN/m^3
Compression Index		
Void Ratio		
Undrained Cohesion (KPa)		
Drained Cohesion (KPa)		
Effective PHI/PHI	35.0 deg.	32.8

Relative Density	65.50%	32.60%
Ka	0.269	0.297
Kp	3.706	3.364
Permeability Coef. (k)cm/s	$1x10^{-3}$	$5x10^{-3}$

4.4. Seismic Considerations

Information obtained from available seismic risk map for Jamaica indicates that the spectral acceleration for short and long periods (0.2 and 1 second) periods for the maximum considered earthquake with a 5% probability of exceedance in 50 years, was deduced as; S_1 =0.55g and 0.25g for 0.2 and 1 second periods respectively. SDs = 0.586 and SD_L = 0.33, recommended Design spectral accelerations. According to the IBC code (2003) and the UBC (1997) code, the site can be classified as site class E (soft/loose soil N < 8 blw/ft).

4.5. Liquefaction Considerations

Shear Strength Problems cause by liquefaction, due to:

i)High water table ii)Relatively loose granular soil materials

iii)Non-uniform grainsize distribution- predominantly medium Sands with little Fines. iv)Design ground Acceleration (earthquake magnitude VIII) relatively high.

The above soil scenario within and below the significant depth of the proposed structure loads on the site suggests that liquefaction susceptibility of a number of layers within the design profiles is a critical issue on the sites. A study of the Liquefaction potential of the layers was done using different ground acceleration values. The results have confirmed, that the soil materials on site down to a depth of 20.5m (in some areas), with Relative Densities less than or equal to 40% ($\leq$ 40%) and at Earthquake Magnitudes greater than or equal to MM6.5, are liquefiable. The critical uncorrected (effective overburden correction), N values corresponding to the limiting Relative Densities is $N \leq 15$ (general guideline for this soil profile).

For liquefaction to occur however (i.e., initiated and mobilized), the grainsize distribution of the suspected layers must be considered. The results suggest that the majority of the soils on site fall into the groups classified as types A and B. These groups have been known to be very resistant to shear strength lost due to liquefaction because of the high fines content (>15%) and the poor uniformity of the particle sizes.

4.6. Excavation Considerations:

The upper soils on site are variable in stiffness. Walls of open trenches will be at risk of failure during moist conditions if they were constructed near vertical. It is our recommendation that excavations be constructed with walls at a minimum slope of 1:3

(hor. to vert.). These excavations should not be loaded following construction with parked heavy equipment and/or overburden from the excavated soil; excavated soils should be stored a minimum of 10m from the edge of the excavation. In areas where loading of open excavation is unavoidable, it will be necessary to use appropriately designed lateral braces for temporary support. The design of the lateral braces should account for the active pressures of the soil and the relevant overburden.

4.7. Settlement Considerations:

For moderate loads from isolated footings (typical imposed loading of 2 storey concrete structures), total settlements (within the loose Type 2 soils) are predicted to be about 81.3mm (3.2"). This level of settlement over is likely to be very significant.

To account for unexplored areas on site, it is strongly recommended that areas below the footprint of the structure be proof rolled with a vibratory compactor after site stripping. Encounter with significant deformation as a result of this process should be reported to the geotechnical engineer immediately.

4.8 Hydrology Considerations:

The close proximity of the sea and the relatively low elevation of the ground level (high water table) are cause for concern during extreme weather conditions (hurricanes, tsunami). A study of existing hydrological data on the area is therefore prudent in order to design and implement the requisite mitigation measures to protect the proposed structures.

4.9. Other Considerations:

1) Infrastructural Considerations:

The soils generally encountered were granular and typically exhibit percolation rates above those generally required for absorption pit usage. Percolation rates deduced were in the order of magnitude of 0.005 cm/s. Absorption pits constructed in this soil environment will require periodic maintenance however environmental restrictions are likely to prohibit the use of this form of sewer disposal in this area.

2) Paved Area Considerations:

The recommended CBR value for the Type 1 soils is 15%. The use of a drainable subbase is not required because of the granular characteristics of the subgrade soils. For parking areas, assuming proper stormwater drainage facilities are in place, it is recommended that the base course for outside traffic be comprised of a minimum thickness of 200mm of approved compacted marl.

It may however be prudent to use concrete pavement for the longterm of the pavement given the anticipated extreme loading and moisture fluctuation the pavements at the dock is likely to be exposed to.

3) Backfill Material Considerations:

The upper strata of soils on site are typical of the Types 1 and 2soils. They are generally suitable for most backfilling purposes. The Fines contents however are variable and any decision to use these soils for backfilling purposes must be confirmed with grainsize distribution and index testing results from a representative stockpile. Care must be taken when removing and stock piling these soils to separate them from the Type 2 Soils.

4) High Water Table Considerations:

The Construction and placement of the substructures/foundations will require that the location be dewatered (well pointing). The drawdown could affect adjacent structures and care should be taken to make allowances for that. Disposal of the groundwater should be approved by NEPA

5) Soil Modification and Deep Foundation

Information required on the use of soil modification techniques and deep foundation can be supplied upon request.

NHL ENGINEERING LIMITED

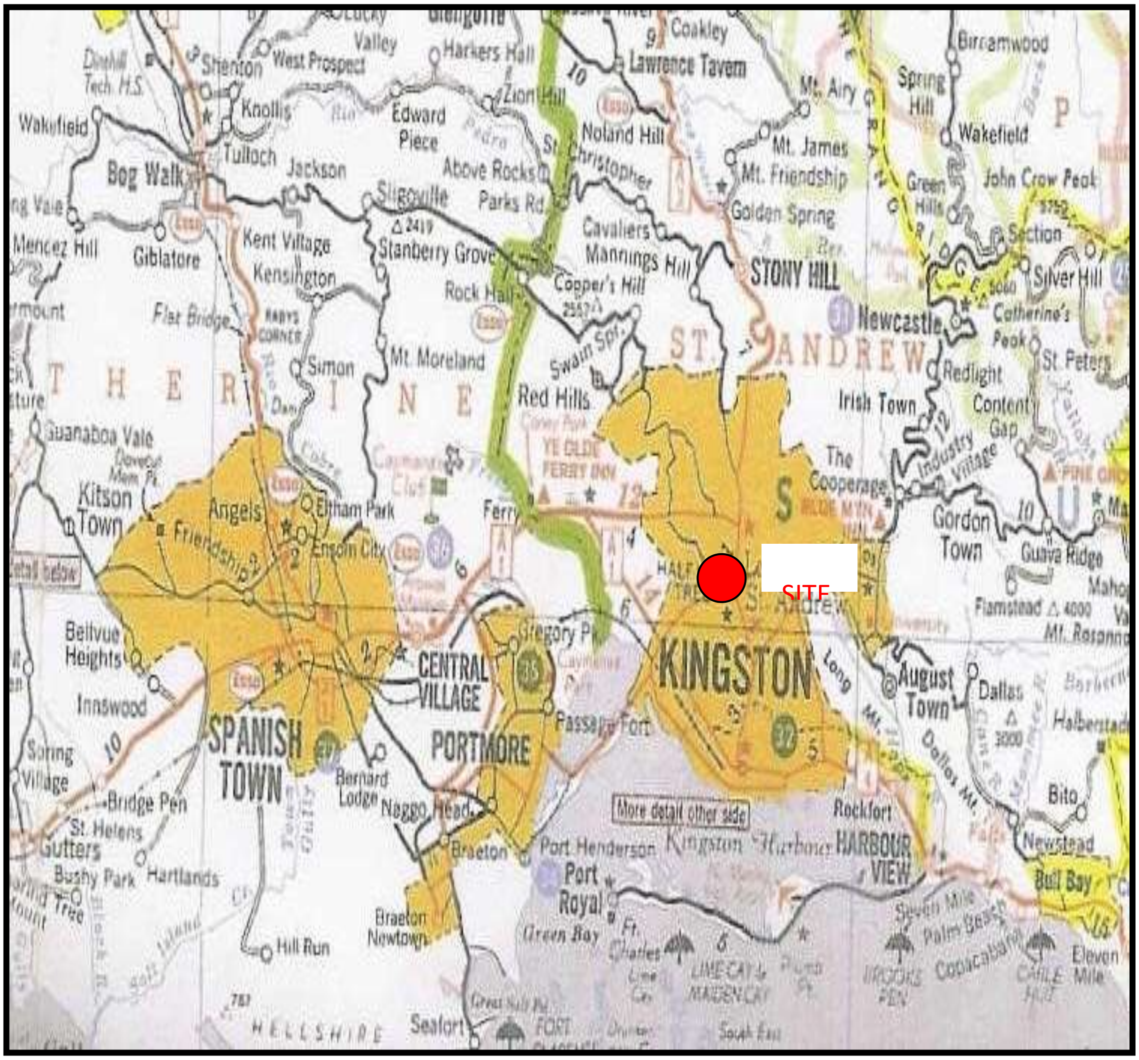
Carlton Hay Ph.D., MSc.

Geotechnical Engineer

Registered Professional Engineer

5.0. APPENDICES

Appendix I



Site Location Plan – Proposed Cruise Terminal Site, Kingston, Jamaica

Test Location Plan - BHs 1, 2 & 3

Site Location Plans - BHs 4 & 5

APPENDIX II - Soil Boring Log

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	Strata Plot	W.L.	SPT Raw Count	Type	ID Mark	Recovery	Plasticity (20 – 80) / Wet Unit Weight (kip/cu.ft) (.07 – .13)	Standard Penetration Test (Blows/ft.) (20 – 100) / Undrained Unconfined Shear Strength (kip/sq.ft) (1.0 – 5.0) Comp. Test + Vane Shear
0	Loose Brown Coarse Sand and Fine Gravel		▼	[illegible]		1	12		
5	Loose Brown Coarse Sand and Fine Gravel			2 4 4		2	15		
	Compact Brown Coarse Sand and Fine Gravel			[illegible]		3	10		
10	Compact Brown Coarse Sand and Fine Gravel			6 5 7		4	8		
15	Loose Coarse Sand and Fine Gravel			2 4 4		5	18		
20	Loose Brown Coarse Sand and Fine Gravel			5 6 3		6	18		
25	Compact Brown Coarse Sand and Fine Gravel			11 7 4		7	18		
30	**note 51 represent refusal on spoon								

		Dates	Job No.	
NHL ENGINEERING LTD CONSULTING ENGINEERS 20 Merrion Road Kingston 6, Jamaica	Start	07.02.18	B.H. No. BH# 1	Sht. 1 of 4
	Completion	07.02.18		
OFFICE BOREHOLE RECORD	Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash · Grab · Split Spoon · T. W. Tube · R. Core

Depth (ft.)	Soil Description	Strata Plot	SPT Blow Count	Samples: Type / ID Mark / Recovery	Plasticity / Wet Unit Weight (kip/cu.ft)	Standard Penetration Test (Blows/ft.) / Undrained Unconfined Shear Strength (kip/sq.ft) Comp. Test + Vane Shear
60	Loose Light Brown Coarse-Fine Silty Sand with some Gravel		2, 2, 2	14 18		
65	Loose Brown Coarse-Fine Silty Sand		5, 5, 4	15		
70	Loose Brown Coarse-Fine Silty Sand with traces of Clay		4, 4, 5	16		
75	Stiff Brown Silty Clay with some Sand		6, 7, 8	17		
80	Very Dense Cream Coarse-Fine Calcareous Silty Sand with some Gravel		27, 50/4"	18		
85	Very Dense Cream Coarse-Fine Calcareous Silty Sand with some Gravel		38, 50/3"	19		
90	**note 51 represent refusal on spoon					

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	07.02.18	B.H. No.	Sht. 3 of 4
	Completion	08.02.18	BH# 1	
OFFICE BOREHOLE RECORD	Final W. L.	4'		

CLIENT:	PORT AUTHORITY OF JAMAICA
PROJECT:	PROPOSED CRUISE TERMINAL SITE
ADDRESS:	DUKE STREET KINGSTON

Location Reference
Eastings: Northings:
Port Royal - St. Andrew
Datum
Elevation:

Type/Size
Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.

Sample Types: Wash; Grab; Split Spoon; T. W. Tube; R. Core

Plasticity 20 – 80; Wet Unit Weight (kip/cu.ft) .07 – .13; Standard Penetration Test (Blows/ft.) 20 – 100; Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0

Depth (ft.)	Soil Description	SPT Blow Count	Samples: Type	ID Mark
90–95	Very Dense Cream Course-Fine Calcareous Sand with some Silt amd some Fine Gravel	25 / 25 / 27	Split Spoon	20
95–100	Very Dense Cream Coarse-Fine Calcareous Silty Sand and Gravel	20 / 23 / 29	Split Spoon	21
100–105	Dense Cream Coarse-Fine Calcareous Silty Sand and Gravel	18 / 18 / 22	Split Spoon	22
105	End of BH @ 100 Feet			

Depth scale: 90, 95, 100, 105, 110, 115

**note 51 represent refusal on spoon

NHL ENGINEERING LTD
CONSULTING ENGINEERS
[illegible]
Kingston 6, Jamaica

OFFICE BOREHOLE RECORD

	Dates	Job No.	
Start	08.02.18	B.H. No.	Sht. 4 of 4
Completion	08.02.18	BH# 1	
Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash, Grab, Split Spoon, T. W. Tube, R. Core

Plasticity: 20 — 80; Wet Unit Weight (kip/cu.ft): .07 — .13
Standard Penetration Test (Blows/ft.): 20 — 100
Undrained Unconfined Shear Strength (kip/sq.ft): 1.0 Comp. Test + Vane Shear 5.0

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	Type	ID Mark	Recovery
0	Compact Brown Coarse Sand and Fine Gravel		▼	5, 6, 10		1	15
5	Compact Brown Coarse Sand and Fine Gravel			8, 5, 5		2	18
	Loose Brown Coarse Sand and Fine Gravel			8, 3, 3		3	18
10	Compact Brown Coarse Sand and Fine Gravel			7, 6, 6		4	18
15	Compact Brown Coarse Sand and Fine Gravel			9, 11, 14		5	18
20	Compact Brown Coarse Sand and Fine Gravel			12, 11, 13		6	18
25	Compact Brown Coarse Sand with a trace of Silt			2, 4, 6		7	18
30	**note 51 represent refusal on spoon						

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29 Monroe Road
Kingston 6, Jamaica

OFFICE BOREHOLE RECORD

	Dates	Job No.	
Start	09.02.18	B.H. No.	Sht. 1 of 4
Completion	09.02.18	BH# 2	
Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA **PROJECT:** PROPOSED CRUISE TERMINAL SITE **ADDRESS:** DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
30	Very Loose Light Brown Coarse-Fine Silty Sand with some Gravel	2 1 1	Split Spoon	8	18
35	Loose Light Brown Coarse-Fine Sand with some Silt	3 3 2	Split Spoon	9	18
40	Loose Light Brown Coarse-Fine Sand with some Silt	4 4 5	Split Spoon	10	18
45	Compact Light Brown Coarse-Fine Sand with some Silt	5 6 7	Split Spoon	11	18
50	Compact Grey Gravel with Clayey Sand	24 5 6	Split Spoon	12	
55	Very Loose Grey Clay, Sand and Gravel	1 1 HW	Split Spoon	13	
60	**note 51 represent refusal on spoon				

Plasticity: 20 — 80 | Wet Unit Weight (kip/cu.ft): .07 — .13 | Standard Penetration Test (Blows/ft.): 20 — 100 | Undrained Unconfined Shear Strength (kip/sq.ft): 1.0 Comp. Test + Vane Shear 5.0

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	09.02.18	B.H. No.	Sht. 2 of 4
OFFICE BOREHOLE RECORD	Completion	09.02.18	BH# 2	
	Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	SPT Blow Count	Samples Type	ID Mark	Recovery
60	Very Loose Grey Clay, Sand and Gravel	1, 1, 1	Split Spoon	14	18
65	Loose Light Brown Clay Sand and Gravel	3, 3, 3	Split Spoon	15	18
70	Very Stiff Brown Sandy Clay with some Gravel	3, 8, 10	Split Spoon	16	18
75	Very Dense Light Brown Clayey Sand and Gravel	45, 50/3"	Split Spoon	17	6
80	Very Dense Cream Coarse-Fine Calcareous Silty Sand and Gravel	23, 23, 50/4"	Split Spoon	18	6
85	Very Dense Cream Coarse-Fine Calcareous Gravel with some Silty Sand	50/3"	Split Spoon	19	3
90	**note 51 represent refusal on spoon				

Plasticity: 20 — 60 | Wet Unit Weight (kip/cu.ft): .07 — .13 | Standard Penetration Test (Blows/ft.): 20 — 100 | Undrained Unconfined Shear Strength (kip/sq.ft): 1.0 Comp. Test + Vane Shear 5.0

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	09.02.18	B.H. No.	Sht. 3 of 4
	Completion	10.02.18	BH# 2	
OFFICE BOREHOLE RECORD	Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
90	Very Dense Cream Coarse-Fine Calcareous Gravel with some Silty Sand	32, 50/5"	X	20	6
95	Very Dense Cream Coarse-Fine Calcareous Silty Sand and Gravel	30, 27, 33	X	21	15
100	Very Dense Cream Coarse-Fine Calcareous Silty Sand with some Gravel	20, 24, 29	X	22	10
105	End of BH @ 100 Feet				
110					
115					

Plasticity: 20 — 80; Wet Unit Weight (kip/cu.ft): .07 — .13; Standard Penetration Test (Blows/ft.): 20 — 100; Undrained Unconfined Shear Strength (kip/sq.ft): 1.0 Comp. Test + Vane Shear 5.0

**note 51 represent refusal on spoon

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.
	Start	10.02.18	B.H. No. — Sht. 4 of 4
	Completion	10.02.18	BH# 2
OFFICE BOREHOLE RECORD	Final W. L.	4'	

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Plasticity: 20 – 80; Wet Unit Weight (kip/cu.ft): .07 – .13
Standard Penetration Test (Blows/ft.): 20 – 100; Undrained Unconfined Shear Strength (kip/sq.ft): 1.0 Comp. Test + Vane Shear 5.0

Depth (ft.)	Soil Description	SPT Blow Count	ID Mark	Recovery
0	Loose Brown Coarse-Fine Sand and Fine Gravel	5, 4, 5	1	18
5	Loose Brown Coarse Sand and Fine Gravel	3, 3, 4	2	14
	Loose Brown Coarse Sand and Fine Gravel with some Dark Brown Organic Material	1, 1, 3	3	18
10	Loose Dark Brown Organic Material [A'] Loose Brown Coarse-Fine Sand and Fine Gravel [B"]	3, 2, 2	4	18
15	Compact Dark Brown Gravel amd Coarse Sand with traces of Dark Brown Organic Material	6, 5, 6	5	18
20	Compact Brown Coarse Sand and Fine Gravel	9, 11, 12	6	18
25	Loose Brown Coarse Sand and Gravel	5, 3, 5	7	18
30	**note 51 represent refusal on spoon			

NHL ENGINEERING LTD CONSULTING ENGINEERS 25 Monroe Road Kingston 6, Jamaica		Dates	Job No.
	Start	12.02.18	B.H. No. BH# 3 — Sht. 1 of 4
	Completion	12.02.18	
OFFICE BOREHOLE RECORD	Final W. L.	4'6"	

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT	

Sample Types: Wash · Grab · Split Spoon · T. W. Tube · R. Core

Depth (ft.)	Soil Description	Strata Plot	RQD	SPT Blow Count	Type	ID Mark	Recovery	Plasticity / Wet Unit Weight (kip/cu.ft)	Standard Penetration Test (Blows/ft.) / Undrained Unconfined Shear Strength (kip/sq.ft) Comp. Test + Vane Shear
30	Loose Light Brown Coarse-Fine Sand with some Silt and some Gravel			4 2 2 2	Split Spoon	8	18		
35	Loose Light Brown Coarse-Fine Silty Sand with some Gravel			2 4 2 2	Split Spoon	9	18		
40	Compact Light Brown Coarse-Fine Sand with some Silt and Gravel			4 7 8	Split Spoon	10	15		
45	Compact Light Brown Coarse-Fine Sand with some Silt			7 5 5 5	Split Spoon	11	18		
50	Loose Light Brown Coarse-Fine Sand with some Silt			2 1 3	Split Spoon	12	1		
55	Loose Light Brown Coarse-Fine Sand with some Silt			2 3 3	Split Spoon	13	0		
60	**note 51 represent refusal on spoon								

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	12.02.18	B.H. No.	Sht. 2 of 4
	Completion	13.02.18	BH# 3	
OFFICE BOREHOLE RECORD	Final W. L.	4'6"		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash; Grab; Split Spoon; T. W. Tube; R. Core

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	Type	ID Mark	Recovery	Plasticity 20 – 80 / Wet Unit Weight (kip/cu.ft) .07 – .13	Standard Penetration Test (Blows/ft.) 20 – 100 / Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0
60	Loose Light Brown Coarse-Fine Sand and Cream Fine Gravel			3 3 4	Split Spoon	14			
65	Loose Light Brown Coarse-Fine Silty Sand with some Clay and Fine Gravel			5 4 5	Split Spoon	15			
70	Very Dense Light Brown Gravel with some Sandy Clay			50/3"	Split Spoon	16			
75	Compact Cream Coarse-Fine Calcareous Sand and Gravel			21 15 12	Split Spoon	17			
80	Compact Cream Calcareous Gravel with some Sand			10 11 9	Split Spoon	18			
85	Compact Cream and Light Brown Calcareous Sand and Gravel			8 7 6	Split Spoon	19			
90	**note 51 represent refusal on spoon								

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	13.02.18	B.H. No.	Sht. 3 of 4
	Completion	13.02.18	BH# 3	
OFFICE BOREHOLE RECORD	Final W. L.	4'6"		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT	

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	Samples: Type	ID Mark	Recovery	Plasticity (20–80) / Wet Unit Weight (kip/cu.ft) (.07–.13)	Standard Penetration Test (Blows/ft.) (20–100) / Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0
90	Compact Cream Coarse-Fine Calcareous Silty Sand and Gravel			6 9 8	X	20			
95	Compact Light Brown-Cream Calcareous Silty Sand and Gravel			10 13 13	X	21			
100	Compact Light Brown-Cream Coarse-Fine Calcareous Silty Sand and Gravel			12 15 14	X	22			
105	End of BH @ 100 Feet								
110									
115									

**note 51 represent refusal on spoon

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	13.02.18	B.H. No.	Sht. 4 of 4
OFFICE BOREHOLE RECORD	Completion	13.02.18	BH# 3	
	Final W. L.	4'6"		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash; Grab; Split Spoon; T. W. Tube; R. Core

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
0–5	Compact Dark Brown Coarse-Fine Silty Sand with some Organic Material	9, 7, 14	Split Spoon	1	18
5–8	Loose Dark Brown Coarse-Fine Silty Sand	3, 2, 3	Split Spoon	2	18
8–10	Compact Dark Brown Coarse-Fine Silty Sand with Fine Gravel	12, 9, 5	Split Spoon	3	18
10–15	Loose Dark Brown Coarse-Fine Silty Sand with some Gravel	4, 3, 4	Split Spoon	4	18
15–20	Loose Dark Brown Corase-Fine Sand with some Gravel	3, 2, 3	Split Spoon	5	15
20–25	Compact Dark Brown Coarse Sand and Fine Gravel	4, 5, 4	Split Spoon	6	11
25–30	Loose Dark Brown-Coarse-Fine Sand	4, 5, 3	Split Spoon	7	15

Plasticity (20 – 60); Wet Unit Weight (kip/cu.ft) (.07 – .13); Standard Penetration Test (Blows/ft.) (20 – 100); Undrained Unconfined Shear Strength (kip/sq.ft) (1.0 Comp. Test + Vane Shear 5.0)

**note 51 represent refusal on spoon

NHL ENGINEERING LTD CONSULTING ENGINEERS 23 Monroe Road Kingston 6, Jamaica		Dates	Job No.
	Start	27.03.18	B.H. No. BH# 4 — Sht. 1 of 4
OFFICE BOREHOLE RECORD	Completion	27.03.18	
	Final W. L.	4'	

CLIENT:	PORT AUTHORITY OF JAMAICA
PROJECT:	PROPOSED CRUISE TERMINAL SITE
ADDRESS:	DUKE STREET KINGSTON

Location Reference
Eastings: Northings:
Port Royal - St. Andrew
Datum
Elevation:

Type/Size
Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.

Sample Types: Wash; Grab; Split Spoon; T. W. Tube; R. Core

Plasticity 20 – 80; Wet Unit Weight (kip/cu.ft) .07 – .13
Standard Penetration Test (Blows/ft.) 20 – 100
Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
30	Loose Brown Coarse-Fine Sand	2, 1, 3	Split Spoon	8	11
35	Compact Brown Coarse-Fine Sand with some Fine Gravel	4, 5, 5	Split Spoon	9	18
40	Loose Brown Coarse-Fine Sand	3, 2, 4	Split Spoon	10	15
45	Compact Brown Medium-Fine Gravel with some Sand	5, 5, 6	Split Spoon	11	16
50	Compact Brown Medium-Fine Gravel with some Sand	9, 10, 15	Split Spoon	12	0
55	Compact Brown Medium-Fine Gravel with some Sand	6, 7, 6	Split Spoon	13	0
60	**note 51 represent refusal on spoon				

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CONSULTING ENGINEERS
23 Monroe Road
Kingston 6, Jamaica

OFFICE BOREHOLE RECORD

	Dates	Job No.	
Start	27.03.18	B.H. No.	Sht. 2 of 4
Completion	28.03.18	BH# 4	
Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathiead Drop Hammer for SPT.	

Sample Types: Wash · Grab · Split Spoon · T. W. Tube · R. Core

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	Type	ID Mark	Recovery	Plasticity (20–80) / Wet Unit Weight (kip/cu.ft)	Standard Penetration Test (Blows/ft.) / Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0
60	Compact Brown Coarse-Fine Silty Sand with traces of Clay (60'-61') Compact Brown Calcareous Gravel and Silty Sand (61'-61'6")			2 5 15		14	18		
65	Dense Light Brown Calcareous Gravel with traces of Sand			16 9 31		15	18		
70	Loose Brown Calcareous Gravel with some Silty Clay with traces of Sand			9 4 5		16	18		
75	Dense Light Brown Calcareous Gravel			13 18 26		17	9		
80	Very Dense Light Brown Calcareous Gravel			14 30 34		18	9		
85	Very Dense Cream Calcareous Gravel with some Silty Sand			19 37 [illegible]		19	12		
90	**note 51 represent refusal on spoon								

NHL ENGINEERING LTD CONSULTING ENGINEERS 20 Monroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	28.03.18	B.H. No.	Sht. 3 of 4
	Completion	29.03.18	BH# 4	
OFFICE BOREHOLE RECORD	Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash · Grab · Split Spoon · T. W. Tube · R. Core

Plasticity: 20 – 80 · Wet Unit Weight (kip/cu ft): 07 – 13 · Standard Penetration Test (Blows/ft.): 20 – 100 · Undrained Unconfined Shear Strength (kip/sq ft): 1.0 – 5.0, Comp. Test + Vane Shear

Depth (ft.)	Soil Description	Strata Plot	RQD	SPT Blow Count	Type	ID Mark	Recovery
90	Very Dense Cream Calcareous Sand with some Fine Gravel			39 50/3"	Split Spoon	20	8
95	Very Dense Cream Coarse-Fine Calcareous Sand with some Gravel			38 40 47	Split Spoon	21	15
100	Very Dense Cream Coarse-Fine Sand with some Gravel			40 50/3"	Split Spoon	22	9
105	End of BH @ 100 Feet						
110							
115							

**note 51 represent refusal on spoon

NHL ENGINEERING LTD CONSULTING ENGINEERS 20 Munroe Road Kingston 6, Jamaica		Dates	Job No.	
	Start	29.03.18	B.H. No.	Sht. 4 of 4
	Completion	29.03.18	BH# 4	
OFFICE BOREHOLE RECORD	Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA
PROJECT: PROPOSED CRUISE TERMINAL SITE
ADDRESS: DUKE STREET KINGSTON

Location Reference
Eastings: Northings:
Port Royal - St. Andrew
Datum
Elevation:

Type/Size
Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.

Sample Types: Wash, Grab, Split Spoon, T. W. Tube, R. Core

Plasticity 20 — 90; Wet Unit Weight (kip/cu.ft) .07 — .13; Standard Penetration Test (Blows/ft.) 20 — 100; Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
0	Compact Dark Brown Sandy Silt with some Organic Material	5, 11, 8	Split Spoon	1	0
5	Compact Brown Coarse-Fine Sand with some Gravel	7, 9, 6	Split Spoon	2	0
	Loose Dark Brown Medium-Fine Gravel with some Sand	4, 3, 5	Split Spoon	3	0
10	Compact Brown Coarse Sand with some Fine Gravel	6, 6, 6	Split Spoon	4	0
15	Loose Brown Coarse Sand with some Gravel	4, 3, 6	Split Spoon	5	0
20	Compact Brown Coarse-Fine Sand with some Fine Gravel	4, 6, 8	Split Spoon	6	0
25	Compact Brown Coarse-Medium Sand	12, 13, 14	Split Spoon	7	0
30	**note 51 represent refusal on spoon				

NHL ENGINEERING LTD
CONSULTING ENGINEERS
Kingston 6, Jamaica

OFFICE BOREHOLE RECORD

	Dates	Job No.	
Start	11.04.18	B.H. No.	Sht. 1 of 4
Completion	11.04.18	BH# 5	
Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA **PROJECT:** PROPOSED CRUISE TERMINAL SITE **ADDRESS:** DUKE STREET KINGSTON	Location Reference Eastings: Northings: **Port Royal - St. Andrew** Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT.	

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	SPT Blow Count	Type	ID Mark	Recovery
30	Dense Brown Coarse Sand and Fine Gravel	6, 16, 25	Split Spoon	8	0
35	Compact Brown Coarse-Fine Sand	6, 9, 9	Split Spoon	9	0
40	Compact Brown Coarse-Medium Sand	10, 11, 10	Split Spoon	10	0
45	Loose Light Brown Calcareous Gravel with some Silty Sand (45'-46') Loose Cream Coarse-Fine Calcareous Sand (46'-46'6")	2, 3, 4	Split Spoon	11	0
50	Compact Light Brown Calcareous Gravel with some Silty Clay	1, 2, 8	Split Spoon	12	0
55	Compact Light Brown Calcareous Gravel with some Silty Sand	9, 7, 7	Split Spoon	13	0
60	**note 51 represent refusal on spoon				

Plasticity (20 – 80) | Wet Unit Weight (kip/cu.ft) (.07 – .13) | Standard Penetration Test (Blows/ft.) (20 – 100) | Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0

NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica OFFICE BOREHOLE RECORD		Dates	Job No.	
	Start	11.04.18	B.H. No.	Sht 2 of 4
	Completion	12.04.18	BH# 5	
	Final W. L.	4'		

CLIENT:	PORT AUTHORITY OF JAMAICA
PROJECT:	PROPOSED CRUISE TERMINAL SITE
ADDRESS:	DUKE STREET KINGSTON

Location Reference
Eastings: Northings:
Port Royal - St. Andrew
Datum
Elevation:

Type/Size
Hollow Stem 6.25" Diameter Auger, 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	Samples: Type	ID Mark	Recovery	Plasticity 20 — 80; Wet Unit Weight (kip/cu ft) 37 — 73	Standard Penetration Test (Blows/ft.) 20 — 100; Undrained Unconfined Shear Strength (kip/sq ft) 1.0 Comp. Test + Vane Shear 5.0
60	Compact Light Brown Calcareous Gravel with some Silty Sand			13 10 8	Split Spoon	14	0		
65	Compact Light Brown Calcareous Gravel with some Silty Sand			10 13 7	Split Spoon	15	0		
70	Stiff Brown Silty Clay with some Gravel			6 6 6	Split Spoon	16	0		
75	Very Dense Cream Calcareous Gravel with some Sand			30 50/4"	Split Spoon	17	6		
80	Very Dense Cream Calcaerous Gravel with some Silty Sand			35 47 49	Split Spoon	18	0		
85	Very Dense Cream Calcaerous Gravel with some Silty Sand			19 30 37	Split Spoon	19	0		
90	**note 51 represent refusal on spoon								

NHL ENGINEERING LTD
CONSULTING ENGINEERS
29 Monroe Road
Kingston 6, Jamaica

OFFICE BOREHOLE RECORD

	Dates	Job No.	
Start	12.04.18	B.H. No.	Sht 3 of 4
Completion	12.04.18	BH# 5	
Final W. L.	4'		

CLIENT: PORT AUTHORITY OF JAMAICA PROJECT: PROPOSED CRUISE TERMINAL SITE ADDRESS: DUKE STREET KINGSTON	Location Reference Eastings: Northings: Port Royal - St. Andrew Datum Elevation:	Type/Size Hollow Stem 6.25" Diameter Auger; 3.25" I.D. Stem, 140 lbs Cathead Drop Hammer for SPT

Sample Types: Wash | Grab | Split Spoon | T. W. Tube | R. Core

Depth (ft.)	Soil Description	Strata Plot	R.Q.D.	SPT Blow Count	samples: Type	ID Mark	Recovery	Plasticity 20 – 80 / Wet Unit Weight (kip/cu.ft) .07 – .13	Standard Penetration Test (Blows/ft.) 20 – 100 / Undrained Unconfined Shear Strength (kip/sq.ft) 1.0 Comp. Test + Vane Shear 5.0
90	Very Dense Cream Calcareous Gravel with some Silty Sand			30 50/3"		20	0		
95	Very Dense Cream Calcareous Gravel with some Silty Sand			36 40 47		21	0		
100	Very Dense Cream Calcareous Gravel with some Silty Sand			40 50/4"		22	0		
105	End of BH @ 100 Feet								
110									
115									
120	**note 51 represent refusal on spoon								

		Dates	Job No.	
NHL ENGINEERING LTD CONSULTING ENGINEERS 29 Monroe Road Kingston 6, Jamaica	Start	12.04.18	B.H. No.	Sht. 4 of 4
	Completion	12.04.18	BH# 5	
OFFICE BOREHOLE RECORD	Final W. L.	4'		

Appendix III Laboratory Physical Soil Test Results

NHL ENGINEERING LIMITED

25 MUNROE ROAD, KINGSTON 6

LABORATORY TEST REPORT

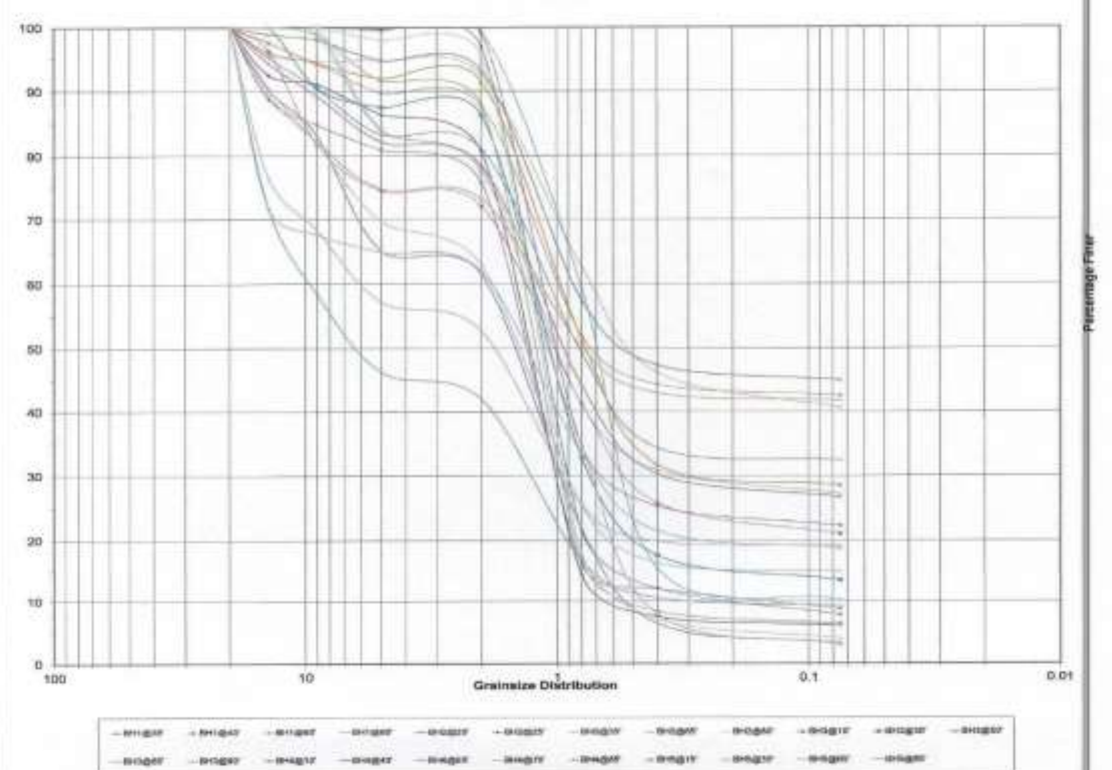
JOB No.: NHL-PORTROYAL-48/03/2018

CLIENT NAME: PORT AUTHORITY OF JAMAICA	LOCATION: PORT ROYAL, ST. ANDREW
PROJECT NAME: PROPOSED CRUISE TERMINAL SITE	SAMPLE TAKEN BY: NHL ENGINEERING LIMITED
CLIENT REP.: MR. CHRISTOPHER HAMILTON	JOB No.: NHL-PORTROYAL-48/03/2018
TYPE OF TEST: SIEVE ANALYSIS	MATERIAL I.D.:
DATE TESTED: MAY 2018	TESTED BY: SHUKU SENIOR

US SIEVE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	100	100	100	100	100	100	100	100	100	100	100	10[illegible]
14	100	96.3	95.5	96.1	88.6	100	100	98.2	100	92.6	100	97.[illegible]
9	100	81.8	94.3	94.7	84.6	100	100	90.4	98.6	91.1	90.9	96.[illegible]
5	99.6	74.5	90.8	94.7	80.9	99.8	99.5	83.3	83.9	89.4	87.5	92.[illegible]
2	97.0	72.1	87.8	92.9	75.8	99.2	99.2	81.1	78.2	80.7	86.3	91.[illegible]
0.8	21.9	41.3	52.3	52.6	16.1	34.6	59.5	49.5	47.2	58.4	32.8	51.[illegible]
0.4	12.2	25.8	44.4	48.2	12.2	25.3	15.5	34.3	30.8	7.4	17.5	31.[illegible]
0.075	7.7	21.0	42.8	40.0	8.7	22.3	10.3	32.4	27.2	6.0	13.5	20.[illegible]

US SIEVE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	100	100	100	100	100	100	100	100	100	100	100
14	98.9	94.3	100	90.3	71.7	89.4	71.5	100	100	78.6	90.5
9	96.0	89.3	98.8	83.1	58.4	82.3	67.6	100	100	68.5	81.3
5	94.8	82.2	97.5	68.1	48.3	74.9	64.9	84.1	97.9	57.2	69.7
2	93.2	76.5	87.9	61.5	42.0	73.2	61.5	77.6	96.8	52.7	62.9
0.8	52.6	44.2	16.7	21.6	16.7	50.2	22.4	34.5	17.9	29.5	29.4
0.4	47.4	30.3	8.3	6.3	10.6	43.0	21.3	7.5	7.3	19.8	16.3
0.075	45.0	20.7	8.3	3.2	9.2	41.8	18.6	3.5	4.2	19.1	14.9

GRADATION CURVES



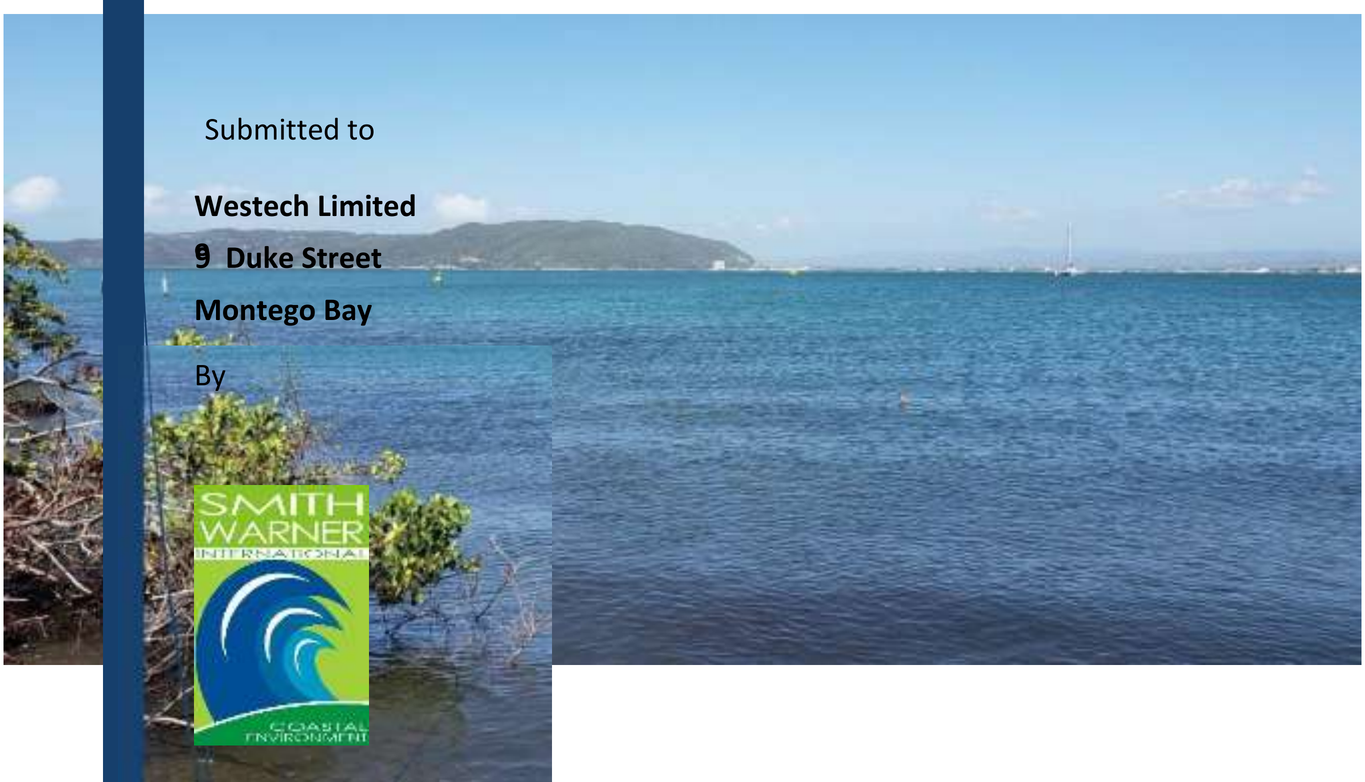
13.1.2 Coastal Design Report – Old Coal Wharf

COASTAL DESIGN REPORT

for a Rubble Stone Revetment

at the

Old Coal Wharf, Port Royal



Submitted to

Westech Limited
9 Duke Street
Montego Bay

By

SMITH WARNER INTERNATIONAL
COASTAL ENVIRONMENT

Contents

Executive Summary

The points below provide the key findings of the coastal process modelling study of Old Coal Wharf.

- The numerical model showed that the deep-water hurricane waves did not reach the site due to its sheltered location;
- The model showed that the largest waves came from wind-generated hurricane waves approaching from the north-west with 0.6m wave heights at the shoreline;
- The project site under the existing conditions was inundated under the 100-year hurricane event with water levels of 2.1m above MSL due to the dynamic storm surge;
- Based on the results, an initial revetment design with a crest height of 2.5m was investigated. The results showed that the overtopping rates exceeded the allowable limit for the structural elements of buildings;
- The revetment was modified to include a berm 2m in length and 1m above MSL. The inclusion of the berm reduced overtopping rates significantly (≤1 l/s per m) and allowed a reduction in the revetment crest height to 2.2m above MSL;
- Floor levels are recommended to be at least 2.2m above MSL;
- The armour stone sizes for the berm revetment ranged between 0.58 to 0.71m or 500 to 900kg stones with a slope of 1:1.5 and a crest width of at least $3D_{50}$ or 2m. The recommended armour thickness is $2D_{50}$ or 1.3m;
- The toe stones for the revetment should range between 0.93 to 1.0m or 2000 to 2500kg;
- Final design drawings along with volumes are attached.

1 Introduction

1.1 *Background*

Smith Warner International Limited (SWI) was contracted by Westech Limited to design a rubble mound revetment along the shoreline north of Old Coal Wharf in Port Royal. The ultimate objective of the study is to provide the following:

- An armour stone design for a 100-year hurricane event, Crest elevation of revetment, and
- Design drawings and volumes.

As a precursor to the revetment design, a coastal processes investigation was conducted to better understand the shoreline under various conditions and to derive design parameters for the revetment; these coastal process investigations are described in the body of this report.

1.2 Site Description

The project site is located on the south coast of Jamaica in the vicinity of an archeologically protected area (Figure 1.1). Wind speeds in the area dictate the wave direction and suggest the waves should come primarily from the east. The site is protected to some extent, as it is located on the north of the

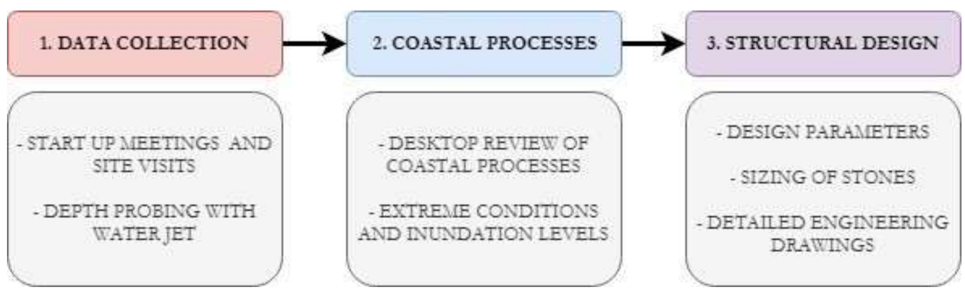
Norman Manley Highway strip and is therefore not exposed to the waves generated in the Caribbean Sea. The waves that form in the harbour do not have much room to grow and therefore do not get large enough to affect the site daily. It is, however, important to understand the conditions under extreme conditions such as hurricanes.

Figure 1.1 Site location

1.3 Technical Approach

The technical approach included:

- Data review and collection – this included site visits along with a site visit report identifying data gaps that would need to be filled.
- Understanding coastal processes – this included updating the model domain and obtaining the extreme hurricane conditions, which will be used to obtain the design wave conditions for the revetment along with the design floor level heights.
- Structural design – detailed engineering drawings along with the engineer's estimate for the revetment.



2 Physical Site Conditions

2.1 Shoreline Characteristics

A site visit was carried out on 21 February 2019 to get a first-hand view of the area and its environs. The project site is located just east of Port Royal facing Kingston Harbour (Figure 2.1), which is generally a calm environment year-round. The land elevation in the areas is low and appears to be less than 1m above mean sea level. This is consistent across the whole shoreline and suggests that under certain storm conditions the site could be inundated. Another observation was the vegetation along the shoreline, likely within the footprint of the proposed revetment, which includes patches of mangroves (Figure 2.2). These are sensitive species that serve an important ecological function and, as such, their presence will have to be considered in the design process. In addition to vegetation on the shoreline, there is seagrass present along the seafloor (Figure 2.3). These are also sensitive species that need consideration in the design process. The seafloor at the project site consisted of a mixture of sediment and a hard bottom subsurface.

Figure 2.1 Project site

Figure 2.2 Low lying shoreline with patches of vegetation

Figure 2.3 Presence of seagrass along the project shoreline

2.2 Bathymetry and Topography

Detailed bathymetric and topographic information is required to model waves in the nearshore of the project site. Figure 2.4 shows the interpolated bathymetric/topographic chart from available and measured data.

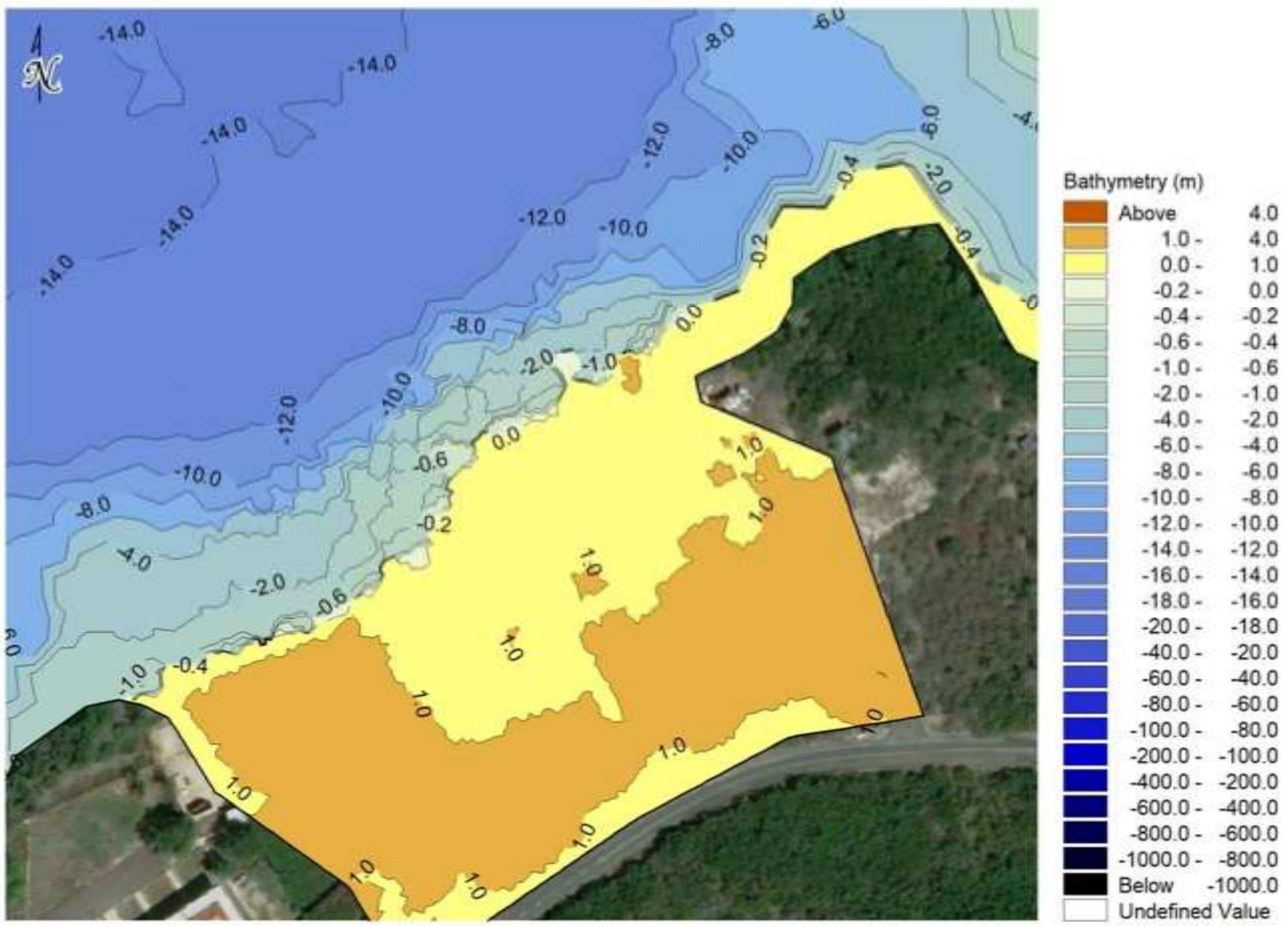


Figure 2.4 Interpolated data showing bathymetric and topographic contours

3 Baseline Coastal Processes

In determining the wave climate for the Old Coal Wharf site, we need to establish extreme conditions. The extreme, or hurricane, wave climate provides design wave heights for different return periods, which are used to ensure that the revetment is designed to withstand these extreme forces.

The National Hurricane Centre (NHC) has archived a database of storm tracks and conditions associated with tropical storms and hurricanes from 1850 to 2017 (HURDAT2). Statistical analysis of the data, along with parametric hurricane models, provide the deep-water wave conditions corresponding to the selected design return period.

3.1 Numerical Model Domain

For the various tasks in the coastal risk assessment analysis, the MIKE suite of computer models, created by the Danish Hydraulic Institute, was used. MIKE21 is a professional engineering software package for the simulation of flows, waves, sediments and ecology in rivers, lakes, estuaries, bays, coastal areas and seas. The spectral wave (SW) module computes the transformation of wind waves as they grow, propagate and break in the nearshore zone. The hydrodynamic (HD) module computes the currents and water level patterns. Linked together (HD+SW) the modules can be used for storm surge calculations.

The set-up of the extreme wave climate is described as follows:

- MIKE21 relies on a flexible computational mesh to compute the waves and hydrodynamics. This mesh consists of bathymetry, topography, coastline and beach profile data. The flexible mesh is ideal for storm surge computations as it facilitates the modelling of large complex areas that may simultaneously require detailed resolution of smaller features. A large-scale mesh was necessary to include fetch and diffraction. The advantage of the flexible mesh allows for moving from large-scale down to small scale detail in the area of interest as shown in Figure 3.1. The areas represented in the flexible mesh ranged from 160m in deep water down to 2m spacings in the project area;

- Offshore wave climate describing the boundary conditions for each scenario (extreme);
- Wind and pressure fields for reproducing past real hurricanes; and
- Calculation of wave conditions and elevation throughout the mesh.

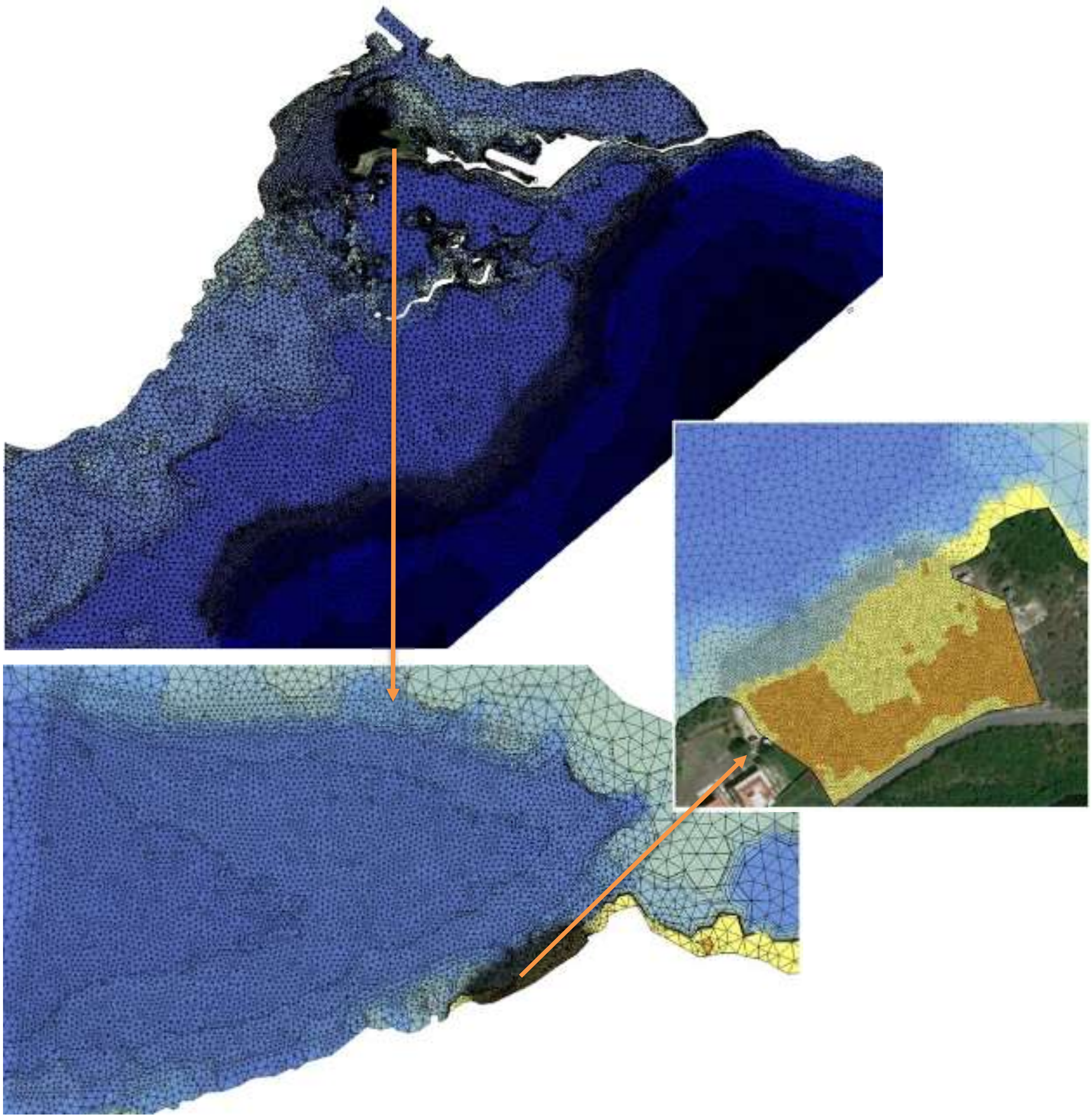


Figure 3.1 Flexible mesh of model domain and project site

3.2 Climate Change

Climate change is defined as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Additionally, it refers to any change in climate over time, whether due to natural variability or as a result of human activity.[19]

Main components of climate change such as rising sea levels and increased storminess may prove damaging for small low-lying shorelines like Old Coal Wharf. Vulnerabilities that may be further exacerbated include:

- Increased storm surge and coastal erosion from more intense hurricane activity;
- Long-term shoreline erosion from higher waves due to higher sea levels;
- Changes in trends of shoreline morphology.

Designing with climate change in mind presents some difficulties because most guidelines are projections that may change in following years. Guidelines have been summarized in the *InterGovernmental Panel on Climate Change (IPCC) Summary for Policy Makers* publication. The section that is applied in our coastal work is the projection for mean global sea level rise: the RCP8.6 scenario value from the *Intergovernmental Panel on Climate Change 2014* report predicts the rate of sea level rise to be 7.5mm/year. The predicted sea level increases correspond to approximately 0.75m over the next 100 years.

3.3 Hurricane Wave Climate

An in-house computer program, HurWave, was used for the hindcasting analysis of hurricane waves. The program was used to scan the NOAA-NHC (National Oceanographic and Atmospheric Administration – National Hurricane Centre) HURDAT database for all storms and hurricanes that have passed within a 300km radius of the project site from the year 1850 to present.

---

[19] Intergovernmental Panel on Climate Changes (IPCC) usage

An analysis of the NHC database shows that for an expanded area of influence of 300km, 110 hurricanes and tropical storms passed within this distance of the project area over the past 166 years (1851 to 2017). The numbers of occurrences within each category, as well as the wind speed classifications, have been broken down according to the categories described by the Saffir Simpson scale and are shown in Table 3-1 and Figure 3.2.

The temporal distribution of this list of storms from the past 166 years is shown in Figure 3.3. It is important to note that while research is still on-going, some scientists predict that climate change will result in a shift to more frequent intense hurricanes, but not necessarily an increase in the overall frequency of hurricanes (Smith et al., 2002).

Table 3-1 Distribution of storm events according to the Saffir-Simpson Scale

Cyclone Category	Wind Speed (m/s)	Wind Speed (km/h)	Number of Events
Tropical Storm	18 – 33	64 – 118	58
1	33 – 43	119 - 154	23
2	44 – 49	155 – 178	12
3	50 – 58	179 – 210	9
4	59 – 70	211 - 250	6
5	> 70	> 250	2

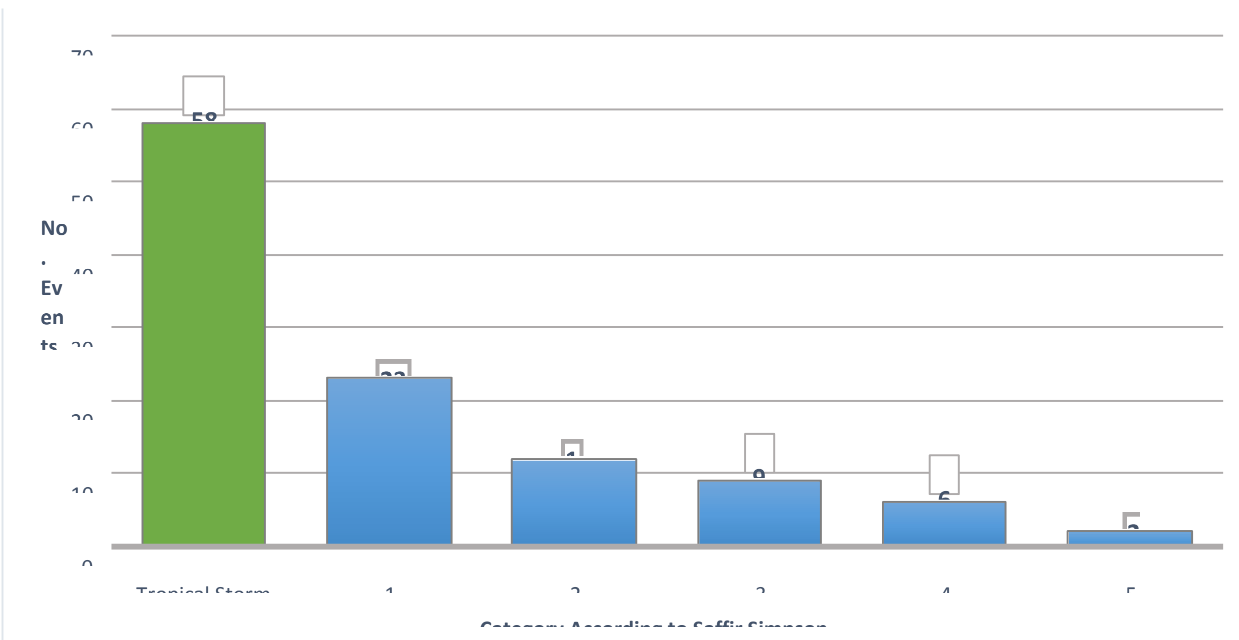


Figure 3.2 Category (Intensity) distribution of storms for Old Coal Wharf (300km radius) from 1851-2017

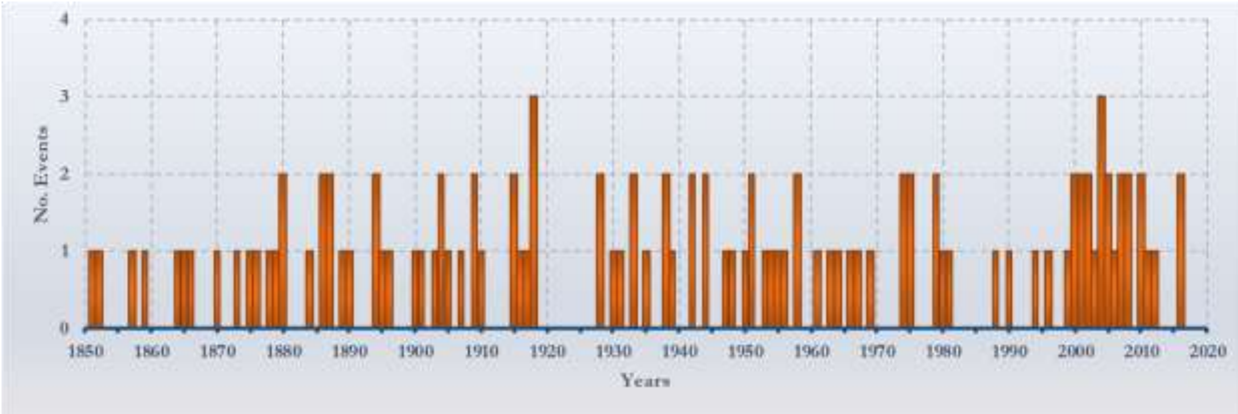


Figure 3.3 Temporal distribution of hurricane occurrence in the offshore of OCW (300 km radius) from 1851

Deep-water wave parameters were calculated for each selected tropical cyclone using parametric models (Cooper, 1988; Young and Burchell, 1996). The resulting wave conditions were segmented into directional sectors and fit to a statistical function describing their exceedance probability. The wave parameter values for 100-year return periods were determined from the best-fit statistical distribution. The deep-water wave parameters corresponding to the 100-year return periods were computed for all directional sectors. Table 3-2 shows the wave heights, wind speeds, and periods for the directional sectors investigated. Due to the location of Old Coal Wharf, the input of waves on the model boundaries for certain directions was not necessary, therefore only wind was applied for these directions along with the design water levels. The north, north-west and west directions are wind fetch only simulations. In other words, the waves are calculated from the unobstructed length of water over which wind from these directions can blow. These directions would have a much lower wave period due to the length of the fetch.

Table 3-2 Boundary wave and uniform wind conditions used for 100-year return period simulations

50 Year Return Scenario Simulations			
Direction	Windspeed (m/s)	Wave height (m)	Wave period (s)
North	35.88	-	-

East	38.77	13.29	16.84
South East	36.89	11.58	15.44
South	33.04	8.05	12.28
West	34.00	-	-
North West	30.62	-	-

The highest and longest waves come from the east sector with deep water wave heights of 13.29m for the 100-year storm. This is expected due to the trajectory of the storms and absence of obstacles or limited fetch.

During a hurricane, elevated water levels associated with the inverse barometric rise (IBR) are destructive, causing flooding and damage to coastal infrastructure. Storm surge is commonly defined as the rise in water surface elevation of the sea above its mean level. Static storm surge is made up of five major components, namely:

1. Inverse Barometric Rise (IBR), (caused by low pressure)
2. Highest Astronomical Tide (HAT),
3. Global Sea Level Rise (GSLR),
4. Wind Setup (when winds push water up onto the land), and
5. Wave Setup (caused by wave breaking).

The total design deep water surface level as shown in Table 3-3 was used as initial condition throughout the domain for the design return period simulation of 100 years. Figure 3.4 shows the maximum significant wave height for the 100-year hurricane return period and Figure 3.5 shows the maximum static water level (storm surge) for the same period.

Table 3-3 IBR and design deep water surface level (m) for a return period of 100 years

Parameter

IBR (m)	0.50
Highest Astronomical Tide (m)	0.24
Sea level rise (m) - RCP8.5 Scenario value from IPCC research: 7.55 mm/yr for 100-year design life	0.75
Total design deep water surface level (m)	1.49

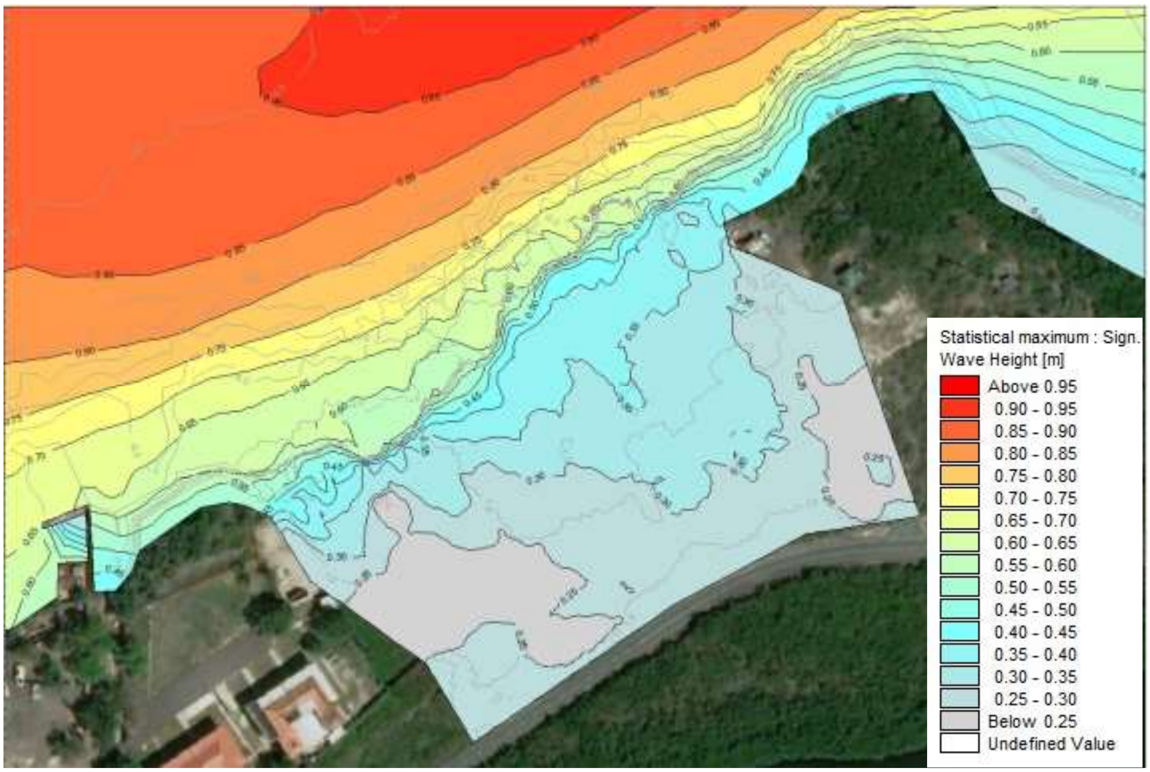


Figure 3.4 Statistical maximum significant wave height for the 100-year hurricane return period

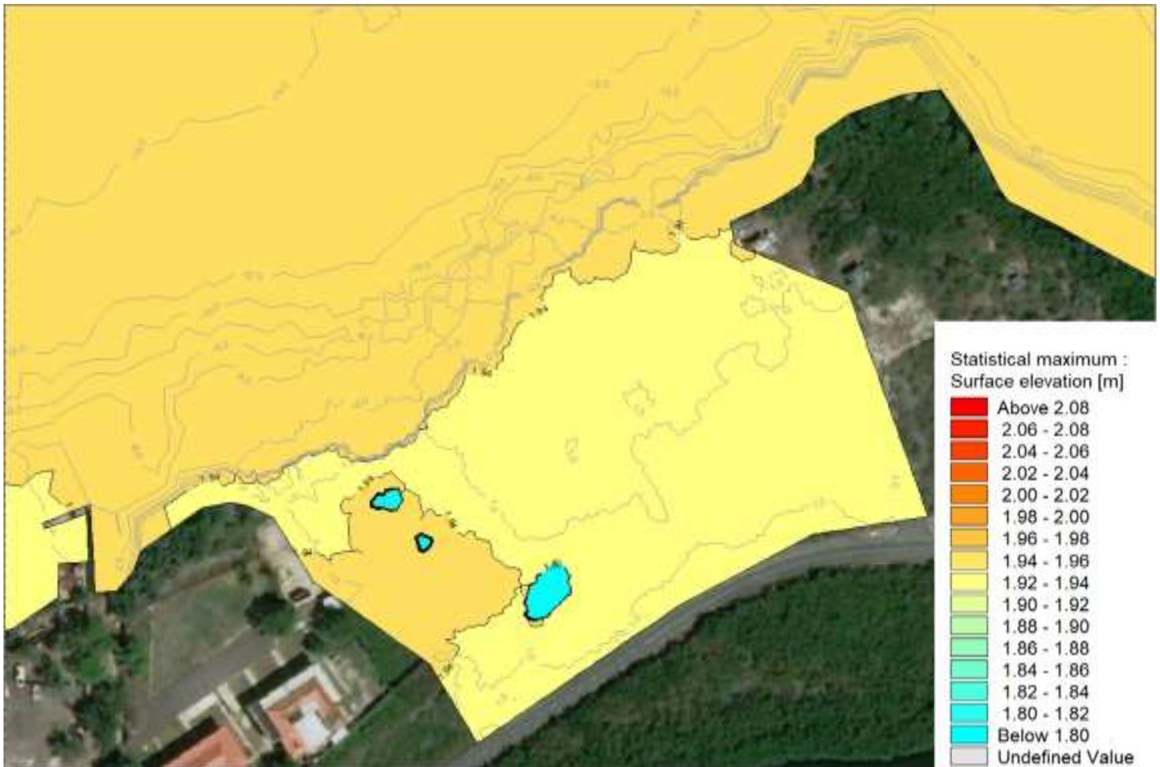


Figure 3.5 Statistical maximum static water level (storm surge) for the 100-year hurricane return period

3.3 Summary and Implications

- The model domain was refined for the project site to ensure that the bathymetry and topography are represented accurately in the model, which leads to accurate wave and storm surge results.
- An updated hurricane hindcast model was developed and the 100-year hurricane wave conditions were extracted.
- Climate change conditions were considered in the water level designs, which lead to a sea level rise of 0.75m over the next 100 years. The total design water level input was 1.49m for the 100-year return period.
- Selected wave conditions were run in the model including hurricane wind input only, with conditions depending on the direction from which the winds approached. This was to ensure that all directions affecting the site were taken into consideration.

- From these results, maximum wave and storm surge conditions from each direction were extracted. This was then compiled into the maximum wave and storm surge heights for the site.
- The results showed wave heights of 0.6m and a static storm surge of 1.94m above MSL at the shoreline. This led to total inundation of the project site.
- These results will be used to calculate the dynamic storm surge and overtopping conditions at the site to provide design floor elevations (described in the following sections).

4 Engineering Design

The modeling used to determine design wave and water level conditions for the revetment and the project site uses the static wave and storm surge results calculated in the baseline coastal processes modelling described previously.

There are several critical infrastructure buildings and facilities that will be affected by wave forces and storm surge inundation during a hurricane (Figure 4.1). These facilities need to be protected by the revetment and adequate floor elevations for the site must also be considered.

Figure 4.1 Old Coal Wharf development plan

4.1 *Run-up and Overtopping*

To obtain the design levels, a 1-dimensional wave model called sBEACH was used to calculate the wave height at the proposed revetment and the dynamic wave run-up at the structure as well as the surge inundation levels. The design water level and wave height were then used to calculate the acceptable wave overtopping rates for the infrastructure located shoreward of the revetment.

A transect profile was extracted from the bathymetry as shown in Figure 4.2 and used as input to the sBEACH model. A wave height of 0.9m, wave period of 3s and a water level of 1.94m (static surge) was used to calculate the dynamic storm surge and inundation levels over land. Figure 4.3 shows the results from sBEACH under existing conditions. The 1-D model shows the wave breaking as it moves over land falling to just under 0.4m. The storm surge model, however, shows a maximum water level of 2.1m over the profile.

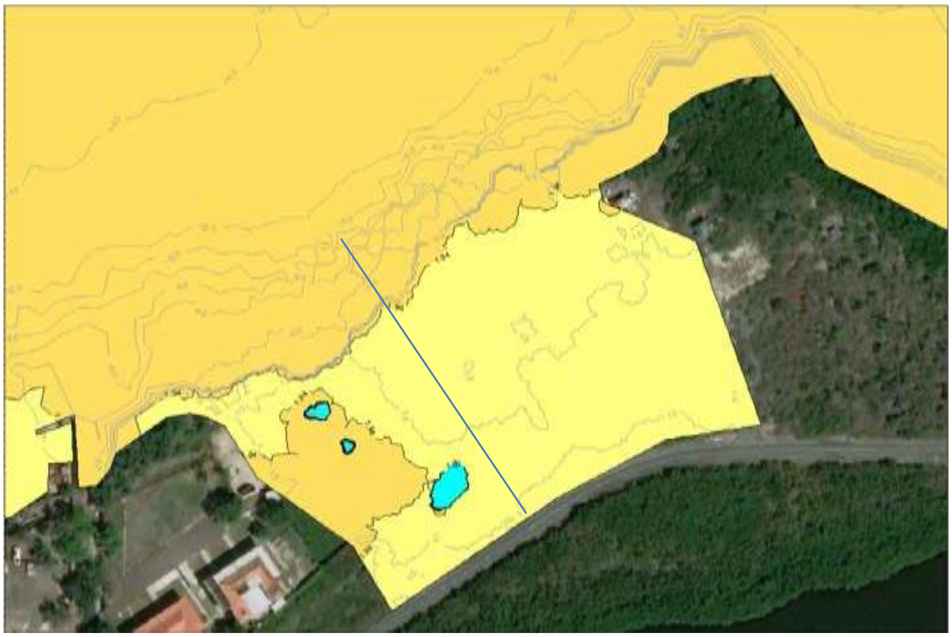


Figure 4.2 Location of extracted profile

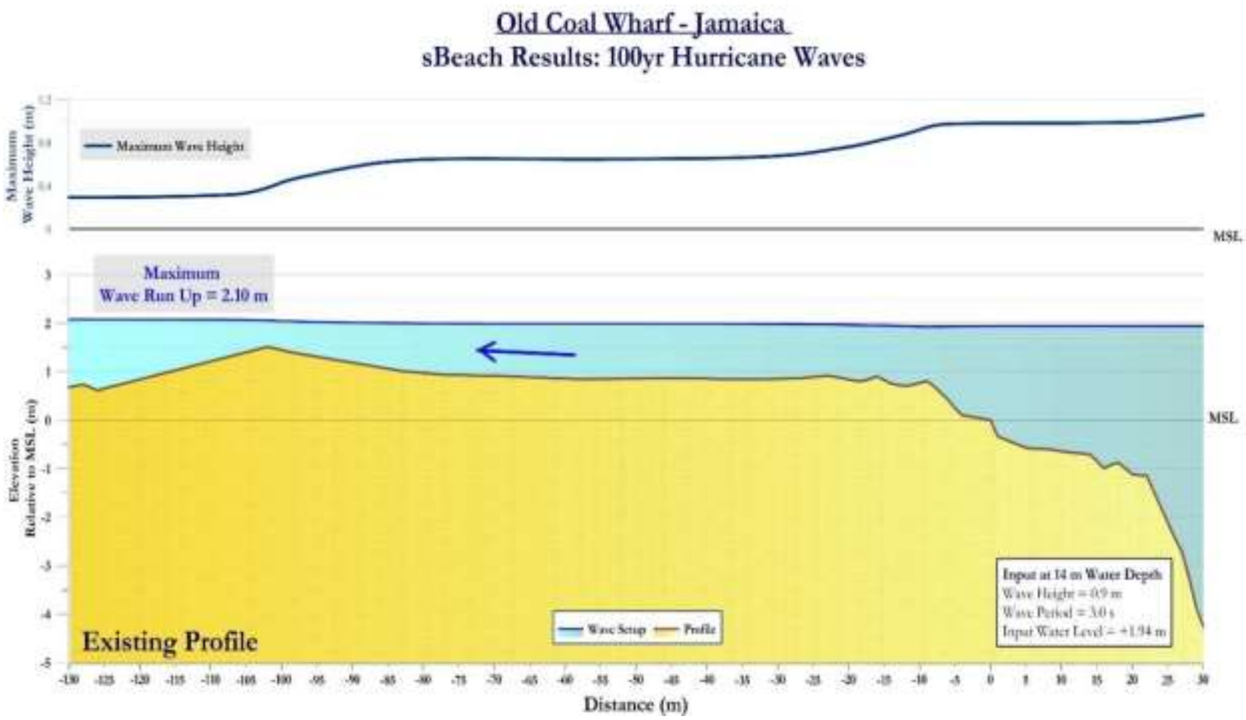


Figure 4.3 Existing wave run-up and wave height

Wave overtopping is the volumetric rate at which run-up flows over the top or crest of a slope, be it a beach, dune or coastal structure as shown in Figure 4.4.

The guidelines used in calculating wave overtopping for the different wave conditions comes from the Eurotop Manual on wave overtopping of sea defences and related structures, 2nd edition[20]. From this manual, the general (tolerable) overtopping discharges and overtopping wave volumes for urban defences is summarised in Table 4-1. To protect the building structure elements, the revetment must be designed to limit the mean discharge to ≤ 1 litre/s per meter run of the revetment.

[20] http://www.overtopping-manual.com/assets/downloads/EurOtop_II_2018_Final_version.pdf

Figure 4.4 Wave overtopping at a seawall with a wide boulevard

Table 4-1 General limits for overtopping for property behind the defence

Hazard type and reason	Mean discharge q (l/s per m)	Max volume V_{max} (l per m)
Significant damage or sinking of larger yachts; H_{m0} > 5 m	>10	>5,000 – 30,000
Significant damage or sinking of larger yachts; H_{m0} = 3-5 m	>20	>5,000 – 30,000
Sinking small boats set 5-10 m from wall; H_{m0} = 3-5 m Damage to larger yachts	>5	>3,000-5,000
Safe for larger yachts; H_{m0} > 5 m	<5	<5,000
Safe for smaller boats set 5-10 m from wall; H_{m0} = 3-5 m	<1	<2,000
Building structure elements; H_{m0} = 1-3 m	≤1	<1,000
Damage to equipment set back 5-10m	≤1	<1,000

The dimensions of the initial revetment included a crest elevation of 2.5m above MSL along with a crest width of 2m along the length of the project site. Figure 4.5 shows that the revetment will provide storm surge protection, however, there is excessive overtopping occurring at a rate (30.2 l/s/m) that is well above the limit for building structure elements.

Figure 4.6 shows the performance of the berm revetment. The inclusion of the berm significantly reduces the wave overtopping to within the acceptable limits for building elements (≤1 l/s per m) while allowing the crest of the revetment to be reduced from 2.5 to 2.2m.

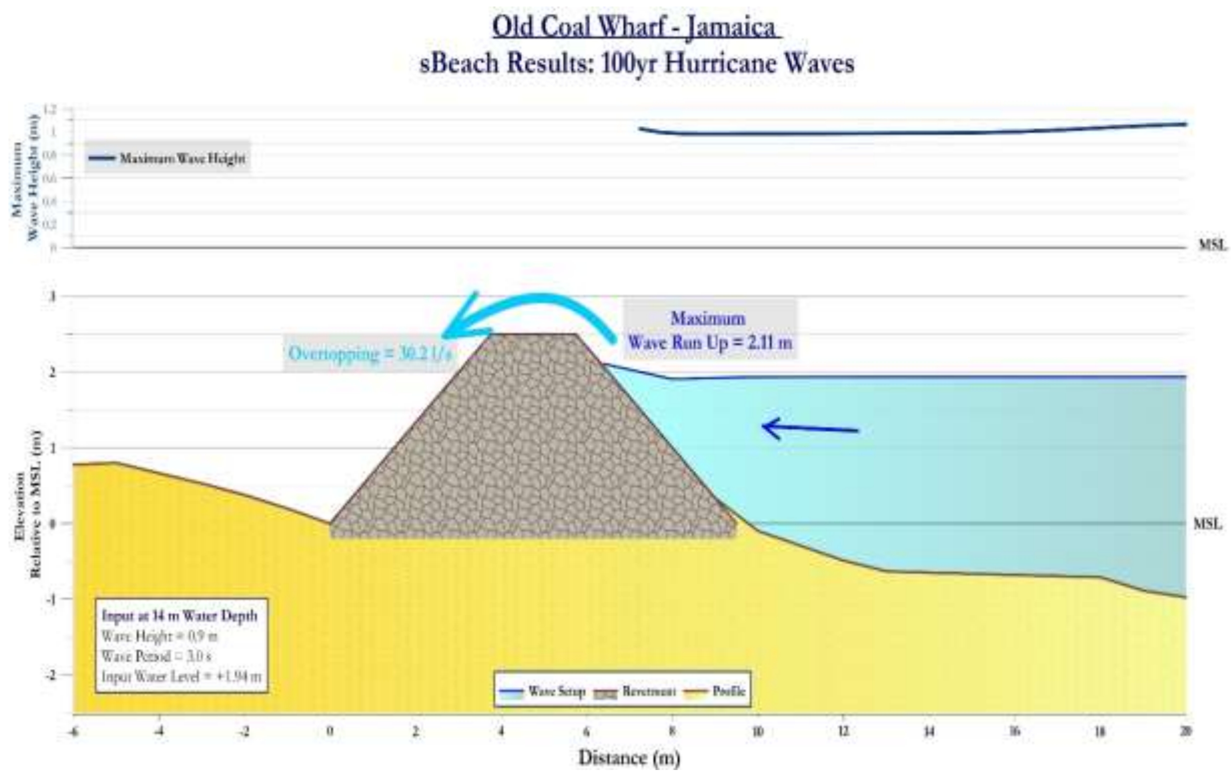


Figure 4.5 Armour stone revetment option

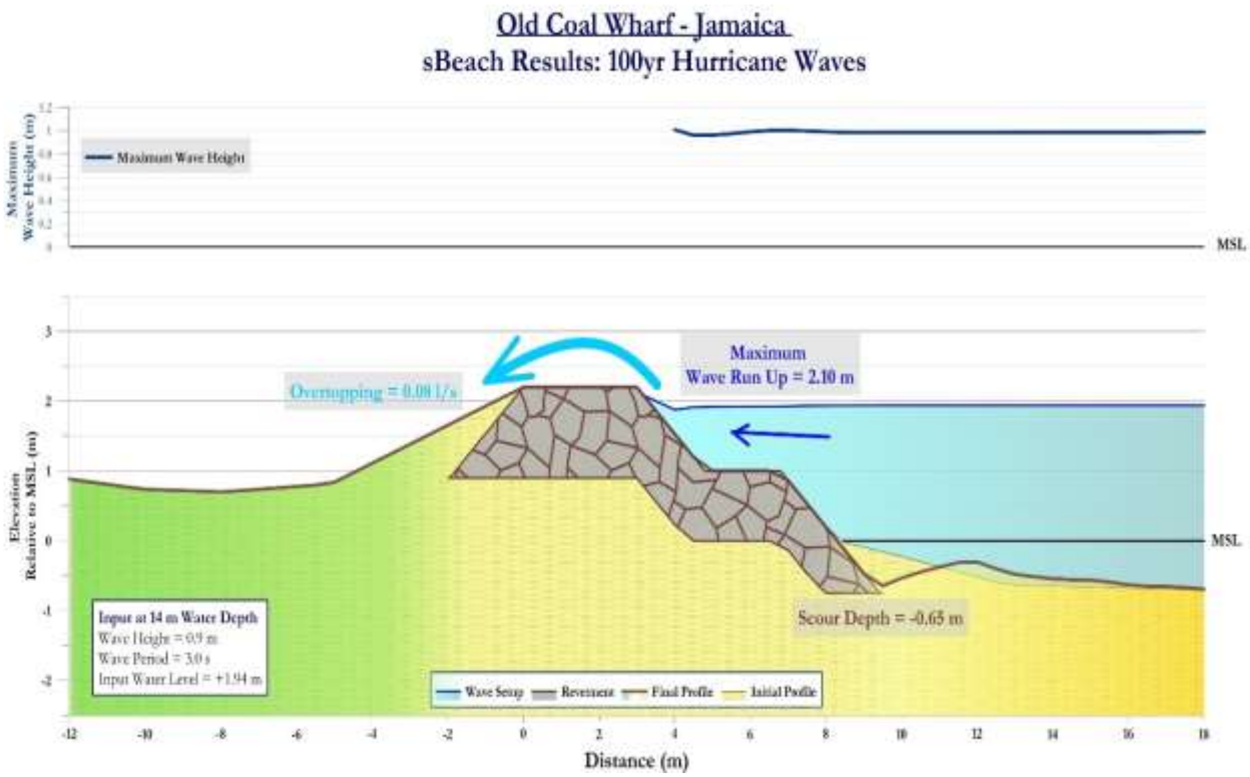


Figure 4.6 Armour stone berm revetment

4.2 Structural Designs

This section describes the analysis carried out to determine the stability of the proposed armour stone revetment. Using the results of the wave modelling, the structures were designed to provide adequate protection against wave attack along the shoreline and provide a buffer against storm surge. The use of armour stone is proposed to provide protection against wave forces for the structures, which have been designed to withstand the 1 in 100-year hurricane condition.

The size of the armour protection and its various characteristics such as layer thickness were developed using an accepted standard method (Van Gent et al, 2003) and results are summarized in Table 4-2.

The volumes for the armour stone, crusher run, and excavations are shown in Table 4-3, along with the area of geotextile required.

The parameters for calculations and the results for the Old Coal Wharf revetment are given in Figure 4.7. Plan and cross-sections of the armour stone revetment are shown in Figure 4.8 to Figure 4.10.

Table 4-2 Design armour stone sizes based on the recalibrated Van der Meer formula

100-year	*Protective Armour Stone Revetment*	
Armour Stone Mass ($M50_{ARMOUR}$) (kg)	Min	Max
Diameter ($D50_{ARMOUR}$) (m)	**500**	**900**
Armour Layer Thickness ($2D_{50}$)	**0.58**	**0.71**
	1.3m	
Minimum Crest Width ($3D_{50}$)	2.0m	

Table 4-3 Volume and area of material for the construction of the revetment

EXCAVATION TO PLACE ARMOUR	275	Cu.m.
GEOTEXTILE	2570	sq. m.
COMPACTED CRUSHER RUN	540	Cu.m.
ARMOUR STONE	3125	Cu.m.

Armour Stone Design

Client	Westech Ltd
Project	Old Coal Wharf Rubble Stone Revetment
Designer	Graham Jervis
Date	April 1, 2019

Input Parameters

Wave Parameters

Significant wave height at toe Hs (m)	0.9
Wave height ratio at toe γH (Hs/H2%)	0.9
Wave height ratio at toe γH (Hs/H2%)	1.0
Design wave period wave period Tp (s)	3.0
Mean wave period Tmean (s)	2.5
Spectral mean wave period Tm-1 (s)	2.7
Depth (m)	1.0
Angle of incident wave B (degrees)	0.0
Safety factor gamma γs	1.0
Reduction factor γb	1.0
Storm duration (hrs)	4.0
Number of waves Nw	5760.0
Minimum Period (s)	2.0
Spectral mean wave period Tm-1 (s)	2.2
Number of waves Nw	7200.0

Diameter Ratios

D50A/D50F	2.0
D50F/D50C	2.0

Constants and Densities

Rock density Pr (Kg/m^3)	2500.0
Density of Sea water Pw (Kg/m^3)	1025.0
Acceleration due to gravity (g)	9.8

Structure Parameters

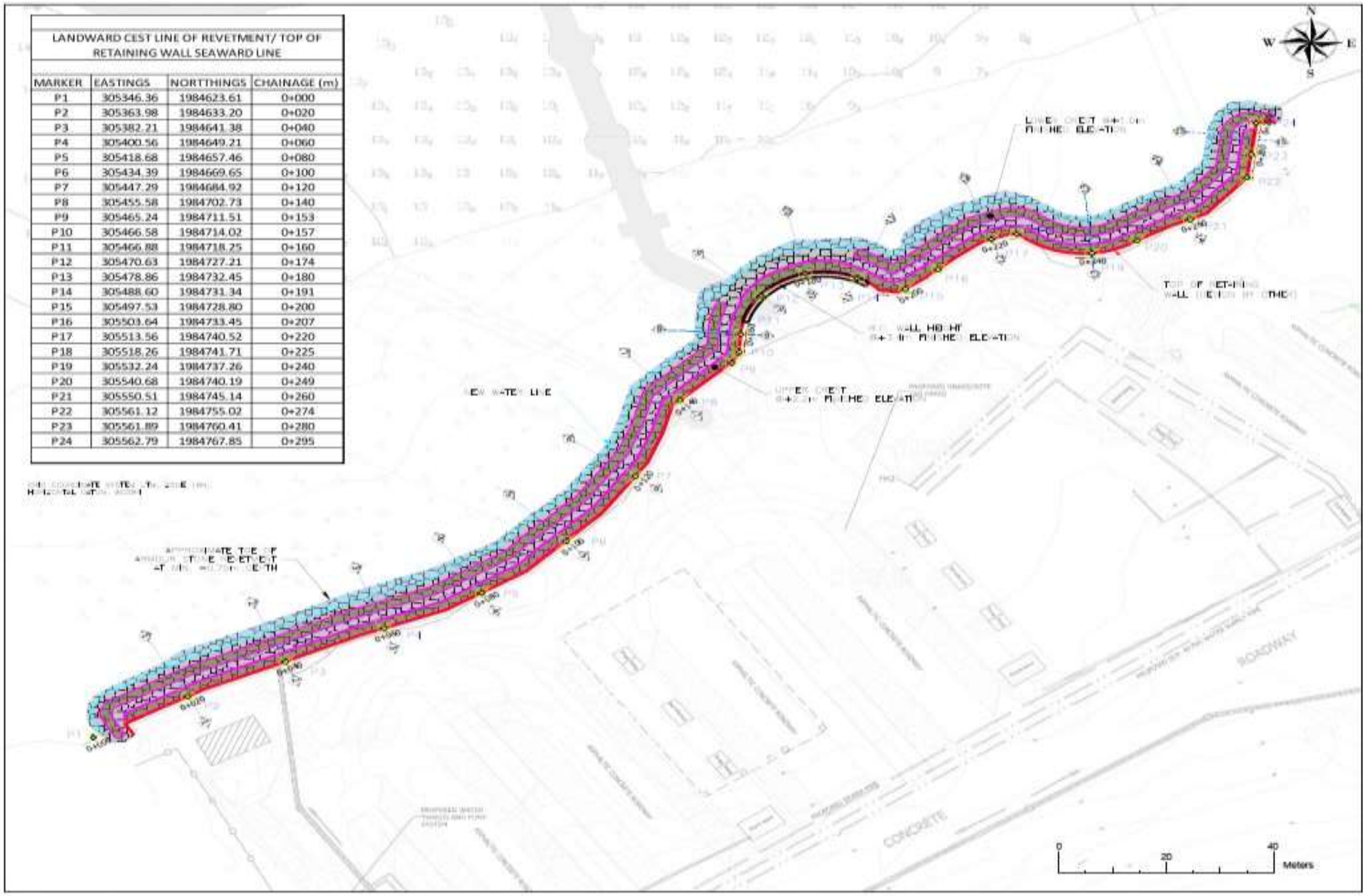
Number of layers	2.0
Rock shape coefficient C	1.0
Structure slope m	1.5
Angle of slope α (degrees)	33.7
Permeability factor Van Gent (P)	0.1
Permeability factor Van der meer (P)	0.1
Damage number (Sd)	2.0

Slope Parameters

Cplunging	6.2
Csurging	1.0
Cplunging (Recalibrated)	8.4
Csurging (Recalibrated)	1.3
Emperical value K	0.0
Stability coefficient	2.4

Van der meer recalibrated (Van Gent et al 2003)			Range	
D_{50} (m)	**M_{50} (Kg)**	Diameter (m)	0.58	0.71
0.65	700	Mass (Kg)	500	900
D_{50max} (m)	**M_{50max} (Kg)**	D_{max} (m)	0.62	0.76
0.68	784	M_{max} (Kg)	600	1100

Figure 4.7 Calculations for armour stone size for the Old Coal Wharf berm revetment designed to withstand the 100 – year hurricane event



LANDWARD CEST LINE OF REVETMENT/ TOP OF RETAINING WALL SEAWARD LINE			
MARKER	EASTINGS	NORTTHINGS	CHAINAGE (m)
P1	305346.36	1984623.61	0+000
P2	305363.98	1984633.20	0+020
P3	305382.21	1984641.38	0+040
P4	305400.56	1984649.21	0+060
P5	305418.68	1984657.46	0+080
P6	305434.39	1984669.65	0+100
P7	305447.29	1984684.92	0+120
P8	305455.58	1984702.73	0+140
P9	305465.24	1984711.51	0+153
P10	305466.58	1984714.02	0+157
P11	305466.88	1984718.25	0+160
P12	305470.63	1984727.21	0+174
P13	305478.86	1984732.45	0+180
P14	305488.60	1984731.34	0+191
P15	305497.53	1984728.80	0+200
P16	305503.64	1984733.45	0+207
P17	305513.56	1984740.52	0+220
P18	305518.26	1984741.71	0+225
P19	305532.24	1984737.26	0+240
P20	305540.68	1984740.19	0+249
P21	305550.51	1984745.14	0+260
P22	305561.12	1984755.02	0+274
P23	305561.89	1984760.41	0+280
P24	305562.79	1984767.85	0+295

Figure 4.8: Plan of armour stone revetment

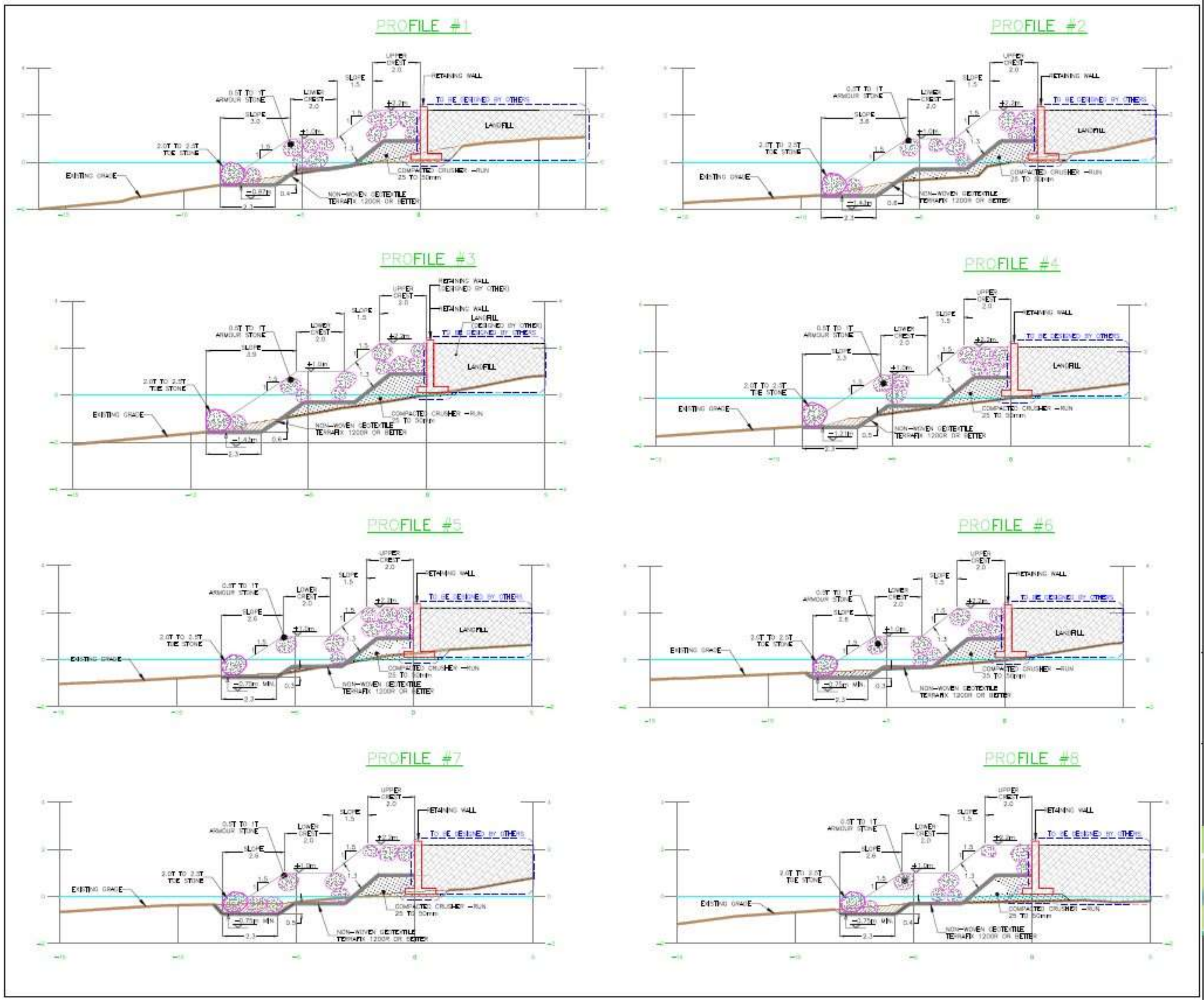


Figure 4.9 Cross-sections for armour stone revetment sheet 1

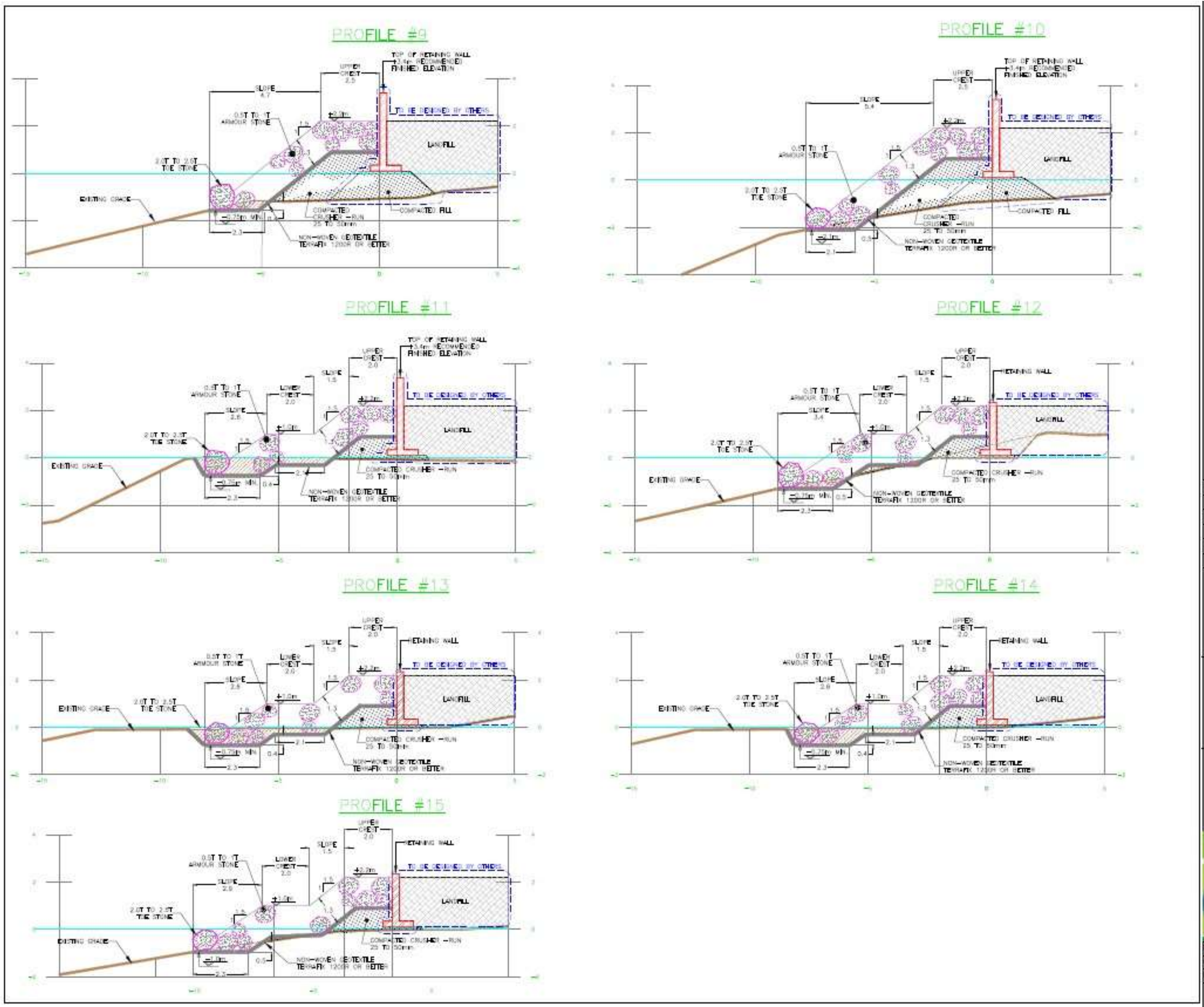


Figure 4.10 Cross-sections for armour stone revetment sheet 2

5 Conclusions

This report examined the extreme hurricane conditions for the 100-year return period and the storm surge associated with this event. The objective was to obtain the design wave conditions for the proposed armour stone revetment and the design water levels for the property to reduce wave overtopping.

Two models were applied in the study, the first was the MIKE21 SW/HD model to transform the deep-water wave conditions to the project site. This produced the static wave and storm surge heights. These results were then used as input to the sBEACH numerical model to obtain the dynamic wave and storm surge elevations.

The results indicated that a berm amour stone revetment is the recommended design with a crest height of 2.2m above MSL.

The storm surge analysis indicates that floor levels should be at least 2.2m above MSL.

The armour stone sizes for the revetment ranged from 0.58m to 0.71m with an armour stone mass ranging between 500 to 900kg. The toe stone ranges from 2000 to 2500kg.

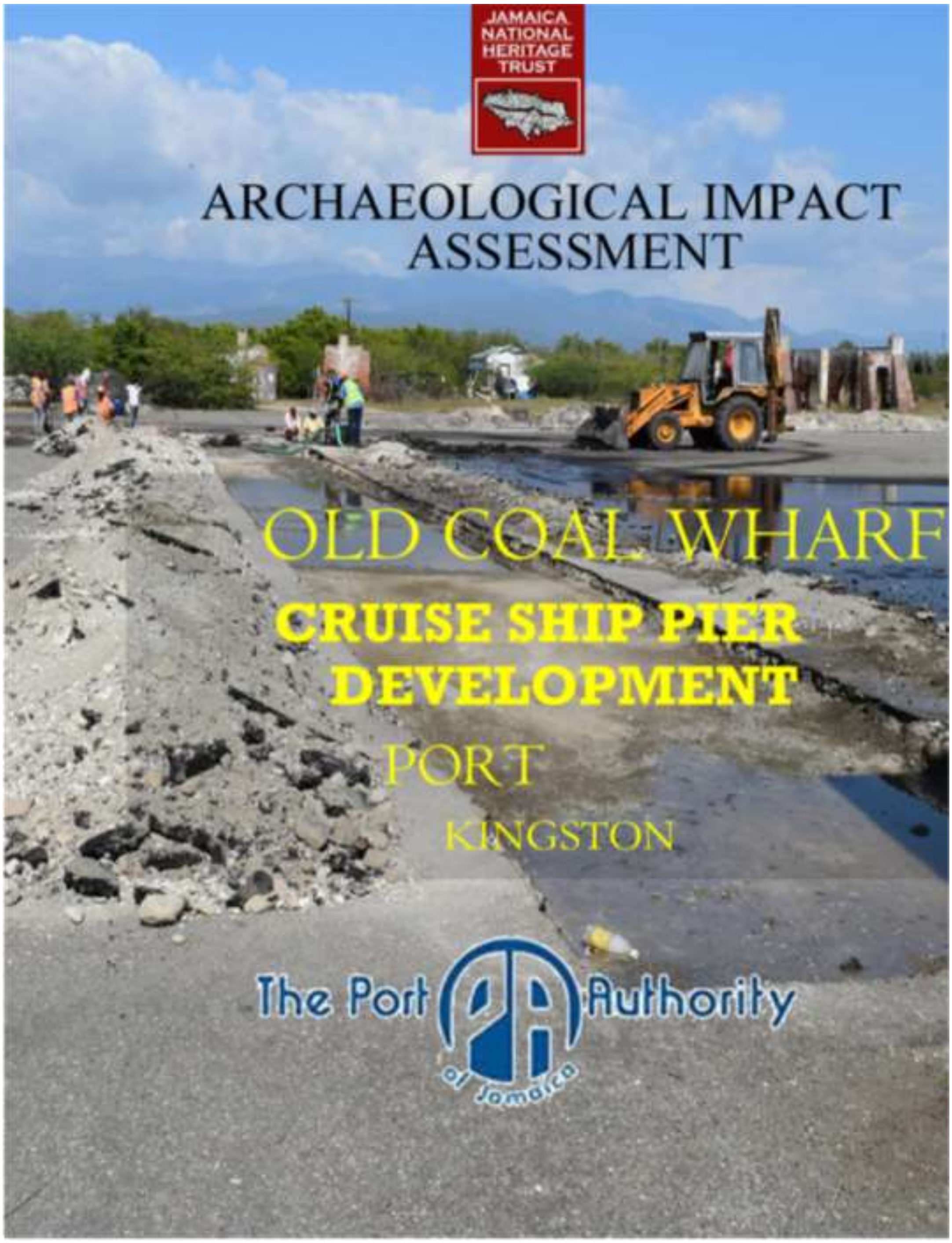
6 References

Cooper, C.K., 1988, "Parametric Model of Hurricane-Generated Winds, Waves, and Currents in Deep Water", *Proc. OTC*, vol. 2, no. OTC 5738, pp. 475-484.

Van Gent, M.R.A., Smale, A.J. and Kuiper, C., 2003. Stability of rock slopes with shallow foreshores. *Proc. Coastal Structures*, ASCE. Portland, USA

Young, I.R.; Burchell, G.P. Hurricane generated waves as observed by satellite. *Ocean Eng*. 1986, 23, 761–776.

13.1.3 Archaeological Impact Assessment



May 2019

ARCHAEOLOGICAL IMPACT ASSESSMENT OLD COAL WHARF

CRUISE SHIP PIER AND TERMINAL DEVELOPMENT

PORT ROYAL

KINGSTON

Prepared for

The Port Authority of Jamaica

15 – 17 Duke Street

Kingston

Prepared by

Archaeology Division

Jamaica National Heritage Trust

79 Duke Street, Kingston

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S. NON-TECHNICAL SUMMARY

S.1 The Jamaica National Heritage Trust (JNHT) has concluded an Archaeological Impact Assessment (AIA) on the property at the Old Coal Wharf site in Port Royal, where the Port Authority of Jamaica (PAJ) has proposed development of a Floating Cruise Ship Pier (Sea Walk) and Terminal. The Sea Walk technology is being utilized on several World Heritage Sites in Europe especially on sites that has very sensitive underwater heritage assets. The study was conducted in March 2019.

S.2 The Old Coal Wharf represented the final phase of the British Naval Dockyard expansion in the 19th century when steam powered vessels became a prominent feature of the British Naval fleet. The proposed development site is situated immediately outside the proposed Port Royal World Heritage Nominated Property boundary delimitation but falls within the proposed buffer zone. It comprises approximately 9 acres of lands at the extreme eastern end of the Port Royal’s Township.

Source: Winston Abrahams 2019, JNHT Sites and Monuments Record – Map 1 shows the proposed development area in proximity to Port Royal World Heritage Nominated Property Boundary Delimitation.

S.3 The Archaeology Impact Assessment (AIA) was done in accordance with the Jamaica National Heritage Trust stipulated standards and guidelines for Archaeological Impact Assessment (AIA) and International Council On Monuments & Sites (ICOMOS) Guidance on Heritage Impact Assessments (HIA) for Cultural World Heritage Properties (Appendix 2). The study was commissioned by The Port Authority of Jamaica (PAJ) and is in partial fulfilment of an Environmental Impact Assessment (EIA) required by the National Environmental Planning Agency (NEPA) and a Heritage Impact Assessment required by World Heritage Committee.

S.4 Its objective was to ascertain the presence of significant archaeological and other heritage assets and describe and appraise their worth in context of the proposed development, World Heritage Nomination, legislative and regulatory considerations. To identify and predict any potential positive, negative, reversible, irreversible, short and long term impact and to indicate possible mitigation to negative impacts, as well as recommendations to enhance positive impacts, also to outline possible alternatives to the project or aspects of it. Where necessary indicate suitable management and monitoring plan during the project's implementation.

S.5 It is envisioned that the development will be a vibrant and sustainable gateway into historic Port Royal; respecting the natural and cultural fabric of the place with special attention on the property's Outstanding Universal Value (OUV). Its establishment will stimulate the preservation and restoration of historic and archaeological assets, while fostering improvement in the quality of life for the Port Royal community. In addition the vision is to expose visitors to:

- The unique history of Port Royal through vibrant living experiences;
- The vibrant culture through the people, their food and way of life;
- Port Royal's British Naval history by visiting Fort Charles, the Old Naval Hospital, Old Naval Cemetery and the sunken St. Peter's Church site in the Old Naval Dockyard.
- The Pirates' truth and legends that made Port Royal World renowned.

S.6 There are a number of pertinent policies, legislation, regulations and environmental standards of the Government of Jamaica (GOJ) relating to environmental protection that are applicable to any development and that a developer will need to consider when embarking on a particular scale and type of development. There are several government agencies mandated with the authority to control certain types of development that may have potential negative impact on the natural and cultural environment. The powers of control and regulation are typically exercised through a system of permits that include checks and balances on what kind and form of development can occur.

S.7 Port Royal's Nomination as a Relict and Continuous Cultural Landscape was submitted to the UNESCO World Heritage Committee in January 2018. The 43rd Session of the World Heritage Committee held between June 30 – July 10, 2019 will make a decision on the Property's nomination.

S.8 Analysis of Impact

Potential Impact and Mitigation Measures

Resource ID	**Potential Impact**	**Mitigation**	**Duration**		**Magnitude**		**Form**	
			Long	Short	Major	Minor	Reversible	Irreversible
A	**Negative Impact** Sections of the discontinuous Coal Wharf parameter wall will be taken down	• The developer adjust plan to preserve parameter wall adjoining the Admiralty House Property. • Restore parameter wall that extends into the sea on the east side of the property • Preserve bricks recovered from the site to restore wall.	√		√		√	
B	**Negative Impact** Modern structure located in area of the site that overlaps the World Heritage Nominated Property is to be destroyed and converted into a	• Abide by the agreement of the key stakeholders that this area should be free any new building • Preserve the area as a green space.	√			√		√
	parking area. **Positive Impact** Inappropriate design modern building to be removed from the nominated property							

C	**Positive Impact** □ The remains of Coal Shed 1 will be preserved and incorporated in development as one of the bus loading area.	• Columns and brick floor should be restored to preserve a level of authenticity. • Iron beams should be assessed to ascertain state of conservation and where possible use in its rehabilitation.	√		√		√	
D	**Positive Impact** □ The standing south wall of Coal Shed 2 will be restored and incorporated in the development. It will become part of the market place.	□ Utilize bricks recovered from the site in the rehabilitation work	√		√		√	
E	**Negative Impact** □ Remains of adjunct building to Coal Shed 2 is slate to be taken down due to its safety hazard status. Section of the main terminal building is slated to be constructed there.	□ Recover bricks and use in restoration of walls and floors	√			√		√
F	**Negative Impact** □ Though the asphalted recreation area will not be destroyed; it will be buried under fill material in an attempt to raise the ground level of the site. In this case the use will be negatively impacted. The Terminal Plaza is planned for this area.		√			√	√	

G	**Negative Impact** The old concrete pier remnants are to be remove from the sea to make way for the installation and operation of the Sea Walk.	• Take the necessary management steps to prevent damage to marine life and significant cultural heritage assets. • Employ the use of silt screen.	√			√		√
H	**Negative Impact** The Electricity Generator House is proposed to be demolished and new structures erected to facilitate private parking and service area.	Though it is in a deplorable condition it is repairable. The developer should consider adjusting its plan to preserve and incorporate in the development.	√		√			√
I	**Negative Impact** Three large anchors found on the site will be buried by raising the site elevation with dump material. The new function of the location will be for private parking and service.	• These significant artefacts should be rescued. • The anchors should be conserved • The artefacts should be displayed at an ideal location on the property in an effort to retain levels of authenticity.	√		√		√	
J	**Negative Impact** The house pillar ensemble is to be covered by fill material		√			√		√
K	**Negative Impact** Mangrove and concrete rubble is to be cleared and the amenities for the small ship jetty constructed.		√			√		√
L	**Negative Impact** A small concrete Jail cell or arm store is to be demolish and train line and facilities built	Preserve jail cell as part of the historical landscape	√			√		√

M	**Negative Impact** Squatter shack attached to jail cell is to be demolished and the area use for train line and loading bay.		√			√	√	
	Positive Impact The development of the site will prevent further squatting and ultimately development of an informal settlement and destruction of mangrove							
N	**Negative Impact** Taino pottery sherds surface scatter will be displaced to accommodate		√			√		√

S.9 Cumulative Impact

Outstanding Universal Value (OUV)

Cumulative impacts have been taken into consideration especially in light of the fact that since January 2018 the State Party has submitted Port Royal's Nomination for inscription on the World Heritage List. This proposed development will present challenges for the site in terms of carrying capacity. Thousands of visitors will be descending on the historic township which could negative impact the property's Outstanding Universal Value (OUV). Tangible assets that exhibit OUV may be damaged by overcrowding or inappropriate activities. However, the project has the potential to stimulate economic growth and social wellbeing; thus alleviating the chronic case of poverty now prevailing in the community. One of the fundamental objectives of World Heritage inscription is to improve the quality of life of people who live in the property and who may be the owners of the culture heritage being recognized of having Outstanding Universal Value (OUV). In this context the cumulative impact during the pre-construction and construction is expected to be negligible. Impact during the operation phase may be both negative and positive. Positive impact is expected to be long tern while negative impact may be short term and reversible.

Archaeological / Research Value

All the archaeological remains uncovered as a result of Test Trench Excavation will be preserved in-situ. The proposal to dump material on the site as a means to raise the elevation of the place to guard against the impact of storm surge and flooding will bury and preserve the remains. The impact duration therefore is long term, its magnitude is minor and form is reversible.

Test Trench 1 was excavated to ascertain the presence of archaeological elements of pre-1692 Port Royal. The trench revealed no archaeological resource from that period down to an approximate depth of 1.8 meters. It must be noted that remains of the period may be at a lower depth. The impact on resource from the period in that overlapping area is uncertain at this time.

Authenticity

Though the site has undergone significant change in function and character since its days as a British Naval Dockyard Coal Wharf elements of authenticity still reside in size, construction material, architectural designs and layout plan. The obvious impact on the site's authenticity will be as follows:

- A change in the size of the property whereby the proposed development will extend beyond the parameter wall southwards to as far as the existing main road thus enlarging the original property size. This impact on authenticity is negative, major, long term but reversible.

- The original layout plan of the coal wharf is strikingly different from that of the proposed development due primarily to the difference in function. The impact will be negative, major, long term and irreversible.

- A tremendous amount of brick and in later days concrete mixed with brick aggregate were used in the construction of buildings and other structures. The new amenities and infrastructures will be erected using reinforced concrete which is considered to perform better in seismic events. This impact will be negative, major, long term and irreversible.

Integrity

The proposed development has the potential of causing increase surface runoff and pollutant into the sea affecting marine life including mangrove habitat; thus seriously degrading the natural setting around the site. Impact may be induced from all three phases of development, pre-construction, construction and operation. The negative impact may be long term or short term but may be reversible.

Social Values

Development of this nature sometimes comes with the negative impact relating to the potential increase in opportunistic persons hoping to capitalize on the benefits to be derived from increased visitor arrivals to the area. This could lead to illegal roadside vending, the growth of informal residential settlements, poor sanitation practices and road congestion.

Aesthetic Values

Another significant adverse impact will be the alteration of the serene aesthetic natural and historical seascape. The mass, scale and design of cruise vessels will undoubtedly dwarf and thus trivialize the scenic quality of the place. One good thing, however, is that the cruise ship activity is a marine-base occupation and event that is compatible to and augments the property’s historical function.

S.9 Mitigation

The main mitigation measures to address these negative impacts are as follows:

- The World Heritage Convention and Operational Guidelines; along with ICOMOS Guidelines (Venice & Washington Charters) on development in Heritage District with assets of Outstanding Universal Value are used to guide development and decision making.

- Ascertain the nominated property's carrying capacity and devise appropriate management strategies to ensure visitor number was within the property's carrying capacity.

- Enforce laws against informal settlement, illegal vending and other unauthorized activities.

- The Urban Development Corporation (UDC) complete and begin to implement the development plan for Port Royal simultaneously with this cruise ship development. In this way the amenities that are currently lacking or have become degraded can be put in place or improved to ensure a better quality of life for the residents.

- Preserve and utilize construction materials and artefacts from the site to retain some level of authenticity.

- Incorporate architectural design elements of the old dockyard into terminal buildings and other adjuvant structures.

- The removal of the remains of the old concrete pier should take into consideration all the necessary management measures to prevent perturbation and siltation that would negatively impact the marine life and cultural remains.

- The development may increase surface runoff into the sea. It is important to set up silt screen especially for the first five years of operation so that this period may be dedicated to robust monitoring of siltation i.

- In order to preserve the buried archaeological remains, the developer should adhere to preliminary discussions, agreement and proposal that newly constructed buildings would use raft foundations.

- Conduct geophysical survey of the Nominated Property and the development site overlap area to augment findings of test trench excavation findings.

1. INTRODUCTION

1.1 PURPOSE

In June 2018, the Port Authority of Jamaica (PAJ) officially proposed the development of a retractable floating cruise ship pier (Sea Walk) and terminal at the Old Coal Wharf site in Port Royal. The Sea Walk

Floating Pier technology will be the first of its kind to be utilized in Jamaica, the Caribbean and perhaps the entire Americas. The technology will be purchased from a Scandinavian Country where the technology is being used on several World Heritage Sites and cruise ship destinations.

The Old Coal Wharf represented the final phase of the British Naval Dockyard expansion in the 19th century when steam powered vessels became a prominent feature of the British Naval fleet. The proposed development site is situated immediately outside the proposed Port Royal World Heritage Nominated Property boundary delimitation but falls within the proposed buffer zone (Map 1). It comprises approximately 9 acres of lands at the extreme eastern end of Port Royal's Township and contains remnants of structures and features associated with coal storage, transportation and usage. The purpose of this report is to present the findings of an Archaeological Impact

Source: Winston Abrahams 2019, JNHT Sites and Monuments Record – Map 1 shows the proposed development area in proximity to Port Royal World Heritage Nominated Property Boundary Delimitation in the Buffer Zone.

Assessment (AIA) to inform decision makers, such as the State Party, Advisory Bodies, World Heritage Committee, permitting Agencies and Departments, NGO's interest groups and the Port Royal Community, of the significant archaeological resources to be potentially impacted. In the cumulated impact it provides a summary of the extent the proposed development will impact the Nominated Property's OUV, authenticity and integrity.

The Archaeology Impact Assessment was done in accordance with the Jamaica National Heritage Trust (JNHT's) stipulated standards and guidelines for Archaeological Impact Assessment (AIA) and ICOMOS Guidance on Heritage

Impact Assessments for Cultural World Heritage Properties. The study was commissioned by The Port Authority of Jamaica and is in partial fulfilment of an Environmental Impact Assessment required by the National Environmental Planning Agency (NEPA) and a Heritage Impact Assessment required by ICOMOS. Its objective was to ascertain the presence of significant archaeological and other heritage assets and describe and appraise their worth in context of the proposed development, World Heritage Nomination, legislative and regulatory considerations. To identify and predict any potential positive, negative, reversible, irreversible, short and long term impact and to indicate possible mitigation to negative impacts, as well as recommendations to enhance positive impacts and also to outline possible alternatives to the project or aspects of it. Where necessary indicate suitable management and monitoring plan during the project's implementation.

Port Royal's Nomination as a Relict and Continuous Cultural Landscape was submitted to the UNESCO World Heritage Committee in January 2018. A decision to inscribe the property will be made at the 43rd Session of the World Heritage Committee between June 30– July 10, 2019. The Nominated Property's Outstanding Universal Value (OUV) may be described as follows:

> *Port Royal was established in 1655 the date England captured the island of Jamaica from Spain. This city built of brick comprised 20.64 hectares (51 acres) and was situated at the tip of a 29 kilometres (18 miles) long sand spit known as the Palisadoes at the southern end of the Port Royal Harbour. This Harbour is now called the Kingston Harbour, and is one of the seven best natural harbours in the world. Notorious as the "the richest and wickedest city on earth", Port Royal was struck on June 7, 1692 by a catastrophic earthquake and tsunami resulting in two-thirds of the city sinking into the Harbour. The city was then rebuilt in wood but again was destroyed by fire in 1703.*

The Port Royal Nominated Property is the Catastrophic Site that existed over its 37 years representing a relict and continuing cultural landscape. Popularly called the "Sunken City of Port Royal, Jamaica", the underwater cultural heritage site is contiguous with a remnant terrestrial palimpsest 'living archaeology site' of outstanding universal value.

Depicting a natural environment that engendered the interaction between humans and nature living in a geomorphological terrain susceptible to extreme seismic events and intense cyclonic episodes, Port Royal fills the gap on the World Heritage List for underwater cultural properties. It has been greatly impacted by a series of natural and anthropogenic disastrous events since 1692. The underwater cultural heritage is one of the best preserved archaeological sites in the world, and the Palisadoes and Port Royal Protected Area is a 2005 designated Ramsar site as Wetlands of International importance.

The Sunken City is a significant time-capsule providing a complete snapshot of 17th century English urban landscape. Outstandingly, it freezes the un-syncretic copying of English urban settlement pattern for colonisation of the New World, where the rent was said to be more expensive in Port Royal than in England at Cheapside, London.

Unrivalled, Port Royal embodies the system of English 17th century seafaring and trading in African enslavement and trafficking to become the leading entrepot in the Americas. This system left a cultural heritage footprint in Port Royal of fortification. Six forts were established around the Port Royal perimeter, making it impregnable.

Port Royal resonates internationally as the infamous centre for Piracy and privateering. Arguably the most famous pirate in the world, Henry Morgan, whose exploits on Panama City and other Spanish colonies in the Americas contributed to the tremendous wealth of Port Royal. Pirates of Port Royal have been romanticized in numerous films, documentaries and literature.

Today, Port Royal exists as a famous residential fishing village, dotted with the relicts of the past as artefacts depicting a continuing cultural landscape of military and naval importance. From its 17th century maritime exploits that continued into a 18th century dockyard and a 19th century coaling wharf, the 20th century Port Royal now houses the Jamaica Defence Force Coast Guards headquarters, and recently added is a campus of the Caribbean Maritime University.

1.2 BACKGROUND

For over three decades there have been numerous proposals advocating the development of cruise ship pier and terminal in Port Royal. While cruise shipping and pier development has always been viewed as a potential catalyst for poverty alleviation, social, economic and infrastructural development of Port Royal by successive administrations, the JNHT rejected those proposals. The proposals were rejected for the reason that they did not go far enough to ensure the preservation of the tangible and intangible heritage fabric of Port Royal. All previous proposals placed the cruise ship pier on the Sunken City which would inflict serious irreversible damage to this World renowned underwater archaeological asset. Port Royal's Sunken City is recognized by marine archaeologists as one of the best preserved underwater archaeological site in the World and the only one of its kind in the Western Hemisphere. It is for this reason *inter alia* why Port Royal has been submitted as a candidate for World Heritage Status.

1.2.1 Site and Location

As a principle of best practice, the PAJ engaged the JNHT and other key permitting entities in preliminary discussions about the feasibility of a Floating Cruise Ship Pier and terminal to be located at the Old Coal Wharf in Port Royal. The PAJ recognized the importance of Port Royal's World Heritage Nomination and expressed its commitment to the preservation of the property's Outstanding Universal Values. It is out of this recognition that the Floating Pier and terminal installation is being proposed at the Old Coal Wharf. The location falls east of World Heritage Nominated Property where there is a small area overlapping Map 2. As recent as the 1990's, it was utilized as the wharf and storage site for imported aggregate used in the repair and expansion of the Norman Manley International Airport's runway. Subsequently, a large portion of the property was asphalted as an entertainment complex.

MAP 2.

Source: Winston Abrahams 2019, JNHT Sites and Monuments Record – Map 1 highlighting Port Royal's World Heritage Nominated Property Boundary Delimitation in relation to the proposed Cruise Ship Terminal Development Property.

1.2.2 Concept

The Floating Cruise Pier technology will be the first of its kind to be utilized in the Caribbean and perhaps the entire Americas. The technology will be purchased from Norway where the technology is being used on several World Heritage Sites and cruise ship destinations. By virtue of its buoyancy it will minimize installation and operational sea floor perturbation. Its ability to retract makes it less obtrusive on the seascape and overall character of the place.

The terminal and adjuvant structures will adopt the architectural designs associated with the historical dockyard coal wharf. These structures are to be constructed on raft foundation to avoid disruption of significant subterranean archaeological assets. Significant above ground heritage resources are to be incorporated in the structural and landscape design.

1.2.3 Long Term Vision for the Site

It is envisioned that the development will be a vibrant and sustainable gateway into historic Port Royal; respecting the natural and cultural fabric of the place with special attention on the property's OUV. Its establishment will stimulate the preservation and restoration of historical and archaeological assets, while fostering improvement in the quality of life for the Port Royal community. In addition, the vision is to expose visitors to:

- The unique history of Port Royal through vibrant living experiences.
- The vibrant culture through the people, their food, and way of life.
- Port Royal's British Naval history by visiting Fort Charles, the Old Naval Hospital, Old Naval Cemetery and the sunken St. Peter's Church site in the Dock Yard.
- The Pirates' truths and legends that made Port Royal world renowned.

1.3 TERMS OF REFERENCE

The Terms of Reference for the Archaeological Impact Assessment (AIA) of the proposed Old Coal Wharf Cruise Ship Floating Pier and Terminal Development at Port Royal are adopted from ICOMOS's Guidance on Heritage Impact Assessments for Cultural World Heritage Properties and JNHT's Guideline for Archaeological Impact Assessment.

1. **Introduction** – Identify the development project to be assessed and explain the executing arrangements for the archaeological impact assessment.

2. **Background Information** – Briefly describe the major components of the proposed project, the implementing agent and a brief history of the project.

3. **Study Area** – Specify the boundaries of the study area for the assessment as well as any adjacent areas within the area of influence of the project and briefly describe its OUV and or the preservation status.

4. **AIA Team** – Identify the individuals responsible for collecting the data and carrying out the archaeological impact assessment and their respective skills.

5 **Scope of Work** – The following tasks will be undertaken:

Task 1. *Desk-Based Assessment* – (a) Research relevant historical documentations: maps, plans, estate accounts, correspondents, titles, and deeds; (b) Research published and unpublished narratives, studies and data sets of the study area, adjoining areas and associated projects; (c) Analysis of satellite images and aerial photographs.

Task 2. *Site Survey* – Conduct archaeological field survey, both intrusive and non-intrusive, in pursuit of base data collection. Artefacts collection and analysis, cultural heritage contexts interpretation and analysis and recording.

Task 3. *Description of the Proposed Project* – Provide a full description of the project and its existing setting, using plans, maps and graphics. This is to include: location, general layout, pre-construction and construction activities, project life span, plans for providing utilities, waste disposal and other necessary services.

Task 4. *Description of the Project Area* – Assemble, evaluates and presents baseline data on the relevant archaeological characteristics of the study area, including (a) Physical environment: geology, topography, soils and drainage system; (b) Biological environment: flora and fauna that have cultural implications; (c) land-use and community perception and attitudes towards the proposed project.

Task 5. *Legislative and Regulatory Considerations* – Describe the pertinent regulations and standards governing land use control, environmental quality, health and safety, protection of heritage assets, protection of endangered species, and tourism facilities, and the Town and Country Development Order.

Task 6. *Determination of Potential Impacts* – identify the major issues of archaeological concerns and indicate their relative worth and weigh it against the importance of the proposed development. Distinguish construction and post-construction phase impacts, significant positive and negative impacts, and direct and indirect impacts. Identify impacts that are cumulative, unavoidable or irreversible.

Task 7. *Mitigation and Management of Negative Impacts* – Recommend feasible and cost effective measures to prevent or reduce the significant negative impacts to acceptable levels.

Task 8. *Development of a Monitoring Plan* – Present a plan for monitoring the implementation of mitigating measures during construction.

Task 9. *Determination of Project Alternatives* – Examine alternatives to the project including the no-action option and alternatives involving reductions in the scale of the development.

Task 10. *Report* - The Archaeological Impact Assessment Report is a concise collation of significant cultural environmental issues. Its main text focus on impact, mitigation and monitoring management plans. The report is organized into ten (10) sections as outlined below:

- Executive Summary
- Introduction
- Policy, Legal and Administrative Framework
- Methodology
- Description of Proposed Project
- Description of Project Area
- Impact Identification/Mitigation Strategies
- Project Alternatives
- Bibliography
- Appendices

1.4 STUDY TEAM

A multidisciplinary team of specialists conducted this Archaeology Impact Assessment study and are enumerated as follows:

Selvenious Walters, M.A. – Co-Principal Investigator – Specialist in Field and Analytical Techniques in Archaeology with over 25 years experience conducting Archaeological Impact Assessments (AIA) on development projects ranging from highway, housing, hotel and power plant construction. He is the co-author and investigator of the Blue and John Crow Mountains World Heritage Site Nomination Dossier (2015).

Dorrick Gray, M.A. – Co-Principal Investigator – Specialist in Field and Underwater Archaeology with over 30 years experience in the field and at the administration level. He is the former Executive Director of the Jamaica National Heritage Trust, PhD student in Anthropology at Syracruse University, New York and the co-author and investigator of the Blue and John Crow Mountains World Heritage Site Nomination Dossier (2015).

Jasinth Simpson, M.A. – Specialist in World Heritage Site Management. She is a co-author and investigator of the Blue and John Crow Mountains World Heritage Site Nomination Dossier (2015) and has over ten years experience working on numerous Archaeological projects.

Michelle Topping, M.A. – Historical and Pre-Historical Archaeology, specializing in intrusive evaluation and artefacts analysis. She has managed one of the most comprehensive Taino archaeological evaluation project (White Marl, St. Catherine) in Jamaica.

Winston Abrahams, M.Sc – GIS and Disaster Management specialist who is responsible for spatial analysis, inventory and mapping identified heritage assets.

1.5 METHODOLOGY

It is anticipated that a number of historical and archaeological assets will be impacted by the proposed development. To this end, a multifaceted approach was employed to identify, inventoried and predict levels of impact.

1.5.1 Identification of Assets

1. Archival Research

   This is a thorough review of all available written and graphic primary and secondary information relating to the area. It helps to identify the likely character, extent and relative quality and or quantity of actual or potential archaeological and architectural resources present. It includes relevant historical documents, journals and books, maps, plans, will, deeds, ledgers, correspondents and other contemporary data found in the nation's repositories such as the Island's Record Office, National Archives, National Library of Jamaica, University of Technology (UTECH), University of the West Indies (UWI) and private collections. Web sites were also consulted.

2. Aerial Photograph / Satellite Image Analysis

   Both types of aerial images were analyzed with the view of detecting soil or vegetation anomalies or marks that may be indicative of buried archaeological features.

3. Transect Linear Field Walk Survey

   In this technique the investigating team spread across the site, combing the property from end to end in search of artefacts assemblages and other small features not identified by the previous techniques. Artefacts assemblages are sometimes indicators of buried assets. The technique is very useful in identifying the location and presence of graves, undocumented Taino and enslaved African settlement and burial grounds.

4. Interviews

Interviews were conducted as another strategy employed to bridge the cultural heritage element data gap. Community members were subjectively selected, in particular the older (senior) citizens, and asked about their recollection of the site's spatial attributes. This method was particularly helpful in identifying the locations of three large anchors partially buried and inundated by shrub vegetation and mangrove. It was also helpful in ascertaining the function and past adoptive reuse of some ruins; essentially it was useful to the researchers in compiling a more comprehensive cultural heritage profile of the property.

5. Intrusive and Non-intrusive Evaluation

In many instances buried archaeological resources are unapparent on the surface. Non-intrusive geophysical survey techniques and or intrusive excavation are used to determine location, character, magnitude and depth of the archaeological resources. In the case of the Old Coal Wharf evaluation, the intrusive technique was chosen due to the fact that more than 60% of the land space is covered with asphalt, compacted river shingle and white limestone; combined averaged 40 cm thick. A JCB backhoe tractor was utilized to remove the overburden deposit and to excavate eleven evaluation trenches ranging between 10 and 30 metres in length and 30 to 160 centimetres deep. Five other evaluation trenches were excavated by hand.

<u>Backhoe excavated trenches</u> – were excavated as follows:

- On areas where historical structure once stood according to Phillip Mayes (1972), Michael Pawson and David Buisseret (1975).
- On locations where new structures are proposed to be erected (Development Plan).
- At the extreme western margin of the property where it is believed a small section of 1692 submerged Port Royal traversed.

Hand Excavated Trenches – were excavated as follows:

- Where brick floor remnants of the eastern coal shed was identified.
- An area where cutstone flooring was observed;
- At three separate locations where local citizens identified the presence of large ship anchors.
- In an area where Taino pottery sherds assemblage was found.

1.5.2 Base Data Recording

A site specific inventory of all cultural heritage resources to be affected by the development was created. It will form part of the Port Royal Heritage Asset Inventory and subsequently incorporated into the National Inventory of Heritage Sites.

The area where artefacts assemblages were identified, samples were collected, study, conserved and stored for future references, and where necessary, displayed as part of the site's heritage assets.

3. POLICY AND LEGISLATIVE FRAMEWORK

3.1 BACKGROUND

There are a number of pertinent policies, legislation, regulations and environmental standards of the Government of Jamaica (GOJ) relating to environmental protection that are applicable to any development and that a developer will need to consider when embarking on a particular scale and type of development. There are several government agencies mandated with the authority to control certain types of development that may have potential negative impact on the natural and cultural environment. The powers of control and regulation are typically exercised through a system of permits that include checks and balances on what kind and form of development can occur. A developer therefore, must be prepared to present, explain, and in some cases alter aspects of a development proposal in order to comply with the permitting requirements. This section therefore, highlights the relevant authorities, legislation and regulations that must be considered in order to acquire the necessary permit applicable to the development.

3.2 DEVELOPMENT CONTROL

3.2.1 Building Act (2016)

This act repeals the Kingston and St. Andrew Building Act and the Parish Council Building Act and makes provision for the regulation of the building industry. This act facilitates the adoption and efficient application of national building standards to be called the National Building Code of Jamaica for ensuring safety in the building environment, enhancing amenities and promoting sustainable development and for connected matters.

The objectives of this Act are to:

a) regulate the design, construction, maintenance, demolition, removal, alteration, repair and use of buildings and building works so as to protect the public safety and health;

b) give effect to the National Building Code of Jamaica;

c) facilitate:

    i. The adaptation and efficient application of internationally recognized building standards; and

    ii. The accreditation of building products, construction, methods, building components and building systems;

d) enhance amenities in general and require the construction of buildings that provide easy access and adequate amenities for persons with disabilities in particular;

e) promote cost effectiveness in construction of buildings;

f) promote the construction of environmentally and energy efficient buildings;

g) establish an efficient and effective system for issuing building permits and certificates of occupancy and for resolving building disputes through alternative dispute resolution;

h) regulate the standard of training and certification and provide for licensing of building practitioners and the recognition of building professionals who are regulated under other Acts; and

i) establish a building and an appeal process.

2.2.2 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The JNHT's functions outlined in Section 4 include the following responsibilities:

- To promote the preservation of National Monuments and anything designated as Protected National Heritage for the benefit of the Island;

- To carry out such development as it considers necessary for the preservation of any National Monument or anything designated as Protected National Heritage;

- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected. Section 17 further states that it is an offence for any individual to:

  i. wilfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a National
  Monument or Protected National Heritage;

  ii. alter any National Monument or mark without the written permission of the Trust;

  iii. remove or cause to be removed any National Monument or Protected National Heritage to a place outside of Jamaica.

2.2.3 Land Acquisition Act (1947)

Section 3 of the Land Acquisition Act (1947) empowers any officer authorized by the Minister to enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;

- Cutting down and clearing away any standing crop, fence, bush or woodland;

- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

The Minister is authorized under Section 5 of the Act to make a public declaration under his signature if land is required for a public purpose provided that the compensation to be awarded for the land is to be paid out of the:

- Consolidated Fund or loan funds of the Government;

- Funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details outlined in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

2.2.4 Land Development and Utilization Act (1966)

Under Section 3 of the Land Development and Utilization Act (1966), the Land Development and Utilization Commission is authorized to designate as agricultural land, any land which because of its "situation, character and other relevant circumstances" should be brought into use for agriculture. However, this order is not applicable to land, which has been approved under the Town and Country Planning Act for development purposes other than that of agriculture. Among the duties of the Commission outlined in Section 14 of the Act is its responsibility to ensure that agricultural land is "as far as possible, properly developed and utilized".

2.2.5 Main Road Act

The Main Road Act of 1932 details the legal basis for main roads and specifically looks at management, laying out of road, taking of lands, encroachment, offenses, lights and carriages, power to arrest and other legalities. In section 5 of this Act, it states that the Minister has the power to declare other roads or parts thereof to be main roads and to also declare that a main road is no longer such. The Chief Technical Director under the Minister's directive is responsible for the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing main roads, and controlling the expenditure of allotted moneys.

2.2.6 Parish Council Act

Under the Parish Council Act each Local Planning Authority may revoke or alter regulation concerning the construction and restriction as to the elevation, size and design of buildings, built with the approval of the relevant Minister. It may also make regulations concerning the installation of sewers on premises.

2.2.7 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries as well as an application for licenses. The Act provides for the establishment of quarry zones, controls licensing and operations of all quarries. The Minister may on the recommendation of the Quarries Advisory Committee declare as a specified area, any area in which quarry zones are to be established and establish quarry zones within any such specified area.

Section 5 of the Act states that a license is required for establishing or operating a quarry though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures are outlined in Section 8. The prescribed form is to be filed with the Minister along with the prescribed fee and relevant particulars. The applicant is also required to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which it was filed.

2.2.8 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica, which is carried out using a modified Torrens System (Centre for Property Studies, 1998). Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

2.2.9 Town and Country Planning Act

The Town and Country Planning Act provide the statuary requirements for the orderly development of land as well as guidelines for the preparation of Development Orders, stipulation for Advertisement Control Regulations, Petrol Filling Stations and Tree Preservation Orders. It establishes the Town and Country Planning Authority, which in conjunction with the Local Planning Authority are responsible for the land use zoning and planning regulations as described in their local Development Orders. The Town and Country Planning Act is administered by the National Environment and Planning Agency (NEPA).

2.3 ENVIRONMENTAL CONSERVATION

2.3.1 Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

The Endangered Species Act deals with restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement. Many species of reptile, amphibian and birds that are endemic to Jamaica but not previously listed under national protective legislation, or under international legislation, are listed in the Appendices of this Act.

2.3.2 Flood Water Control Act (1958)

The Flood Control Act of 1958 is administered by the National Works Agency and designates specific personnel with the responsibility of and the required power to ensure compliance with the legislation.

Any government department/agency or statuary body or authority appointed by the Minister may enter land in the flood-water control area to:

- Survey, measure, alter or regulate water courses, maintain or build tools required to undertake works;
- Clean watercourse or banks of such deposit where required; Construct, improve, repair or maintain floodwater works.

Wilfully or maliciously blocking, obstructing, encroaching on or damage any watercourse, pipe or appliances use to execute works under the Act is an offence.

2.3.3 Natural Resources Conservation Authority Act (1991)

The Natural Resources Conservation Authority Act was passed in the Jamaican Parliament in 1991 and provided the basis for the establishment of the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development in Jamaica through the protection and management of Jamaica’s natural resources and control of pollution. Sections 9 and 10 of the NRCA Act stipulates that an Environmental Impact Assessment (EIA) is required for new projects and existing projects undergoing expansion. The body is also responsible for investigating the effect on the environment of any activity that may cause pollution or which involves waste management. Sections of the Act that relate specifically to pollution control state that:

(i) No person shall discharge on or cause or permit the entry into waters, on the ground or into the ground, of any sewage or trade effluent or any poisonous noxious or polluting matter.

(ii) No person is allowed to construct or reconstruct or alter any works designed for the discharge of any effluent.

The Act also empowers the authority to require of any owner or operator of a pollution control facility to provide information on the performance of the facility, the quantity and condition of effluent discharged and the area affected by the discharge of such effluent. The Authority has the right to consult with any agency or department of Government having functions in relation to water or water resources to carry out operations to:

(a) Prevent pollutants from reaching water bodies.

(b) Remove and dispose of any polluting matter or remedy or mitigate any polluted water body in order to restore it.

2.3.4 The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

The island of Jamaica and the Territorial Sea of Jamaica have been declared a Prescribed Areas. No person can undertake any enterprise, construction or development of a prescribed description or category except under and in accordance with a permit. The Natural Resources Conservation (Permits and Licenses) Regulations (1996) give effect to the provisions of the Prescribed Areas.

2.3.5 Water Resources Act (1995)

The Water Resources Act of 1995 established the Water Resources Authority (WRA). This Authority is authorized to regulate, allocate, conserve and manage the water resources of the island. The Authority is also responsible for water quality control and is required under Section 4 of the Act to provide upon request to any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources. It is the responsibility of the WRA as outlined in Section 16 to prepare, for the approval of the Minister, a draft National Water Resources Master Plan for Jamaica. Areas to be covered in this Draft Master Plan of 1990 included objectives for the development, conservation and use of water resources in Jamaica with consideration being given to the protection and encouragement of economic activity, and the protection of the environment and the enhancement of environmental values. Section 25 advises that the proposed user will still have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, Section 21 of the Act stipulates that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority (NRCA) or any other relevant body as indicated by the Minister. With regard to underground water, Section 37 states that it is unlawful to allow this water to go to waste. However, if the underground water "interferes or threatens to interfere with the execution or operation of any underground works", it will not be unlawful to allow the water to go to waste in order to carry out the required works provided that there is no other reasonable method of disposing of the water. The Authority also has the power to determine the safe yield of aquifers (Section 38).

2.3.6 Wildlife Protection Act (1945)

The Wildlife Protection Act of 1945 prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams, and authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtle, one land mammal, one butterfly, three reptiles and several species of birds including rare and endangered species and game birds.

2.4 PUBLIC HEALTH AND WASTE MANAGEMENT

2.4.1 Clean Air Act (1964)

This act refers to premises on which there are industrial works, the operation of which is in the opinion of an inspector likely to result in the discharge of smoke or fumes or gases or dust in the air. An inspector may enter any affected premise to examine, make enquiries, make tests and take samples of any substance, smoke, fumes, gas or dust as he considers necessary or proper for the performance of his duties.

2.4.2 Country Fires Act (1942)

Section 4 of the Country Fires Act of 1942 prohibits the setting of fire to trash without prior notice being given to the nearest police station and the occupiers of all adjoining lands. In addition, a space of at least 4.5 metres (15 feet) in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Section 6 of the Act empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit. Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);

- Negligent use or management of a fire which could result in damage to property (Section 13a);

- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

2.4.3 Natural Resources Conservation Authority (Air Quality) Regulations, 2002.

Part I of this Act stipulates license requirements and states that every owner of a major facility or a significant facility shall apply for an air pollutant discharge license. Part II speaks to the stack emission targets, standards and guidelines.

The Act states that no person shall emit or cause to be emitted from any air pollutant source at a new facility, any visible air pollutants the opacity or pollutant amount of which exceeds the standards. Every owner of a facility with one or more air pollutant source or activity shall employ such control measures and operating procedures as are necessary to minimise fugitive emissions into the atmosphere, and such owner shall use available practical methods which are technologically feasible and economically reasonable and which reduce, prevent or control fugitive emissions so as to facilitate the achievement of the maximum practical degree of air purity. Under this Act a "major facility" is described as any facility having an air pollutant source with the potential to emit:

(a) One hundred or more tonnes of any one of total suspended particulate matter (TSP);

(b) Particulate matter with a diameter less than ten micrometres (PM10);

(c) Sulphur oxides measured as sulphur dioxide (SO2);

(d) Carbon monoxide (CO);

(e) Nitrogen oxides (NOx) measured as equivalent nitrogen dioxide;

(f) Five or more tonnes/y lead;

(g) Ten or more tonnes per year of any single priority air pollutant; or

(h) Twenty-five or more tonnes per year of any combination of priority air pollutants;

2.4.4 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act (2001) is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The Solid Waste Management Authority (SWMA) is to take all steps as necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused or disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management.

2.4.5 Noise Abatement Act (1997)

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specific equipment. This act has been said to address “some concern but is too narrow in scope and relies on subjective criterion” (McTavish). Given this, McTavish conducted a study to recommend wider and more objective criteria in accordance with international trend and standards, but tailored to Jamaica’s conditions and culture. To date, apart from the Noise Abatement Act (1997) Jamaica has no other national legislation for noise.

2.4.6 Noise Standards

Jamaica has no national legislation for noise, but World Bank guidelines have been adopted by the National Environment and Planning Agency (NEPA), and are used for benchmarking purposes along with the draft National Noise Standard that is being prepared. The guidelines for daytime perimeter noise are 75 decibels and 70 decibels for night time noise.

2.4.7 Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;
- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

2.4.8 Public Health Act (1976)

The Public Health (Air, Soil and Water Pollution) Regulations 1976, aim at controlling, reducing, removing or preventing air, soil and water pollution in all possible forms. Under the regulations given:

i. No individual or corporation is allowed to emit, deposit, issue or discharge into the environment from any source.

ii. Whoever is responsible for the accidental presence in the environment of a contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay.

iii. Any person or organization that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants.

iv. No industrial waste should be discharged into any water body which will result in the deterioration of the quality of the water.

2.7 INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

2.7.1 UNESCO World Heritage Convention 1972

The World Heritage Convention was adopted by the General Conference of the United Nations Education, Scientific and Cultural Organization (UNESCO) in 1972 to protect internationally outstanding natural and cultural from a number of threats; many of which not only persist , but have intensified to date.

Article 5 of the convention states that: To ensure that effective and active measures are taken for the protection, conservation and preservation of the culture and natural heritage situated on its territory, each State Party to this convention shall endeavour, in so far as possible, and as appropriate for each country:

1. To adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of the heritage into a comprehensive planning programme;

2. To set up within its territories, where such services do not exist, one or more services for the protection, conservation and presentation of the cultural and natural with an appropriate staff and possesses the means to discharge their function;

3. To develop scientific and technical studies and research and to work out such operating method that will make the State capable of counteracting the changes that threaten its cultural and natural heritage;

4. To take the appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage, and

5. To foster the establishment or development of national or regional centres for the training in the protection, conservation and presentation of the cultural and natural heritage and to encourage scientific research in this field.

Article 6 further states:

1. Whilst fully respecting the sovereignty of the State on whose territory the cultural and natural heritage is situated, and without prejudice to property rights provided by national legislation, the State Parties to this Convention recognize that such heritage constitutes a world heritage for whose protection it is the duty of the international community as a whole to cooperate.

2. The State Parties undertake, in accordance with the provision of this convention, to give their help in the identification, protection, conservation and presentation of the cultural and natural heritage, if the States on whose territory it is situated so request.

3. Each State Party to this Convention undertakes not to take any deliberate measure which might damage directly or indirectly the cultural and natural heritage situates on the territory of other State Parties to this Convention.

2.5.2 UNESCO Convention on the Protection of Underwater Cultural Heritage (2001)

The convention is a treaty that is intended to protect all traces of human existence having a cultural, historical or archaeological character which have been underwater for over 100 years. This extends to the protection of shipwrecks, sunken cities, prehistoric art work, treasures that may be looted, sacrificial and burial sites and old ports that covers the ocean floors.

2.5.3 Convention on Biological Diversity

The objectives of the Convention on Biological Diversity are "the conservation of biological diversity, sustainable use of its components and the fair equitable sharing of the benefits arising out of the utilization of genetic resources". This is the first global, comprehensive agreement which as its focus, all aspects of biological diversity: genetic resources, species and ecosystems. The Convention acknowledges that the "conservation of biological diversity is a common concern of humankind and an integral part of the development process". In order to achieve its goals, the signatories are required to:

- develop plans for protecting habitat and species.
- provide funds and technology to help developing countries provide protection.
- ensure commercial access to biological resources for development.
- share revenues fairly among source countries and developers.
- establish safe regulations and liability for risks associated with biotechnology development.

Jamaica's Green Paper Number 3/01, entitled *Towards a National Strategy and Action Plan on Biological Diversity in Jamaica,* and speaks to Jamaica's continuing commitment to its obligations as a signatory to the Convention.

4. PROJECT DESCRIPTION

4.1 PRE-CONSTRUCTION PHASE

In preparing the site for the installation of the retractable floating pier (Sea Walk) and the erection of terminal structure and adjunct amenities, this preliminary phase of work propose the following actions:

a) The removal of remnants of the early 20th century iron and concrete pier in order to install the new retractable floating apparatus (Plate 1). This will be done by using techniques that will have the least possible damaging effects on the sea floor and the shoreline.

Plate 1. Remnants of modern concrete wharf element on the Old Coal Wharf property, 2015.

b) The relocation of a decommissioned Jamaica Defense Force Coast Guard vessel and the clearance of remnants of other vessels from the shoreline (Plate 2).

Plate 2. A decommissioned Coast Guard vessel and the remains of other crafts.

c) Removal of secondary vegetation comprising mainly of acacias and other shrubs along with household and commercial debris dumped on the property (Plates 3 and 4).

Plates 3 and 4. Portrays images of secondary vegetation, primarily acacia, household refuse and remains from sea vessels.

d) Raising the site surface above high tide and storm surge levels by dumping 60 cm thick stone aggregate on the property.

4.2 CONSTRUCTION PHASE

4.2.1 Site Layout Plan and Building Design

The proposed development at the Old Coal Wharf consists of a retractable Floating Cruise Ship Pier (Sea Walk) and terminal facilities will be built in phase 1 of the construction phases. A train and rail system to take visitors into the Historic District and other natural and cultural sites along the Palisados, such as Fort Rocky, the Old Naval Cemetery and Refuge Cay, will be constructed in phase 2 of the project. Table 1 indicates buildings and structures to be constructed in both phases 1 and 2 as highlighted in Plans 1 and 2. Figure 1 shows the architectural design concept of buildings which are inspired by designs used in the Naval Dockyard during the 18th

and 19th centuries. Figure 2 illustrates the sites conceptual layout from four different angles and Figure 3 highlight the orientation of cruise ship and floating pier.

Table 1. Development Elements of Phases 1 and 2

Elements ID No.	Description	Phase
1	Floating Pier and Promenade	1
2	Terminal Building	1
3	Main Plaza	1
4	Bus loading with retail and restrooms	1
5	Bus loading with retail and restrooms	1
6	Market Place (Craft Shops)	1
7	Taxi, Coaster and Tram	1
8	Restaurant with outdoor dining	1
9	Small Vessel Jetty	2
10	Train Station and Railway track	2
11	Tram Loading	1
12	Staff and Public Parking	1
13	Entry / Exit: Taxi, Coaster Tram	1
14	Pedestrian Crosswalk and Improved Walkway	1
15	Entry / Exit: Taxi, Coaster Tram	1
16	Staff Office / Maintenance and Service	1
17	Bus Loading Building	1
18	Bus Loading Building	1
19	Bus Loading Building with Retail and Restrooms	1
20	Amphitheater	1

PLAN 1.

PLAN 2.

Source: Port Authority of Jamaica, 2018

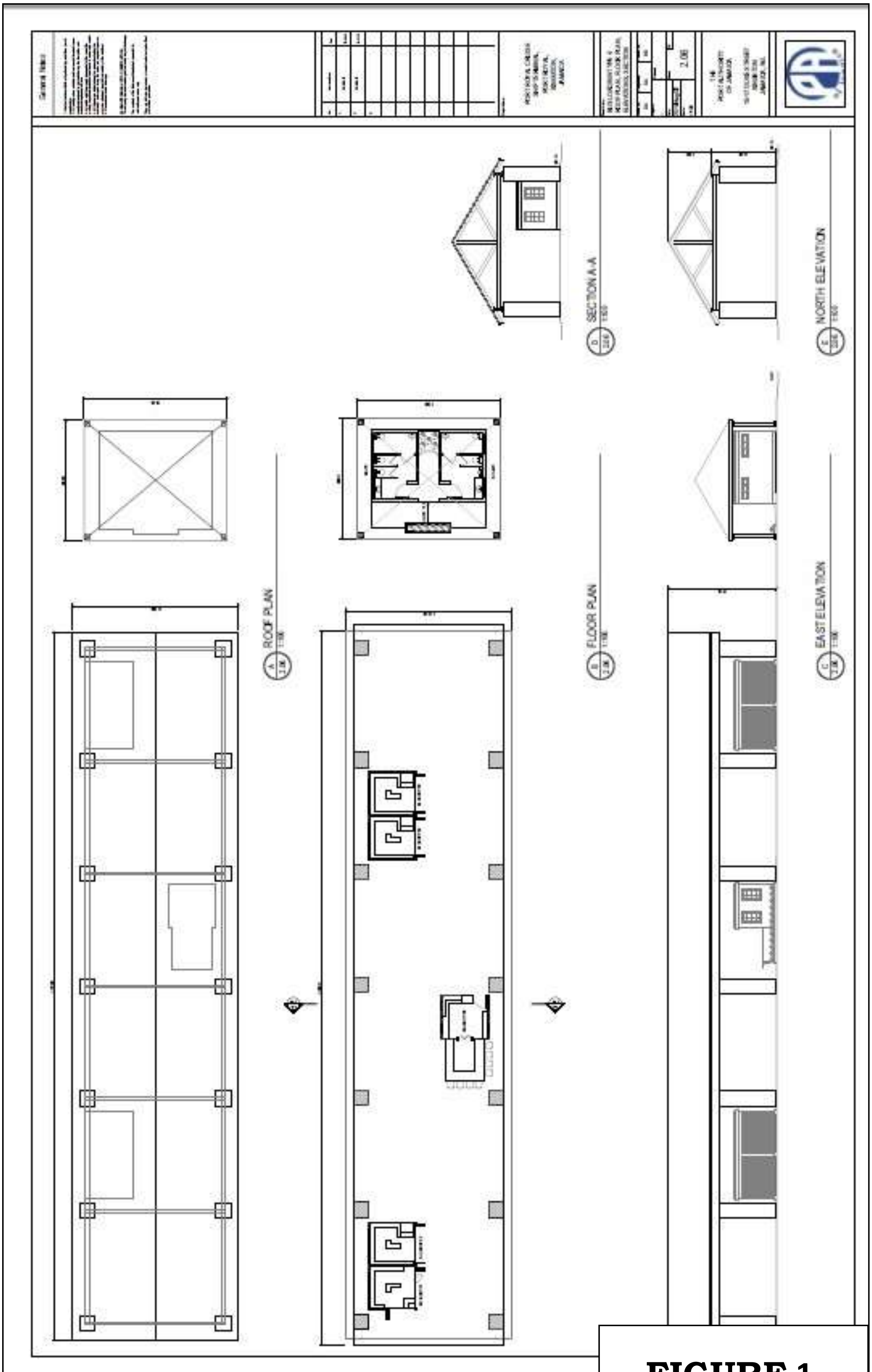


FIGURE 1.

Source: **Port Authority of Jamaica, 2018**

CONCEPT DESIGN OF TERMINAL BUILDINGS

FIGURE 2.

Source: **Port Authority of Jamaica, 2018**

Source: **Port Authority of Jamaica, 2018**

ORIENTATION OF FLOATING PIER AND CRUISE SHIP

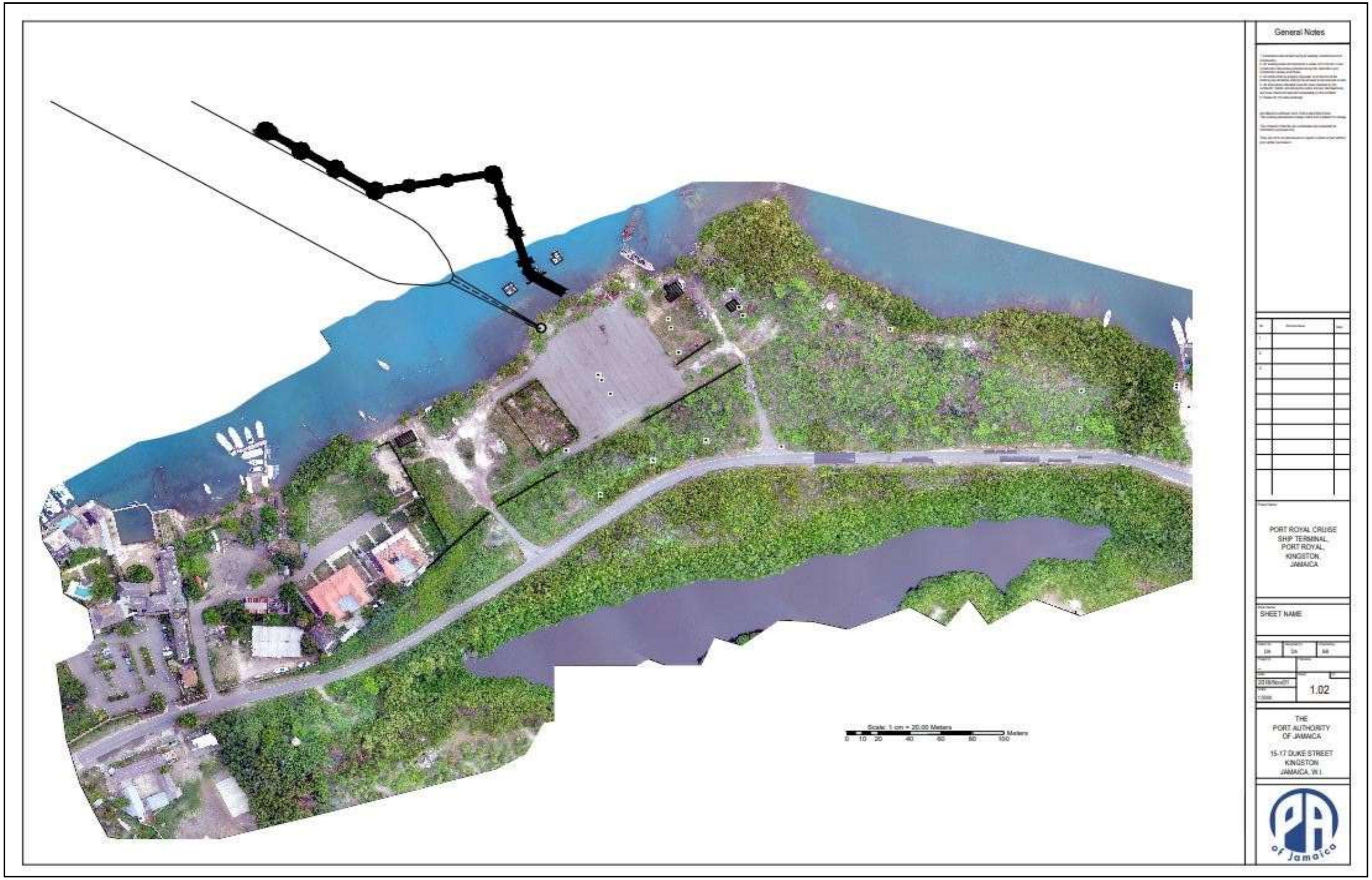


FIGURE 3.

Source: **Port Authority of Jamaica, 2018**

The small ship jetty will be installed near the welcome area at the Old Coal Wharf to facilitate the movement of both local and cruise ship visitors to locations throughout the Kingston Metropolitan area (Map 3).

MAP 3.

SMALL FERRY JETTY AND DESTINATIONS

Source: Port Authority of Jamaica, 2019 : The map indicates five proposed destinations where visitors will be transported to from Port Royal via the small ship jetty at the Old Coal Wharf.

4.2.2 Construction Method

Sea Walk Floating Pier

As aforementioned, the Sea Walk Floating Pier is a retractable mechanism that is anchored to shore and extends to docked vessels allowing visitors to disembark. The technology does not require pilling or construction of any sort on the sea floor and its buoyancy will produce little to no perturbation. Sea Walk is being used on several World Heritage Sites in Europe.

The amenities required to support the operation of the Sea Walk consists of four structures that will be constructed using concrete;

(i) A Shore Mooring Dolphin or Bollard on which the mooring lines from the Cruise ship will be tethered;
(ii) A Shore Connection Platform which is the fixed structure to which the Sea Walk is anchored;
(iii) An Access Trestle which is the extension of the walkway which will connect the Sea Walk to the landside gateway area;
(iv) A Dolphin which serves as the connection point for the Sea Walk when it is being stowed in the folded position.

The distance between ship and shore is 63 metres. The total length of the Sea Walk system is 228 metres consisting of three segments. Typical size of ships expected to dock at the Coal Wharf average 265 meters long with a 165 air draft.

<u>Terminal Buildings and Structures</u>

The aforementioned architectural design of terminal buildings will reflect design elements of 18^{th} and 19^{th} centuries of Port Royal's Naval Dockyard architecture. They will be constructed with masonry reinforces concrete and wood erected on flat plate raft foundations which will require pilling. This type of foundation will ensure in-situ preservation of detected and undetected subsurface archaeological resources.

4.2.3 Operations

<u>Utilities:</u>

Water will be supplied from the municipal water supplier, the National Water Commission via a proposed improved water system for the town. Electricity will also be provided by the national supplier, the Jamaica Public Service; augmented by backup generators stationed at the site's service centre.

Solid Waste Management:

Solid waste will be disposed of by haulage to the municipal solid waste land fill site at Riverton City, St. Andrew.

Sewage treatment and effluent disposal:

Final design specification is being detailed by the National Water Commission in conjunction with the Port Authority of Jamaica.

Several locations outside the proposed 9 acre development property are being explored. The new system is expected to service not only the cruise ship terminal but the entire Port Royal Township. NEPA requires an application for a licence to treat and discharge sewage effluent. During this application process details of the final design will be made available to NEPA for consideration and approval. It is anticipated that NEPA standards will be met, in the final design. No sewage will be collected from cruise ships.

4. DESCRIPTION OF STUDY AREA

4.1 LOCATION

The proposed development site located in the historic township of Port Royal at the end of the Palisadoes tombolo which borders the city of Kingston and Kingston Harbour to the south (Map 4). Its geographical location is latitude 17.941467N and longitude 76.836458W and is situated at the extreme eastern end of Port Royal; just east of the Admiralty Houses premises now operated by the Caribbean Maritime University (CMU) as dormitories for its students (Map 5). This approximate 9 acres of land, referred to as “Old Coal Wharf”, was a part of the 19th century Naval Dockyard.

PORT ROYAL LOCATION

MAP 4.

Map 4: *Source:* Port Authority of Jamaica, 2019

SITE LOCATION

MAP 5.

Map 5: *Source: Port Authority of Jamaica, 2018*.

4.2 TOPOGRAPHY

The site is a flat coastal landform that was formed initially by silting after the 1692 earthquake. Much of it may have been dump-up to facilitate the eastern most expansion of the British Naval Dockyard Coal Wharf in the 19th century. After 1905, subsequent dumping and leveling of marl was employed to facilitate varied use of the place. In recent times, a large section of the property was covered with asphalt to transform the space into an Entertainment Centre. Today, the highest point is about 1.6 meters above sea level but more than two-thirds of the land space average about 60 cm and a portion is swamp (Plate 5).

4.3 VEGETATION

For the most part vegetation cover may be described as sparse dry coastal secondary shrub with a small patch of wetland mangrove. In the expansion of the Naval Dockyard in the 19th century most of the natural vegetation was displaced. Most of this vegetation is found on the property fringes consisting mainly of acacia, cactus, mangrove, shrub and weeds (Plate 5).

Plate 5. *Source:* JNHT Research Unit, 2019. The image shows the site's topography and vegetation cover.

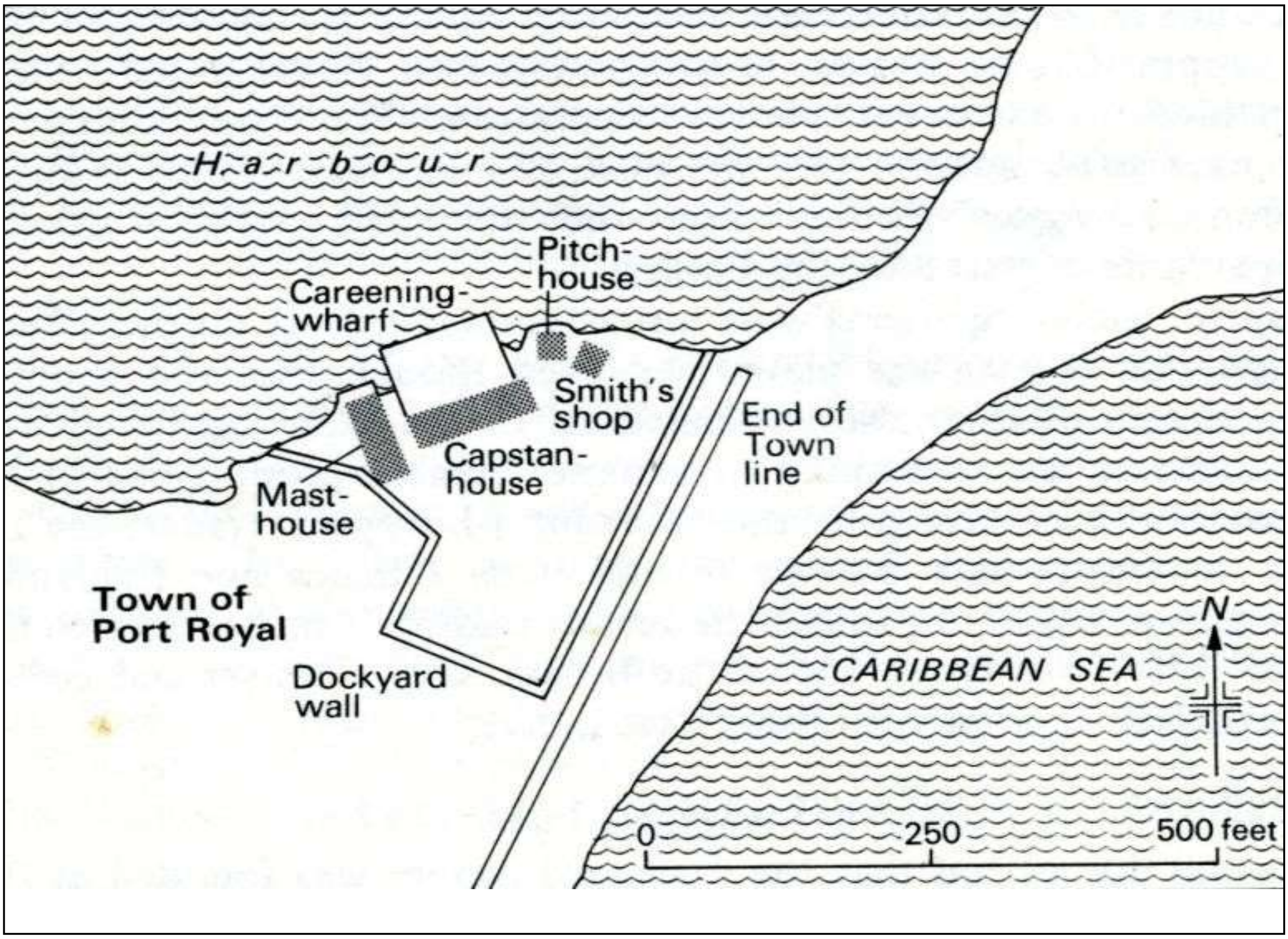
4.4 LAND USE

As indicated earlier, the site was initially used as the British Naval Dockyard Coal Wharf where imported coal was shipped and stockpiled to fuel the steam ships of the British Navy stationed at Port Royal. Since 1905, uses are miscellaneous but in recent times it was used for the offloading and storage of imported aggregate used for the development and expansion of the Norman Manley International Airport's runway. Subsequently, a large track was asphalted and utilized as an entertainment venue. Currently, it is used for squatting, dumping household refuse and disuse sea vessel remains, chalk coal burning, fish cleaning and recreational fishing.

4.5 HISTORICAL/ARCHAEOLOGICAL BACKGROUND

Port Royal became the most important British Base in the Caribbean between the 1692 – 1815 (Pawson and Buisseret,1975). Most of the naval vessels in Port Royal in the early 18th century fell into a state of disrepair as there was no proper place for careening. By 1715 – 1763, a proper dockyard was founded at Port Royal so that naval ships could be refitted. The continuing piracy activity in the Caribbean and the growing enmity between Spain and England, which led to the declaration of war with Spain in 1739, were probably a major factor in the establishment of the dockyard (Mayes, 1972).

Sir Chaloner Ogle, forwarded plans to the Admiralty in March 1734, which were approved for a careening place to be proposed in Port Royal. The "drift wharf " as it was referred to, was constructed by May 1735, as it was rather scanty in appearance however, by 1739, several structures were constructed in the dockyard. The 1739 plan of the dockyard shows a Careening-wharf, Pitch house, Mast-house, Capstan-house and Smith's shop all contained within a properlywalled enclosure (Plan 3).



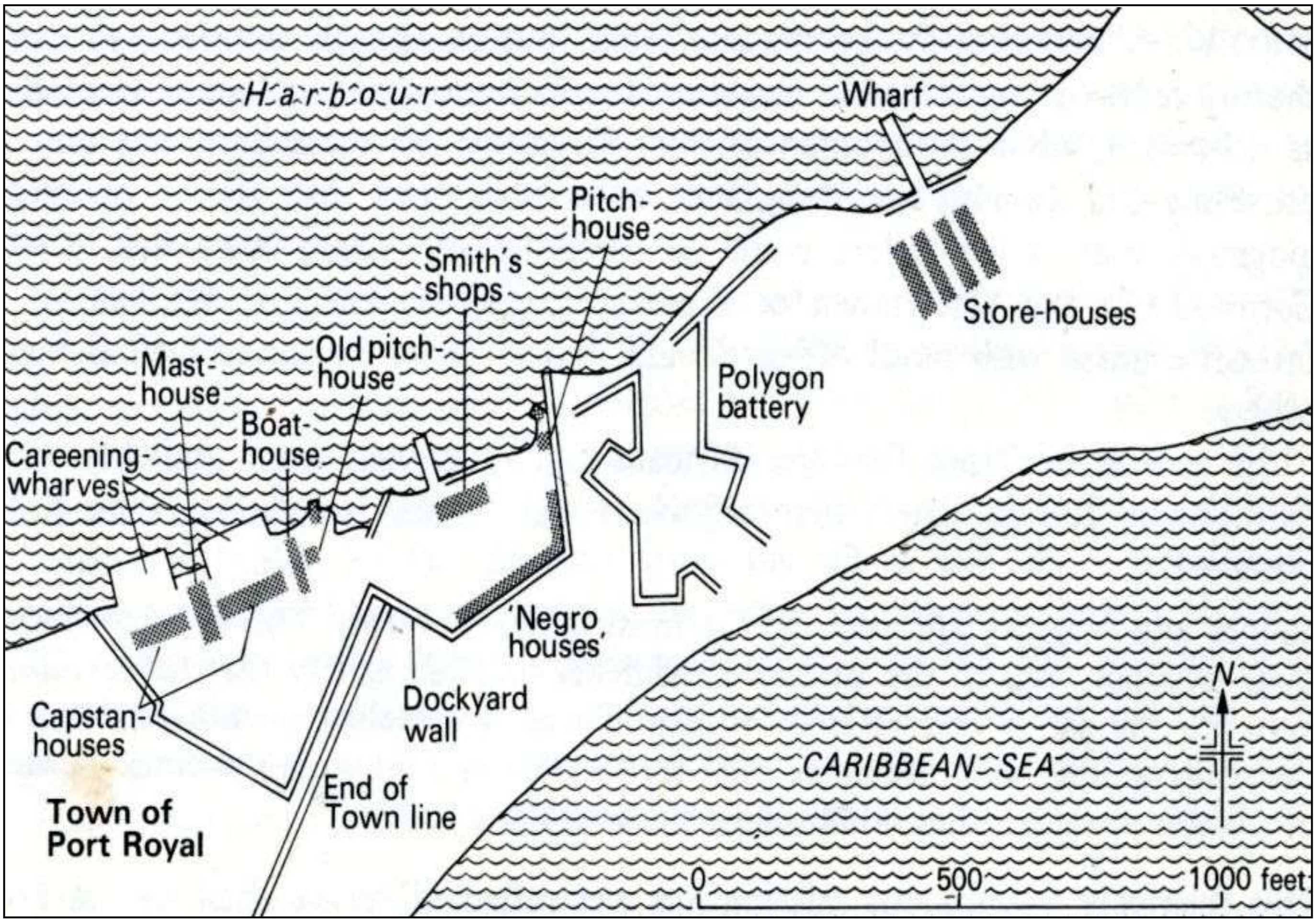
Plan 3 *Source: Pawson and Buisseret, 1975* - **Plan of the dockyard in 1739**

In response to the need to service more and larger ships, the dockyard saw a steady expansion in the mid 1760s, with the construction of a new careening-wharf to the west of the existing one.

To accommodate the careening-wharf the dockyard wall was expanded westward and a new Capstan-house was built. By 1770, the wall around the dockyard to the east was also extended to enclose a large area which the Smith's Shop was built. The 1799 Plans by Pawson and Buisseret, 1975 (Plan 4) and Phillip Mayes, 1972 (Plan 5) shows the expansion of the dockyard at this time. Mayes Plan went a bit further by indicating the existence of Store Houses, Negro Kitchen and Negro Houses at the extreme east end of the site.

DOCKYARD EXPANSION PLAN (1799)

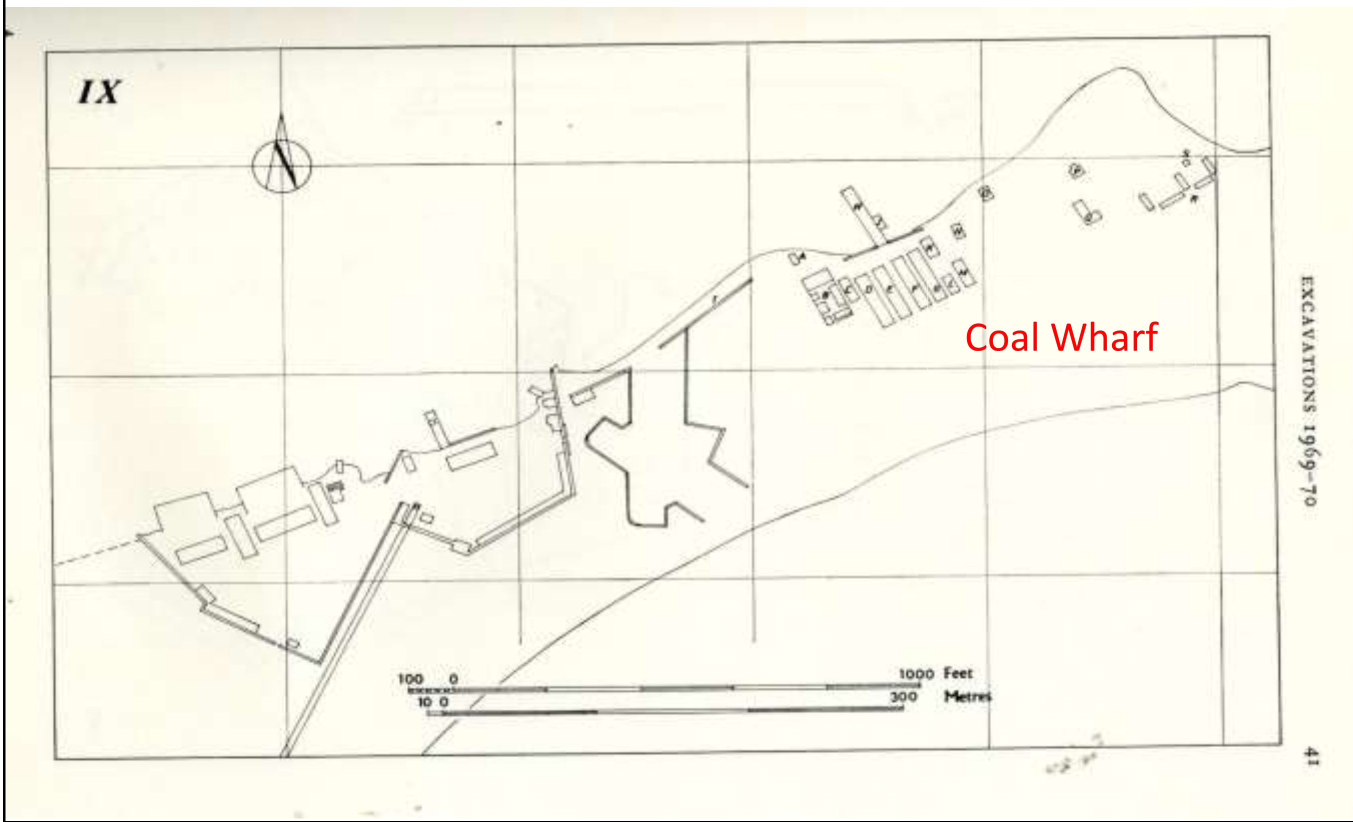
(Pawson and Buisseret)



Plan 4 *Source*: Pawson and Buisseret 1975

DOCKYARD EXPANSION PLAN (1799)

(Phillip Mayes)



Key

Agent's House and Office M. Store House

A.

B. Counting House N. Clerk's Kitchen

Store House O. Cooper's Shade

C.

D. Store House P. Cooper's Chimney

E. Store House Q. Store House

F. Store House R. Negro Houses

J.

Wharf S. Negro Kitchen

K.

House for Convenience of Sailors

L.

Clerk's Lodging Room

Plan 5. *Source:* Phillip Mayes, 1972

In 1815, the town of Port Royal suffered a disastrous fire which destroyed few of the buildings at the edge of the dockyard. A new wall was built at the western end of the dockyard which was separated from the town by a fire-gap about fifteen yards wide. Port Royal's naval status was changed in 1838 from an independent command to becoming the headquarters of the Jamaica Division of the North America and West Indian station. This new status saw to the completion of very extensive buildings such as a new stores-block crowned with a conspicuous clock tower and a new boat slip.

Between 1861 and 1862, the dockyard was improved by the addition of coaling-sheds and coaling wharves at the eastern end, on the site of the 1799 victualling yard. A supply of about 10,000 tons of coal was kept here and great sheds formed a distinctive feature of Port Royal (Plan 6). They also enabled the yard to deal with the latest naval vessels, which increasingly used coal (Pawson and Buiserret, 1975).

According to Phillip Mayes (1972), it can be fairly assumed that the dockyard of the mid to late 19th century was separated into two sections, the dockyard at the west end and the coal and victualling yards at the east, divided by the remains of the Polygon Battery. Mayes, who conducted excavations at the Old Naval Dockyard Site between 1968 and 1971, was able to work out a whole comparative sequence of scaled maps, which permitted him in particular to identify different phases in the development of the dockyard (Pawson and Buisseret, 1975).

Post 1894, there were slight changes in the layout of the Coal Wharf. By this time too, the Polygon Battery was almost completely decayed away and new structures erected in that area (Plan 7).

Key

M1. Recreation Room for Officers

Q2. Covered Coal Wharf

N1. Canteen and Bowling Alley

O1. Petty Officer's Quarters

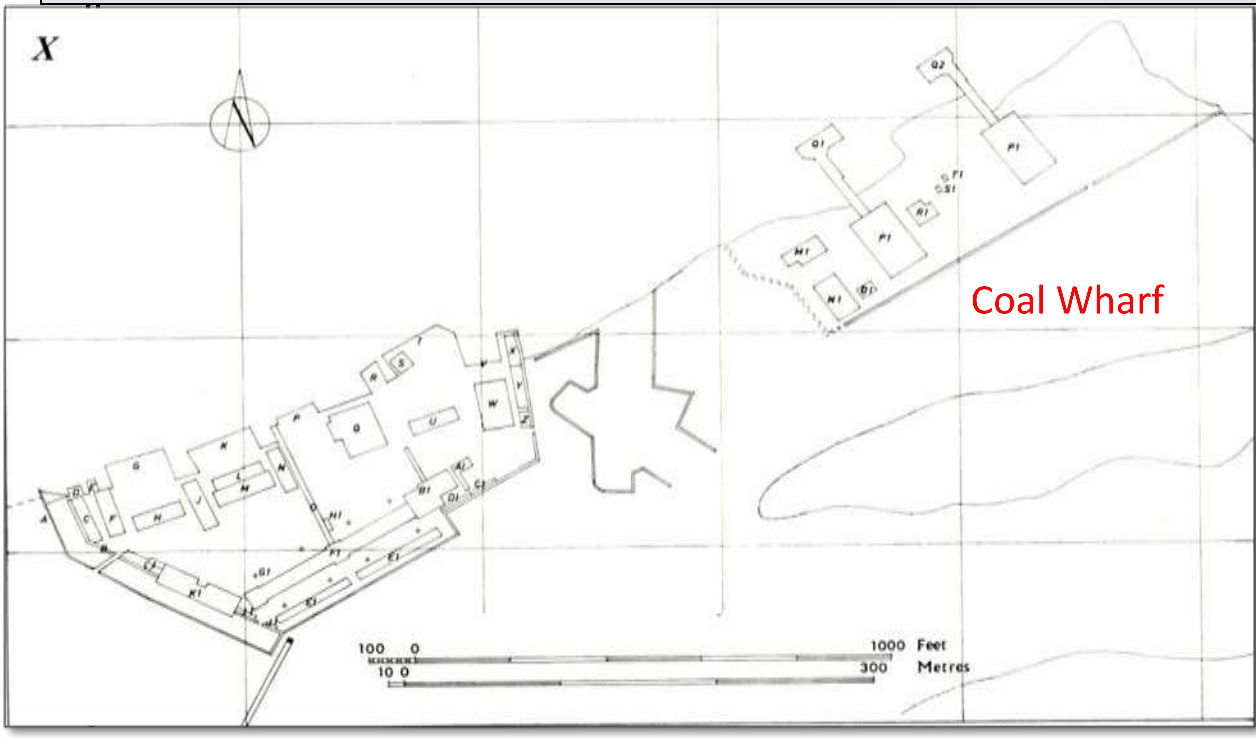
P1. Coal Store

Q1. Covered Coal Wharf

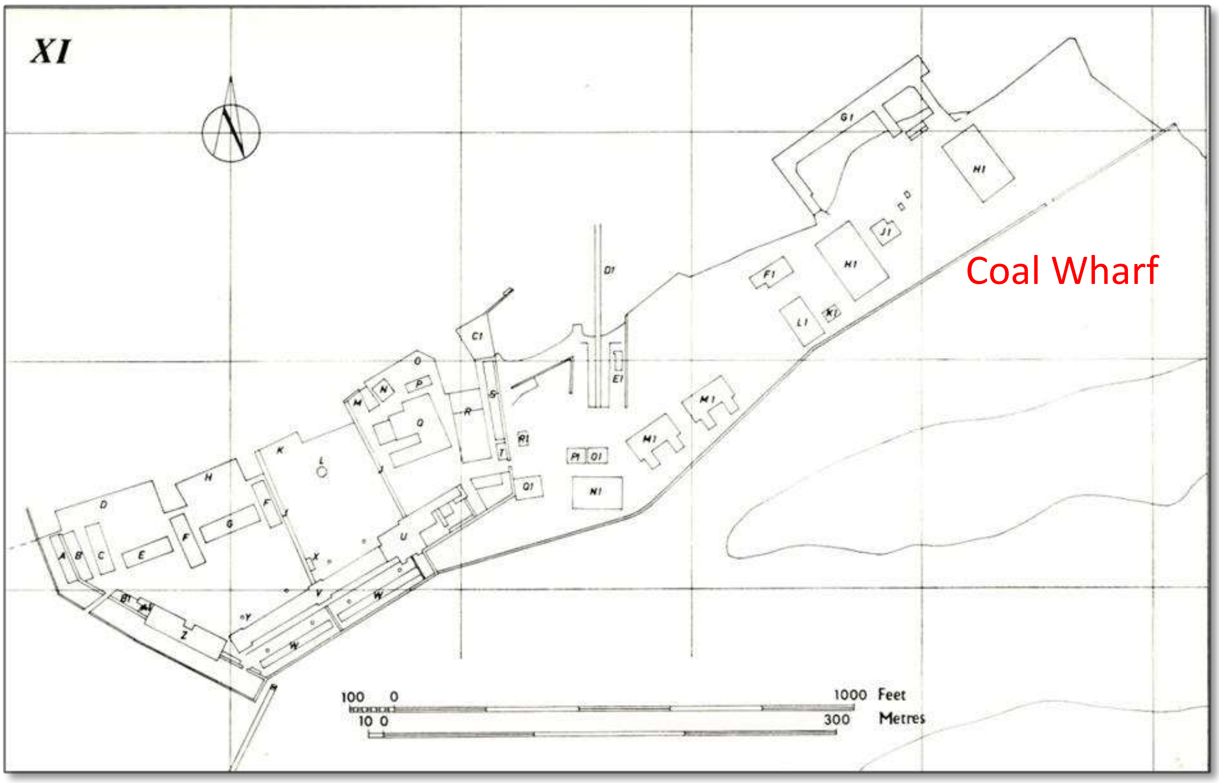
R1. Storeman's Quarters

S1. Kitchen

T1. Stone Tanks, 25 tons



expanded Dockyard c.1800-1862, with addition of Coal Wharf and sheds (Mayes, 1972)



Key

F1. R.N. Club

G1. Coal Wharf

H1. Coal Shed

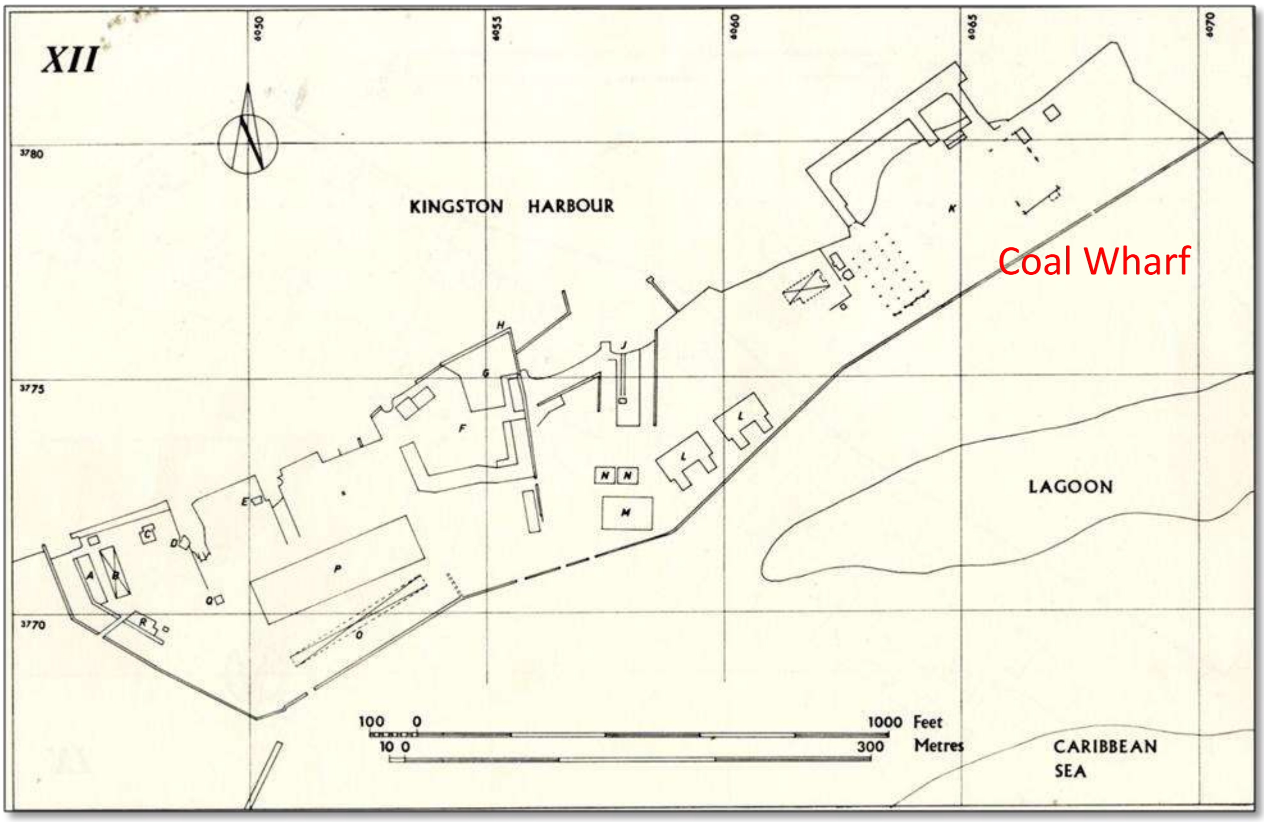
J1. Chief Engineer's House

K1. Billiard Room

L1. R.N. Canteen and Bowling Alley

Plan 7. Showing slight changes to the layout of the Coaling Wharf section of the Naval Dockyard, post 1894 (Mayes, 1972)

By the early 20th century, the focus of British sea power shifted with the development of a powerful fleet of steam warships based at dockyards in Britain and the Mediterranean. The chain of small dockyards (including Port Royal) serving the North Atlantic were shut down, only Halifax and Bermuda remained. The Naval Dockyard at Port Royal was closed in 1905 (Senior, 2003). Following its closure, the dockyard rapidly fell into decay; many of its buildings were intentionally demolished and others collapsed of neglect. The Coal Wharf structures were dismantled in the 1950s (Pawson and Buisseret, 1975). Mayes' map of the Naval Dockyard in 1971 shows the site as derelict (Plan 8).



Plan 8. Showing derelict structures at the site of the Coal Wharf, 1971 (Mayes, 1972)

A section of the Old Coal Wharf was covered by marl in the 1990s in preparation for the storage of aggregate for the construction of the extended runway for the Norman Manley International Airport. The area was later asphalted for the use as an entertainment centre

(Plate 6).

Plate 6. Showing a section of the asphalted surface at the Old Coal Wharf, JNHT photograph, 2009

5. CULTURAL HERITAGE

5.1 INTRODUCTION

Several methods were employed to identify cultural heritage assets that may be impacted by the proposed development. These methods included archival search, interviews and aerial photograph analysis. Transect Linier Field Walk Survey and Intrusive Archaeological Evaluation (Excavation) was used to confirm the presence and or conservation status of identified resources. In addition, they were used to identify cultural heritage assets that were never before documented on the site. This section presents the result of the Field Walk Survey and Excavations; including a description and inventory of cultural elements identified. It also identifies the potential impact and prescribes appropriate mitigation strategies to ensure their insitu or ex-situ preservation and use.

5.2 RESOURCE IDENTIFICATION

5.2.1 Transect Linier Field Walk Survey

A. <u>Dockyard Coal Wharf Parameter Wall</u>: This is a circa 1800 brick wall, averaging 2 meters high and 45 centimetres wide, which ran the entire length of the Old Coal Wharf bordering the property to the south. The wall has become discontinuous because of brick theft; especially in areas obscured by vegetation overgrowth. Approximately one-half of the wall is demolished; the remaining portion is, nonetheless, one of the most significant tangible historical element still standing (Plates 7 and 8).

Plate 7 and 8. Shows two sections of the Old Coal Wharf perimeter wall. Approximately one half of the wall was destroyed by vandals.

B. <u>Modern Concrete House:</u> A small concrete house built on wooden and concrete pillars is situated in the northwest corner of the site. It was abandoned by the Morgan's Harbour Hotel, but a section is currently occupied by one informal settler. The structure's contribution to the property's character and historical significance is unremarkable (Plate 9).

Plate 9. An abandon modern concrete building once used to housed employee of the Morgan's Harbour Hotel.

C. **Old Coal Shed No.1:** Despite the fact that this remain is represented by 28 square columns, some of which are connected by heavy duty iron beams, it represents a significant characteristic of the 19th century reinforced brick aggregate concrete. The southern side is closed with a braced brick wall about 45 cm thick while all other sides remained open. For the most part its brick floor is in tact but will require significant repairs (Plate 10).

Plate 10. Shows the remai Shed No.1

D. **Old Coal Shed No.2:** This Coal Shed is so badly deteriorated that all the columns have disappeared. The only surviving element is the imposing braced brick wall on the southern side; similar to that of Shed 1.

Though in need of urgent repair, this feature is another significant remnant of the property (Plate 11).

Plate 11 . The image illustrates the remnants of Coal Shed No.2

E. **Adjunct Structures to Coal Shed No.2:** There two adjunct brick and concrete structure on the east side of Coal Shed No.2 that are so badly deteriorated only a few sections of their walls remain standing. Their precarious nature makes them extremely hazardous. Despite their danger two homeless individuals have used scraps of board and zinc to erect make-shift onto them (Plate 12).

Plate 12 . Dilapidated adjunct structure to Coal Shed no.2

F. Entertainment Zone: The entire area between Coal Sheds 1 and 2, amounting to 0.647 hectares (1.6 acres) was asphalted in the late 1990s and utilized as an Entertainment Zone for hosting large events such as stage shows. This feature has no value to the preservation of the site's historical integrity (Plate 13).

Plate 13. A large asphalted area at the Old Coal Wharf used as an entertainment venue.

G. Old Concrete Pier: This element of the site has fallen into disrepair. The concrete masonry has separated from its metal reinforcement and fallen into the sea. Today only some iron piles supporting derelict concrete slabs are visible, these nonetheless are of moderate tangible historical value to the site (Plate 14).

Plate 14. The remnants of an old concrete pier.

H. Electricity Generator Station: A small degenerated concrete building about 7 meters long and 6 meters wide with partially collapsed zinc roof. According to one elderly citizen it housed the electricity generator which provided electricity for the Dockyard in the early 1900s. The structure was altered by removing a portion of its wall and using concrete blocks in an attempt to expand the structure to be used for living accommodation. Its contribution to the property's evolution is significant but its state of conservation (structural integrity) is very poor (Plate 15).

Plate 15 . A small degenerated concrete building

said to have housed a generator that provided electricity for the Naval Dockyard.

I. **Anchors:** Three large anchors averaging 4.5 meters long were identified on the site east of Coal Shed No.2. Only about onethird (1/3) of each comprising a fluke were exposed at the surface. They assumed a position that suggested they were being used as mooring devices (See Plates 33, 34, 35 & 36).

J. **House Foundation:** An ensemble of concrete foundation pillars and steps were observed on the western side of the cluster of mangrove situated on the property's east end. The pillars are about 50 cm above ground and were fabricated with concrete mixed with brick aggregate. It appeared that these pillars may have supported a wooden building (Plate 16).

Plate 16. An ensemble of concrete foundation pillars of a demolished structure on the periphery of degraded mangrove.

K. **Concrete Rubble:** In the mangrove several small piles of concrete rubbles were identified. It is uncertain at this time the origin of the concrete slabs. Mayes 1799 map indicated the presence of store houses, Negro houses and kitchen in this general vicinity. It is doubtful, however, that these modern concrete slabs represent elements of those structures. The rubble is considered to be of little value (Plate 17).

Plate 17. Concrete rubble and foundation in mangrove.

L. **<u>Jail Cell</u>:** Just south of the mangrove lies a small concrete box structure measuring 2 meters cube. It has slab concrete roof, one small iron grilled window approximately 40 centimetres square and large iron hinges suggesting it had a very heavy door. The structure is slightly tilted caused by the shifting sand on which it was constructed

(Plate 18).

Plate 18. A 2 meter cube concrete structure that may have been a jail cell or ammunition store.

M. **<u>Squatter Hut</u>:** Less than 1 meter from the Jail Cell a squatter erected a dwelling from scraps of boards, zinc sheeting, cloth and other materials (Plate 19).

Plate 19. A squatter dwelling attached to the aforementioned concrete cube structure.

N. **<u>Taino Ceramic Surface Scatter</u>:** Just south of the squatter hut, outside the displaced Dockyard wall in an area occupied by acacia and cactus, a sparse scatter of Taino pottery sherd assemblage was observed. For the historical/pre-historical record of the site the find is significant but from an archaeological preservation perspective the value of the assemblage is unremarkable (Plates 20 and 21).

Plates 20 and 21. Illustrate scatter assemblage of Taino pottery sherds on site.

5.2.2 Test Trench Excavation

Placement and excavation of test trenches was based on three fundamental factors:

i. Where historical document or archaeological narrative located historical structures that no longer exists.
ii. Where the developer proposes to erect key infrastructure and buildings.
iii. Where field walk survey identified anomalies, features or artefacts that needed further clarification.

Test Trench 1: In an area close to the Admiralty Houses perimeter wall on the western side of the Old Coal Wharf property a trench 42 meters long, 3 meters wide and 1.8 meters deep was excavated. According to historical documents and archaeological studies a section of pre-1692 Port Royal traversed this area. The pre-1692 Port Royal delineation is currently being used as Port Royal's World Heritage Nomination boundary delimitation. The purpose of this trench was to ascertain the presence and character of archaeological evidence associated with 1682 Port Royal and or any other subsequent valuable archaeological assets. The trench

Plates 22 and 23. The top image shows the length, depth and profile of the trench while the bottom image highlight the small gutter associated with the Admiralty Houses.

result was unremarkable at that depth. There were no substantial pre or post 1692 Port Royal archaeological feature or artifacts was uncovered except for a small concrete gutter linked to the late 19th century Admiralty Houses. The soil profile is characterized by several layers of sand with one layer of coal averaging 30 cm thick at 1.2 meter depth. Artefact recovered from the unit was extremely sparse and includes a few ceramic creamware sherds and olive green wine bottle fragments (Plates 22 and 23).

Test Trench 2 : The unit is a 37 meter long by 3 meter wide trench orientated in a east west direction abutting coal shed 1 on the eastern side. Its placement was intended to provide information on the House for Convenience of Sailors, the Clerk's Kitchen and Coopers Shade, indicated on Phillip Mayes plan of 1799. Unfortunately, after cutting through 10 cm of asphalt and another 20 cm of marl the backhoe encountered a thick layer of concrete pavement which proved difficult to break through. The trench was closed after just 30 cm depth. No artefacts were recovered (Plate 24).

Plate 24. Test Trench 2 showing exposed concrete pavement.

Test Trench 3: At the east end of trench 2 a concrete block anomaly was encountered and the area was expanded, 11 meters by 8 meters, to expose the feature in its entirety. The anomaly turned out to be two concrete encasement containing two wooden piles. It appeared the feature was flattened by an heavy duty equipment as the wooden pile showed signs of shattering at the base of the concrete and at the top. Portions of the wooden piles are left in the sand substrate. It is unclear whether the remains belong to the Coopers Shade or the later Stone Tanks. Only three pieces of ceramic creamware sherds from the same vessel were recovered (Plate 25).

Plate 25. The remains of a demolished structure in the vicinity of stone tanks (Phillip Mayes Plan of site between 1800- 1862).

Test Trench 4: Oriented in a north south direction and measuring 4 by 11 meters square; this unit was placed parallel to Coal Shed 1 in the area once occupied the Chief Engineer's House (Phillip Mayes Plan, 1894). Excavation of the unit revealed no evidence of a structure. The trench exhibited a well defined soil profile of the site in which the surface is represented by an 8 cm thick asphalt pavement; this is followed by a 10 cm thick deposit of marl. Below the marl is a level of sand averaging 20cm. It superimposed another layer of marl ranging between 15 and 20 cm thick and commencing 10 cm above the water table. The coal residue layer continues below the water and then followed by the sand substrate. No artefacts were found.

Test Trench 5: It measured 8 by 6 meters square and was placed in the area of the Kitchen (Phillip Mayes Plans 1800 – 1862 and 1894). In addition, a section of the west wing of the terminal structures is proposed for construction in this location. At about 55 cm deep mangled iron bars fastened to concrete rubble; commingled with broken wood and brick were unearthed. The rubble continued below the water table but again no artefact in terms of ceramic or glass was uncovered (Plate26).

Plate 26. Test Trench 5 depicts brick commingled with concrete rubble and mangled iron bars.

Test Trench 6: Measuring 26 by 6 meters square; this unit was excavated south of Trench 5 where the proposed bus loading structure with retail shops and rest rooms will be placed. Majority of the trench did not exceed depth of 40 cm. The unit was dominated by concrete pavement that appeared to be the floor of a structure. Some parts of the floor were covered with stone and hard lime mortar. A section of the lime mortar flaked and separated from the concrete. The northern quarter of the unit was characterized by broken blocks of concrete rubble with twisted reinforce iron bars and pieces of broken wood. The concrete rubble, broken wood and mangled iron bar are symptomatic of a demolished structure

At the extreme southern end the concrete pavement ended to expose a layer of brick followed by a coal residue level averaging about 30 cm thick, below the coal debris was send substrate. Apart from the mangled iron bars and concrete rubble and broken wood; no artefacts were present (Plates 27 and 28).

Plates 27 and 28. The Plate to the left features the concrete floor of a structure and the plate on the right highlights the rubble of concrete with mangled reinforce iron bars.

Test Trench 7: The unit, 3 x 30 meters square, was excavated in the proposed main plaza. No concrete pavement was observed in this trench but there were two small concrete features with wood in the centre. These concrete features are believed to be encasement for wooden piles. The soil profile constituted an asphalt surface about 8 cm thick, followed by a fairly even marl layer

Plate 29. The image shows Test Trench 7

about 10 cm; below which is sand 20 cm, then another marl layer 20 cm. This lower level marl stratigraphy interfaced with the coal debris layer. Ten centimetres in the coal debris the water table was encountered. The coal residue which was about 25 cm thick superimposed the sand substrate. Remains of a modern PVC water pipe was the only artefact observed (Plate 29).

Test Trench 8: Its placement due east of Test Trench 3 intended to test the proposed location for the construction of the terminal main building. Orientated in an east west direction and measuring 17 meters long by 3 meters wide, the unit exhibited similar concrete pavement at 40 cm deep and below t

s

the characteristic coal deposit followed by sand (Plates 30 and 31).

Plates 30 and 31. The first image shows the east end of Trench 8 in the concrete pavement is broken to expose the water table and coal deposit below. The second image shows the west end of the unit where the concrete pavement extends.

Test Trench 9: The unit measuring 6 meters by 2 meters square was excavated in the centre of Coal Shed 2. The terminal east wing consisting of bus loading shed, shops and restrooms will be placed there. The intent of the unit was also to ascertain the foundation and submerged archaeological status of the Coal Shed.

Excavation result was unremarkable. Only some modern objects were uncovered which is symptomatic of a disturbed area. Again the water table was encountered at a depth of 60 cm (Plate 32).

Plate 32. The image show the coal residue level.

Test Trench 10: This trench measuring 2 x 4 meters square sought to define the archaeological nature of anchor 1. The high water table made excavation difficult but it was clear that the anchor was similar to the others; measuring 4.5 meters and a large chain is attached to its ring (Plate 33).

Plate 33: depicts the excavation of the first of three anchors located almost on the shoreline where the water table is close to the surface. Majority of the anchor is submerged in water.

<u>Test Trench 11:</u> It was used to excavate anchor 2 which is situated furthest from the shoreline and just east of the electricity building. This anchor had a chain attached to it measuring 33 meters that is connected to anchor 1 (Plates 34 and 35).

Plates 34 and 35: In the first instant the image shows the similarities between anchor s1 and 2. The second image highlights the long chain that connects them.

Test Trench 12: It was used to clarify the archaeological context of anchor 3. Just after about 20 cm into the soggy mangrove soil it became apparent that the anchor was encased in lime mortar (Plate 36).

Plates 36. Anchor 3 located in mangrove and encased in lime mortar.

Test Trench 13: This trench is a combination of four 2 meter square units used to clarify a cutstone pavement on the shoreline in front of Coal Shed 2. The excavation revealed a buried brick paved area with a feature appearing the remnants of a boat slip that is associated with the cutstone pave area and the adjuvant ruin abutting Coal Shed 2 (Plates 37 and 38).

Plate 37 and 38 The images on the left shows a cutstone pavement at the shoreline end of Coal Shed 2. The image on the right shows the remnant of a contagious brick pavement with features resembling a boat slip**.**

14: A trench measuring 14 x 2 meters square was used to test the area in which Taino pottery sherds were identified. The trench was divided into six 2 meters square unit which were excavated to a depth of 50 cm where the water table was encountered. The trench result was unremarkable, only few scattered pieces of pottery sherds along with a slightly larger amount of olive green wine bottle and clear glass fragments, pearlware, creamware, and stoneware sherds were recovered (Plate 39).

Plate 39. It shows Test Trench 14 which was excavated to clarify the archaeology context of Taino pottery sherds assemblage observed on the surface.

Spatial Distribution of Identified Above Ground Cultural Heritage Assets

MAP 6.

Source: *Edward Coore, 2019 (JNHT Sites and Monuments Record).* Map x. highlights the location of the above ground cultural heritage resources that may be affected by the proposed development

Spatial Distribution of Excavated Trenches

MAP 7.

Source: *Edward Coore, 2019 (JNHT Sites and Monuments Record).* Map x. highlights the location of the above ground cultural heritage resources that may be affected by the proposed development

6. IMPACT IDENTIFICATION AND MITIGATION MEASURES

6.1 INTRODUCTION

This section of the study looks at the potential impacts on the cultural heritage resources identified in section 5 and necessary mitigation measures to reduce or prevent negative impact. The identification of impact was done base on the three phases of developmental work, pre-construction, construction and operation. Analysis of impacts was done in the context of negative or positive, major to minor, direct or indirect, long term or short term and reversible or irreversible impact. The findings are presented in Table 2 below. Consideration was also given to the cumulative impact as well.

Several key issues have been identified for the property and are ultimately relevant to the determination of impact and the mitigation measures. The main issues are outlined below;

- The low lying nature of the site makes it susceptible to storm surges and flooding. The historical records show that properties in Port Royal have been damaged or destroyed by hurricanes over the centuries. Very low elevation makes the area prone to storm surge flooding. Even less severe weather series resulting in swelling of the sea results in section of the property becomes inundated.

- Port Royal is also renowned for earthquakes and the devastating impact it has on life and property. Numerous severe seismic events over the centuries have resulted in the submergence of buildings and structures on land. The 1692 earthquake destroyed nearly two-thirds of the historic town, a significant portion of the land-mass sank into Port Royal Harbour. Damages seen in the Coal Wharf parameter wall and the tilting of the jail cell may be attributed to seismic events or liquefaction of the sand on which the site was constructed.

6.2 ANALYSIS OF IMPACT

Table 2. Potential Impact and Mitigation Measures

Resource ID	Potential Impact	Mitigation	Duration		Magnitude		Form	
			Long	Short	Major	Minor	Reversible	Irreversible
A	**Negative Impact** Sections of the discontinuous Coal Wharf parameter wall will be taken down.	• The developer adjust plan to preserve parameter wall adjoining the Admiralty Houses Property. • Restore parameter wall that extends into the sea on the east side of the property. • Preserve bricks recovered from the site to restore wall.	√		√		√	

B	**Negative Impact** Modern structures located in area of the site that overlaps the World Heritage Nominated Property are to be destroyed and	• Abide by the agreement of the key stakeholders that this area should be free any new buildings. • Preserve the area as a green space.	√			√		√
	converted into a parking area. **Positive Impact** Inappropriate design modern buildings are to be removed from the nominated property							

C	**Positive Impact** The remains of Coal Shed 1 will be preserved and incorporated in development as one of the bus loading area.	• Columns and brick floor should be restored to preserve a level of authenticity. • Iron beams should be assessed to ascertain state of conservation and where possible used in its rehabilitation.	√		√		√	
D	**Positive Impact** The standing south wall of Coal Shed 2 will be restored and incorporated in the development. It will become part of the market place.	Utilize bricks recovered from the site in the rehabilitation work.	√		√		√	
E	**Negative Impact** Remains of adjunct building to Coal Shed 2 are slated to be taken down due to its safety	Recover bricks and use in restoration of walls and floors.	√			√		√

	hazard status. Sections of the main terminal buildings are slated to be constructed there.							
F	**Negative Impact** Though the asphalted recreation area will not be destroyed; it will be buried under fill material in an attempt to raise the ground level of the site. In this case the use will be negatively impacted. The Terminal Plaza is planned for this area.		√			√	√	
G	**Negative Impact** The old concrete pier remnants are to be removed from the sea to make way for the installation and operation of the Sea Walk.	• Take the necessary management steps to prevent damage to marine life and significant cultural heritage assets. • Employ the use of silt screen.	√			√		√

H	**Negative Impact** The Electricity Generator House is proposed to be demolished and new structures erected to facilitate private	Though it is in a deplorable condition it is repairable. The developer should consider adjusting its plan to preserve and incorporate it in the	√		√			√
	parking and service areas.	development.						
I	**Negative Impact** Three large anchors found on the site will be buried by raising the site elevation with dump material. The new function of the location will be for private parking and service.	• These significant artefacts should be rescued. • The anchors should be conserved. • The artefacts should be displayed at an ideal location on the property in an effort to retain levels of authenticity.	√		√		√	
J	**Negative Impact** The house pillar ensembles are to be covered by fill		√			√		√

	material.							
K	**Negative Impact** Mangrove and concrete rubble are to be cleared and the amenities for the small ship jetty constructed.		√			√		√
L	**Negative Impact** A small concrete Jail cell or arm store is to be demolished and train line and facilities built.	Preserve jail cell as part of the historical landscape.	√			√		√
M	**Negative Impact** Squatter shack							

	attached to jail cell is to be demolished and the area used for train line and loading bay. **Positive Impact** The development of the site will prevent further squatting and ultimately development of an informal settlement and destruction of the mangrove.		√			√	√	
N	**Negative Impact** Taino pottery sherds surface scatter will be displaced to accommodate development.		√			√		√

An inventory of the cultural heritage resources identified on the site may be seen in Appendix 1.

6.3 CUMULATIVE IMPACT

6.3.1 Impact

Outstanding Universal Value (OUV)

Cumulative impacts have been taken into consideration especially in light of the fact that since January 2018 the State Party has submitted Port Royal's nomination for inscription on the World Heritage List. This proposed development will present challenges for the site in terms of carrying capacity. Thousands of visitors will be descending on the historic township which could negative impact the property's Outstanding Universal Value. Tangible assets that exhibit OUV may be damaged by overcrowding or inappropriate activities. However, the project has the potential to stimulate economic growth and social wellbeing; thus alleviating the chronic case of poverty now prevailing in the community. One of the fundamental objectives of World Heritage inscription is to improve the quality of life of people who live in the property and who may be the owners of the culture heritage being recognized of having Outstanding Universal Value. In this context, the cumulative impact during the pre-construction and construction is expected to be negligible. Impact during the operation phase may be both negative and positive. Positive impact is expected to be long tern while negative impact may be short term and reversible.

Archaeological/Research Value

All the archaeological remains uncovered as a result of Test Trench Excavation will be preserved in-situ. The proposal to dump material on the site as a means to raise the elevation of the place to guard against the impact of storm surge and flooding will bury and preserve the remains. The impact duration therefore is long term, its magnitude is minor and form is reversible.

Test Trench 1 was excavated to ascertain the presence of archaeological elements of pre-1692 Port Royal. The trench revealed no archaeological resource from that period down to an approximate depth of 1.8 meters. It must be noted that remains of the period may be at a lower depth. The impact on resource from the period in that overlapping area is uncertain at this time.

Authenticity

Though the site has undergone significant change in function and character since its days as a British Naval Dockyard Coal Wharf elements of authenticity still reside in size, construction material, architectural designs and layout plan. The obvious impact on the site's authenticity will be as follows:

- A change in the size of the property whereby the proposed development will extend beyond the parameter wall southwards to as far as the existing main road thus enlarging the original property size. This impact on authenticity is negative, major, long term but reversible.

- The original layout plan of the coal wharf is strikingly different from that of the proposed development due primarily to the difference in function. The impact will be negative, major, long term and irreversible.

- A tremendous amount of brick and in later days concrete mixed with brick aggregate were used in the construction of buildings and other structures. The new amenities and infrastructures will be erected using reinforced concrete which is considered to perform better in seismic events. This impact will be negative, major, long term and irreversible.

Integrity

The proposed development has the potential of causing increase surface runoff and pollutant into the sea affecting marine life including mangrove habitat; thus seriously degrading the natural setting around the site. Impact may be induced from all three phases of development, pre-construction, construction and operation. The negative impact may be long term or short term but may be reversible.

<u>Social Values</u>

Development of this nature sometimes comes with the negative impact relating to the potential increase in opportunistic persons hoping to capitalize on the benefits to be derived from increased visitor arrivals to the area. This could lead to illegal roadside vending, the growth of informal residential settlements, poor sanitation practices and road congestion.

<u>Aesthetic Values</u>

Another significant adverse impact will be the alteration of the serene aesthetic natural and historical seascape. The mass, scale and design of cruise vessels will undoubtedly dwarf and thus trivialize the scenic quality of the place. One good thing however, is that the cruise ship activity is a marine-base occupation and an event that is compatible to and augments the property's historical function.

6.3.2 Mitigation

The main mitigation measures to address these negative impacts are as follows:

- The World Heritage Convention and Operational Guidelines; along with ICOMOS Guidelines (Venice & Washington Charters) on development in Heritage District with assets of Outstanding Universal Value (OUV) are used to guide development and decision making.

- Ascertain the nominated property's carrying capacity and devise appropriate management strategies to ensure visitor number was within the property's carrying capacity.

- Enforce laws against informal settlement, illegal vending and other unauthorized activities.

- The Urban Development Corporation (UDC) complete and begin to implement the development plan for Port Royal simultaneously with this cruise ship development. In this way, the amenities that are currently lacking or have become degraded can be put in place or improved to ensure a better quality of life for the residents.

- Preserve and utilize construction materials and artefacts from the site to retain some level of authenticity.

- Incorporate architectural design elements of the old dockyard into terminal buildings and other adjuvant structures.

- The removal of the remains of the old concrete pier should take into consideration all the necessary management measures to prevent perturbation and siltation that would negatively impact the marine life and cultural remains.

- The development may increase surface runoff into the sea. It is important to set up silt screen especially for the first five years of operation so that this period may be dedicated to robust monitoring of siltation.

- In order to preserve the buried archaeological remains, the developer should adhere to preliminary discussions, agreement and proposal that newly constructed buildings would use raft foundations.

- Conduct geophysical survey of the Nominated Property and the development site overlap area to augment findings of test trench excavation findings.

7. ANALYSIS OF ALTERNATIVES

7.1 ALTERNATIVE SITES

7.1.1 Chocolata Hole

The area known as the Chocolata Hole in Port Royal has been the focal point of numerous cruise ship pier development plans for many decades. It had been proffered that the location is ideal, it is in close proximity to the most significant heritage assets; including the Sunken City and Fort Charles, most infrastructure are already in place and it is in the centre of historic Port Royal. The Jamaica National Heritage Trust continues to object to any such development in that space. It argues the following

The space is too small to facilitate the required terminal development and infrastructure.

- Cruise ship pier construction and ship docking would inflict irreparable damage on the Sunken City, one of the most significant archaeological site in the world and the only one of its kind in the western hemisphere.
- Crowd control would be very difficult
- Overcrowding would result in serious damage on the historical assets.

7.1.2 Kingston Harbour

Kingston City and Kingston Harbour is considered by many the best location for cruise ship operation. The harbour is deep enough to accommodate vessels of any size without the requirement for dredging. Nearly all the required facilities are already in place. The site suffers from major drawback; crime and violence.

7.2 ALTERNATIVE DESIGN

The construction of a concrete or wooden pier mounted on piles would significantly reduce purchase, construction and maintenance cost. Installation of a retractable floating Sea Walk pier will require specialized skills not available in Jamaica, this will undoubtable add to its cost. It is important to note however, that the technology will have less impact on the natural marine and underwater cultural heritage assets. Also its ability to retract makes it less obstructive to other vessels when not in use.

7.3 NO-ACTION ALTERNATIVE

Defalting on the proposed development may result in:

- Loss of potential employment opportunity for community members.
- Lost potential opportunity for infrastructural development and improved housing stocks.
- Lost opportunity for poverty alleviation.

8. MONITORING PROGRAMME

The aim of this monitoring programme is to ensure compliance with relevant legislation, implementation of mitigation to minimize negative impacts. If a permit is granted for the proposed development, the Port Authority of Jamaica (PAJ) should provide the Jamaica National Heritage Trust (JNHT) with the final project plans and a schedule of phased activities. The JNHT will use the schedule to monitor the activities of the project and its impact on the cultural resources.

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APPENDIX 1

INVENTORY OF OLD COAL WHARF CULTURAL HERITAGE ASSETS

Photo letter/number	Photo	X Coordinates	Y Coordinates	Description
A		**767371**	643504	Old Coal Wharf parameter wall - Plate 7.
B		767208	643482	Modern concrete house – Plate 10.
C		767312	643486	Old Coal Shed No. 1 – Plate 10.
D		767382	643533	Old Coal Shed No. 2 – Plate 11.

Photo letter/number	Photo	X Coordinates	Y Coordinates	Description
E		**767375**	643577	Adjunct Structures to Coal Shed No.2 – Plate 12.
F		**767333**	643527	Entertainment Zone - The entire area between Coal Sheds 1 and 2 - Plate 13.

G		767277	**643574**	Old Concrete Pier – Plate 14.
H		767409	643570	Electricity Generator Station – Plate 15.

Photo letter/number	Photo	X Coordinates	Y Coordinates	Description
K		767432	643611	Concrete rubble in mangrove.

L		767471	**643572**	Small Jail Cell which lies south of the mangrove.
M		767365	**643593**	Squatter hut.
N1		767454	643534	Taino ceramic surface scatter.
N2		767454	643534	Taino pottery sherd assemblage was observed.

Photo letter/number	**Photo**	**X Coordinates**	Y Coordinates	Description

Test Trench 1		**767231**	643428	Test Trench 1 is located to Admiralty Houses perimeter wall.
Test Trench 2		767286	643528	Test Trench 2 showing exposed concrete pavement.
Test Trench 3		767319	643540	The remains of a demolished structure in the vicinity of stone tanks (Phillip Mayes Plan of site between 1800-1862).
Photo letter/number	**Photo**	X Coordinates	Y Coordinates	Description
Test Trench 5		767323	643522	Test Trench 5 depicts brick commingled with concrete rubble and mangled iron bars.

Test Trench 6		767319	643533	The concrete floor of a structure.
Test Trench 7		767342	643532	The image shows Test Trench 7 at the coal residue level.
Test Trench 8		767340	643559	The second image shows the west end of the unit where the concrete pavement extends.
Test Trench 9		767371	643562	The image shows Test Trench 7 at the coal residue level.

Photo letter/number	Photo	X Coordinates	Y Coordinates	Description
Test Trench 10		767402	643572	Anchor 1.
Test Trench 11		767408	643564	Anchor 2.

Test Trench 12		767408	643564	Anchor 3.
Test Trench 13		767374	643590	Remnant of a contiguous brick pavement with features resembling a boat slip.

The Underwater City of Port Royal

Jamaica

Date of Submission: 02/03/2009

Criteria: (iv)(v)(vi)

Category: Cultural

Submitted by:
Jamaica National Heritage Trust

State, Province or Region:
Middlesex Country, Kingston and St. Andrew Parish, Port Royal District

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Description

Port Royal, Jamaica, commonly referred to as "the wickedest city on earth" conjures images of marauding pirates, daring naval conquests, looting, riches, destruction and devastation. It boats an intriguing and turbulent history as it rapidly grew to become the most important trading post in the New World. At the height of its glittering wealth, on June 7, 1692, Port Royal was consumed by an earthquake and two thirds of the town sank into the sea. A series of fires and hurricanes followed and the town was never restored to its former glory. Port Royal lived out its days as a British naval station and remains as a small fishing village today.

Port Royal falls into the category of "catastrophic sites," places that are devastated by some natural disaster and in the act of destruction, preserved *in situ.* The universal significance of Port Royal stems from the fact that it is distinctly different from most archaeological locations. Generally archaeological excavations represent a long period of time where buildings were constructed, renovated, added, fell into disrepair, were abandoned, collapsed and perhaps built over. In contrast, after just 37 years of existence, the bustling city of Port Royal literall sank into the harbour in a matter of minutes, remaining perfectly preserved as it was on the day of the earthquake.

The following is a historical description of the events that led to the growth, destruction and rebuilding of Port Royal. While, this submission focuses mainly on the underwater city, it is also necessary to mention the development of Port Royal, post-earthquake to the present day and to maintain context. The historical background is followed by a physical description of the underwater city and some of the important terrestrial remains found on the modern-day site.

Historical description and context

The Port Royal Cay

Port Royal is situated on the end of an 18-mile long sand spit known as the Palisadoes, 15 miles from the centre of Kingston, capital of Jamaica. Currently, the peninsula is one continuous strip although at various times throughout its history, the tip on which Port Royal stands was a cay completely surrounded by water.

Evidence of Taino activity on this cay was revealed by underwater excavations in the 1960s. The excavation team found shards of Taino pottery, dated sometime after 1000 AD, and part of a stone *metate,* used to grind corn. It is not known whether the Taino established a permanent settlement here and more likely, they used the sand spit simply as a fishing camp.

Pre 1692

When the Spanish arrived in Jamaica in the 1500's, they discovered that the cay was an ideal spot for careening, that is, a place to clean and refit boats and scrape the hulls clean. They named the area *Cayo de Carena* but built nothing more than a few timber warehouses at the site.

Regular occupation at the site began when Britain captured Jamaica from Spain in 1655. The English immediately recognized the cay's strategic importance in defending the island from the threat of recapture by the Spanish or the possibility of French invasion. They set about fortifying the place and completed Fort Cromwell (later enamed Fort Charles) in less than two years. Construction continued over the next two decades until six well-armed forts surrounded the little cay. Thus Port Royal, during its period of prosperity, was better defended than any of its contemporary Spanish cities, such as Cartagena, Havana, Vera Cruz or Porto Bello.

Within this fortified area the town grew rapidly. Due to its safe and protected location, its flat topography and deep water close to shore, large ships could easily glide in to be serviced, loaded and unloaded. Along with the ships, sailors and merchants alike established themselves to benefit from the many trading and outfitting opportunities there. Between 1655 and 1692, Port Royal grew faster than any town founded by the English in the New World. In 1662 Port Royal recorded 740 inhabitants. At its' height in 1692, population estimates vary from 6500 to 10,000. With approximately 2000 buildings densely packed into 51 acres, a realistic estimate would be between 6500 and 7000 inhabitants of whom perhaps 2500 were slaves.

Centred on the slave trade as well as export of sugar and raw materials, Port Royal became the mercantile hub of the Caribbean and the most economically important English port in the Americas. The city boasted merchants, artisans, tradesmen, captains, slaves, and notorious pirates who all participated in an expansive business network. It had a governor's house, king's house (court of chancery), four churches and a cathedral. Many of the buildings were made of brick, indicating a certain amount of wealth not found at other contemporaneous settlements. Inventories of Port Royal's citizens reveal much prosperity and the observation that, unlike the other English colonies, Jamaica used coins for currency instead of commodity exchange.

During the early days'of Port Royal's development, officially sanctioned privateering was also a common practice. Privateers or Buccaneers were awarded official contracts from England to raid Spanish, Dutch and French ships in the Caribbean.

Part of the booty was reserved for the Crown and the rest flowed into the coffers of Port Royal's bawdy citizens. While, this practice was officially ended by the 1670 Treaty of Madrid, privateering and/or piracy, continued well into the 18th century. In 1689, nearly half of the population was involved in this trade.

This then, was Port Royal at its zenith, a vibrant city centre with expensive goods flowing through the harbour day in and day out. See Captain John Taylor, writing in 1688, described Port Royal as "a formidable City: well built, strongly fortified, and Populated by a valiant Inhabitant." He counted some 600 brick houses and an equal number built of timber. According to Taylor they were mainly four storeys high with cellars, tiled roofs and sash windows and had large shops and store houses attached.

Francis Hanson, writing in 1682 gave a detailed account of the wealth of the average Port Royal citizen.

'The Town of Port Royal, being as it were the Store House or Treasury of the West Indies, is always like a continual art or Fair where all sorts of choice Merchandizes are daily imported, not only to furnish the Island, but vast quantities are thence again transported to supply the Spaniards, Indians and other nations, who in exchange return us bars and cakes of Gold, wedges and pigs of Silver, Pistoles, Pieces of Eight and several other Coyns of both Mettles, with store of wrought Plate, Jewels, rich Pearl Necklaces and of Pearl unsorted or undrill'd several Bushels;

... Almost every House hath a rich Cupboard of Plate which they carelessly expose, scarce shutting their doors in the night, being in no apprehension of Thieves for want of receivers.

... And whereas most other Plantations ever did and now do keep their accounts in Sugar, or the proper Commodities of the place, for want of Money, it is otherwise in Jamaica, for in Port-Royal there is more plenty of running cash (proportionally to the number of its inhabitants) than in London.'

Earthquake and Post 1692

In the midst of this decadence, Port Royal was struck by a severe earthquake at 20 minutes to noon, June 7, 1692. Three violent shocks, each stronger than the previous ripped the earth followed by a giant tidal wave. Within minutes, two-thirds of the entire town disappeared under water. Nearest to the water's edge, the streets filled with warehouses were the first to go. The cemetery sank while the church tower crumbled to the ground. One by one, the Forts disappeared under the rising waves.

One survivor, Rev. Dr. Heath, rector of Port Royal recalled, "we heard the Church and Tower fall, upon which we ran to save ourselves; I...made towards Morgan's Fort, because being a wide open place I thought to be there securest from the falling houses; but as I made towards it, I saw the earth open and swallow a multitude of people; and the sea mounting in upon us over the fortification."

Of the original 51 acres, 20 sank to a depth of 10 feet and 13 slid to a depth of 35 feet. Two thousand people died immediately and a further 3000 died of injuries and disease shortly after.

While, most survivors fled to the mainland, some did remain. Officials like the secretary, receiver general and port officers were soon ordered back to work. Trade and privateering was also revived and Spanish treasure was soon filling the coffers once more.

But disaster struck again when a great fire broke out in a warehouse on January 9, 1703. The fire spread quickly, aided by large quantities of gunpowder and other flammable material stored in the various areas of town. The narrow streets and the close proximity of buildings made salvaging almost impossible. By midnight the entire town was reduced to ashes. As noted tersely in the log of one the boat masters, "Port Royal burnt, all but the Castle."

Following the fire, a contentious Bill was proposed that would shift all commerce to the growing centre of Kingston. Merchants were in favour of relocating as they claimed Kingston was healthier and safer than Port Royal. Seamen and sailors countered that Kingston was too difficult for their ships to access. Afier much argument, the Bill was rescinded and both cities were left to develop side by side. However, Port Royal was never to recover as an important commercial core. A series of humcanes in 1712, 1722, 1726 and 1744 damaged the town to such an extent that it never recovered its former significance as a merchant epicentre. For the rest of the century Port Royal's role and importance shifted as it became the main British naval centre in the Caribbean.

Port Royal - 18th century to the present

Port Royal's role as a British Naval Station extends from 1713 to 1905. During this time, the Station grew in size and tactical efficiency and Port Royal began to shelter fleets for offensive operations.

From 1715 to 1763, a dockyard was founded and consistently expanded in order to facilitate large navy ships. By 1770 it was properly equipped to handle trans-Atlantic voyages. Between 1763 and 1815, the dockyard was efficiently administrated and a new careening wharf was built south of the existing one. Naval operations officially ceased in 1905. Today, Port Royal is a small fishing village with a population of about 2000.

As the focus of this submission is the sunken city of Port Royal, on the surface, there is little to immediately suggest the town's turbulent past. Most of Port Royal's secrets lay deep under the water and considerable work has been conducted on the section that remains submerged.

Physical description

Early excavations by Edwin Link uncovered two small areas near the King's Warehouse and Fort James in 1956 and 1959. In 1960, Norman Scott excavated around Fort Carlisle. In 1966 and 1968, Robert Mam excavated remains of the fish and meat markets, two taverns, and three ships located along the western edge of the city. In the seventies, Antony Priddy conducted land excavations on of a block of lower-class houses and recovered thousands of artifacts and architectural features."

The most extensive research was carried out from 1981 to 1990 by the Nautical Archaeology Program of Texas University, in cooperation with the Jamaica National Heritage Trust (JNHT). This excavation concentrated on the submerged remains on Lime Street, near its intersection with Queen and High Streets in the commercial center of the town. At present, eight buildings have been investigated resulting in detailed data and an unrivalled collection of in situ artifacts.

The construction features five of the investigated buildings exemplify the variety of architectural styles found in the city center. Some were well-built, multi-storied brick structures, while others were simple, earth-bound, hastily erected frame buildings."

The following is a brief description of some of the findings of the five investigated buildings.

Building 1 is a well-built brick building, measuring 53 ft. wide and 47 ft. deep. It consists of six ground-floor rooms divided into three, two-room units, each of which appear to have housed a distinct business or activity. The volume of fallen bricks on the floors and the remains of stairwell components showed that there was also at least one upper storey, which probably held living quarters.

The front rooms are aligned with the south side of Lime Street. They are connected, respectively, by an interior wooden doorway to three back rooms, which were added later. Plastered, whitewashed walls and heningbone patterned brick floors comprise the three front rooms. The bricks of the back-room floors were laid out end-to-end.

From the large assortment of leather scraps, shoe soles, a wooden lathe, and some planks, it appears that this unit housed a combination cobbler/wood turner's shop. Large quantities of cut animal bones and sea turtle shells suggest also that butchering and/or food preparation occurred in the unit's back area. Also, a large number of recovered artifacts associated with the selling and consumption of alcohol suggest that this unit appears to have been used as a tavern. At least 60 dark-coloured glass liquor bottles, as well as jugs, tankards and kegs, were recovered from this area.

Building 2 is a poorly preserved frame building, with few walls excavated. There is no evidence of brick flooring, but there is a fragment of a plaster floor and wood planking for a floor. Building 2 faced Lime Street, but its poor condition allows for neither its size nor function to be determined at present.

Building 3 is timber-framed, about 38 ft. wide and about 27 ft. deep. It has raised sills on a mortar foundation, with intempted floor sills at the corners and major intersections. The large post size suggests that Building 3 had two stories. The stairs were possibly located at the rear.

Two front rooms face onto Lime Street and two back rooms are possibly extensions of the yard. The remains of an exterior kitchen, or 'cook room,' was also revealed. A large number of unused white clay tobacco pipes, corked and monogrammed wine bottles and various measuring scales and weights suggest that the building was possibly used as a storage area for the various activities in the adjacent buildings and for the nearby outdoor market.

Building 4/5 is a large and rambling complex consisting of at least six rooms and three back yards. The complex is approximately 65 ft. wide and over 40 ft. long and represents at least two, possibly three, houses or combination houses/shops.

The architectural layout of Building 4 was disrupted by the earthquake, which badly affected several areas of the building, including remains of doorways. Horizontal displacements have also skewed the floor and walls several feet. Interpretation of the building is further complicated by the 70 ft. long remains of a ship that washed over from the harbour in the tidal wave that followed the earthquake. It ploughed through Building 4's front wall, and came to rest in the middle of the rooms. The assemblage of domestic/food preparation artifacts in Building 4 suggests it was some kind of residence-accommodation perhaps for the servants/slaves, who worked in Building 5.

Building 5 has a separate entrance, plastered floor, and collection of pewter plates which may suggest it was used for entertaining or serving food to patrons. Stacks of about *25* pewter plates found in a cupboard under the remains of the staircase and an assortment of unused white clay smoking pipes and uncorked glass bottles located near the door indicate the possibility that this area also functioned as a storage space.

One room contained artifacts associated with food preparation, such as cast-iron and brass cooking pots, as well as a large brass strainer and a silver spice grater. Remains of a hearth, oven and several measuring weights in the old English wheat system were also found in this area indicating the presence of kitchen with bread production.

On land, the major areas of the town remain surrounded by perimeter walls and separated into several distinct quarters. Within each of these sections there are some visible structures that span the entire range of Port Royal's history. They are described briefly below.

The Naval Hospital

The Naval Hospital was rebuilt in 181 8 replacing an earlier structure destroyed by fire in 1815. Construction was carried out largely by African slaves supervised by the royal engineers of the British Army. It is a rare example of a building that used pre-fabricated cast iron units imported from England. These iron columns are attached on a base beneath the structure in a "raft-foundation." This gives added stability and strength to resist hurricanes and earthquakes. Currently, the building houses the National Museum of Archaeology as well as storage, lab and oflice space.

The Naval Dockyard

Several structures in the dockyard remain today including ruins of the coaling wharf and the naval storehouse, as well as the Admiralty Houses built in the late 1800s to accommodate senior naval personnel. The foundations of St. Paul's church (1682) have also been found about seven inches below current ground level. Future excavation at this site could reveal streets and houses of the pre-earthquake Port Royal.

The Village of Port Royal

Today, only two historic buildings remain in the modem town. These are the gaol-house, built in 1710 from large cut stone and timber with brick door and window cornices, and McFarlane's Bar, constructed in the 19th century. The bar has a street-level gallery, sash windows and louvers on the upper floor.

The Playing Field and Chocolata Hole

The current playing field is identified as the former site of Lime Street, one of the most important streets in the pre-earthquake city. Lime Street is in fact continued underwater and is well preserved, with major significance as an archaeological site. Chocolata Hole was a bay in front of Fort Charles until it was filled in sometime after the earthquake. On the east side of Chocolata Hole is St. Peter's church (1725) and the former Military Hospital Laboratory.

Justification of Outstanding Universal Value

At its height, Port Royal represented the global centre of the British merchant trade in the 17Ih century. Typical of an English colonial port town, yet unique in its unprecedented consumer wealth, carousing buccaneers, and thriving middle class, Port Royal was unparalleled anywhere in the world. In 1692, without warning, the dazzling city fell to a great earthquake which engulfed the town in a matter of minutes leaving behind nothing but a detailed and permanent record buried under the sea.

As the only sunken city in the Western Hemisphere, the assemblage of buildings both on land and underwater illustrate a vivid picture of life during the era of colonial expansion in the new world. The Outstanding Universal Value of this site can be justified through the use of criteria (iv), (v) and (vi) as discussed below.

Criteria (iv): be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage in human history

During its short-lived glory days, Port Royal was at once a typical 17th century port city, a major center for urban trades, and a stronghold for pirates and privateers.

The underwater assemblage of excavated buildings in the sunken city is an excellent example of an architectural ensemble representing everyday life in a colonial port town. Combining the cache of historical documents with the underwater excavations has allowed a detailed reconstruction of this significant stage in human history to emerge. Study of the buildings and landscape has contributed significantly to understanding 17th century town-planning, architecture, diet, cooking activities, and other aspects of daily life.

For example, from the documentary and archaeological evidence much can be gleaned about Port Royal's habits of dress, eating, and recreation. Inhabitants dressed in a manner that closely followed the fashion trends in London. In 1687, John Taylor wrote that Port Royal's merchants were living, "to the height of splendour, in full ease and plenty, being sumptuously arrayed." The men, as were in vogue during the reign of Charles II, wore Turkish garments and fashionable jewellery. Merchants' wives wore long tucked-up skirts with pointed waists and large lace collars. According to historical inventories, many different materials were sold in town including; plain silk, flowered silk, Persian silk, plain and coloured calico, fine women's hose, ribbons and cotton gloves.

Clothing for slaves was much less elaborate. White indentured servants dressed in plain canvas drawers, costing two shillings a pair. A shirt could be purchased for four shillings, a jacket for one shilling, six pence. They may also have owned inexpensive stockings, shoes and a neck cloth. Slaves wore coarse and cheap clothing cut from brown Ozenbrigge, a type of inexpensive German linen. Female slaves were probably also clad in cast-off clothing from their mistresses.

By all accounts, the people of Port Royal ate and drank well and copiously. Wine and beer was abundant. One resident wrote, "our drink is chiefly Madeira wine, lemmonadoes, punch, and brandy...cacao-drink, sugar-drink and rap made of molasses." The food was varied, some produced locally and much arriving with the ships from overseas. Three separate markets were supervised by special town officials. A central market on High Street sold herbs, fruit and fowl. At the west end of High Street was a market for meat including beef, mutton, veal, lamb and local turtle. Neat to the wharf, a third market sold fresh fish.

With its soldiers, sailors, slaves, pirates and prostitutes, it is little wonder that Port Royal had a reputation for bawdiness and amusement. Attending church was a social diversion as much as a spiritual activity. Other forms of recreation included playing dominoes or strolling down the Palisadoes in the evenings. In town, dne could frequent any of the numerous inns and taverns. Some establishments held cock-fighting or bull and bear baiting and several had billiards rooms. The census of 1680 also mentions a brothel establishment belonging to a John Stan; containing 21 white women and two black women.

Another significant aspect of Port Royal during this time is the role it played as the hub for pirates in the West Indies. This brief but dynamic era in human history resulted from illegitimate but lucrative opportunities for common seamen to attack European merchant ships and seize their valuable cargo. Piracy was sometimes given "legal" status by colonial powers, especially England and the Netherlands. Known as "privateering," contracts or letters of marque were awarded to ship captains who were then permitted to raid enemy strongholds in the name of the Crown. The term "Buccaneers" was also used to describes those privateers localized to the Caribbean who attacked the Spanish, French and Dutch ships.

In the 1660s, privateering was becoming so attractive to colonists that merchant-ships and plantations were suffering from a shortage of labour. Buccaneer ships returning to town were welcomed by a gun salute which also became a signal to stop working and to head for the docks to view the loot. The moment the prize anchored, officials would board the ship to confiscate a fifth of the booty for the King, a tenth for the Admiralty and a twelfth for the Governor.

Some of the famous buccaneers based at Port Royal included Henry Morgan, Edward 'Blackbeard' Teach and 'Calico Jack' Rackham. Many first-hand accounts survive describing the antics of the seamen carousing in the streets of Port Royal bearing plundered trinkets from all over the world.

Consequently, Port Royal became the premier location for goods and slave trade in the new world. The rapid expansion of trade in the 17th century caused European merchants to quickly establish themselves either personally or through their representatives and merchant marine activity grew rapidly. Imported products included; flour, wine, spirits, salt, beef, fish, various fruits and vegetables. A wide variety of English goods such as cloth, iron work and naval stores were also imported.

The re-export trade dealt with goods manufactured in England, Europe and the North American colonies. A section of this re-export trading included illicit arrangements with Spanish American colonies, but there was also legal trading with the various English, French and Dutch possessions in the Caribbean during times of peace and war.

Port Royal was also the auction centre for the slave trade in the Caribbean. A gun was fired to give notice of the sale and business was conducted on board the ships or on the wharfs. While, no personal account from an African slave is to be found, there is one from the white indentured servant, John Coad. He describes how he was taken aboard a ship in England with 100 other convicts. They were shut "under deck in a very small room where we could not lay ourselves down without lying upon one another." When they reached Port Royal it was discovered that 22 convicts had died on the journey.

Thus the archaeological assemblage of Port Royal, as evidenced through both documentary and physical materials, provides a clear and detailed picture of life in the 17th century, a window into the pirate life, and a clear notion of goods that were being traded internationally.

Criteria (v): be an outstanding example of a traditional human settlement, land-use, or seause which is representative of a culture or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change

The underwater city of Port Royal is one of the world's best representations of a people and way of life that was lost due to the impact of irreversible environmental change. Known as the 'city that sank' a great earthquake swallowed the majority of town into the ocean one fatehl June morning in 1692. The earthquake claimed many lives but also preserved many aspects of the inhabitants' daily existence at that moment in time.

Because of this, Port Royal is one of the most important archaeological sites in the Caribbean and a unique site worldwide. In contrast to many other archaeological digs, investigation of Port Royal has yielded much more than simply trash and discarded items. Since, the town only existed 37 years before destruction by the earthquake, it is one of the few catastrophic sites where cultural features and material are found more or less undisturbed. An unusually large amount of perishable, organic artifacts have been recovered, preserved in the oxygen-depleted underwater environment, including some human remains.

Notably, this history is intricately linked with the topography and geography of the area. Port Royal is located at the vulnerable end of the Palisadoes spit which is formed as loose sand and gravel from rivers in the Blue Mountains is deposited into the Caribbean Sea. From here, winds and a strong westerly current cany the sediment towards the cays off Kingston. These cays, which are the surface projections of an extensive underwater shelf, slow down the current and the river water is deposited around and in between them.

Breaking waves also add to the sedimentary material. The waves encourage precipitation of lime carbonate which creates a type of cement loosely binding all the other materials together. Thus, the Palisadoes peninsula was initially a series of these small cays which were connected over the last 400 years into a continuous strip by deposition of muddy sand, silt and gravel.'8 Predictably, land formed in this manner from unconsolidated material is highly unstable especially given the very steep slope at the water's edge. So, it was during the earthquake of 1692 that this fluidized layer contributed to the landslide wherein the northern section of the cay slipped down and outwards horizontally instead of toppling over vertically. This outward movement preserved much of the city remarkably intact as it sank. Presently, it is estimated that 13 acres lie buried and only a small percentage of this land has been fully excavated.

Since 1692, there has been very little coastal movement on the north side of the spit, probably because the harbour has inhibited the passage of the gravel-laden waters. To the south and west however, much growth has occurred with each decade adding its contribution of layers and continuing to change the shape of Port Royal. Currently the Palisadoes rest about 2 to 6 feet above sea level. The south side of the spit is sand and shale beaches supporting cacti and shrubs, while the northern side bears a mangrove coastline.

The great earthquake was not the only environmental disaster to affect Port Royal. From 1597-1994 the city has been hit by at least 47 hurricanes and major storms, nine earthquakes of major or moderate intensity and two major fires. It is a testament to the tenacity and courage of the residents of Port Royal that they continue to live there even to the present day.

As a city battered by natural disasters, yet continuing to stand, Port Royal epitomizes a human settlement interacting with an environment inflicting irreversible and constant change.

Criteria (vi) be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance

Seventeenth-century Port Royal can be directly and tangibly associated with the origin of two of the most significant events in human history, the wnsumer revolution and the industrial revolution.

The consumer revolution refers to the period from the late 16th to 19th century in which there was a marked increase in consumption of goods and products by individuals from different economic and social backgrounds. It allowed a diverse group of people to purchase similar items that previously may have only been available to those the upper middle classes. This revolution allowed individuals who were not necessarily wealthy to indulge, and for the first time consume, products that were luxury as well as necessity. The consumer revolution was manifested mainly in Europe and its colonies, and may also be seen as a driving force for the subsequent Industrial Revolution.

This Industrial Revolution was a period roughly defined from the 17th to 19th century when major changes in agriculture, manufacturing and transportation had a profound effect on the socio-economic conditions in Britain.

The onset of the Industrial Revolution marked a major turning point in human society; almost every aspect of daily life was eventually influenced in some way. It was characterized by transition from an economy largely based on manual labour to machine-based manufacturing. This process eventually spread throughout Europe, North America and the world, continuing today as industrialization.

Each of these significant events represented a massive cultural shift from previous norms and helped shape current concepts of consumerism and global trade. Port Royal was one of the first places to display indicators of the burgeoning consumer revolution, and it was the main export hub for supplies and raw materials that were required to set the wheels of the industrial revolution in motion. In this way it is directly and tangibly related to these events of outstanding universal value.

As evidenced by the various probate inventories and material artifacts recovered from the underwater city, the citizens were consuming a large number of items for luxury and not simply necessity. Materials such as secular books, silver plate, spices, porcelain and fine cloth could all be found in Port Royal. Furthermore, the prevalence and consumption of these luxury items here was not matched by comparable groups in England or North America for another 20 to 40 years. This suggests that unique social and historical circumstances at Port Royal facilitated the early adoption of consumerist behaviour which was later transferred widely throughout the English-colonial world.

Indicators of this consumerist behaviour include social climbing and the display of wealth, both prevalent attributes in Port Royal. A variety of reasons are suggested for this behaviour. The relatively short lifespan and young median age of Port

Royal's citizens may have induced a high risk/fast reward mentality. As well, since Port Royal was a boomtown, built in a very short time-span, it lacked the established family hierarchies and traditional social tiers that defined other English cities.

According to historians and archaeologists, people of low to middle income and social standing should not have been purchasing small trinkets and items of luxury in the 1680s-90s. The consensus among scholars, who have studied consumer behaviour in England and the colonies, is that widespread middle class consumption of nonutilitarian consumer goods did not begin until sometime between 1720 and 1740. But in Port Royal, even those of modest means such as a small-time merchant, inn-keeper or carpenter had and displayed these times freely.

On a larger scale, this increasing consumer demand eventually contributed to the impetus for mass-produced, machine-manufactured items that defined the industrial revolution. In order to facilitate this large-scale production, raw materials in the forms of metals, goods and capital was needed and all of it passed through Port Royal on its way to Britain.

Recall that Port Royal was first and foremost a trading city and the 17th century was a time of enormous change and expansion in the realm of international trade. As knowledge of the globe increased, so too did the opportunity for increased economic transactions. With that came an increased need for wealth. As European mercantile companies sent out more vessels on voyages, cash was required to cover expenses. This means that cash flow was weighted towards purchase of commodities and ship outfitting expenses, which culminated in Port Royal's harbour.

Records indicate that between 1686 and 1691, 240 vessels arrived from England and Africa and 363 came in from North American colonies. The vessels carried a total tonnage of almost three times that of vesselsfrom North American colonies. And these statistics do not include the many unrecorded vessels which catered to privateers and smugglers. Various Navigation Acts were implemented to funnel all proceeds from trade, directly or indirectly, into the coffers of the mother country. This put Jamaica directly in the middle of a very lucrative trade system and thus it began to provide the materials, capital and man-power that were required for the early stages of the industrial revolution.

Finally, it is worth noting that Port Royal may have been the most multi-cultural English city of its time in terms of the nationalities and religions of its citizen. It was seen by many as the logical rendezvous point for all manner of people and occupations. This became increasingly true as a result of the growing mercantile endeavours of the city's English and European population.

English and Anglicans were the dominant majority, while West African slaves constituted the largest minority. Port Royal also contained a significant population of Jewish merchants, who travelled from places such as Suriname, Brazil and London. English and Scottish Quakers were present as well as people of Asian and North African descent. The buccaneers were of Irish, Spanish, Dutch and French origin. Indigenous peoples from both South and North America were also present, often as crewmen on pirate ships. Considering that the 17th century environment was not particularly tolerant of religious and cultural differences, in Port Royal this melding of people from all comers of the globe carries significant universal value.

Statements of authenticity and/or integrity

Authenticity

Port Royal is the only authentic sunken city in the Western Hemisphere. Combined with its wealth of archives and documentary material, the value attributed to its heritage is credible and genuine in every way. Reliable records can be found from the 17th through to the 19th century. These information sources include diaries, store and warehouse inventories, itemized merchant's lists, captain's logs and probate lists which describe in infinite detail the nature, and historical context of the cultural heritage of Port Royal's citizens.

Many of the materials found in the underwater city of Port Royal, are perfect expressions of authenticity, found just exactly as they were originally being used or where they were stored. Cast-iron skillets and pots were still in the hearth with charred wood from the fire concreted to their surfaces. Stacks of pewter plates were found as they fell from their storage space under the stairs in what is surmised to be the serving area of one building. The remains of children were found among the broken walls of their home. Also, uncovered were the remains of barrels containing the trash of the day, including the trimmings of a man's beard and hair in a yard area. Many ceramics were found intact or broken where they fell.

In terms of authenticity in location, several maps from the 16th and 17th century alternately show Port Royal as a cay or connected to the main peninsula. Similarly, the progressive filling-in of Chocolata Hole expresses an authentic change in the landscape over time.

In 1996 the Jamaica National Heritage Trust (JNHT) designated Port Royal as Protected National Heritage, meaning that the town as a homogenous whole is important to identity and legacy of the Jamaican people. This designation dictates that whatever development takes place within the township is sensitive to the area's historical significance and respects authentic architecture, culture and spirit of the town.

Integrity:

Today Port Royal is a living community of over 2000 members. The wholeness and intactness of the continued cultural heritage here is illustrated by several factors.

First, the global significance of the property can be measured quantifiably by the abundant historical records and the accessibility of a detailed and immaculately preserved archaeological site in the underwater city. Furthermore, the area serves as an interactive research centre, with the old Naval Hospital housing the National Museum of Historical Archaeolo-gv. and the Centre for Archaeological and Conservation Research. The Centre comprises some 50 individuals who engage in diverse areas of research, analysis, support services, and public relations. In the future, the intention is to provide additional facilities and staff to maximize research and public education programs.

The property also meets the conditions of integrity in being of adequate size to ensure a complete representation of the features which convey its significance as a colonial and trading center in the 17th century.

The terrestrial portion of Port Royal contains several visible structures from post-earthquake Port Royal. In addition, as seen by the subterranean discovery and excavation of St. Paul's Church, there may be more of the original Port Royal ruins underground which may have been buried as the earth shifted and changed with the various earthquakes and hurricanes. These could provide a rich potential source for further research.

Port Royal does suffer from some threats to its integrity. Notably, because of its peculiar location on the end of the Palisadoes peninsula, Port Royal is extremely vulnerable to damage caused by natural disasters. Thus, active steps are being taken to ensure that all recovered artifacts are properly documented, restored and preserved to ensure that the history and cultural heritage will be available for future generations to enjoy.

Tourism development, poor local infrastructure and a non-regulated fishing industry also present threats to the integrity of this property. The JNHT is currently working with local stakeholders, government, and the Port Royal community to address these issues and ensure proper management and sustainable solutions. Working towards conservation and World Heritage Status for Port Royal is a desirable mechanism for building community participation, and will serve to initiate awareness of cultural preservation among the local, regional and global populations.

Comparison with other similar properties

National/Regional

There is no national or regional comparison for Port Royal as it is the only authentic sunken city in the Western Hemisphere. In terms of geography, the Caribbean is under-represented on the World Heritage List. Jamaica currently has only one site on its tentative list and no sites with World Heritage Status. The addition of Port Royal to the Tentative List would be beneficial for the country and the region and could serve as a centre of exploration for archaeologists and nautical researchers around the world.

International and Inscribed sites

On an international scale there are very few sites that may be compared to Port Royal. There are three catastrophic sites as well as several shipwreck sites that may hold similarities. These are described briefly below.

Pompei and Herculaneum, Italy: Arguably, one of the most famous catastrophic sites is Pompeii and Herculaneum in Italy. During the eruption of the Mount

Vesuvius volcano in 79 AD, these two ancient Roman cities were covered in ash and lava. Several of the villas in the area as well as the commercial town centers were completely engulfed, immediately preserving many aspects of daily life *in situ.* Archaeological excavation here is ongoing and the area has been open to the public since the mid-18th century. Pompei and Herculaneum are World Heritage Sites nominated under the cultural criteria (iii) (iv) and (v). While, they are excellent examples of preserved in situ sites, they are not contemporaneous with Port Royal and the two are incomparable in terms of history, culture, geography etc..

Ozette, USA: Around 1700, a mudslide completely engulfed a Makah Native Indian village near Lake Ozette in Washington D.C. The mudslide preserved several houses and their contents which remained buried until 1970, when tidal erosion revealed the front edge of a wooden long house. Subsequent excavation lasted 11 years and produced over 55,000 artifacts, spanning a period of occupation around 2000 years. The dig represents the most complete recovery of items illustrating life in an ancient Northwest coastal Indian village. The recovered artifacts shed light on the daily activities of the Makah people from whaling, fishing and seal hunting, to toys, games and tools. Ozette is not a World Heritage Site and does not appear on the tentative list for the USA.

Kekova, Turkey: The partly sunken ruins of an ancient town and dockyard destroyed by an earthquake can be found on the northern side of the Turkish island of Kekova. The earthquake occurred sometime during the 2nd century and the partially sunken city reflects the Byzantine Empire which rebuilt it. While, both Port Royal cay and Kekova island suffered damage from a major earthquake, resulting in a sunken city, the differences between the two sites outweigh the similarities. Kekova is on the World Heritage Tentative List for Turkey.

Red Bay, Canada: Red Bay comprises the largest known 16th century Basque whaling station in North America. The assemblage of submerged and terrestrial archaeological sites represents an early example of economic exploitation of North American natural resources by European commercial interests. Submerged cultural resources found in the harbour include well-preserved remains of a number of vessels that illustrate northern Iberian ship and boat-building technology and whaling activity of the 16th century. The remains of about a dozen shore stations comprising workshops, dwellings and wharves, represent the industrial processes of whaling to produce whale oil prized by the European market. A cemetery, other burial sites, and lookouts are also present. Red Bay is listed on the Tentative List for Canada.

While all these sites have some similar elements, none may be directly comparable to Port Royal which is unique among global cultural heritage sites.

UNESCO WORLD HERITAGE CENTRE 1992 - 2019

https://whc.unesco.org/en/tentativelists/5430/

13.2 Data Tables

Sewage Plant

Date	COD [mg/l]		BOD [mg/l]		TSS [mg/l]		TN [mg/l]		COD	TSS	TN	BOD
	in	out	in	out	in	out	in	out	%removal			
7-Dec-16	424	203			495	155	91	48	52%	69%	47%	
8-Dec-16	377	226			523	41	107	38	40%	92%	64%	
11-Dec-16	406	206			328	107	88	45	49%	67%	49%	
19-Dec-16	346	105	260	20	459	59	82	36	70%	87%	56%	92
21-Dec-16	439	51			389	18	117	29	88%	95%	75%	
22-Dec-16	308	95			297	32	91	27	69%	89%	70%	
26-Dec-16	246	96			587	26	61	20	61%	96%	67%	
2-Jan-17	418	118			844	74	80	35	72%	91%	56%	
5-Jan-17	319	116			683	44	117	36	64%	94%	70%	
1-Feb-17	1,152	155			1,501	106	81	30	87%	93%	62%	
2-Feb-17	990	308			1,213	88	102	29	69%	93%	72%	
6-Feb-17	948	145			3,245	62	89	35	85%	98%	61%	
8-Feb-17	957	256			642	56	92	35	73%	91%	62%	
9-Feb-17	788	249			651	37	88	32	68%	94%	63%	
16-Feb-17	639	269			361	73	84	42	58%	80%	50%	
20-Feb-17	540	292			387	51	82	37	46%	87%	55%	
16-Mar-17	491	293			1,108	147	108	44	40%	87%	59%	
2-Apr-17	735	130			678	56	73	51	82%	92%	31%	
18-Apr-17	506	144	216	18	776	44	92	19	72%	94%	79%	92
AVG	**580**	**182**	**238**	**19**	798	67	**91**	35	**68%**	**89%**	**62%**	**92%**

Source: Fluence Corp 2019

load of TSS is normally over design values due to cowsheds wastewater
the impact of this high load is shown in effluent quality

13.3 Photos and Maps

Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf

Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf

Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf

Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf

Fauna observed on the seafloor and in the seagrass in the inshore area at the Old Coal Wharf

Mangrove stand on the eastern boundary of the project footprint.

The frame of the sunken barge at M3 is overgrown by various sponges, tunicates, bryozoans and macroalgae. Patchy seagrass beds can be found closer to shore, near a lush, healthy mangrove stand.

The frame of the sunken barge at M3 is overgrown by various sponges, tunicates, bryozoans and macroalgae. Patchy seagrass beds can be found closer to shore, near a lush, healthy mangrove stand.

The frame of the sunken barge at M3 is overgrown by various sponges, tunicates, bryozoans and macroalgae. Patchy seagrass beds can be found closer to shore, near a lush, healthy mangrove stand.

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Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Sessile organisms covering the sunken vessel at site M4. The sunken vessel provides a refuge for juvenile fish.

Map of Jamaica depicting the location of Port Royal

The Port Royal Cruise Pier EIA Study Area

Palisadoes-Port Royal Protected Area

Palisadoes-Port Royal Protected Area – Conservation Zone B

Sea Walk

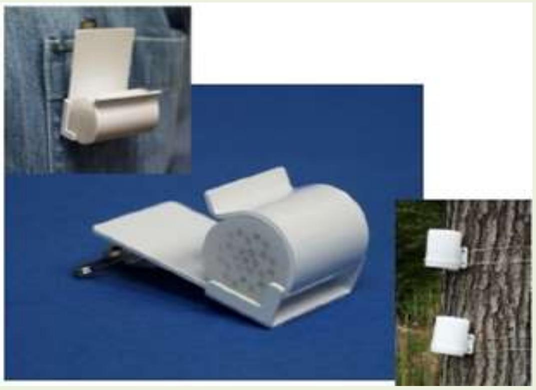
Sea Walk

Sea Walk

Sea Walk

Sea Walk

Sea Walk

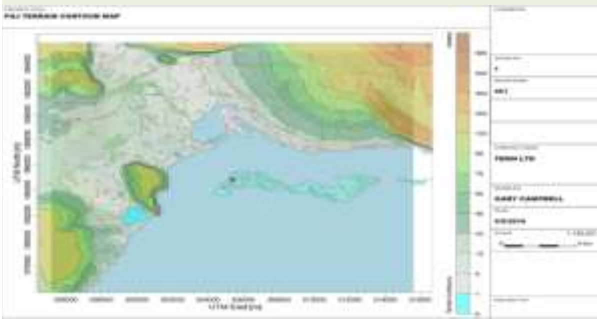


Ogawa passive sampling devices (PSDs)

PSDs were attached to this pole at the fence boundary of the OCW and the Admiralty building.

Site in proximity to Gloria's Seafood Restaurant and the Police Station where the PSDs were placed.

The samplers were mounted under a custom built shelter



Digital Terrain Elevation Map Overlap

Sampling Sites for Physico/Chemical Baseline Assessment

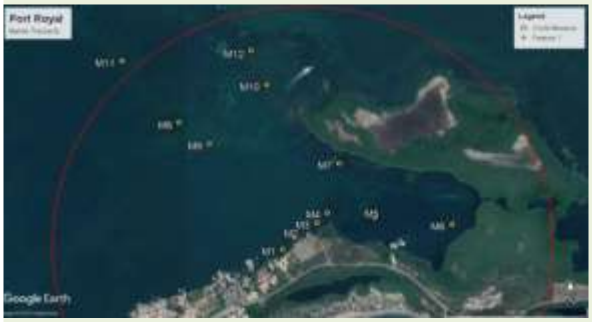
Samples at Site GW (Groundwater) at Old Coal Wharf

Samples at Site GW (Groundwater) at Old Coal Wharf

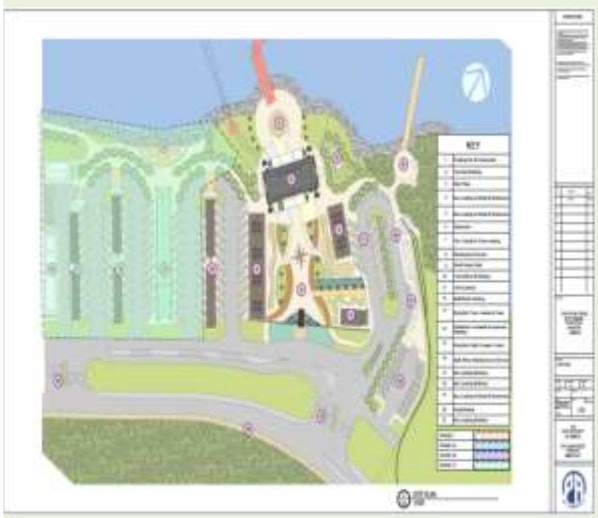
Storage of water samples for transport to labs

Storage of water samples for transport to labs

Proposed location of sampling sites for terrestrial flora, avifauna and other fauna within the study site. The precise location of transects may be refined pending the initial reconnaissance of the study area.

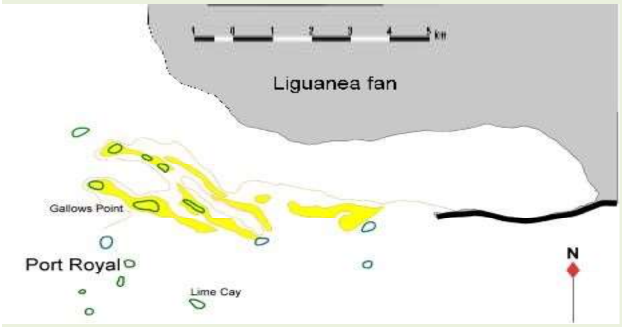


Marine survey sites in Port Royal.

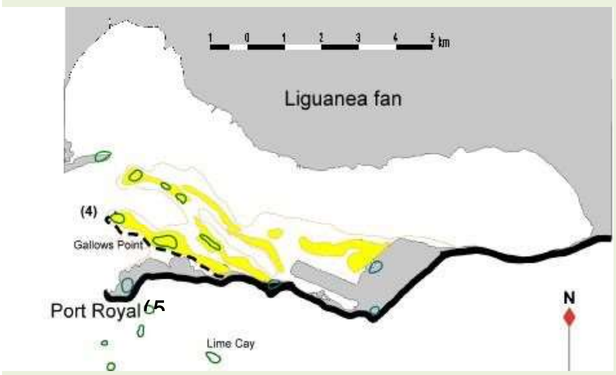


Site Plan.

Historical map by Gascoigne 1728 showing several break points in the Palisadoes resulting from the 1722 hurricane



Initial state of Port Royal and other cays over 4,000 yrs. ago (modified after Robinson and Rowe, 2004). Initial spit from mainland (black polyline); Cays/islands (green polygons); shoals (yellow shaded polygons) and thin polyline shows the assumed extend of shallow water.



Present day evolution of the Palisadoes (5) as the spit complex/tombolo extended to Port Royal (black polyline)

Partially buried ship's anchor and chain

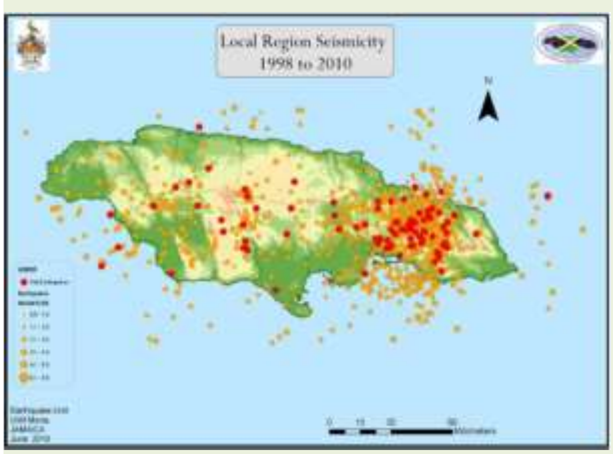
Palisadoes sediment sources

Geology map (Sheet 18 metric series) of The Palisadoes

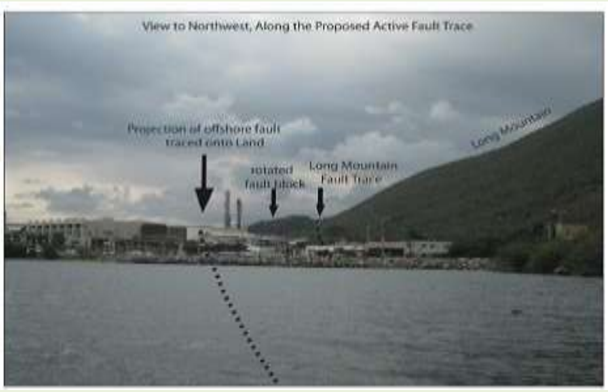
The eastern portion of the site is described by Calcareous Marl layer – made ground (approx. 15cm) with blackened/grey sand and gravel layer at depth (>20cm)

Western portion of the site is characterised by grey sands and gravels to approx. 0.8m followed by a mixture of soil and coal dust layer at depth. Standing groundwater at 3m depth in the background.

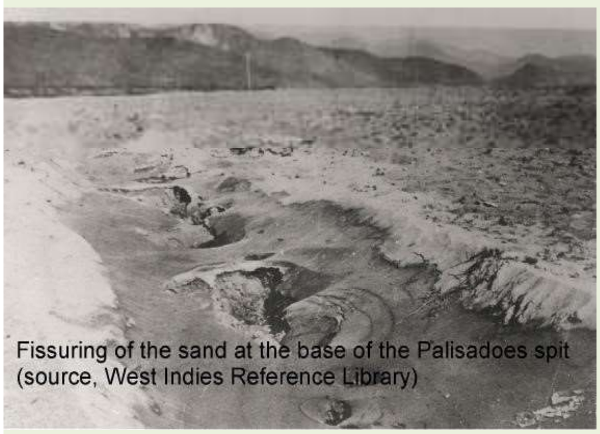
Hydrostratigraphic map indicating the site as an "Alluvium Aquifer" (light blue polygon)



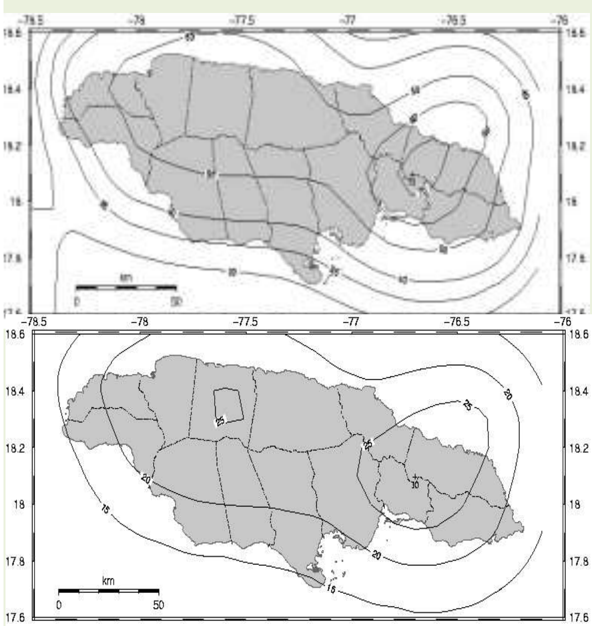
Local Region Seismicity 1998 to 2010



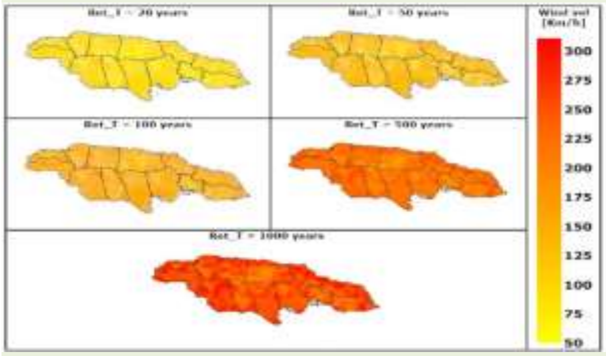
Photograph from Hornbach et al (2011) showing the trace of the identified offshore fault (black dashed line)



Sand fissures after 1907 earthquake due to liquefaction at the eastern end of the Palisadoes



Seismic hazard map of Jamaica showing the anticipated acceleration in average rock with a 2,475 year return showing Spectral Response Acceleration of 0.2 second (top) and 1.0 second (bottom) expressed as a percentage of gravity.



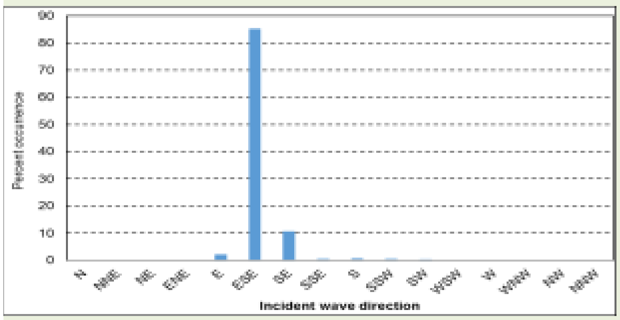
Maximum wind velocity maps (km/h) for different return periods (IDB 2009 Report)

Port Royal study site within the Kingston Harbour. Numerical wave station is located at the bottom of the figure. Yellow line scale = 5 km.

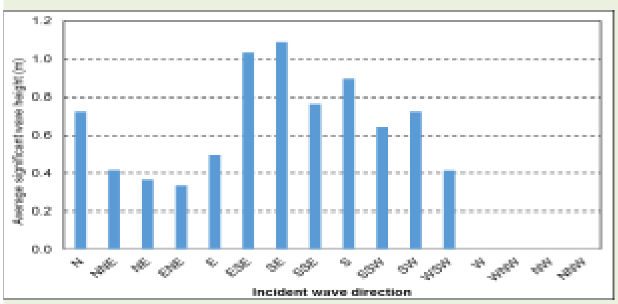
Port Royal study site is located at the entrance to a secondary embayment surrounded by mangrove islands within the Kingston Harbour. Yellow line scale = 1 km.

Shoreline conditions at the eastern end.

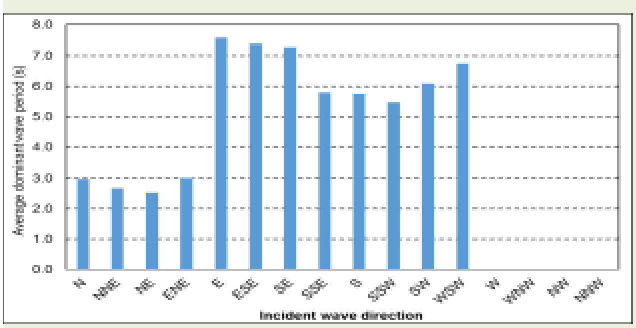
Shoreline conditions along the western section.



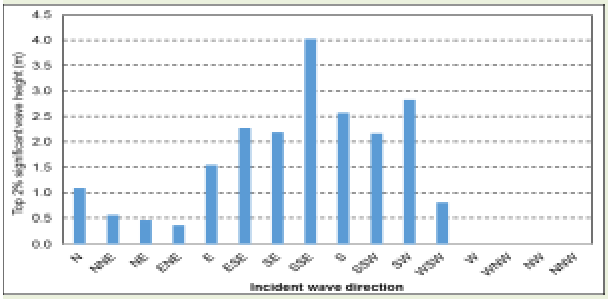
Frequency of occurrence of waves approaching from different directions



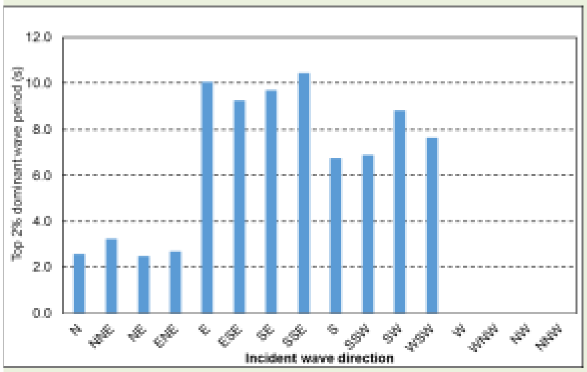
Average significant wave height waves approaching from different directions.



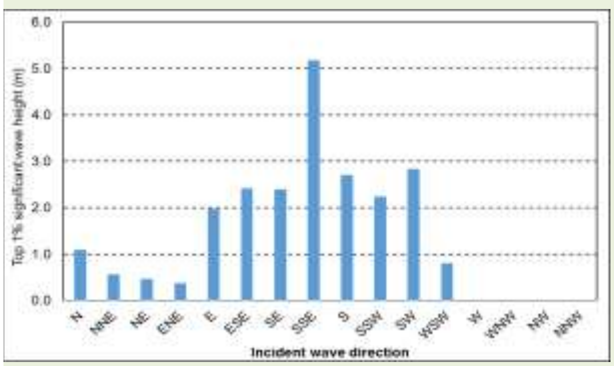
Average peak wave period waves approaching from different directions.



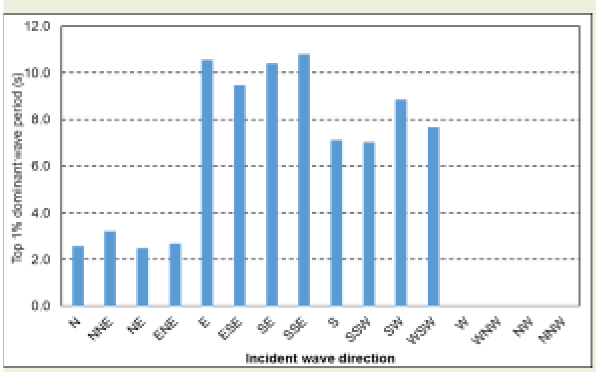
Average significant wave height of top 2% highest waves approaching from different directions.



Average peak wave period of top 2% highest waves approaching from different directions

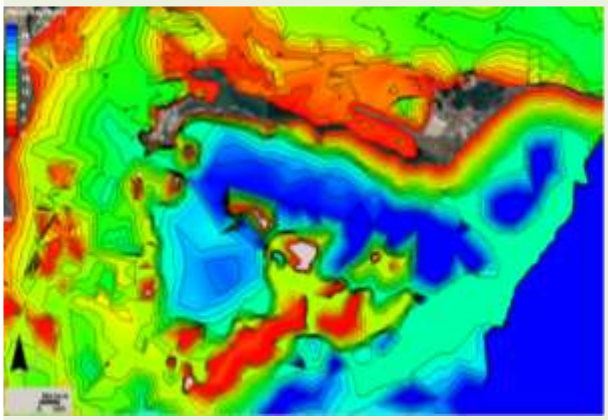


Average significant wave height of top 1% highest waves approaching from different directions

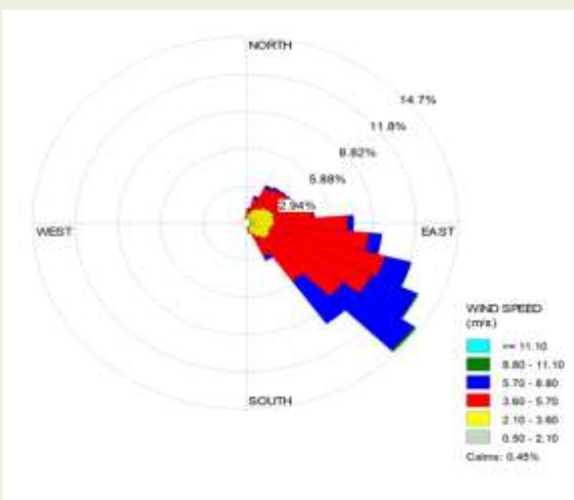


Average peak wave period of top 1% highest waves approaching from different directions

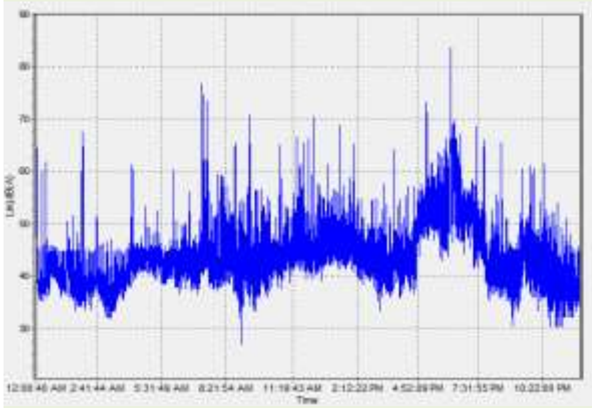
Most frequently occurring offshore incident wave directions



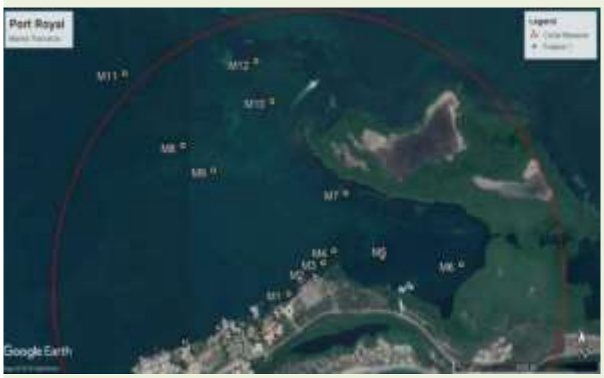
Nearshore bathymetry at the entrance to the Kingston Harbour and at the project site. The depth is referred to means sea level



Wind Rose for MM5 Data 2013-2017 for Pseudo Meteorological Station



Noise Data log for the Old Coal Wharf, March 17, 2019



Marine survey sites in Port Royal.

The old piles are overgrown with sessile organisms including oysters, sponges, ascidians and they also serve as a habitat for juvenile fish.

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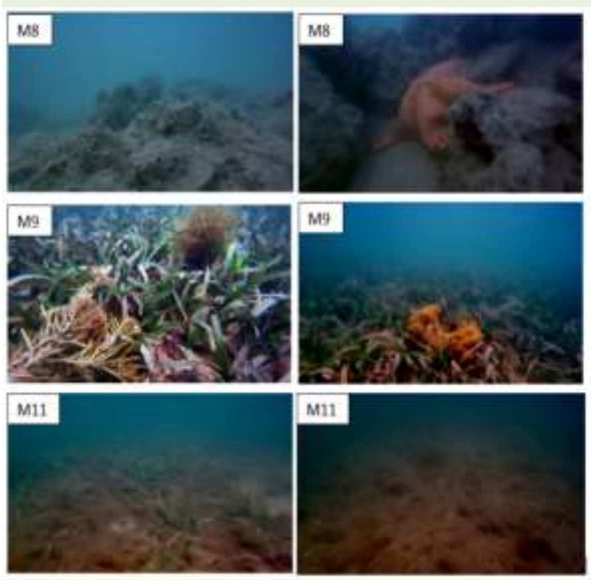

Substrate types at survey sites M8, M9 and M11.

Scleractinian species found at the sites M1 and M2 (from top to bottom): *Solenastrea bournoni,Siderastrea siderea*, *Mani areolata, Siderastrea radians,* and *Occulina diffusa* .

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Diversity of sponges found throughout the survey sites located in the immediate vicinity of the project site (M1-M4).

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Location of fauna and flora assessment sites.

Beach vegetation

Scrubland vegetation

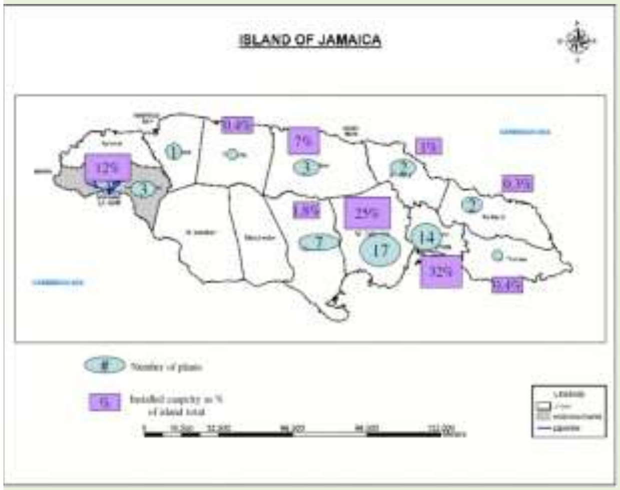
Scrubland vegetation

The Salinas observed in the project area.

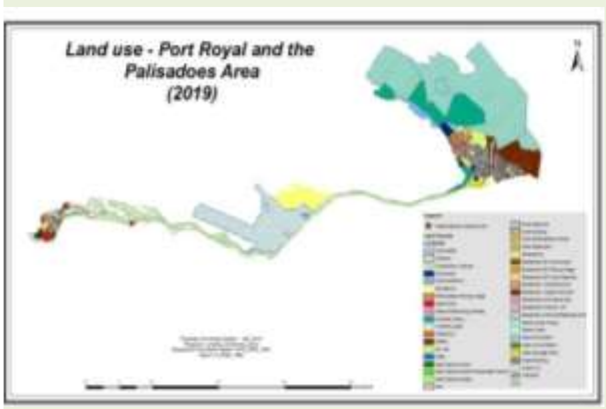
Melocactus communis (endemic)observed on the property during the study

A stand of Red Mangroves within the area surveyed

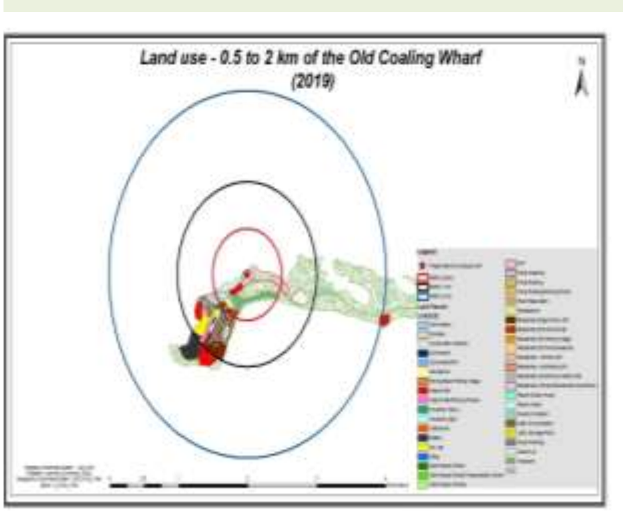
Anolis observed on a twig on the scrubland



National Water Commission Sewage Treatment Plants in Jamaica



Land uses – Port Royal and the Palisadoes



Land uses within 0.5 to 2 km of the Old Coaling Wharf

Land uses within Port Royal and its Environs

Residential – Multi-family

Single family

Institutional (Caribbean Maritime University)

Institutional (Caribbean Maritime University)

Jamaica Defence Force Coast Guard

Jamaica Constabulary Force

Jamaica Fire Brigade

Fort Charles

Old Naval Hospital

St. Peters Church

Old Coal Wharf

Fishing Pier

Boats Docked at Fishing Beach

Gloria's Restaurant Entrance

Gloria's Restaurant

Commercial and Recreational land Use

Welcome Sign

Public Park

Housing Project Area Abandon by HAJL

Open Space used for parking by Gloria's Customers

Proposed Master Plan of the Immediate Project Impact Zone (Port Royal)

Proposed Land Use of the Project Site

Proposed Future Development in the Port Royal Historic District, Promenade and Entry Plaza

PROJECT TITLE:

PAJ 24HR PM10 DISPERSION MAP

PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 39.69 [ug/m^3] at (300488.34, 1985906.45)

34.85 35.00 36.00 37.00 38.00 39.00 39.69

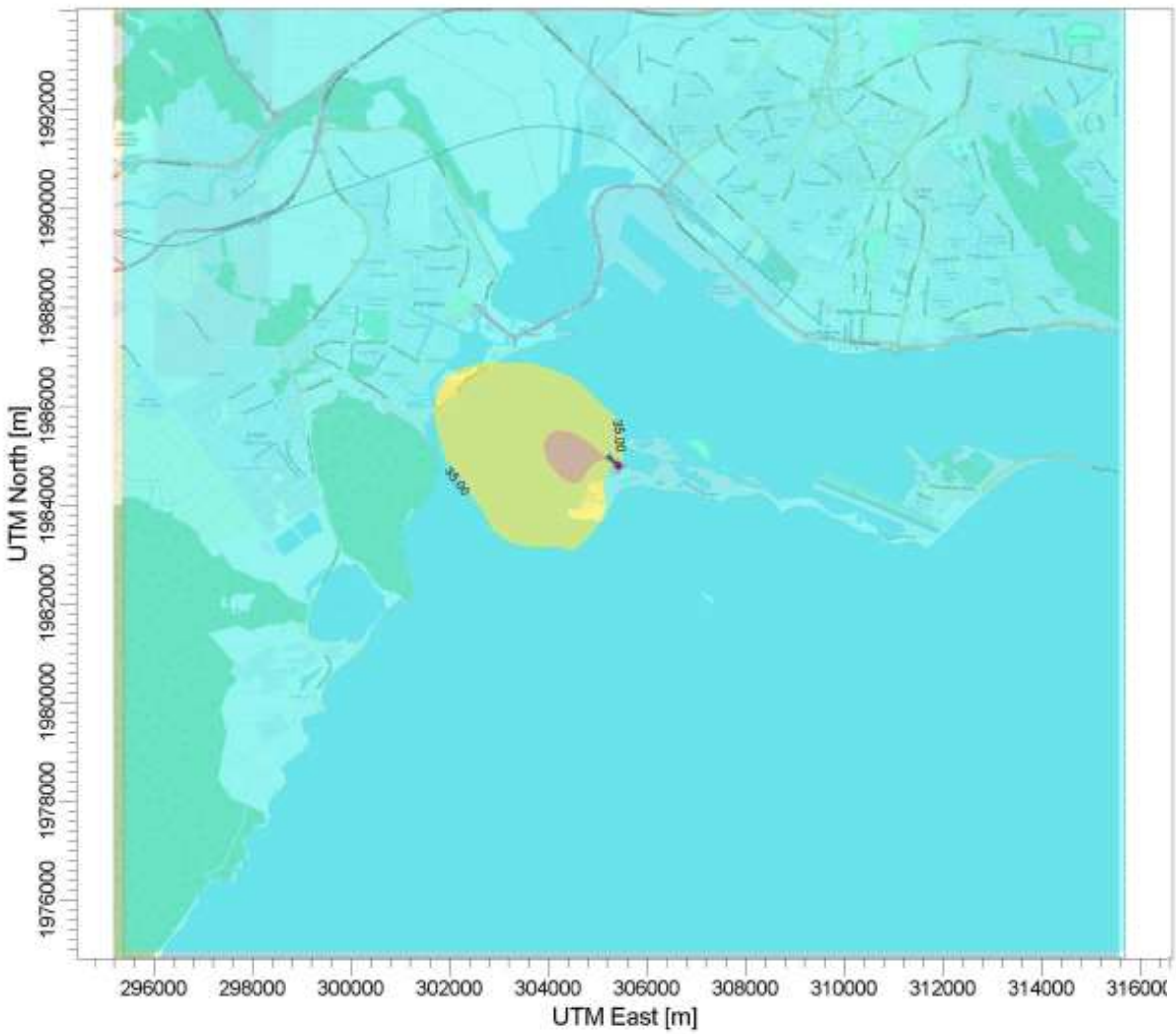
COMMENTS:	SOURCES:	COMPANY NAME:	
	1	TEMN LTD	
	RECEPTORS:	MODELER:	
	446	GARY CAMPBELL	
	OUTPUT TYPE:	SCALE: 1:139,759	
	Concentration	0 — 5 km	
	MAX:	DATE:	PROJECT NO.:
	39.69 ug/m^3	3/5/2019	

AERMOD View - Lakes Environmental Software

C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERPM\PAJPIERPM.isc

PROJECT TITLE:

PAJ ANNUAL PM10 DISPERSION MAP



PLOT FILE OF PERIOD VALUES AVERAGED ACROSS 0 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 35.92 [ug/m^3] at (304544.38, 1984910.15)

34.84 35.00 35.50 35.92

COMMENTS:

SOURCES:

1

COMPANY NAME:

TEMN LTD

RECEPTORS:

446

MODELER:

GARY CAMPBELL

OUTPUT TYPE:

Concentration

SCALE:

1:139,759

0 5 km

649

MAX:

35.92 ug/m^3

DATE:

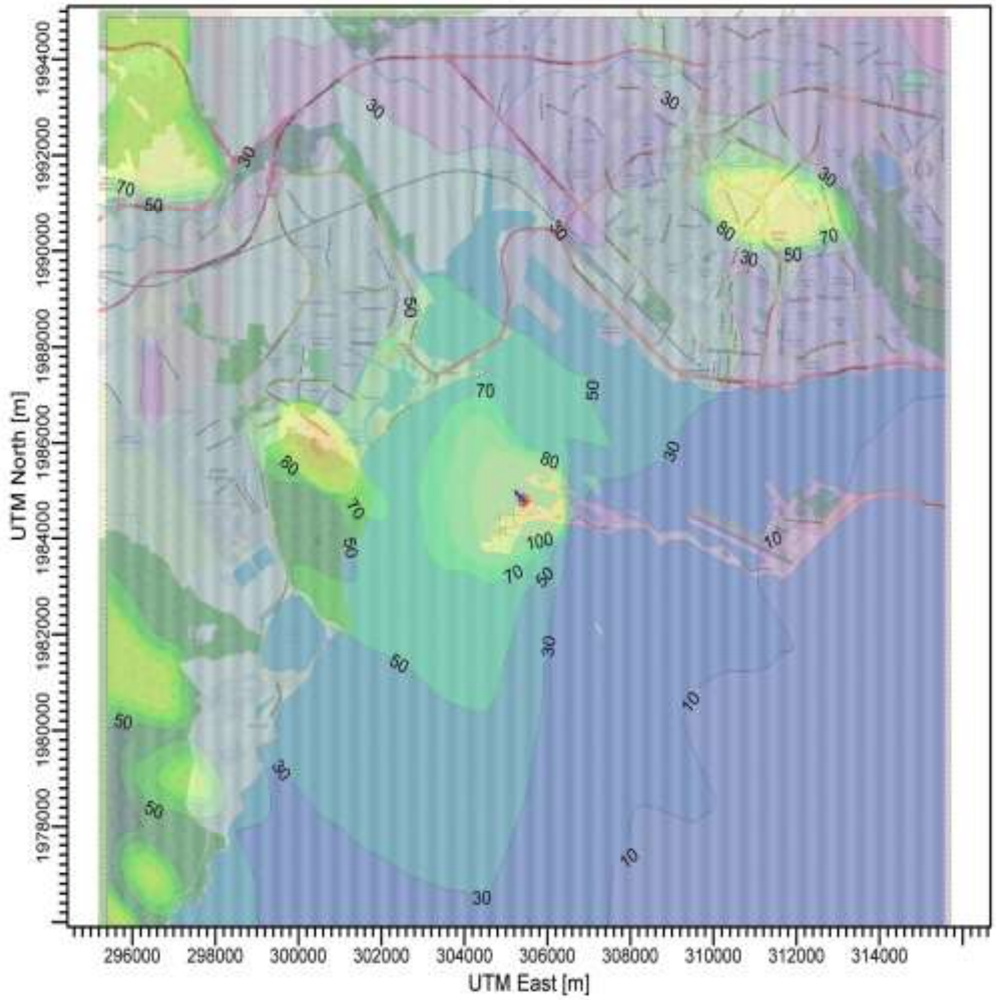
3/5/2019

PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERPM\PAJPIERPM.isc

PROJECT TITLE:

PAJ 1HR SO2 DISPERSION MAP



PLOT FILE OF HIGH 4TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

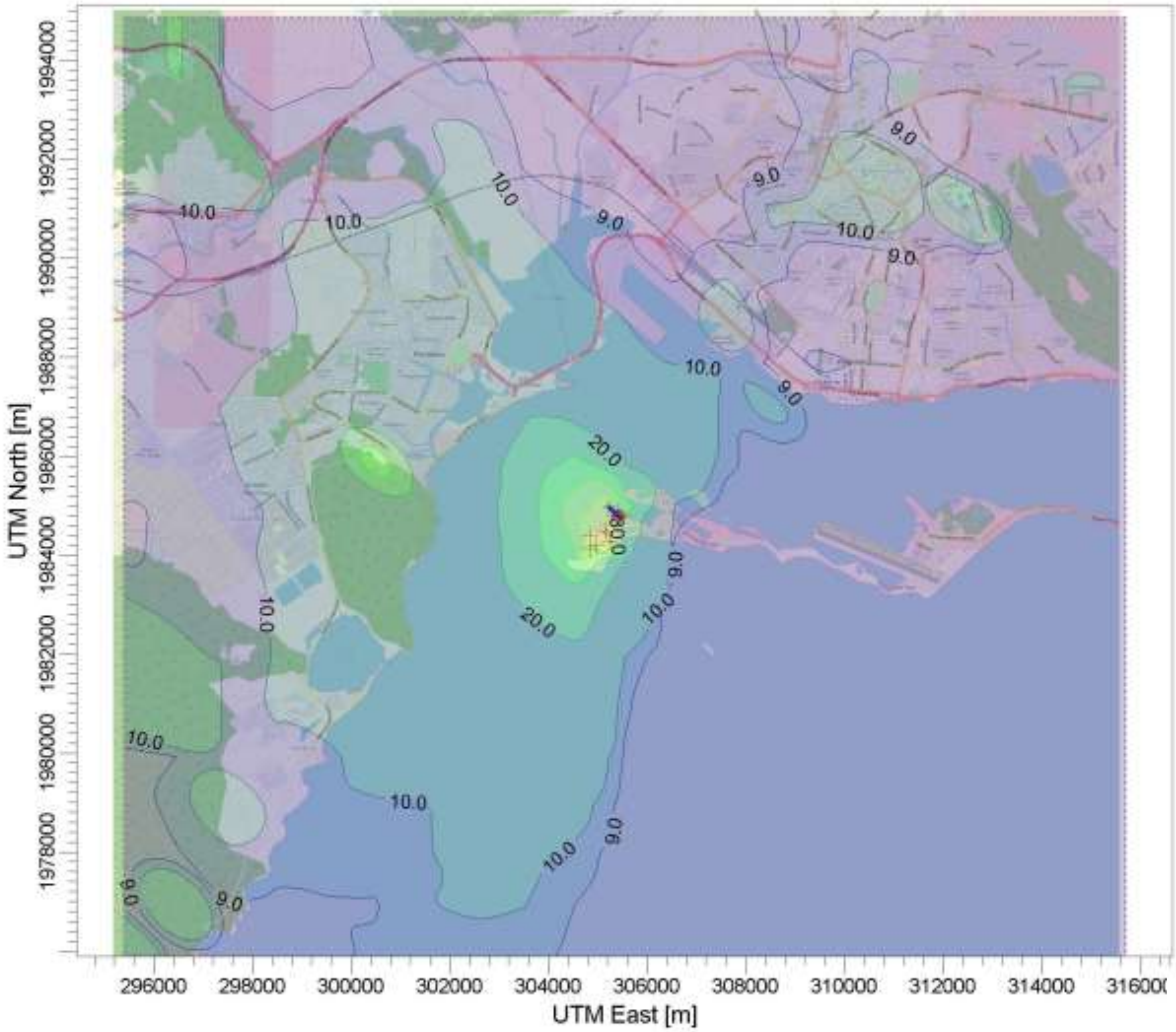
Max: 599 [ug/m^3] at (300488.34, 1985906.45)

8 10 30 50 70 80 100 300 500 599

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,678 (0 — 5 km)	
	MAX: **599 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

PROJECT TITLE:

PAJ 24HR SO2 DISPERSION MAP



PLOT FILE OF HIGH 4TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 72.6 [ug/m^3] at (305181.00, 1984489.00)

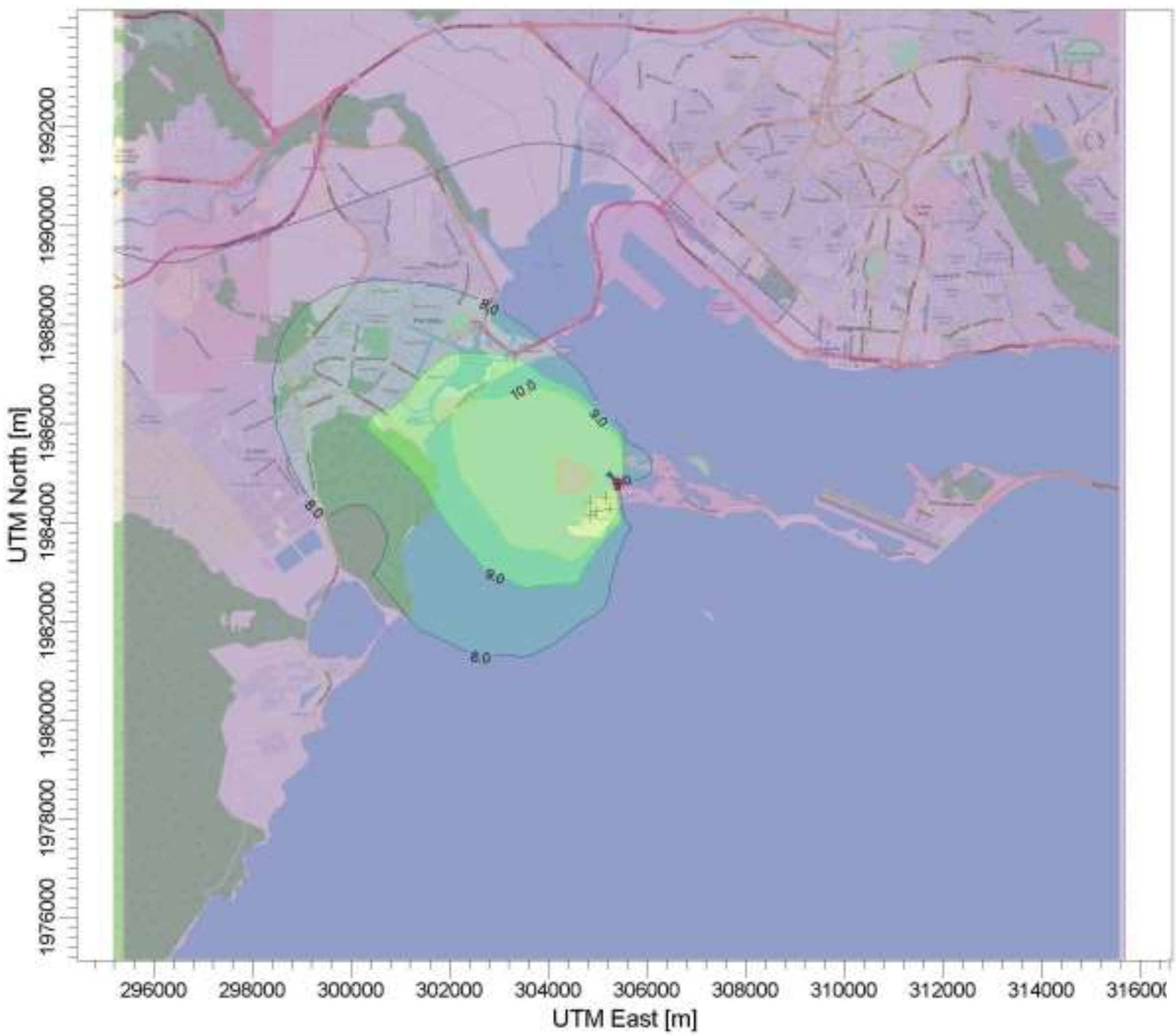
7.2 9.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 72.6

COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 — 5 km	651
	MAX: **72.6 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIER\PAJPIER.isc

PROJECT TITLE:

PAJ ANNUAL SO2 DISPERSION MAP



PLOT FILE OF PERIOD VALUES AVERAGED ACROSS 0 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 24.0 [ug/m^3] at (304544.38, 1984910.15)

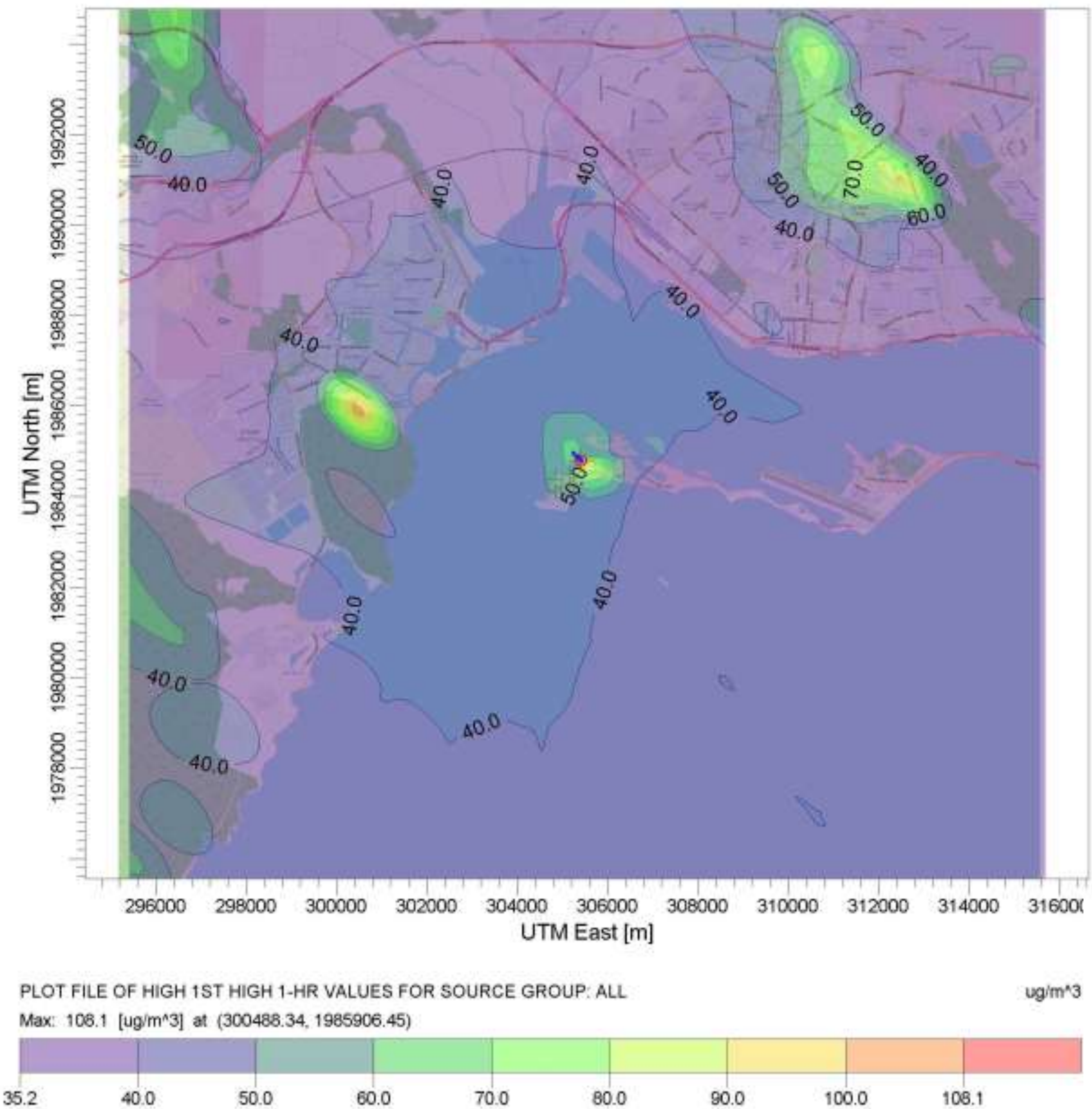
7.1 8.0 9.0 10.0 20.0 24.0

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **24.0 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIER\PAJPIER.isc

PROJECT TITLE:

PAJ 1HR NOX DISPERSION MAP



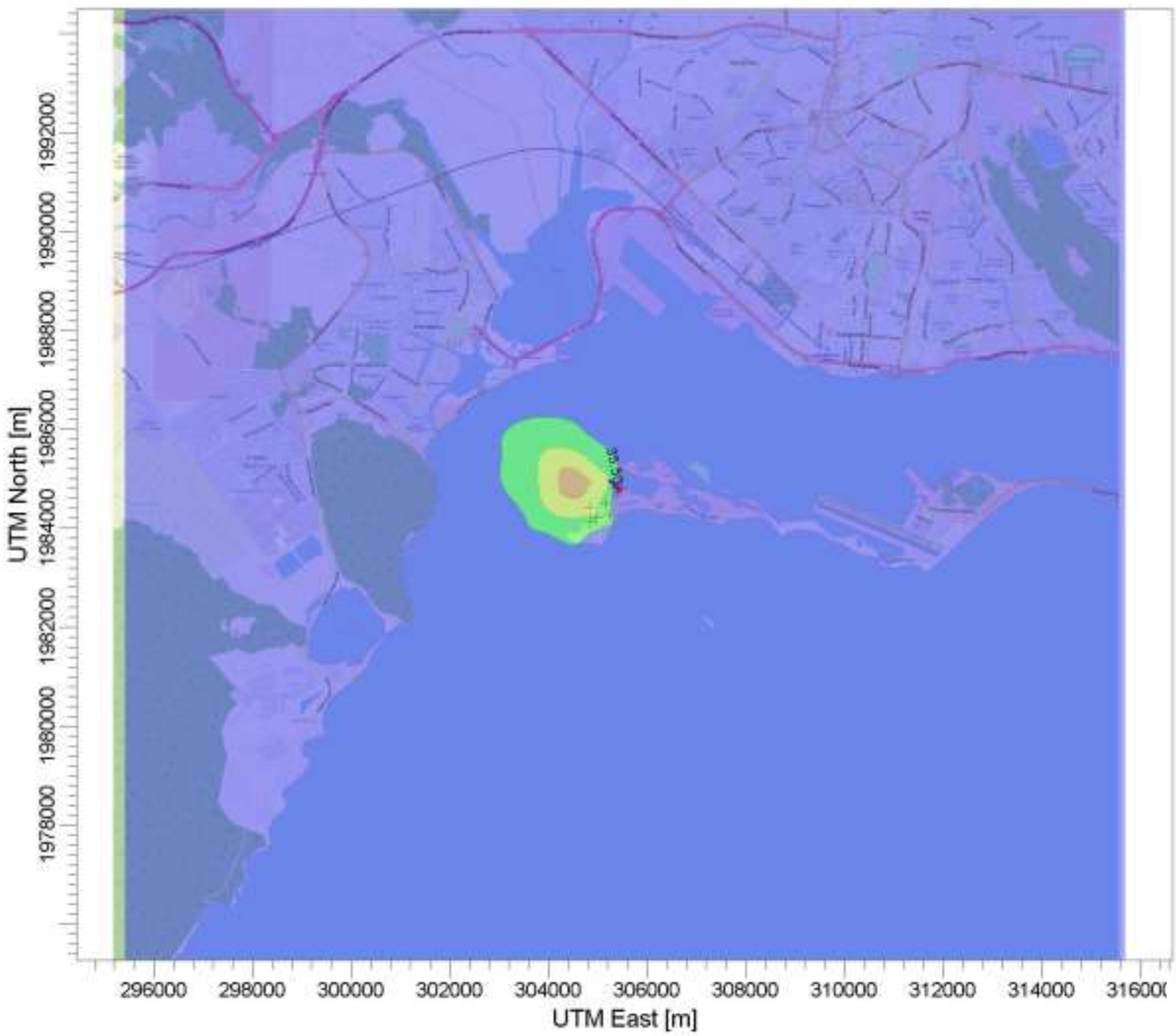
COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 — 5 km	
	MAX: **108.1 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

653

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERNOX\PAJPIERNOX.isc

PROJECT TITLE:

PAJ ANNUAL NOX DISPERSION MAP



PLOT FILE OF PERIOD VALUES AVERAGED ACROSS 0 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 36.90 [ug/m^3] at (304544.38, 1984910.15)

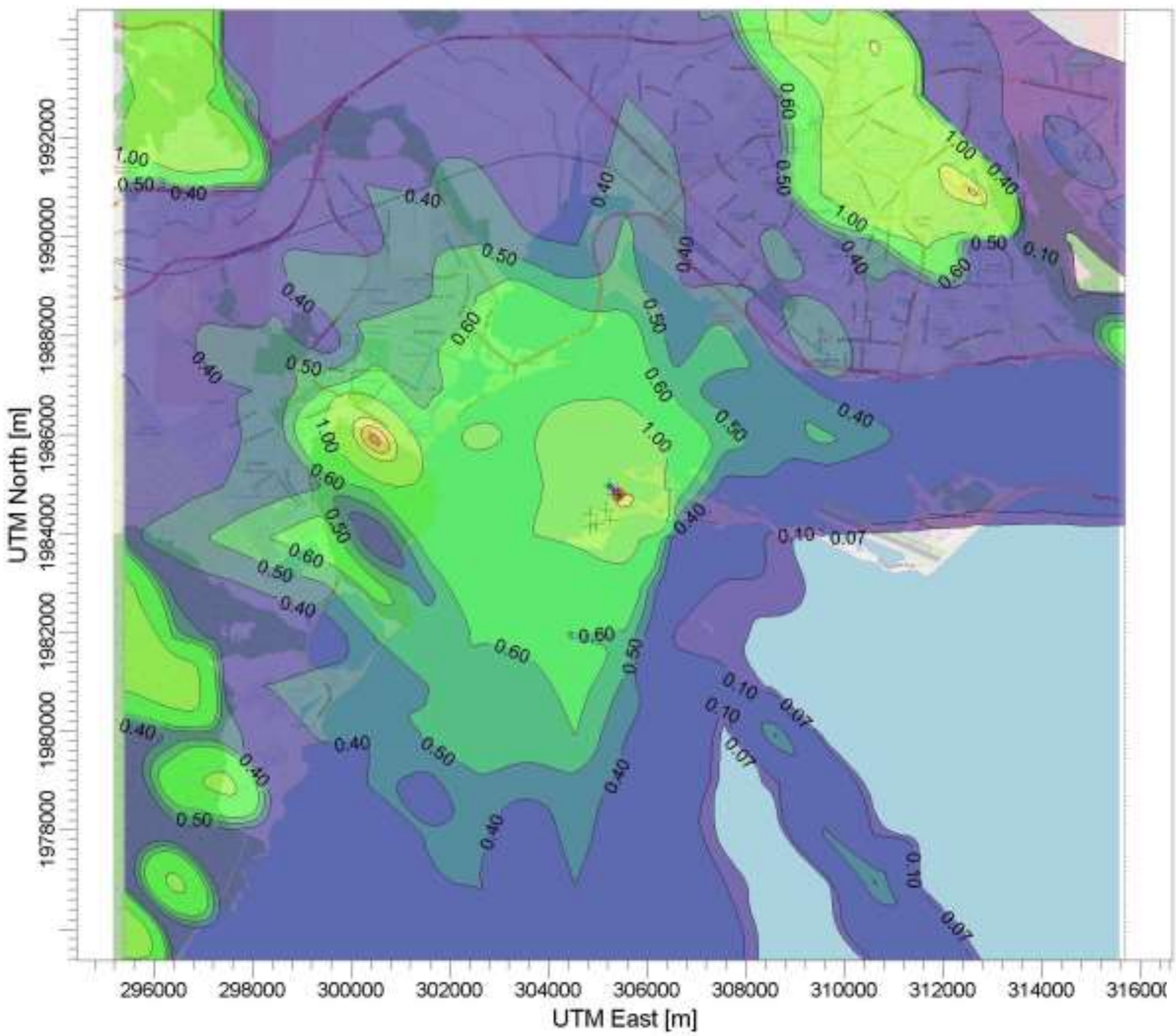
34.97 35.50 36.00 36.50 36.90

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **36.90 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERNOX\PAJPIERNOX.isc

PROJECT TITLE:

PAJ CO 1HR DISPERSION MAP



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

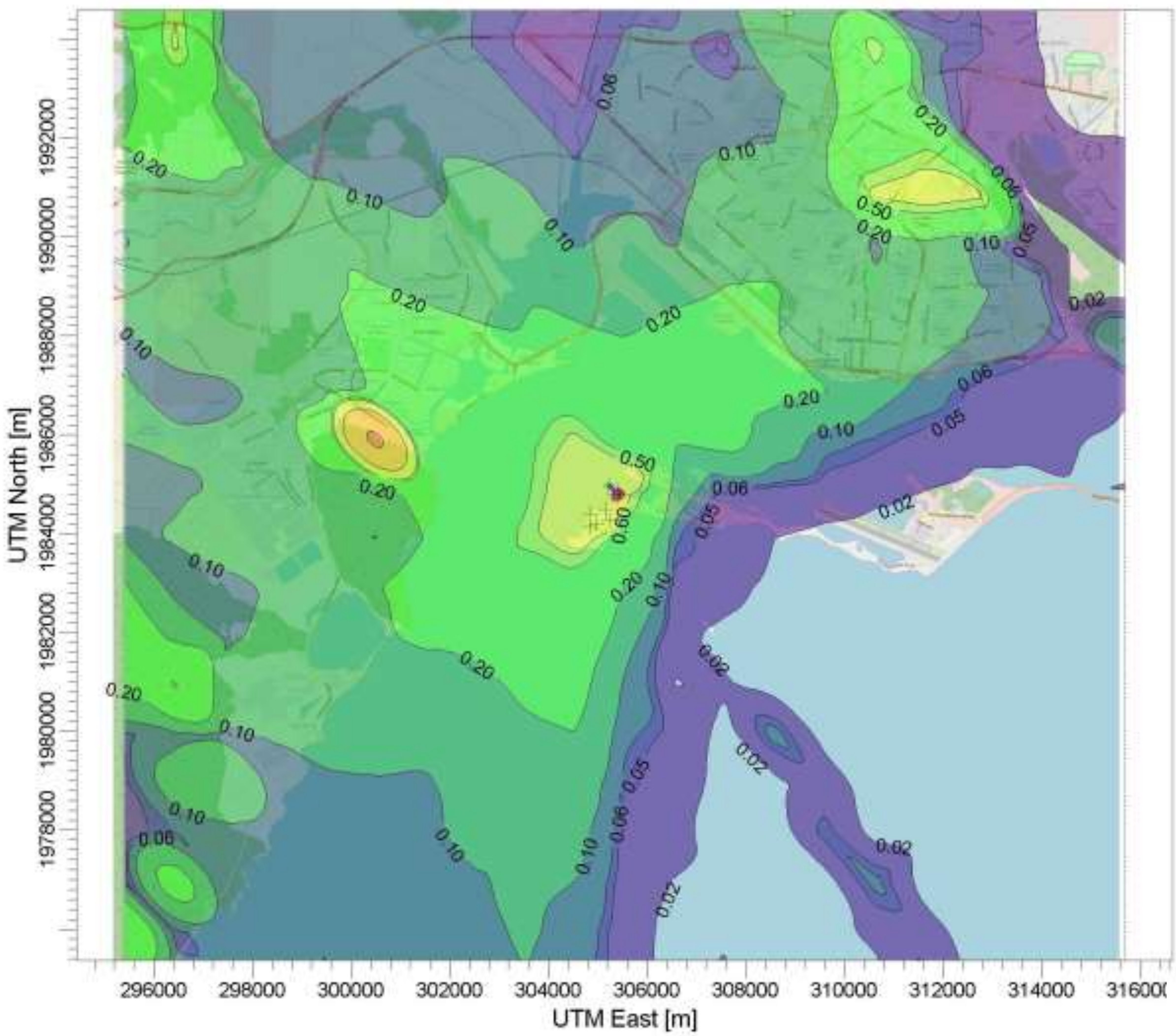
Max: 6.64 [ug/m^3] at (300488.34, 1985906.45)

0.07 0.10 0.40 0.50 0.60 1.00 4.00 5.00 6.00 6.64

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 — 5 km	655
	MAX: **6.64 ug/m^3**	DATE: **4/5/2019**	PROJECT NO.:

PROJECT TITLE:

PAJ CO 8HR DISPERSION MAP



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL — ug/m^3

Max: 2.35 [ug/m^3] at (300488.34, 1985906.45)

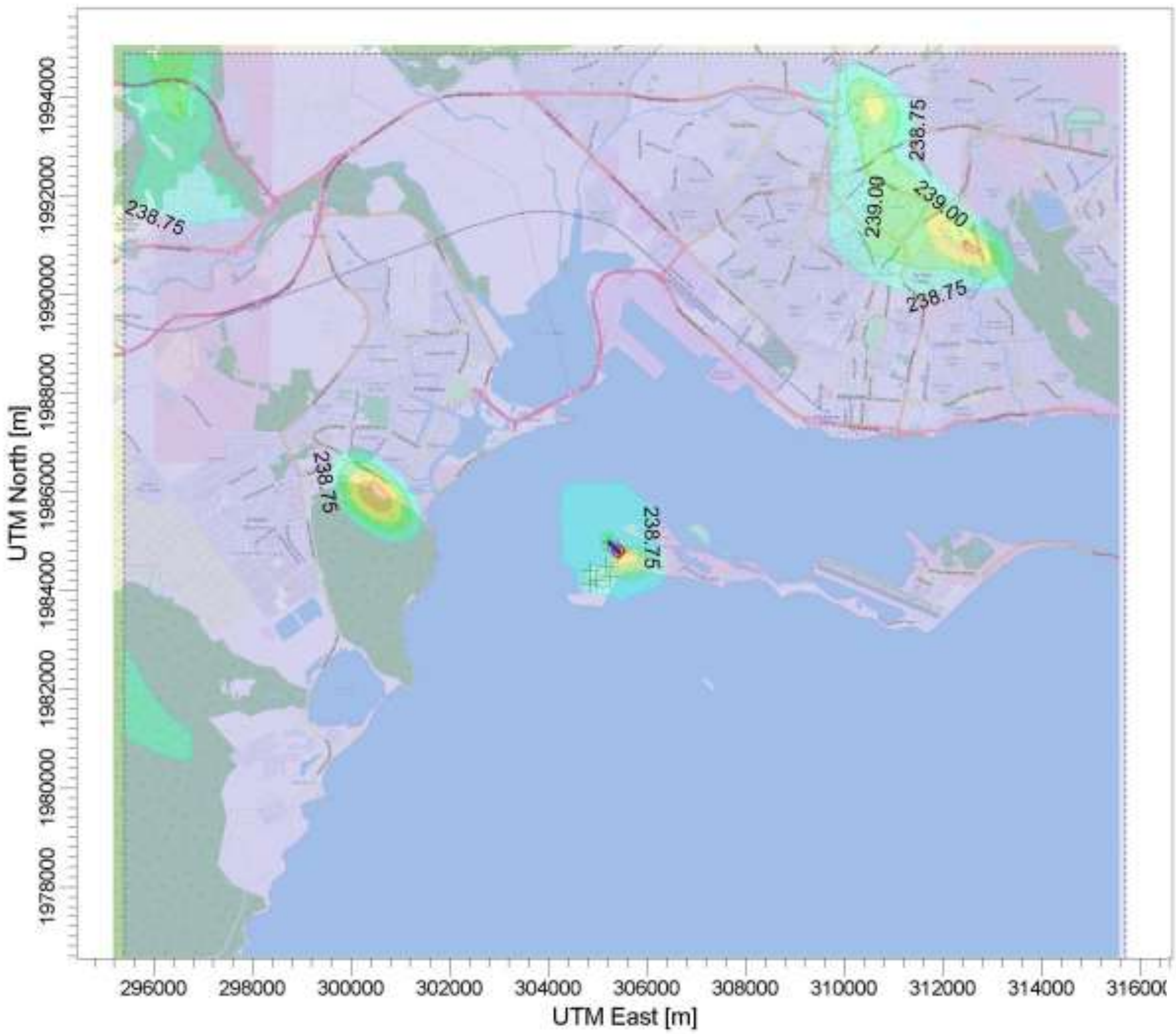
0.02 0.05 0.06 0.10 0.20 0.50 0.60 1.00 2.00 2.35

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS:	MODELER:	
	451	**GARY CAMPBELL**	
	OUTPUT TYPE:	SCALE: 1:139,759	
	Concentration	0 ▬▬ 5 km	
	MAX:	DATE:	PROJECT NO.:
	2.35 ug/m^3	**4/5/2019**	

AERMOD View - Lakes Environmental Software — C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERCO\PAJPIERCO.isc

PROJECT TITLE:

PAJ 1HR VOC DISPERSION MAP



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 239.88 [ug/m^3] at (300488.34, 1985906.45)

238.50 238.75 239.00 239.25 239.50 239.88

COMMENTS:	SOURCES:	COMPANY NAME:	
	1	**TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **239.88 ug/m^3**	DATE: **4/5/2019**	PROJECT NO.: 657

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERVOC\PAJPIERVOC.isc

13.4 Glossary of Technical Terms Used

TERM/ABBREVIATION	DEFINITION
$\mu g/m^3$	Micrograms per cubic meter
AESTHETICS	Concern with beauty or the appreciation of beauty
ANTHROPOGENIC STRESSORS	Resulting from the influence of human beings on nature
AVIFAUNA	Bird Life
BILGE WATER	Dirty water that collects inside the bilge of a ship
Bn (bn)	Billion
CO	Carbon Monoxide
CRUISE PAX	Cruise Passengers
CSTP	Constant Spring Treatment Plant
DEMOGRAPHIC	Relating to the structure of population
ECOSYSTEM	A biological community and their physical environment
ENDEMIC	Native and restricted to a certain place
ES	Environmental Score (from RIAM)
ESSJ	Economic and Social Survey Jamaica
FAUNA	All animals of a particular area
FLORA	Plant life ocurring in a particular region
FLOWPATHS	Direction of movement of a liquid or gas
FRDC	Four Rivers Development Company
ft^2	Square Foot
GDP	Gross Domestic Product (Broad measure of a nation's overall activity)
GREYWATER	Waste water from baths, sinks, washing machine and kitchen
HARDSTANDING	Ground surface with hard material
IMPACT ZONE	Geographical area that will be affected by a proposed or actual action
INVASIVE SPECIES	A species that is not native to a specific location and has a tendancy to spread to a degree that can damage the environment, economy or human health
JNAAQS	Jamaica National Ambient Air Quality Standard
JNHT	Jamaica National Heritage Trust
KSA	Kingston and St. Andrew
LVIA	Landscape and Visual Impact Assessment

TERM/ABBREVIATION	DEFINITION
m^2	Square Metre
MITIGATION	Action to reduce severity
MOAF	Ministry of Agriculture and Fisheries
MPM	Metropolitan Parks and Markets
MTP	Mona Treatment Plant
NEPA	National Environment & Planning Agency
NO_3	Nitrate
NO_X	Nitrogen Oxides
NRCA	Natural Resource Conservation Authority
NWC	National Water Commission
PAH	Polyaromatic Hydrocarbons
PIOJ	Planning Institute of Jamaica
PM	Particulate Matter
PM_{10}	Particulate matter ≤ 10 µ
PO_4	Phosphate
P-PRPA	Palisadoes-Port Royal Protected Area
PRML	Port Royal Marine Lab
PRO	Petroleum Range Organics
PUTRESCIBLE SOLID WASTE	Solid Waste which contains organic matter which can be broken down by micro organism
RAMSAR SITE	Wetland designated to be of international importance under the RAMSAR Concention
RIAM	Rapid Impact Assessment Matrix
RV	Range Value (from RIAM)
SEAWALK™	Floating Pier
SO_2	Suphur Dioxide
STATIN	Statistical Institute
TEM NETWORK	Technological & Environmental Management Network
TERRESTRIAL	Relating to the earth/land
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UTM	Universal Transverse Mercator - System of Coordinates
VOC	Volatile Organic Compound
WRA	Water Resources Authority

13.5 Terms Of Reference

TERMS OF REFERENCE

For An ENVIRONMENTAL IMPACT ASSESSMENT
For The

PORT ROYAL CRUISE PIER DEVELOPMENT

A t
Port Royal By:

Port Authority of Jamaica

Updated: 5 June 2019

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NATIONAL ENVIRONMENT & PLANNING AGENCY
By PAJ
Dated 5 June 2019NAT
Foreword

The purpose of this document is to establish the Terms of Reference (TOR) for the Environmental Impact Assessment (EIA). The TOR outlines the aspects of an EIA which when thoroughly addressed, will provide a comprehensive evaluation of the proposed site, in terms of predicted environmental impacts, required mitigation strategies and potentially viable alternatives to the proposed development/project.

The EIA report must be produced in accordance with the approved TOR.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the Agency. Approval for the TOR must be obtained from the Agency, in writing, prior to the commencement of the EIA study.

The National Environment and Planning Agency and the Natural Resources Conservation Authority reserve the right to reproduce, transfer and disclose any and all contents contained in the submitted environmental impact assessment report withouDRTt written consent of the proponent, consultants and/or its agents.

The Terms of Reference to conduct the EIA are as follows:

1. Executive Summary

Provide a brief statement on the content of the EIA report. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project etc. In addition, it should include relevant background information and provide a summary of the main findings, including but not limited to main impacts and mitigation measures, analyses and conclusions in the report.

2. Introduction

The Introduction should give a background, explain the need for and the context of the project. The Introduction should also provide the delineation and justification of the boundary of the study area, general methodology, assumptions and constraints of the study. The study area shall include at least the area within a 1km radius and surrounding protected heritage of the boundaries of the proposed project area.

Purpose of the project, project proponent, brief description of the project – name, nature, size, location of the project, its importance to the country and region.

Land description – land parcel (Volume and Folio/Valuation Number), street/scheme address, parish and total acreage of the land.

The proponent should confirm that the project meets the approval Terms of Reference and environmental and planning standards applicable for the project.

3. Legislation and Regulatory Consideration

Outline the pertinent regulations, polices and standards governing environmental quality, safety and health, cultural significant finds, protection of endangered species, protected areas and land use control. The examination of the legislation should include but not be limited to the Natural Resources Conservation

Authority Act and Regulations, Beach Control Act, Jamaica National Heritage Trust Act, Wild Life

Protection Act, Town and Country Planning Act, Kingston and St. Andrew Provisional Development Order, Plans including the Urban Development Corporation and the Draft Palisadoes-Port Royal Protected Area Zoning Plan 2014-2019, Harbours Act, Port Authority Act, Maritime Areas Act, National Solid Waste Management Act and the Fishing Industry Act and appropriate international conventions/protocols/treaties

(such as Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat,

Convention on the Prevention of Marine Pollution by Dumping of Waste and other Matter (London

Convention), The International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention or BWM Convention), The Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) where applicable.

Describe the traditional land use and advice of any prescriptive rights including public access rights.

4. Methodology and Approach

Clearly outline the methodologies and approaches in conducting the study including collecting and analyzing data, stakeholder consultation, dates on which surveys are conducted etc.

5. Project Description

The description should detail the elements of the Port Royal Cruise Pier Development highlighting the activities which will be involved in all the major aspects of the development. This section should provide:

- Capacity of the port, proposed for handling, details of ancillary operations etc.
- Details of Tram service to be utilized on site, including but not limited to: distances, routes, equipment, and passenger capacity.

- Detailed information regarding the proposed wastewater treatment system including but not limited to activity from which wastewater is generated, type of system (i.e. components) and the discharge points as well as justification of system ability to meet NRCA effluent discharge standards, etc.
- Relevance of the project in the light of existing local and national development plans and policies for Port Royal including existing Master Development and Heritage Plans.
- Detailed description of the project objectives, coverage and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development).
- Description of project site, level of existing land development, transport and connectivity, demographic aspects, socio, cultural and economic aspects, communities and settlements and the integration of the existing town of Port Royal.
- A comprehensive description of all aspects of the project noting areas for modification (land reclamation, temporary storage of material and spoils dispersal), supported by the use of maps, diagrams and other visual aids where appropriate. This description should detail all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to seagrass or coral relocation, wetland modification, sediment transport patterns.
- DRAFDetails of the methods and technologies involved for design, construction, and operation including equipment to be employed to undertake each aspect of the project including deployment of berth, storage of material and secondary activities including but not limited to refueling of vessels.
- Comprehensive description of the use of existing and the need for additional public infrastructure – road, waterways, water supply, electrical power, sewage treatment in relation to Port Royal, during construction as well as operational phases.
- Details of temporary/permanent housing for the workers.

Essential maps to be provided should include but not limited to:

- Site maps illustrating areas to be developed – port services, areas for disposal or storage of spoils, and areas to be preserved in their existing state.

- A map of the project area and 10km area (landward and seaward) from boundary of the proposed/existing project area, delineating Palisadoes-Port Royal Protected Area / sensitive ecosystems areas/parish boundaries.

Land use map of the study area [1:12,500] scale based on recent satellite imagery of the project areas and 10km from the proposed project boundary delineating forest area and built up areas, water bodies, human settlement and other surface features such as ports, airports, roads, major industries etc.

Bathymetric charts of the offshore area giving general morphology of the coastal stretch to a scale of 1:50,000 shall be submitted covering water depth up to 10m beyond the maximum proposed depths of the project and covering a distance of 5km along the coast from the project limits on both sides.

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6. Description of the Environment

This section involves the generation of baseline data which is used to describe the study area as follows:

i. Physical environment – land, soils and geology (inclusive of geotechnical analysis), beach, sand dunes, meteorology, air and noise. (The supporting technical documents should be included in the appendix)

ii. Biological environment:

- Baseline data on chemical parameters in the open sea and in the proposed port area (including faecal coliform, phosphates, DO, Turbidity, pH, FC, Nitrates, BOD, oil and grease).
- Coastal and oceanographic data; tide, waves, storm surge, currents, coastal erosion and shoreline change. If protective coastal structures are being implemented, the design of same should be included in the report, with all supporting technical documents in the appendix.
- Detailed description of the flora and fauna (terrestrial and aquatic) present at the land-based and marine sites with special emphasis on rare, threatened, endangered, endemic, protected, invasive and economically important species. Include possible biological loss of habitat fragmentation.

iii. Socio-economic and cultural environment.

- This section should provide details on the demography, regional setting, location assessment, current and potential land-use patterns (of neighbouring properties); description of existing infrastructure; and other material assets of the area should be explored. There should also be an assessment of the present and proposed uses of the site and surrounding areas including any land acquisition needs, any prescriptive or public access rights, and impacts on current users of the area during and post development. Effects on socio-economic status such as changes to public access and recreational use, impacts on existing and potential economic activities, public perception, contribution of development to national economy and development of surrounding communities.

- An assessment of artifacts, archaeological and cultural features of the site conducted in collaboration with Jamaica National Heritage Trust,
- Baseline socio-economic data – demography, particularly on human settlements, existing infrastructure facilities and additional needs at the proposed project area and surrounding communities including any land acquisition needs. This assessment should include but not limited to: livelihood of the populations, awareness of the population about the proposed activity, information on fisher folk and other marine interest.

7. Public Participation

Describe the public participation methods, timing, type of information provided and collected from public and stakeholder target group meetings. The instrument used to collect the information must be included in the appendix. Stakeholder meetings should be held to inform the public of the proposed development and the possible impacts. This will also gauge the feeling/response of the public toward the development.

The list of stake holders to be consulted is to include but not limited to:

a. Ministry of Industry, Commerce, Agriculture and Fisheries – Fisheries Division
b. National Works Agency
c. Ministry of Tourism
d. Maritime Authority of Jamaica
e. Jamaica National Heritage Trust
f. Caribbean Maritime University
g. Tourism Product Development Company
h. Urban Development Corporation
i. Port Royal Brotherhood
j. Kingston and St. Andrew Municipal Corporation
k. Office of Disaster Preparedness and Emergency Management

l. Social Development Commission
m. Airports Authority of Jamaica
n. Jamaica Defense Force
o. The University of the West Indies
p. Royal Jamaica Yacht Club
q. Forestry Department
r. Jamaica Fire Brigade

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.

Public Meetings should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA). A public meeting will be held to present the findings of the EIA once the EIA is completed and submitted for consideration. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project will require a further public meeting to be undertaken by the developer and all changes made to the document should be clearly outlined to the public.

This public presentation should be:

- Conducted at an appropriate location agreed to by the NEPA
- Held in accordance with NEPA's Guidelines for Conducting Public Presentations which is available on the Agency's website (www.nepa.gov.jm)

All findings must be presented in the EIA report and must reflect the headings which have been outlined in the body of the TOR. References should be provided. Hard copies and an electronic copy of the report will be required for submission. The report should include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

8. Impact Identification and Assessment/ Analysis of Potential Impacts

A detailed analysis of the project components should be done in order to: identify the major potential environmental, health and safety impacts of the project; distinguish between levels of impact, significance of impact (a ranking from major to minor/significant to insignificant should be developed), positive and negative impacts, duration of impacts (long term or short term or immediate), direct and indirect impacts, reversible and irreversible impacts and identify avoidable impacts. Cumulative impacts should also be evaluated taking into account previous developments and any proposed development immediately adjacent to the subject development within the area.

Assessment of potential impacts as it relates to the infrastructural requirements of the development including wastewater/ sewage treatment, potable water, electricity, solid waste management, drainage and any other physical infrastructure and in relation to the town of Port Royal and the location of the port.

The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate or minor, and presented in separate matrices for all the phases of the project (i.e. preconstruction, construction, operational, and decommissioning/closure). The potential impacts may be subdivided into Physical Impacts, Biological Impacts and Socio-economic and Cultural Impacts.

All impacts including cumulative impacts should be listed, ranked and assessed.

The impacts to be assessed will include but not limited to the following:

Physical

In general, for this proposed development, the physical impacts may include the effect on soil and geology (site clearance, storm water runoff, loss of topsoil, potential erosion, change in drainage patterns, flooding risks (as it pertains to the site and the surrounding environs/communities), air, particularly in the context of the potential impact that the proposed development may have on communities (generation of dust from transportation, material storage and handling); water (possible contamination of surface and subsurface resources from improper waste disposal, storm water runoff); the landscape (loss of character of the area, impact of evacuation); material assets (effects of vibration on surface structures as it pertains to the site and the surrounding environs/communities, damage to roads during transportation.

The physical impacts should explore, but are not limited to the following:

o Impacts of construction activities such as site clearance, earthworks and spoil disposal o Impacts of accidental oil and chemical spills o Impacts on Air Quality, with the use of Air Dispersions modeling to project cumulative impacts.

o Impacts on Water Quality (pollution of potable, surface and ground water) o Impacts/demands/requirements of the following must be quantified:

- Water Supply
- Drainage
- Sewage Treatment and Disposal – Empirical data must be provided to show that the sewage treatment facility has the capacity to remove the nutrients to meet Natural Resources Conservation Authority's Trade Effluent Standards
- Solid Waste Disposal
- Electrical Power (fossil fuels, wind, sun, wave and tidal)
- Communications and other utility requirements

- Transport Systems and supporting infrastructure required o Operation and maintenance – waste disposal, site drainage, sewage treatment and disposal solution and air quality
   - o Impacts on visual aesthetics and landscape
   - o Noise o Dust o Vibration
   - o Change in drainage pattern
   - o Carrying Capacity of the proposed site

Natural Hazard

Impact of natural hazards including but not limited to hurricanes, earthquakes, and flooding potential shall be examined.

Biological

These will address the effects on flora and fauna, such as the loss of habitats, niches and species. Direct and indirect impact and associated risks on ecology and the terrestrial aquatic habitats, where relevant. Emphasis should be placed on any rare, protected, threatened, endangered, and endemic species found. This should include habitat loss and fragmentation, loss of species, niches and natural features due to construction and operation. The impact of noise, dust and vibration on floral and faunal species should be explored.

Heritage

Loss of and damage to artifacts, archaeological, geological and paleontological features.

Human/Social/Cultural

Effects on the socio-economic status as changes to public access and recreational use; impacts on existing and potential economic activities; contribution of the development to the national economy and development of surrounding communities should be examined. Socio-economic and cultural impacts to include land use/resource effects, health and safety of the potential workers as well as the residents of the surrounding environs should be described. Public perception as it relates to loss of property value, loss of aesthetic enjoyment among other things should be explored.

Public Health Issues of Concern

The impact of the proposed development particularly in the context of the potential impacts on human health, that is, air quality, noise pollution, water quality (e.g. possible respiratory effects) should be examined, in terms of what is the identified impact and proposed mitigation.

Risk Assessment

Analyze the risks posed to the development and by the development, including risks associated with climate change, earthquakes and tsunami. This should include: 1) Identifying the hazards 2) Assessing the potential consequences 3) Assessing the probability of the consequences 4) Characterizing the risk and uncertainty and 5) rehabilitation and resettlement action plan.

9. Mitigation Measures

The EIA should seek to provide mitigation measures to address, as far as possible, any adverse impacts due to proposed usage of the site anDdR AF T utilizing of existing environmental attributes for optimum development. The mitigation measures should endeavour to avoid, reduce and remedy the potential negative effects while at the same time enhancing the positive impacts projected. Mitigation and abatement measures should be developed for each potential impact identified. This should include recommendations for the enhancement of beneficial impacts and quantify and assign financial and economic values to mitigating methods. Green technology should be examined. A statement is to be made on strategies that will be used to conserve energy and water in relation to this development.

10. Analysis of Project Alternatives

Alternatives to the proposed development/project including the no-action alternative should be examined. These should be assessed according to the physical, ecological and socio-economic parameters of the site. This examination of alternatives should incorporate the use of the history the overall area in which the site is located and previous uses of the site itself. Alternatives should also address specific aspects of the project such as methods proposed in the execution of the project (works) that have been identified as being causes of major impacts.

A rationale for the selection of any project alternative should be provided.

11. Conclusion and Recommendation

12. List of References

13. Appendices

The appendices should include but not limited to the following documents:

- 13.1 Reference documents
- 13.2 Photographs/ maps
- 13.3 Data Tables
- 13.4 Glossary of Technical Terms used
- 13.5 Terms of Reference

13.6 Composition of the consulting teaDR AF T m, team that undertook the study/assessment, including name, qualification and roles of team members

13.7 Notes of Public Consultation sessions

13.8 Instruments used in community surveys

14. Activities

In order to effectively and efficiently conduct the EIA it will be necessary to carry out various activities which include:

14.1. Documentation Review

All documentation pertaining to the development will need to be reviewed. These should include, but not limited to, the project profile, site plan, drainage plan, vegetation clearance plan, applications made for financing or planning approval, and any technical and engineering studies that have been done.

14.2. Analysis of Alternatives

Alternatives to the site location, project design and operation conditions will be analyzed including the "no-action" alternative. These alternatives will be assessed based on the physical, ecological and socio-economic parameters of the site identified. The physical, biological and sociological settings will provide the framework in which to assess the different project alternatives. This would clarify, for instance, whether the site could be used for other purposes as well as whether there are any particular aspects of the development that can be sited differently, operated differently, etc.

14.3. Impact Assessment

The consultant should carry out a detailed assessment of the project components (preconstruction, construction, operational and

decommissioning/closure stages) in order to identify the potential impacts (positive, DR AFTnegative and cumulative impacts) that will be associated with the projects. The significance and magnitude (major, moderate and minor) of the impacts identified will also be evaluated through the use of weighted matrix.

The impacts to be assessed will include but not limited to the following:

- Effects of project design and engineering;
- Effects on visual aesthetics and landscape;
- Effects of noise and vibration;
- Effects of operation activities such as site clearance and geological formation, earthworks, hurricanes, access routes, transportation networks and soil disposal;

- Effects of operation and maintenance activities such as waste disposal, traffic management, site drainage, sediment, sewage, public access;
- Effects on ecology including effect on terrestrial and other habits;
- Emphasis should be placed on any rare, endangered, and endemic species found;
- Effects on socio-economic status such as changes to public

access, recreational use, existing and potential agricultural activities, contribution of development to national economy and development of surrounding communities.

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as, references. GIS reference should be provided where applicable. One hard copy and an electronic copy must be submitted to NEPA for review after which ten (10) hard copies and an electronic copy of the report should be submitted. One copy of the document should be perfect bound.

The report should include appendices with items such as maps, site plans, the study team and their individual qualifications, photographs, and other relevant information. All of the foregoing should be properly sourced and credited.

13.6 Consulting Team

Water Quality/Environmental Impact Assessment

Paul Carroll, M.Sc.

Mr. Paul Carroll, Consulting Principal of TEM Network is a pioneer in the field of environmental science in Jamaica with over thirty years' experience in environmental management. As a former Director of the, Natural Resources Conservation Department, Government of Jamaica, he was responsible for setting up the environmental chemistry laboratory at that agency as well as implementing the island wide environmental monitoring programme. Of particular note were his contributions to the Beach Control Authority, the National Oil Spill Contingency Plan, Watershed Project Commission, and development of policy for key coastal resources. Mr. Carroll was a part of the USAID/TSS/DEMO project team assisting the Government of Jamaica, Natural Resources Conservation Authority (NRCA) in the formulation of national policies for key coastal resources. He was consultant for the declaration of the Port Royal/Palisadoes Protected Area. Mr. Carroll is principal consultant with direct responsibility for all environmental chemistry studies carried out by Technological and Environmental Management Network Limited (TEMN).

Ecology

Peter Gayle, M.Phil. (Ph.D. candidate)

Mr. Peter Gayle is a Marine Ecologist who spent several years with the Natural Resources Conservation Authority (NRCA) as a Research Assistant in the Aquatic Resources Division. He is currently the Principal Scientific Officer at the University of the West Indies Discovery Bay Marine Laboratory. Mr. Gayle brings to the team over 30 years of experience with a variety of environmental and commercial services such as Biological Marine (monitoring) Surveys, Ecosystem Restoration and Management, and Seafloor Surveys. Other associated skills relate to Open and Closed Circuit Mixed Gas Diving, Remote Video Scanning and Still Photography, Marine Co-ordination, Search and Recovery Missions, Light Salvage, Security Inspections and Surveys of docks, ships' hulls, cooling systems and propulsion gear. At present he is using UAV and submersible ROV operations for environmental monitoring combined with 3D photogrammetry of coral fragments. His PhD research is focused on the factors affecting the (ex situ) growth of coral micro-fragments with a view to generating increased numbers of coral out-plants for reef restoration.

Bernadette Charpentier, M.Sc.

Mrs. Bernadette Charpentier is an Ecologist specializing in marine and freshwater ecosystems, and spatial ecology. In addition to her Bachelor and Master of Science degrees in Ecology, she is certified in Geographic Information Systems for Environmental Management and is experienced in conducting UAV/ROV photogrammetric surveys, ecosystem risk assessments, and providing scientific advice to stakeholders, managers and scientists pertaining to conservation and management of aquatic species and ecosystems. Mrs. Charpentier brings to TEMN over 15 years of international consulting experience in Environmental Impact Assessment, stakeholder consultation and project management.

Brandon Hay, M.Phil.

Mr. Brandon Hay is an Ornithologist and an Ecologist and is the Portland Bight Fish Sanctuaries manager at Caribbean Coastal Area Management Foundation. Mr. Hay brings over 23 years' experience in the field of Ornithology and conservation to the team. He is a member of Birds Caribbean.

Damion Whyte, M.Phil., PMP, (Ph.D. candidate)

Damion Whyte is a Zoology Ph.D. student at University of the West Indies (UWI), Mona, where he is currently evaluating the flora and fauna of Goat Island with regard to the reintroduction of the Jamaican Iguana. He has a Postgraduate Diploma in Environmental Management and international certification as a Project Management Professional (PMP), with over 16 years' experience in the field of environmental management. He has conducted faunal (e.g., birds, bats, and crocodiles) and botanical surveys, wetland assessments, water quality analyses, environmental audits, environmental remediation and environmental monitoring for several of the island's leading environmental firms over the years. He also serves on several Committees (e.g., Chairperson for the Endangered Species Working Group for the National Environmental and Planning Agency (NEPA), Jamaican Iguana Working group, American Crocodile Working Group) in relation to the environment and is a member of several organizations including Birdlife Jamaica, Jamaica Institute of Environmental Professionals (JIEP), Jamaica Cave Organization (JCO) and Natural History Society of Jamaica (NHSJ).

COASTAL DYNAMICS

Pierre Diaz, B.Sc.

Mr. Diaz holds a degree in Physical Oceanography from the Florida Institute of Technology and is one of Jamaica's leading Oceanographers. A former resident Oceanographer at the Natural Resources Conservation Authority (NRCA), he served as Technical Advisor to the Beach Control Authority, and was responsible for implementation of the National Coastal Erosion Program. Mr. Diaz is a private coastal engineering consultant who specializes in the design and installation of coastal structures used for beach creation and stabilization purposes, as well as the assessment of site-specific coastal developmental potential. He brings to the team extensive experience in coordinating oceanographic surveys, specializing in the tracking and prediction of ocean currents for design and implementation of coastal works.

SOCIO ECONOMICS

Allison Richards PhD – Environmental Planner

Dr. Allison Richards is a Geographer, Development and Environment Planner. She holds a

PhD from George Mason University in Environmental Science and Public Policy. Allison also holds a Master's degree in Geography specialising in Environmental Planning and Sustainable Development; and a Bachelor degree (honours) in Geography. In addition, she has a wide knowledge of computer applications including geographic information systems.

Dr. Richards brings to the team, over 15 years of international and local consulting experience in conducting socioeconomic impact assessments; land use and visual impact

assessments; public consultations and developing and providing policy advice for sustainable development, environmental sustainability and disaster risk reduction. She also has experience in energy management, water resources management, and integrating sustainability into businesses. She is trained in geographical information systems (GIS), multi-hazard risk assessment, strategic environmental assessment and social research methods and policy analysis.

HYDROGEOLOGY

Brain Richardson, M.Sc.

Mr. Brian Richardson will be one of the key experts in this assignment. He has over 15 years of experience in the field of hydrogeology. His experience spans throughout the Caribbean and the United Kingdom where he conducted varied exercises which includes evaluation of run off potential, determination of the impact of developments on watersheds and the review of engineering designs, proposing new designs and monitoring. His competence has been solidified through United Kingdom based training and being a part of professional organisations in Jamaica, the United Kingdom and the United States of America.

13.7 Survey Instrument

GENERAL PUBLIC (STAKEHOLDERS) SURVEY (April 2019)

Port Authority of Jamaica

Cruise Ship Terminal, Old Coaling Wharf, Port Royal, Jamaica

PERSONAL/CONFIDENTIAL

Personal Interview Schedule (Target: Head of Household or Persons above 18 years of age)

Interviewer:___________________ Location: _____________ Date: ___________________

The Port Authority of Jamaica (PAJ) seeks to develop a cruise ship terminal and floating pier on lands at Old Coaling Wharf, Port Royal, Jamaica. This project is a part of the strategic plan for the development of cruise shipping in Jamaica, and to establish Kingston as a port of call. Port Royal has been identified as an ideal location for Kingston's first cruise shipping facility, due to its rich heritage, strong brand, existing attractions and proximity to the capital city and its offerings. The proposed development site is located on Port Royal Main Road in Port Royal, Kingston and is a previously developed site, of approximately 3.6

hectares (9 acres) in size. This lot formed part of the Old Naval Dockyards and is commonly described as "Old Coaling Wharf", as the area was used for the storage and provisioning of coal to naval vessels.

The PAJ intends to utilize SeaWalk™ technology, to create a floating articulated pier which extends from the shore connection point out to the ship, is positioned and secured alongside, and allows access for passengers, baggage, trolleys and crew to move from the ship's gangway onto the pier and to shore. When in use, the SeaWalk™ pier is extended out to the ship and attached along the shipside at the shell doors; when not required, the three segments are folded close to shore. The "Cruise Ship Pier" concept envisages: a terminal area, administrative building and a series of bus and tram loading structures with a gross area of approximately 35,650 ft2 (~3,313 m2).

This questionnaire is being administered in order to determine the social and economic characteristics of the community in which you live and to garner views and perspective on the proposed project and the likely potential impacts associated with the construction and operational phases of the project.

All information provided will be kept confidential and used solely for fulfilling the requirements of the social impact assessment study.

Please tick the response(s) which most applies to you (√)

A. General Respondent Profile

1. Sex: **Male** ☐ **Female** ☐

2. To what age group do you belong? **<20** ☐ **20-29**☐ **30-39**☐ **40-49**☐ **50-59**☐ **60-69**☐ **70 & over**☐

3. Are you the head of your household? **Yes** ☐ **No** ☐

4. Including yourself, how many people live in your household? ______

   (a) # of adults _____ (b) # of children less than 18 years _____

5. Where do you currently live (community name)? ________________________________

6. How long have you lived there? ________________ (years)

B. Perception of the Proposed Development

Before this interview, were you aware of proposed plans develop a cruise ship terminal and floating pier on lands at Old Coaling Wharf, Port Royal, Jamaica? **Yes** ☐ **No** ☐

7. If yes, through what medium? **Newspaper** ☐ **Television** ☐ **Radio** ☐ **Councillor** ☐

Community Member ☐ **Other (specify)________________**

8. How important do you think the proposed cruise ship terminal and floating pierare to the following:

	Very Important	Important	Somewhat Important	Not Important	Why?
Jamaica tourism and cruise industries					
Port Royal and its Environs					

9. How do you think the proposed project will affect the following during the:

a. **Construction phase** of the project?

	Positively	***Negatively***	***No Effect***	***How?***
Water quality				
Coastal and marine resources				
Noise Levels in Port Royal				
Water Sports (Fishing, Diving, etc.)				
Fishing community (Fishers, fishing areas, etc.)				
Stay-over Tourism				
Job Opportunities (locals)				
Local Businesses (local economy)				
JamaicanEconomy				
Residents				
Visual aesthetics of the area				

	Positively	***Negatively***	***No Effect***	***How?***
Traffic				
Heritage Sites (monuments, buildings)				

b**. Post Construction/Operations phase** of the project?

	Positively	***Negatively***	***No Effect***	***How?***
Water quality				
Coastal and marine resources				
Noise Levels in Port Royal				
Water Sports (Fishing, Diving, etc.)				
Fishing community (Fishers, fishing areas, etc.)				

	Positively	***Negatively***	***No Effect***	***How?***
Cruise tourism				
Stay-over Tourism				
Job Opportunities (locals)				
Local Businesses (local economy)				
Jamaican Economy				
Residents				
Visual aesthetics of the area				
Traffic				
Heritage Sites (monuments, buildings)				

10. What other types of negative impacts would you associate with this project?

____

____

11. What other types of benefits (positive impacts) would you associate with this project?

____

12. Do you think any particular group in your community or Jamaica will be put at a disadvantage because of this project? Explain

____

13. Do you think the necessary skills required for the construction and operational phases of the project can be found in your community? **Yes** ☐ **No** ☐

14. Do you think there will be any direct benefits to you from this project? **Yes**☐ **No** ☐

(State reason[s] for answer)____

C. Port Royal

15. What do you value most about Port Royal (e.g. sense of community, history, shopping, business etc.)?

____

____

16. How important are the following cultural and heritage resources in Port Royal to Jamaica?

Resource	**Ranking**				
	Not Important	Somewhat Important	Important	Very Important	Do not know
Port Royal Forts (Fort Charles, Fort Morgan, etc.)					
Giddy House					
Historic Naval Hospital					
St. Peter's Church					
Port Royal Terrestrial Archaeology					
Port Royal Underwater Archaeology					

17. How would you rank the loss or damage to any of these cultural heritage resources to Port Royal and Jamaica?

Resource	Ranking				
	Not Significant	Somewhat Significant	Significant	Very Significant	Do not know
Port Royal Forts (Fort Charles, Fort Morgan, etc.)					
Giddy House					
Historic Naval Hospital					
St. Peter's Church					
Port Royal Terrestrial Archaeology					
Port Royal Underwater Archaeology					

D. Natural Resources

18. How important are the following natural resources to Port Royal?

Resource	Ranking

	Not Important	Somewhat Important	Important	Very Important	Do not know
Terrestrial Wildlife e.g. birds, crocodiles					
Coastal resources e.g. mangroves, beaches					
Marine wildlife and resources e.g. Fisheries, turtles, seagrass					

19. Do you use any of these resources? **Yes** ☐ **No**☐

20. If Yes, which ones ___________________ and for what purpose(s)? _____________________________
____
____

21. Are there any pollution sources or stress factors affecting the natural resources of Port Royal and its environs?**Yes** ☐ **No**☐

(b) If yes what is the type of pollution? ____

(c) What is the source of this pollution?____

E. Fishing Survey

22. How are you involved in the fishing industry? **Fisherman**☐**Facilitates** R**ecreational fishing excursions**☐ **Facilitates sightseeing/diving excursions** ☐ Other ☐ Specify _____________

23. Is the Port Royal Harbour the only dock/landing area used by you for fishing related activities?

Yes ☐ **No** ☐ *If NO, Please list others*____

24. How long have you been using port facilities in Port Royal, name the facility/location used?

____
______

25. Do you fish Full-time ☐or Part-time☐ (b) how long have you been fishing?________

26. How many days per week do you fish? 1-2 days ☐ 3-4 days ☐ 5-6 days ☐ 7 days per week ☐

27. What time of day do you undertake fishing activities? _________________________

28. Do you fish from a………? boat☐pier or dock☐ Other☐_________________________

29. If you use a boat, what type (s) of boat do you use? FRP ☐ Wooden ☐ Sports Fishing Boat ☐ Other______________

30. Do you own or rent the boat you use? Own ☐ Rent ☐Other, specify ___________________

31. How often do you carry out maintenance and repair activities on your boat?

Monthly ☐ Quarterly ☐ Yearly ☐ On a needs Basis ☐

32. Where is/are your main fishing ground(s). ________________________Please identify on map below.

33. What is the distance travelled one-way to fishing locations (from dock to fishing/excursion location)?

____

34. What type of fishing method do you use? Hand or Rod Line ☐ Spear fishing (Diving) ☐

Cast netting ☐ Trolling ☐ Seine nets ☐ Fish pots ☐ Other __________________

35. What is your main target fish? Shell fish ☐ Reef fish☐ Coastal pelagic fish ☐ Bottom Fish☐ Ocean pelagic fish ☐ Other, List ☐_______________________________________

36. What type of fish do you usually catch?

____

37. What is your average fish catch (lbs.) per day?

____

38. Have you observed any **Increase** ☐or **Decrease**☐in fish catch over the years?

   a. What do you think has caused the change?

   ____

39. How much of your catch do you sell per day?

____

40. Who do you **mainly** sell to? Market ☐ Restaurants ☐ Hotels ☐ Middleman/agent ☐

Local shoppers ☐ Supermarket ☐ Other☐specify_____________________

41. What is your average weekly earnings from fishing? ______________

42. How much on average do you spend for each fishing trip?

____

43. What items are covered in your expenses? e.g. gas

____

44. What is your level of satisfaction with your fishing/excursion grounds? Very satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very dissatisfied ☐

   a. What is the reason for your answer?

   ____

   ____

   ____

45. Is water quality an issue where you fish or carry out fishing excursions? Major ☐ Minor ☐ Not a concern ☐

46. What are some of the other issues facing fishing community?

____

____

____

47. What types of improvements does the fishing/excursion community need?

____

____

____

48. Any other comments/views on the proposed project?

_______________________________________ ___________________________________

____

49. Are you a registered operator? **Yes** ☐Specify Licensing

Body_____________________________ **No**☐

F. Excursionists Survey

50. What are your locations for excursions? please list below

- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________

51. What types of activities are offered on these excursions?

- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________

52. What types of equipment are required for excursions?

- ____
- ____
- ____

53. How often do you carry out maintenance and repair activities on boats used for excursion activities?

Weekly☐ Monthly☐ Quarterly☐ Yearly☐ On a needs Basis☐

54. What is your main target audience for your excursion tours? Local residents☐

Visitors☐ Other, specify ________________________________

55. What is your average weekly earnings from excursions?_________________________________

56. How has the number of excursions you offer changed in the past five years

Increased☐ Decreased ☐ Remain the same☐Don't know ☐

57. What is your level of satisfaction with your destination of your excursions? Very satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very dissatisfied ☐

58. Is water quality an issue where you carry out excursions? Major ☐ Minor ☐ Not a concern ☐

59. What are some of the other issues facing tour operators in your community?

____

____

____

____

60. What types of improvements do tour operators need?

____

____

____

Business Survey

61. Type of business (retail shop, restaurant/bar, hotel, etc.)?

____

62. What is your relationship with the owner of this business?

____

63. How long have you been operating this business here? _______________

64. Do you have membership in any professional/business organization (e.g., Chamber of Commerce etc.)

Yes ☐ **No** ☐ *If NO, Please list*

____

65. What is your estimated average monthly sale? JM$___________

66. What are the major items you sell?

____

67. Do you own or rent this facility? Own ☐ Rent☐ Rent-free☐ Other, specify

____

68. Can you estimate your average monthly expense?

JM$_____________________________________

69. What are some issues facing businesses in your community?

____

____

____

70. What types of improvements does the business community need?

____

____

____

71. Any other comments/views on the proposed project?____

____

____

____

Thank you for your cooperation and participation in this survey☺☺☺

Interviewer Comments and Observations

13.8 Stakeholders Meetings

Meetings were held by the PAJ with the stakeholders (community and key agencies) over the period February to June 2019 to sensitise them to the proposed development of the cruise ship pier and to provide a forum for discussing their concerns and relevant issues

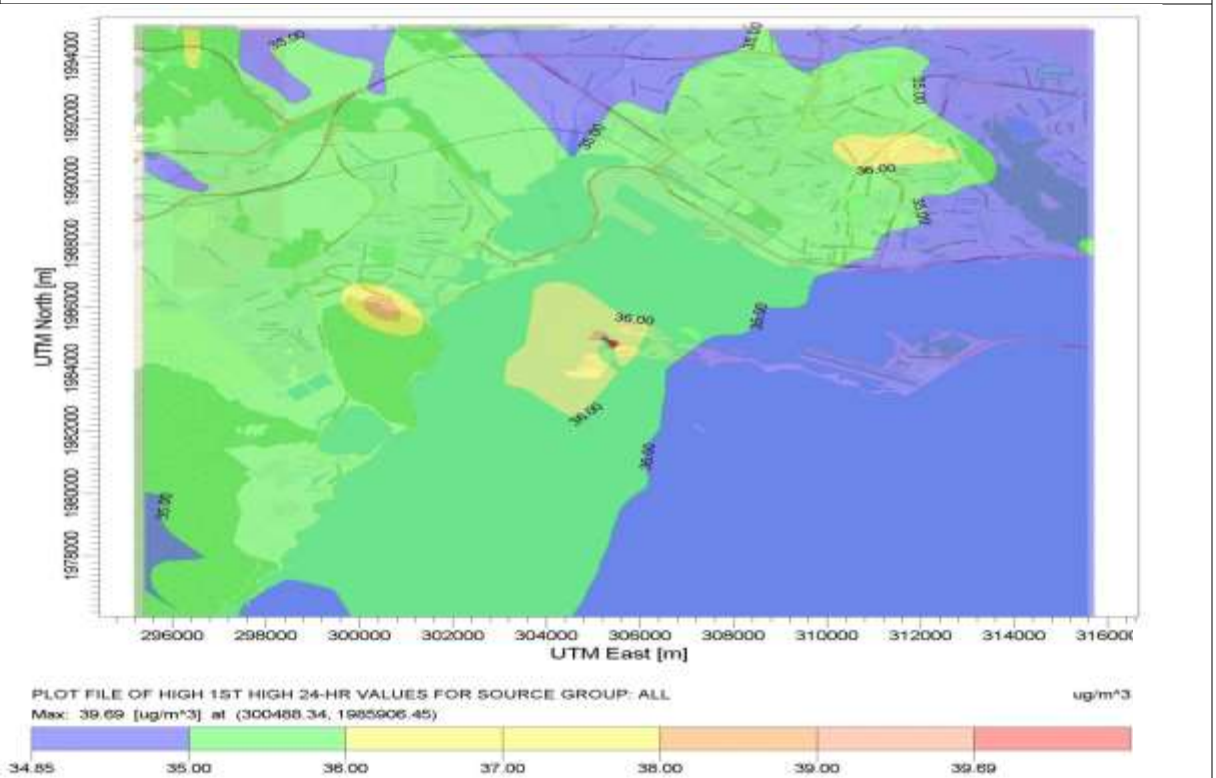
Stakeholder	**Date of Meeting**
Agencies and Stakeholder Groups (UDC, JNHT, NWC, NWA, NHT, NEPA)	20-Feb-19
Community	9-Mar-19
Community - Fisher Folks	22-Mar-19
Community	23-Mar-19
Community	6-Jun-19

PROJECT TITLE:**PAJ ANNUAL PM10 DISPERSION MAP**

13.9 Dispersion Model Maps

Dispersion Fallout Concentration Plot for 24Hour PM_{10}(Full view)

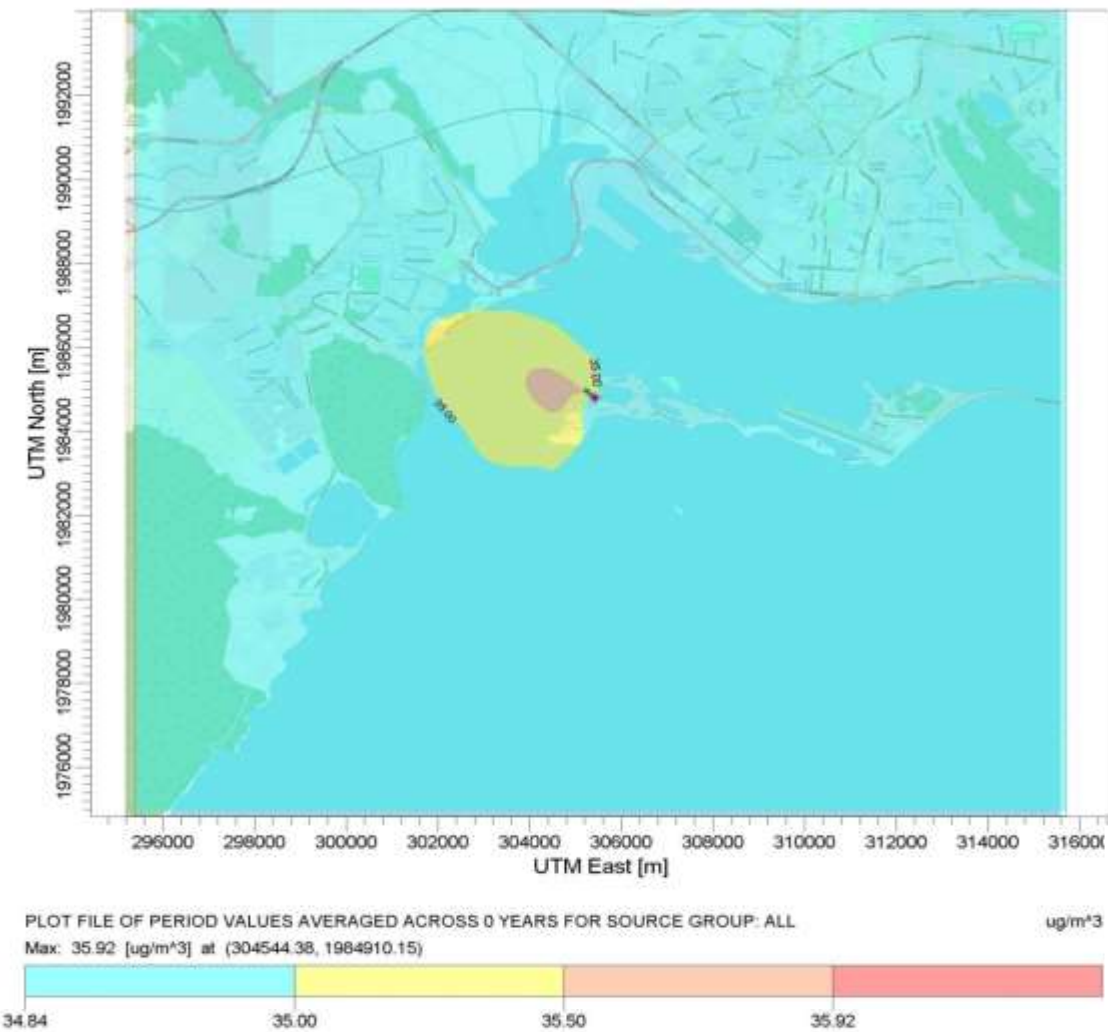
PROJECT TITLE:**PAJ 24HR PM10 DISPERSION MAP**



COMMENTS:	SOURCES:**1**	COMPANY NAME:**TEMN LTD**	
	RECEPTORS:**446**	MODELER:**GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX:**39.69 ug/m^3**	DATE:**3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERPM\PAJPIERPM.isc

Dispersion Fallout Concentration Plot for 1 Hour SO_2 (Full Screen)



COMMENTS:	SOURCES:**1**	COMPANY NAME:**TEMN LTD**	
	RECEPTORS:**446**	MODELER:**GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE:1:139,759 0 ▬▬▬ 5 km	
	MAX:**35.92 ug/m^3**	DATE:**3/5/2019**	PROJECT NO.:

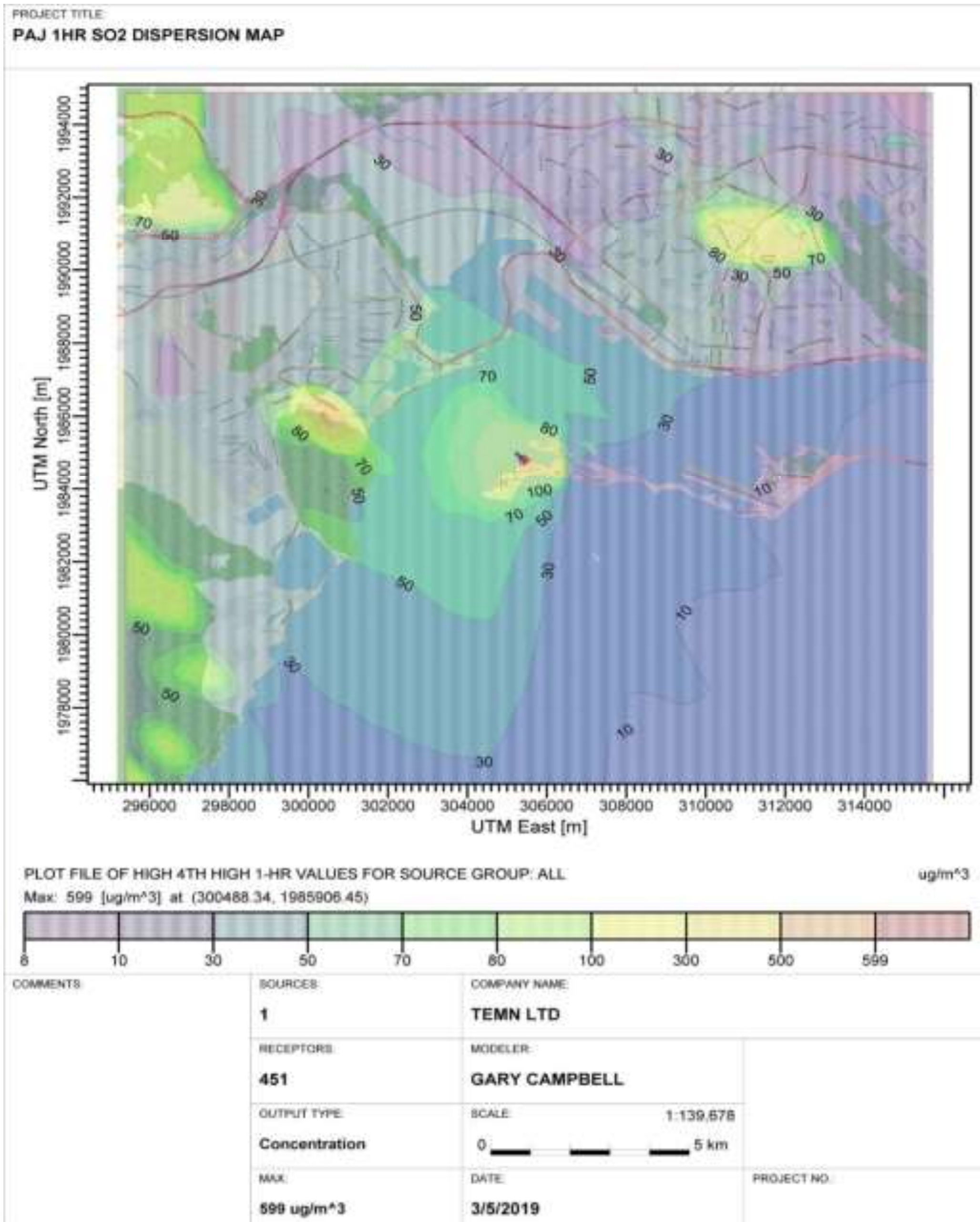
AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERPM\PAJPIERPM.isc

Dispersion Fallout Concentration Plot for Annual PM10 (Full screen)

1

9

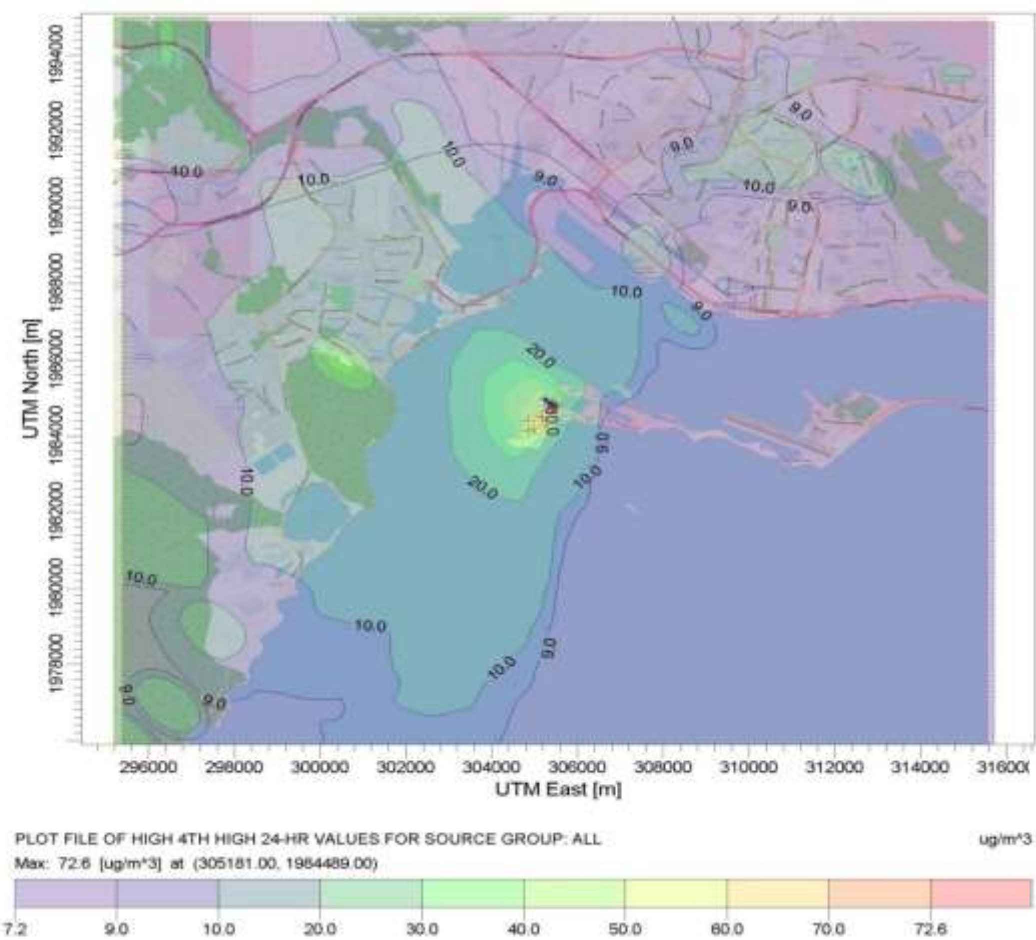
7



AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIER\PAJPIER.isc

Dispersion Fallout Concentration Plot for 24 Hr SO_2 (Full screen)

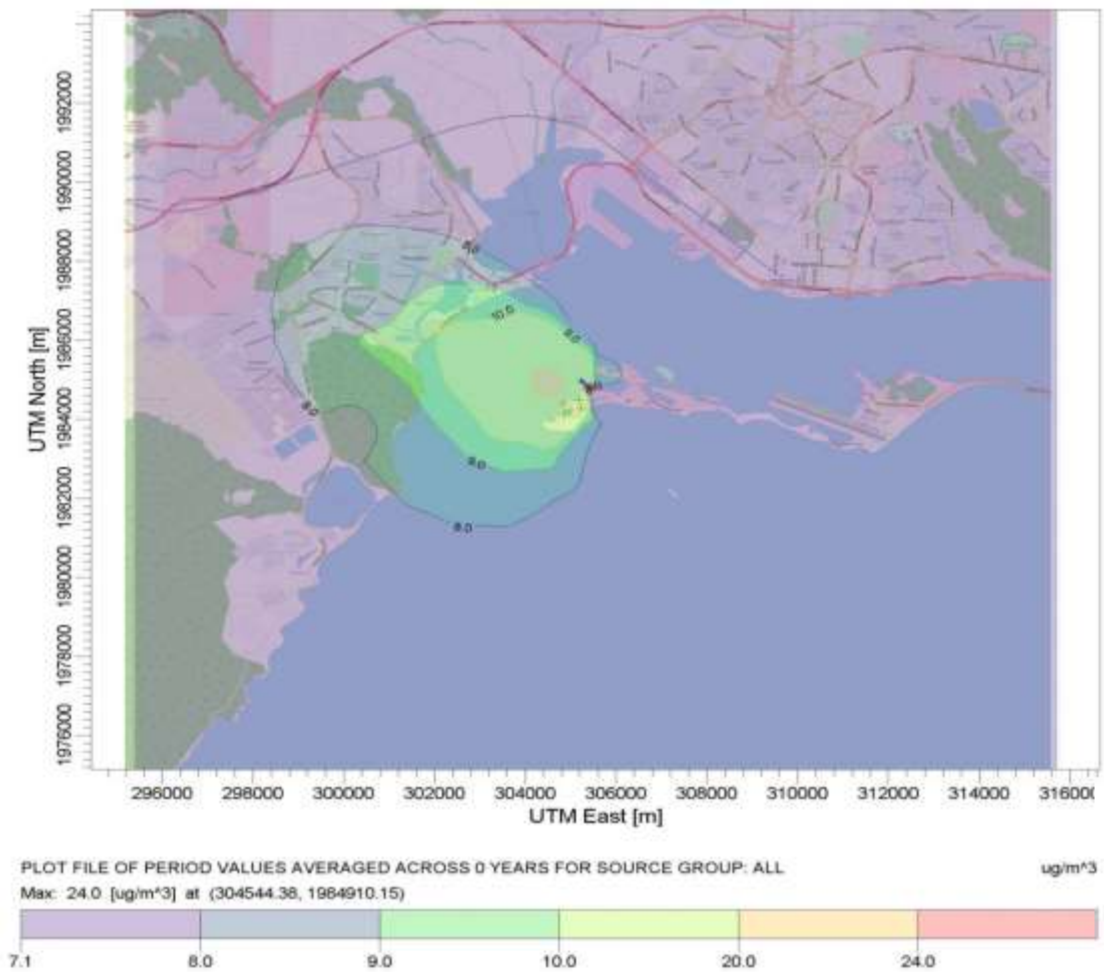
PROJECT TITLE:
PAJ 24HR SO2 DISPERSION MAP



COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139 0 5 km	
	MAX: **72.6 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIER\PAJPIER.isc

PROJECT TITLE:
PAJ ANNUAL SO2 DISPERSION MAP

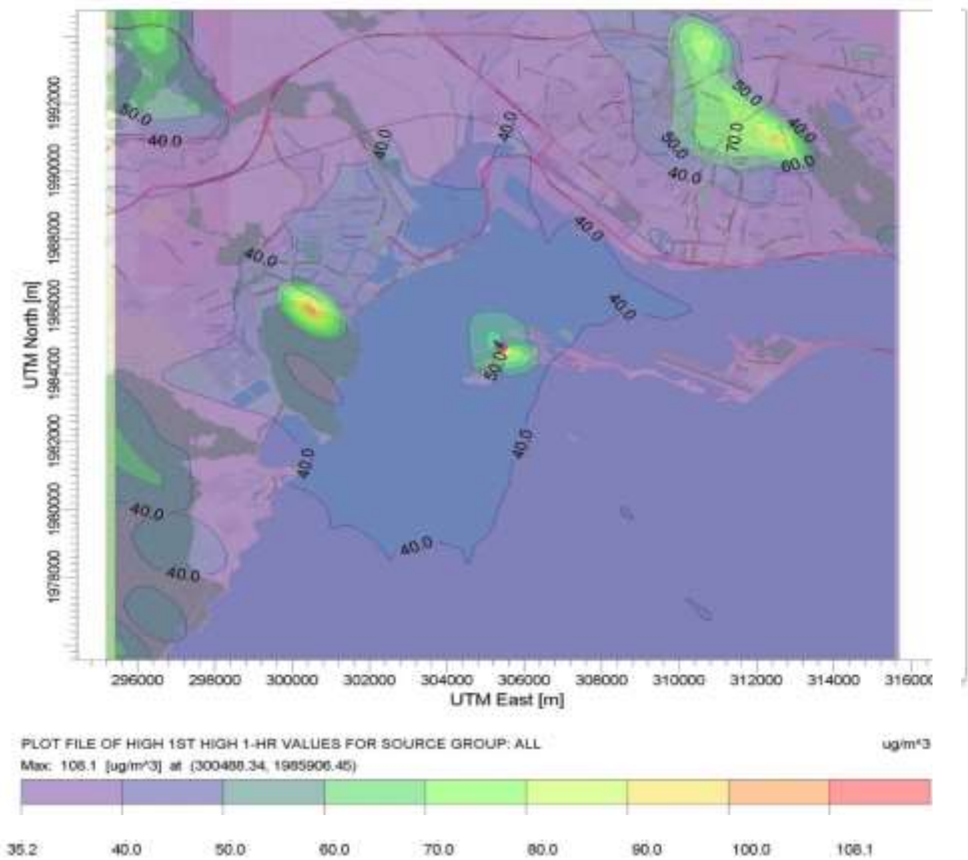


COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **24.0 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIER\PAJPIER.isc

Dispersion Fallout Concentration Plot for Annual SO_2 (Full Screen)

PROJECT TITLE:
PAJ 1HR NOX DISPERSION MAP



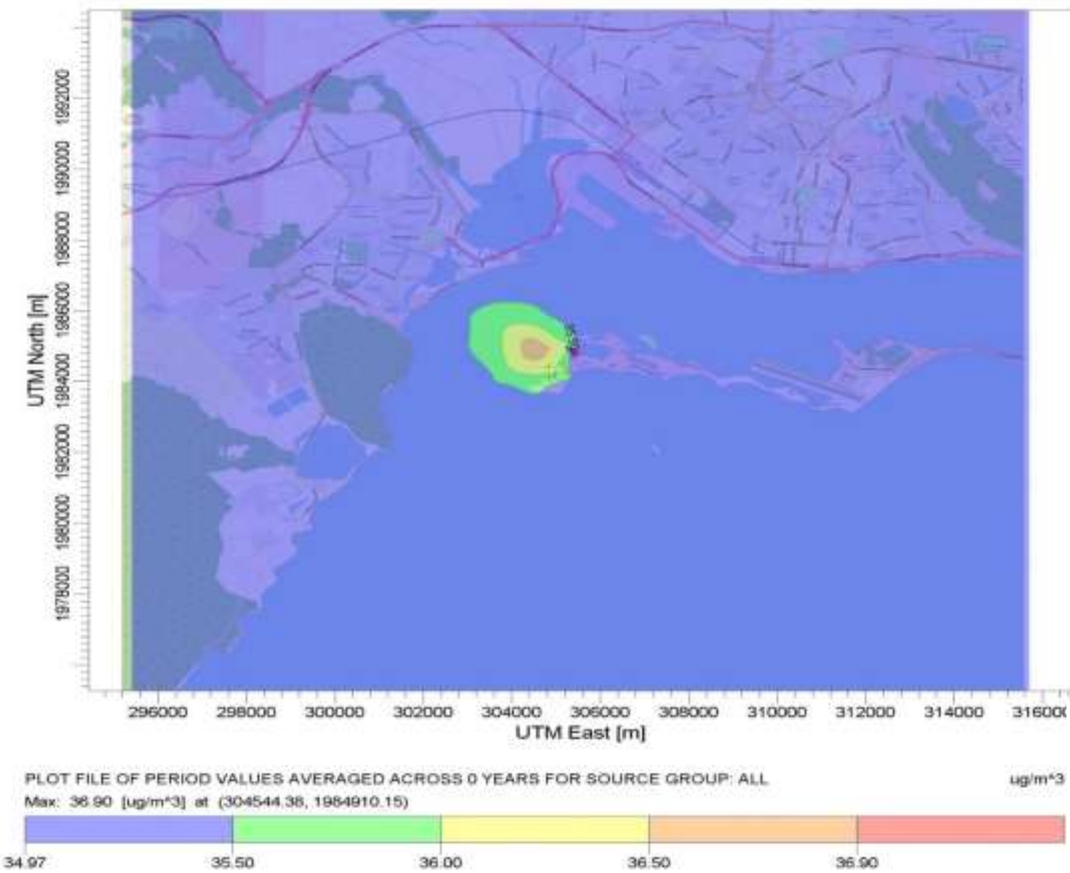
COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **108.1 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERNOX\PAJPIERNOX.isc

Dispersion Fallout Concentration Plot for 1 Hour NO_2 (Full Screen)

PROJECT TITLE:

PAJ ANNUAL NOX DISPERSION MAP			

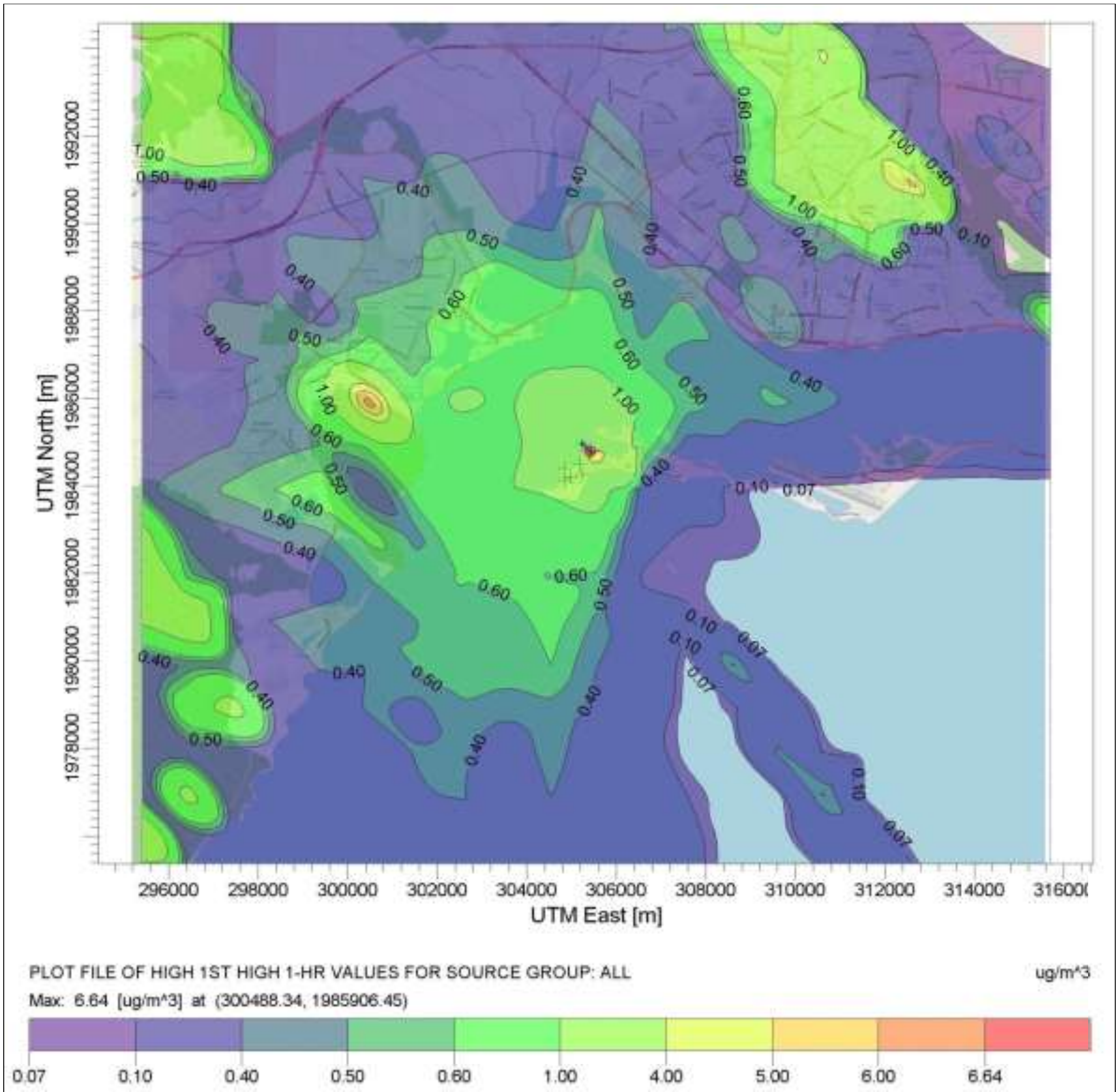


COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **36.90 ug/m^3**	DATE: **3/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERNOX\PAJPIERNOX.isc

Dispersion Fallout Concentration Plot for Annual NO_2 (Full Screen)

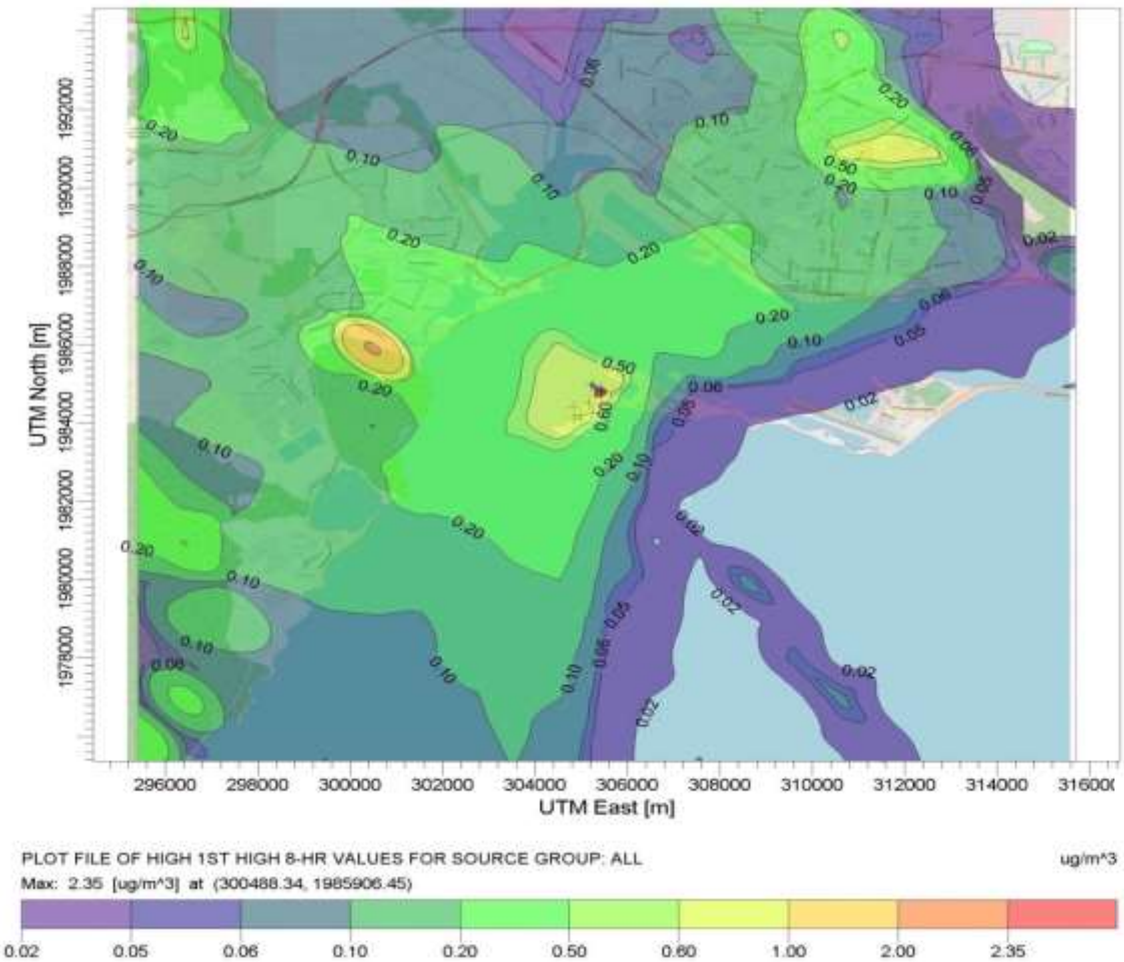
PROJECT TITLE: **PAJ CO 1HR DISPERSION MAP**



COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139 0 5 km	
	MAX: **6.64 ug/m^3**	DATE: **4/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERCO\PAJPIERCO.isc

PROJECT TITLE:
PAJ CO 8HR DISPERSION MAP

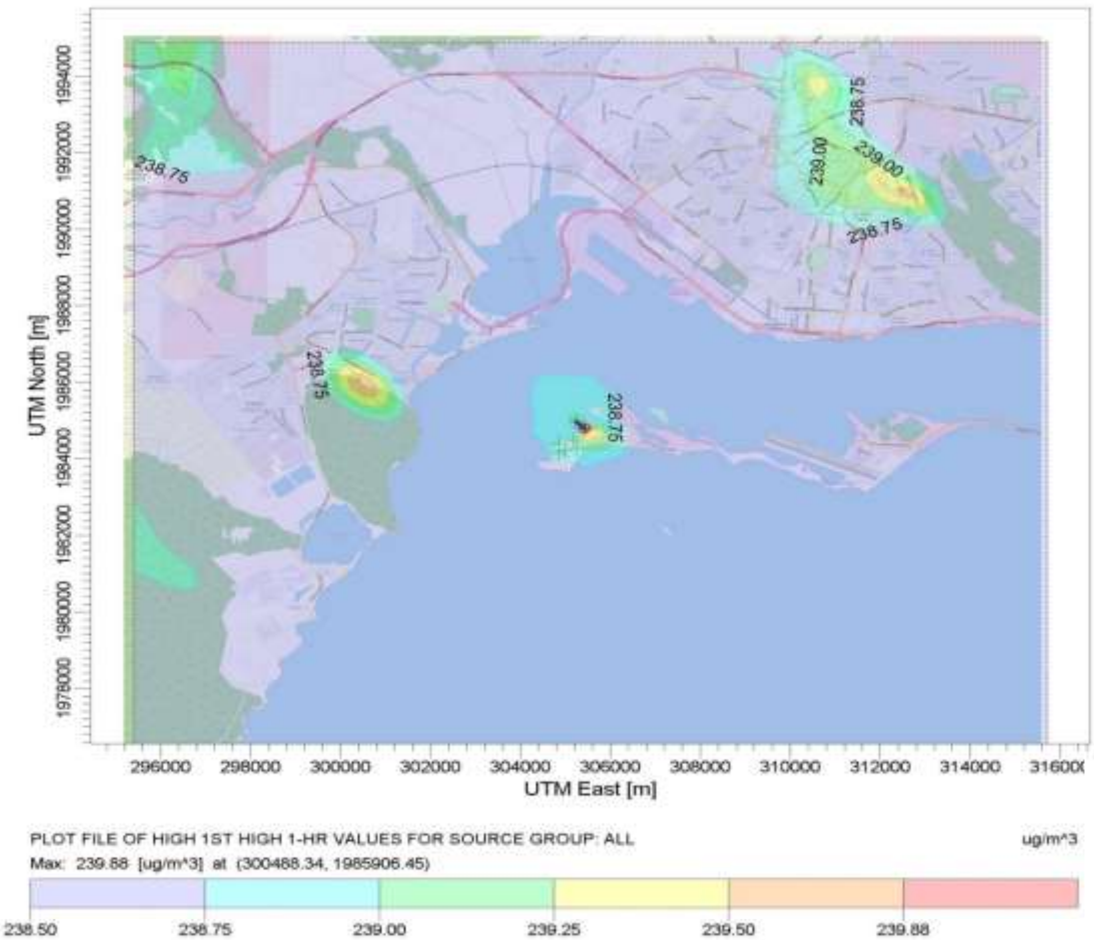


<table>
<tr><td rowspan="4">COMMENTS:</td><td>SOURCES: 1</td><td colspan="2">COMPANY NAME: TEMN LTD</td></tr>
<tr><td>RECEPTORS: 451</td><td>MODELER: GARY CAMPBELL</td><td rowspan="2"></td></tr>
<tr><td>OUTPUT TYPE: Concentration</td><td>SCALE: 1:139,75
0 5 km</td></tr>
<tr><td>MAX: 2.35 ug/m^3</td><td>DATE: 4/5/2019</td><td>PROJECT NO.:</td></tr>
</table>

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERCO\PAJPIERCO.isc

Dispersion Fallout Concentration Plot for 8Hr CO

PROJECT TITLE:
PAJ 1HR VOC DISPERSION MAP



COMMENTS:	SOURCES: **1**	COMPANY NAME: **TEMN LTD**	
	RECEPTORS: **451**	MODELER: **GARY CAMPBELL**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:139,759 0 5 km	
	MAX: **239.88 ug/m^3**	DATE: **4/5/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\Gary Campbell\Desktop\Port Royal\PAJPIERVOC\PAJPIERVOC.isc

Dispersion Fallout Concentration Plot for 1Hr VOC

13.10 RIAM Scoring Methodology

The assessment criteria fall into two groups:

Criteria that are of importance to the condition, and which can individually change the score obtained.

Criteria that are of value to the situation, but individually will not be capable of changing the score obtained.

The value ascribed to each of these groups of criteria is determined by the use of a series of simple formulae. These formulae allow the scores for the individual components to be determined on a defined basis.

The scoring system requires simple multiplication of the scores given to each of the criteria in group (A). The use of multiplier for group (A) ensures that the weight of each score is expressed (since summation of scores could provide identical results for different conditions).

Scores for the value criteria group (B) are added together to provide a single sum. This ensures that the individual value scores cannot influence the overall score, but that the collective importance of all values in group (B) is fully taken into account.

The sum of the group (B) scores is then multiplied by the result of the group (A) scores to provide a final assessment score (ES) for the condition.

The process can be expressed as follows.

$$(a1) \times (a2) = aT$$

$(b1)+(b2)+(b3) = bT$

$(aT)x(bT) = ES$

Where:

(a1) and (a2) are the individual criteria scores for group (A)

(b1) to (b3) are the individual criteria scores for group (B)

aT is the result of multiplication of all (A) scores

bT is the result of summation of all (B) scores

ES is the assessment score for the condition.

Positive and negative impacts are depicted by using scales that go from negative to positive values through zero for the group (A) criteria. Zero is the 'no-change' or 'no-importance' value. The use of zero in group (A) criteria allows a single criterion to isolate conditions which show no change or are unimportant to the analysis.

Zero is avoided in the group (B) criteria. If all group (B) criteria score zero, the final result of the ES will also be zero. This condition may occur even where the group (A) criteria show a condition of importance that will be recognised. To avoid this, scales for group (B) criteria use '1' as the 'no-change/no-importance' score.

Assessment criteria

The criteria, together with their appropriate judgment scores are as follows:

Group (A) criteria

<u>Spatial Importance of condition (A1)</u>

A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.

The scales are defined as follows:

4 = important to national/international interests

3 = important to regional/national interests

2 = important to areas immediately outside the local condition (aspect-specific study areas)

1 = important only to the local condition (Petrojam plant site)

0 = no importance.

<u>Magnitude of change/effect (A2)</u>

Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition:

+3 = major positive benefit

+2 = significant improvement in status quo

+1 = improvement in status quo

0 = no change/status quo

-1 = negative change to status quo

-2 = significant negative dis-benefit or change

-3 = major dis-benefit or change.

Group (B) criteria

Permanence (B1)

This defines whether a condition is temporary or permanent, and will be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).

1 = no change/not applicable

2 = temporary

3 = permanent.

Reversibility (B2)

This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It will not be confused or equated with permanence.

1 = no change/not applicable

2 = reversible

3 = irreversible.

Cumulative (B3)

This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent/irreversible situation.

1 = no change/not applicable

2 = non-cumulative/single

3 = cumulative/synergistic

It is possible to change the cumulative component to one of synergism, if the condition warrants consideration of additive effects.

Overall Assessment

The various ES values are grouped into ranges and assigned alphabetic or numeric codes (see **Table 13.10-1**) so they may be more easily compared.

Table 13.10-1: Range Value Codes for the Environmental Score (ES)

Environmental Score (ES)	Range value (RV)	Range value (RV) (Numeric)	Description of Range

	(Alphabetic)		
72 to 108	E	5	Major positive change/impact
36 to 71	D	4	Significant positive change/impact
19 to 35	C	3	Moderate positive change/impact
10 to 18	B	2	Positive change/impact
1 to 9	A	1	Slight positive change/impact
0	N	0	No change/status quo/not applicable
-1 to -9	-A	-1	Slight negative change/impact
-10 to -18	-B	-2	Negative change/impact
-19 to -35	-C	-3	Moderate negative change/impact
-36 to -71	-D	-4	Significant negative change/impact
-72 to -108	-E	-5	Major negative change/impact

13.11 RIAM Detailed Matrix

RIAM ALTERNATIVE 1: NO ACTION

Activity/Discipline	**Spatial Importance (0 to 4)**	**Magnitude of change/effect (-3 to + 3)**	**Permanence (1 to 3)**	**Reversibility (1 to 3)**	**Cumulative (1 to 3)**		
Parameter	A1	A2	B1	B2	B3	ES	RV
Physical and Chemical Components:							
Water Quality - Marine							
DO	1	0	1	1	1	0	
TSS/TUR	1	0	1	1	1	0	
TPH	1	0	1	1	1	0	
Heavy Metals	1	0	1	1	1	0	
Salinity	0	0	1	1	1	0	
Nutrients (N/P)	1	0	1	1	1	0	
Water Quality - Stormwater							
DO	1	0	1	1	1	0	
TSS	1	0	1	1	1	0	
O/G	0	0	1	1	1	0	
pH	0	0	1	1	1	0	
Heavy Metals	0	0	1	1	1	0	
Flow of nutrients into marine waters and salinity reduction	1	0	1	1	1	0	

Gaseous Emissions (Ambient)							
SO2	0	0	1	1	1	0	
NOx	0	0	1	1	1	0	
CO	0	0	1	1	1	0	
TSP	0	0	1	1	1	0	
VOC	0	0	1	1	1	0	
CO2	0	0	1	1	1	0	
Occupational Emissions (Port Area)							
VOCs	1	0	1	1	1	0	
Dust	1	0	1	1	1	0	
Noise & Vibration	1	0	1	1	1	0	
Solid Waste Management							
Site Waste management	0	0	1	1	1	0	
Putrescible Solid Waste	1	0	1	1	1	0	
Municipal Waste	0	0	1	1	1	0	
Metal Scrap	1	0	1	1	1	0	
Hydrodynamics							
Changes to the local current patterns from ships at berth	0	0	1	1	1	0	
Waves and Sediments							
Effects of prop wash (resuspension of sediments)	0	0	1	1	1	0	
Deposition of silt and fine sediments within the port over time	0	0	1	1	1	0	

Changes to the wave patterns in the form of reflection from the revetment	0	0	1	1	1	0	
Natural Hazards							
Hurricanes, Eartquakes,Tsunamis	4	0	1	1	1	0	
Climate Change (rising SST's; storm activity)	4	0	1	1	1	0	
Biological and Ecological Components:							
Terrestrial							
Impacts on biota & habitats	0	0	1	1	1	0	
Terrestrial (Avifauna)	0	0	1	1	1	0	
Marine Ecology							
Coral bleaching/disease/reduced fitness/reduced recruitment	3	-2	2	2	3	-42	
Loss of biodiversity (Scleractinian coral/threatened species)	1	-1	2	2	3	-7	
Loss of biodiversity (other reef fauna)	1	-1	2	2	3	-7	
Loss of ecosystem functionality (habitat fragmentation, loss of functional connectivity, etc.)	0	0	1	1	1	0	
Habitat degradation of nearby reefs and seagrass	1	0	1	1	1	0	
Construction - debris/waste/sewage	0	0	1	1	1	0	

Resuspension of sediments (prop wash)	0	0	1	1	1	0	
Continued habitat degradation (loss of coral cover, phase shift due to cruise ship traffic)	0	0	1	1	1	0	
Loss of habitat-collision, anchor damage	0	0	1	1	1	0	
Operational - Invasive species	0	0	1	1	1	0	
Accidental spills/releases (Bilge, Black and grey water)	0	0	1	1	1	0	
Impacts of Mass tourism on Natural Resources						0	
Socio-Economic and Cultural Components:							
Sociological and Cultural Components							
Community Development, Infrastructure & Social Services	3	0	1	1	1	0	
Public Perception (Socio-Economic, Socio-Cultural)	3	0	1	1	1	0	
Public Perception (Environment)	3	0	1	1	1	0	
Public Health & Safety	3	0	1	1	1	0	
Heritage/Historical Sites (Admiralty House)	4	0	1	1	1	0	
Heritage/Historical Sites (Port Royal Town)	4	0	1	1	1	0	
Housing (Squatting)	3	0	1	1	1	0	
Traffic and Pedestrian							

Baseline Traffic Growth (Land)	1	0	1	1	1	0	
Baseline Traffic Growth (Marine)	4	0	1	1	1	0	
Pedestrian Traffic	1	0	1	1	1	0	
Cruise Shipping							
Cruise Market Patronage introduced to Port Royal	0	0	1	1	1	0	
Economic and Operational Components							
Macro-economic (Cruise Tourism)	3	0	1	1	1	0	
Macro-economic (Employment and Income)	3	0	1	1	1	0	
Micro-economic (Port Royal)	2	0	1	1	1	0	
Water Sports/Dive Operators (Excursions/ Livelihoods)	2	0	1	1	1	0	
Fishing Community	2	0	1	1	1	0	
LVIA (Land Use)	2	0	1	1	1	0	
LVIA (Visual Aesthetics)	3	0	1	1	1	0	

RIAM ALTERNATIVE 2 – FIXED JETTY

Environmental Component During Construction							
Activity/Discipline	**Spatial Importance (0 to 4)**	**Magnitude of change/effect (-3 to + 3)**	**Permanence (1 to 3)**	**Reversibility (1 to 3)**	**Cumulative (1 to 3)**		
Parameter	A1	A2	B1	B2	B3	ES	RV
Physical and Chemical Components:							
Water Quality - Marine							
DO	1	-1	2	2	3	-7	
TSS/TUR	2	-1	2	2	3	-14	
TPH	2	-1	2	2	3	-14	
Heavy Metals	2	-1	2	3	3	-16	
Nutrients (N/P)	2	-1	3	3	3	-18	
Salinity	0	0	1	1	1	0	
Water Quality - Stormwater							
DO	1	-1	3	2	3	-8	
TSS/TUR	1	-1	3	2	3	-8	
O/G	1	-1	2	2	3	-7	
pH	1	-1	2	1	1	-4	

Heavy Metals	2	-1	3	3	3	-18	
Flow (Nutrients into marine waters and salinity reduction)	1	-1	2	2	3	-7	
Gaseous Emissions - Ambient							
SO2	1	-1	2	2	1	-5	
NOx	1	-1	2	2	1	-5	
CO	1	-1	2	2	1	-5	
TSP	1	-1	2	2	1	-5	
VOC	1	-1	2	2	1	-5	
CO2	1	-1	2	2	1	-5	
Occupational Emmissions - Port Area							
VOCs	1	-1	2	2	1	-5	
Dust	2	-1	2	2	1	-10	
Noise & Vibration	2	-2	2	1	1	-16	
Solid Waste Management							
Site Waste management	1	-2	2	1	1	-8	
Putrescible Solid Waste	1	-1	2	1	1	-4	
Municipal Waste	1	-1	2	1	1	-4	
Metal Scrap	1	-1	2	1	1	-4	
Hydrodynamics							
Changes to the local current patterns from ships at berth	1	0	2	1	1	0	

Waves and Sediments							
Effects of prop wash (resuspension of sediments)	2	-1	2	2	3	-14	
Deposition of silt and fine sediments within the port over time	2	-1	2	2	3	-14	
Changes to the wave patterns in the form of reflection from the revetment	1	-1	3	3	2	-8	
Natural Hazards:							
Hurricanes, Eartquakes,Tsunamis	4	0	1	1	1	0	
Climate Change (rising SST's; storm activity)	4	0	1	1	1	0	
Biological and Ecological Components							
Terrestrial							
Impacts on biota & habitats	1	-1	3	3	3	-9	
Terrestrial (Avifauna)	1	-2	3	3	3	-18	
Marine Ecology							
Coral bleaching/disease/reduced fitness/reduced recruitment	1	-1	3	3	3	-9	
Loss of biodiversity (Scleractinian coral/threatened species)	1	-1	3	3	3	-9	
Loss of biodiversity (other reef fauna)	1	-1	3	3	3	-9	
Loss of ecosystem functionality (habitat fragmentation, loss of functional connectivity, etc.)	2	-2	3	3	3	-36	
Habitat degradation of nearby reefs and seagrass	2	-2	3	3	3	-36	
Construction - debris/waste/sewage	2	-2	2	2	3	-28	
Resuspension of sediments (prop wash)	2	-2	2	2	3	-28	

Continued habitat degradation (loss of coral cover, phase shift due to cruise ship traffic)	2	-2	2	2	3	-28	
Loss of habitat-collision, anchor damage	1	-3	3	3	3	-27	
Operational - Invasive species	2	-1	3	3	3	-18	
Accidental spills/releases (Bilge, Black and grey water)	2	-1	2	2	3	-14	
Impacts of mass tourism on Natural Resources						-14	
Socio-Economic and Cultural Components:							
Sociological and Cultural Components							
Community Development, Infrastructure & Social Services	3	-1	1	2	3	-18	
Public Perception (Socio-Economic)	3	1	2	2	3	21	
Public Perception (Environment)	3	-2	3	2	3	-48	
Public Health & Safety	3	-1	2	2	3	-21	
Heritage/Historical Sites (Admiralty House)	4	-1	3	3	2	-32	
Heritage/Historical Sites (Port Royal Town)	4	-1	3	3	2	-32	
Housing (Squatting)	3	-1	2	2	3	-21	
Traffic and Pedestrian							
Construction Phase (Land)	2	-1	2	2	2	-12	
Proposed Mitigation Measures (Construction)	2	-1	2	2	2	-12	
Construction Phase (Marine)	4	-1	2	2	3	-28	
Proposed Mitigation Measures (Construction)	4	-1	2	2	3	-28	

Pedestrian Traffic	2	0	1	1	1	0	
Cruise Shipping							
Construction Phase						0	
Cruise Market Patronage introduced to Port Royal	4	0	1	1	1	0	
Economic and Operational components							
Macro-economic (Cruise Tourism)	3	0	1	1	1	0	
Macro-economic (Employment and Income)	3	2	2	2	3	42	
Micro-economic (Port Royal)	2	2	2	2	3	28	
Water Sports/Dive Operators (Excursions/ Livelihoods)	2	-2	2	2	3	-28	
Fishing Community	2	-2	3	3	3	-36	
LVIA (Land Use)	2	-1	2	3	2	-14	
LVIA (Visual Aesthetics)	2	-1	2	3	2	-14	

RIAM ALTERNATIVE 3 – FIXED JETTY

Environmental Component During Construction							
Activity/Discipline	**Spatial Importance (0 to 4)**	**Magnitude of change/effect (-3 to +3)**	**Permanence (1 to 3)**	**Reversibility (1 to 3)**	**Cumulative (1 to 3)**		
Parameter	A1	A2	B1	B2	B3	ES	RV
Physical and Chemical Components:							
Water Quality - Marine							
DO	1	-1	2	2	3	-7	
TSS/TUR	2	-1	2	2	3	-14	
TPH	2	-1	2	2	3	-14	
Heavy Metals	2	-1	2	3	3	-16	
Nutrients (N/P)	2	-1	3	3	3	-18	
Salinity	0	0	1	1	1	0	
Water Quality - Stormwater							
DO	1	-1	3	2	3	-8	
TSS	1	-1	3	2	3	-8	
O/G	1	-1	2	2	3	-7	
pH	1	-1	2	1	1	-4	
Heavy Metals	2	-1	3	3	3	-18	

Flow (Nutrients into marine waters and salinity reduction)	1	-1	2	2	3	-7	
Gaseous Emissions - Ambient							
SO2	1	-1	2	2	1	-5	
NOx	1	-1	2	2	1	-5	
CO	1	-1	2	2	1	-5	
TSP	1	-1	2	2	1	-5	
VOC	1	-1	2	2	1	-5	
CO2	1	-1	2	2	1	-5	
Occupational Emissions - Port Area							
VOCs	1	-1	2	2	1	-5	
Dust	2	-1	2	2	1	-10	
Noise & Vibration	2	-2	2	1	1	-16	
Solid Waste Management							
Site Waste management	1	-2	2	1	1	-8	
Putrescible Solid Waste	1	-1	2	1	1	-4	
Municipal Waste	1	-1	2	1	1	-4	
Metal Scrap	1	-1	2	1	1	-4	
Hydrodynamics							
Changes to the local current patterns from ships at berth	0	0	1	1	1	0	
Waves and Sediments							
Effects of prop wash (resuspension of	1	-1	2	3	1	-6	

sediments)							
Deposition of silt and fine sediments within the port over time	0	0	1	1	1	0	
Changes to the wave patterns in the form of reflection from the revetment	1	-1	3	3	2	-8	
Natural Hazards:							
Hurricanes, Eartquakes,Tsunamis	4	0	1	1	1	0	
Climate Change (rising SST's; storm activity)	4	0	1	1	1	0	
Biological and Ecological Component							
Terrestrial							
Impacts on biota & habitats	1	-1	3	3	3	-9	
Terrestrial (Avifauna)	1	-2	3	3	3	-18	
Marine Ecology							
Coral bleaching/disease/reduced fitness/reduced recruitment	1	-1	3	3	3	-9	
Loss of biodiversity (Scleractinian coral/threatened species)	1	-1	3	3	3	-9	
Loss of biodiversity (other reef fauna)	1	-1	3	3	3	-9	
Loss of ecosystem functionality (habitat fragmentation, loss of functional connectivity, etc.)	1	-1	3	3	3	-9	
Habitat degradation of nearby reefs and seagrass	2	-1	3	3	3	-18	
Construction - debris/waste/sewage	2	-2	2	2	3	-28	
Resuspension of sediments (prop wash)	2	-2	2	2	3	-28	
Continued habitat degradation (loss of coral cover, phase shift due to cruise ship traffic)	1	-1	3	3	3	-9	
Loss of habitat-collision, anchor damage	1	-3	3	3	3	-27	

Operational - Invasive species	2	-1	3	3	3	-18	
Accidental spills/releases (Bilge, Black and grey water)	2	-1	2	2	3	-14	
Impacts of mass tourism on Natural Resources							
Socio-Economic and Cultural Components:							
Sociological and Cultural Components							
Community Development, Infrastructure & Social Services	3	-1	2	2	3	-21	
Public Perception (Socio-Economic)	3	1	2	2	3	21	
Public Perception (Environment)	3	-1	3	2	3	-24	
Public Health & Safety	3	-1	2	2	2	-18	
Heritage/Historical Sites (Admiralty House)	4	-1	3	2	2	-28	
Heritage/Historical Sites (Port Royal Town)	4	-1	3	2	1	-24	
Housing (Squatting)	3	-2	3	2	3	-48	
Traffic and Pedestrian							
Construction Phase (Land)	2	-1	2	2	2	-12	
Construction Phase (Marine)	4	-1	2	2	3	-28	
Pedestrian Traffic	2	0	1	1	1	0	
Cruise Shipping							
Construction Phase						0	
Cruise Market Patronage introduced to Port Royal	4	0	1	1	1	0	

Economic and Operational components							
Macro-economic (Cruise Tourism)	3	0	1	1	1	0	
Macro-economic (Employment and Income)	3	2	2	2	3	42	
Micro-economic (Port Royal)	2	2	2	2	3	28	
Water Sports/Dive Operators (Excursions/ Livelihoods)	2	-2	2	2	3	-28	
Fishing Community	2	-2	2	3	3	-32	
LVIA (Land Use)	2	-1	2	3	3	-16	
LVIA (Visual Aesthetics)	2	-1	2	3	1	-12	

RIAM Alternative 3 Post Construction With Mitigation

Environmental Component Post Construction							
Activity/Discipline	Spatial Importance (0 to 4)	Magnitude of change/effect (-3 to + 3)	Permanence (1 to 3)	Reversibility (1 to 3)	Cumulative (1 to 3)		
Parameter	A1	A2	B1	B2	B3	ES	RV
Physical and Chemical Components:							
Water Quality - Marine							
DO	1	-2	2	2	3	-14	
TSS/TUR	2	-1	3	1	3	-14	
TPH	2	-1	2	3	3	-16	
Heavy Metals	1	-1	3	3	3	-9	
Nutrients (N/P)	2	-2	2	2	3	-28	
Salinity	0	0	1	1	1	0	
Water Quality - Stormwater							
DO	1	-1	2	2	1	-5	
TSS	2	-1	2	1	3	-12	
O/G	1	-1	2	2	3	-7	
pH	1	-1	2	2	1	-5	
Heavy Metals	1	-1	3	3	3	-9	
Flow (Nutrients into marine waters and	2	-1	2	2	3	-14	

salinity reduction)							
Gaseous Emissions - Ambient							
SO2	1	-1	2	1	1	-4	
NOx	1	-1	2	1	1	-4	
CO	1	-1	2	1	1	-4	
TSP	1	-1	2	1	1	-4	
VOC	1	-1	2	1	1	-4	
CO2	1	-1	2	1	1	-4	
Occupational Emissions - Port Area							
VOCs	1	-1	2	2	1	-5	
Dust	2	-1	2	2	1	-10	
Noise & Vibration	2	-2	3	3	3	-36	
Noise Mitigation:							
Use electric vehicles	1	1	3	2	1	6	
Control speed	2	1	3	2	1	12	
Optimise public transport to decrease number of vehicles	2	1	3	2	1	12	
Install Sound Barriers	2	1	3	3	1	14	
Solid Waste Management							
Site Waste management	1	-1	2	1	1	-4	
Putrescible Solid Waste	1	-1	2	1	1	-4	
Municipal Waste	1	-1	2	1	1	-4	
Metal Scrap	1	-1	2	1	1	-4	
Mitigation: Solid Waste Management							

Conform to NSWMA Act	1	1	3	3	1	7	
Separation of waste	2	1	3	2	1	12	
Hydrodynamics							
Changes to the local current patterns from ships at berth	0	0	1	1	1	0	
Waves and Sediments							
Effects of prop wash (resuspension of sediments)	1	-1	2	3	1	-6	
Deposition of silt and fine sediments within the port over time	0	0	1	1	1	0	
Changes to the wave patterns in the form of reflection from the revetment	1	-1	3	3	2	-8	
Mitigation: Waves and Sediments							
Use of tug boats to bring vessels to and from berths	2	1	3	1	1	10	
Use of revetments to reduce wave reflection	2	1	3	3	1	14	
Natural Hazards:							
Hurricanes, Eartquakes,Tsunamis	4	0	1	1	1	0	
Climate Change (rising SST's; storm activity)	4	0	1	1	1	0	
Biological and Ecological Component							
Terrestrial							
Impacts on biota & habitats	1	-1	3	3	3	-9	
Terrestrial (Avifauna)	1	-2	3	3	3	-18	
Landscaping using species native to the area	1	1	3	2	3	8	

Marine Ecology							
Coral bleaching/disease/reduced fitness/reduced recruitment	1	-1	3	3	3	-9	
Loss of biodiversity (Scleractinian coral/threatened species)	1	-1	3	3	3	-9	
Loss of biodiversity (other reef fauna)	1	-1	3	3	3	-9	
Loss of ecosystem functionality (habitat fragmentation, loss of functional connectivity, etc.)	1	-1	3	3	3	-9	
Habitat degradation of nearby reefs and seagrass	2	-2	3	3	3	-36	
Construction - debris/waste/sewage							
Resuspension of sediments (prop wash)	2	-3	2	2	3	-42	
Continued habitat degradation (loss of coral cover, phase shift due to cruise ship traffic)	1	-2	3	3	3	-18	
Loss of habitat-collision, anchor damage	1	-2	3	3	3	-18	
Operational - Invasive species	2	-1	3	3	3	-18	
Accidental spills/releases (Bilge, Black and grey water)	2	-1	2	2	3	-14	
Impacts of mass tourism on Natural Resources	1	-2	2	2	3	-14	
Mitigation: Marine Ecology							
Limit use of thrusters	1	2	3	1	3	14	
Planting mangrove seedlings in the shoreline revetment structure	1	1	1	1	1	3	
Install bubble screen syustem to mitigate spread of resuspended solids	2	2	3	1	3	28	
Install sea turtle friendly lights at the facility	1	1	3	1	3	7	
Develop and execute waste management plan	1	1	3	1	3	7	
Enforce cruise ship compliance with	2	1	3	1	3	14	

Jamaica and MARPOL regulations							
Design and implement environmental monitoring plan to inform adaptive management strategy	2	1	3	1	3	14	
Socio-Economic and Cultural Components:							
Sociological and Cultural Components							
Community Development, Infrastructure & Social Services	3	2	3	3	3	54	
Public Perception (Socio-Economic)	3	3	3	2	3	72	
Public Perception (Environment)	3	-1	3	2	3	-24	
Public Health & Safety	3	1	3	2	3	24	
Heritage/Historical Sites (Admiralty House)	4	2	3	3	3	72	
Heritage/Historical Sites (Port Royal Town)	4	3	3	3	3	108	
Housing (Squatting)	3	1	3	2	3	24	
Traffic and Pedestrian							
Construction Phase (Land)	3	-1	3	3	3	-27	
Construction Phase (Marine)	4	-1	3	2	3	-32	
Pedestrian Traffic	3	-1	3	2	3	-24	
Cruise Shipping							
Operations Phase						0	
Cruise Market Patronage introduced to Port Royal	3	3	3	2	3	72	
Economic and Operational Components							

Macro-economic (Cruise Tourism)	3	3	3	3	3	81	
Macro-economic (Employment and Income)	3	3	3	2	3	72	
Micro-economic (Port Royal)	3	3	3	2	3	72	
Water Sports/Dive Operators (Excursions/ Livelihoods)	4	2	3	2	3	64	
Fishing Community	3	1	3	2	3	24	
LVIA (Land Use)	3	3	3	3	3	81	
LVIA (Visual Aesthetics)	3	3	3	3	3	81	

RIAM SUMMARY

Activity/Discipline	Alternative 1 No Project		Alternative 2 Sea Walk		Alternative 3 Fixed Jetty		Operation (No Mitigation)		Operation (With Mitigation)	
Parameter	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**	**ES**	**RV**
Physical/Chemical:	**0**	0	**-216**	-5	**-238**	-5	**-238**	-5	**-214**	-5
Water Quality - Marine and Stormwater	0	0	-121	-5	-121	-5	-133	-5	-133	-5
GasseousEmmissions - Ambient/Occupational	0	0	-45	-4	-45	-4	-39	-4	-39	-4
Noise and Vibration	0	0	-16	-2	-16	-2	-36	-4	-36	-4
Solid Waste Management	0	0	-20	-3	-20	-3	-16	-2	-16	-2
Hydrodynamics and Dredge Plumes	0	0	0	0	0	0	0	0	0	0
Waves and Sediments	0	0	-14	-2	-36	-4	-14	-2	10	2
Natural Hazards	0	0	0	0	0	0	0	0	0	0
Biological/Ecological	**-56**	-4	**-205**	-5	**-269**	-5	**-223**	-5	**-128**	-5
Terrestrial	0	0	-27	-3	-27	-3	-27	-3	-19	-3
Marine Ecology	-56	-4	-178	-5	-242	-5	-196	-5	-109	-5
Socio-Economic and Cultural	**0**	0	**-124**	-5	-176	-5	**397**	5	**770**	5
Sociological/Cultural	0	0	-94	-5	-130	-5	49	4	306	5
Traffic and Pedestrian	0	0	-12	-2	-24	-3	-72	-5	-83	-5
Cruise and Cargo	0	0	0	0	0	0	72	5	72	5
Economic and Operational	0	0	-18	-2	-22	-3	348	5	475	5
Overall Scores	**-56**	**-4**	**-545**	**-5**	**-683**	**-5**	**-64**	**-4**	**428**	**5**

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