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Potential Site Options for a Logistics Hub in Jamaica

Background

As the "Economy versus Environment" debate raged over the proposed USD1.5 Billion logistics hub proposed to be built at the Goat Islands, Smith Warner International Ltd. (SWI) had a unique opportunity to explore possible site options for the project. The opportunity came in the form of four Master of Engineering students from the Technical University of Delft (TU Delft) in Holland. Over the past 10 years, SWI has hosted five groups of Masters level students from TU Delft who execute a Coastal Engineering project under our instruction and guidance. This project is then graded by their Dutch Professors and those grades contribute to their degree. This year's group – soon-to-be graduates majoring in Coastal Engineering and Port Planning – arrived just in time for the announcement of the proposed site for the transshipment port. Their assignment: *Develop site options for a transshipment port, giving due consideration to the needs of a logistics hub, and assess possible approaches to developing the Goat Islands, while giving due consideration to the anticipated environmental concerns.*

This article presents the findings of that research project, which was carried out independently, in the absence of influence from any client either within or outside of Jamaica. The information is presented in the hopes that it might bring a reasoned analysis to the debate, and to highlight the relevance and need for such a detailed study in the decision-making process for what could be a landmark project for Jamaica.

The right site conditions for a port

The transshipment port, as discussed in public media, would be the largest component for the logistics hub. Appropriate site conditions for the operation of such a port must therefore be clearly understood. First, the site must be sheltered to minimize operational downtime under day-to-day wave conditions and to avoid colossal infrastructure damage during a hurricane. Sheltering could be provided naturally by locating the port in an existing harbor, or through man-made breakwater structures. Second, all ports need a deep access channel for ships, and for larger vessels coming through the improved Panama Canal a minimum water depth of 18m will be required. Dredging (deepening the seabed) is costly, so an important consideration will be the distance offshore to which dredging would have to be done to reach the natural 18m depth. Other, more technical, considerations such as wind speed, the relative direction of the access channel to currents and waves, and positioning of a turning basin for the ships, are also relevant.

The viability of any development is often directly linked to its environmental sustainability and, as such, the potential impacts on the marine and surrounding terrestrial environment deserve due consideration. Finally, land space must be available to meet current and future expansion requirements, but land can be artificially created through reclamation using the material dredged for the access channel.

In summary therefore, the main requirements for the port are: adequate land space (naturally or artificially created) and a sheltered zone not too far from deep water.

What's in a hub?

The success of a logistics hub goes beyond the physical site conditions. A logistics hub, in the context of Jamaica's plans, is where the transshipment of goods takes place through the interconnection of services that benefit from being virtually in the same space. The efficient provision of such services is a key ingredient to the success of the hub. As such, the people providing these services should be close by, which is also a pre-requisite for maximizing the socio-economic benefits. Getting the goods and services in and out of the hub must be efficient, which can be achieved in different ways. Therefore, multiple modes of transportation such as railways, highways and airports (passenger and cargo) must all be tied to the port. Support components must be in abundance, including excellent telecommunications, an affordable and reliable energy supply, and a capable, well-trained workforce. The hub may also incorporate industrial activities such as manufacturing, assembly and fabrication, IT, and myriad support services such as insurance, logistics and banking.

Criteria for site selection

The multiple needs of such a development for its short and long-term viability were reduced to five main criteria:

1. *Development costs:*
    - Land reclamation – costs associated with creating land for the development;
    - Sheltering – costs associated with construction of breakwaters to protect against hurricanes;
    - Dredging – costs associated with dredging so that ships can get to the port.
2. *Proximity to population centres:* Towns and cities should provide a competent work force and, to a lesser extent, a market to supply or consume a portion of the goods. The economic benefits for the people, and by the people, are best derived with this in place.
3. *Expansion potential:* Gradual site expansion lowers initial development costs and can facilitate fine-tuning of the development to respond to market needs as they are observed in the future.
4. *Connectivity:* It is essential that the hub is linked to local consumer and industrial areas outside the hub, preferably through multi-modal transportation systems (highways, airports and/or railways).
5. *Minimal environmental impacts and/or sustainability*: Consideration must be made for the preservation of sensitive areas as well as the mitigation of potential environmental impacts.

How big should the port be?

The final consideration before looking at potential sites is the required size of the port area. Once this is understood, practical concepts for the transshipment port can be developed and the feasibility of the respective sites evaluated. The size of a transshipment port largely depends on the projected annual throughput. This refers to how many containers are expected to pass through the port each year. The current port of Kingston, for example, does approximately 1.8 million TEU's (the twenty-foot equivalent unit, TEU, is a unit of cargo capacity often used to describe the capacity of container ships and terminals and is based on the volume of a 20-foot-long container). It does so within an area of 2.5 square kilometers (km^2). Freeport, Bahamas does 1.1 million TEU's within a port area of 0.5 km^2. Rotterdam, one of the busiest ports in Europe does 11.8 million TEU's within an area of 8.3 km^2. The land area reportedly needed for the proposed Goat Island port at the start of this project was 3,000 acres (12 km^2). A significant portion of this area, it appears, is to be dedicated to other industrial activities in the logistics hub.

In terms of this analysis, it was important to separate the area needed for the port from the area needed for the logistics hub. In the absence of any stated projections or plans, an estimate was derived using the relationship between throughput and surface area for transshipment ports around the world. A throughput of 7 million TEU's was assumed, which would need an area of approximately 3 km^2. The table below shows our assumed breakdown of area of some other critical parameters. As a perspective reference, this throughput would be more than three times the current throughput of the Port of Kingston and twice what has been reported will be funded by Brazil for a new transshipment port in Cuba.

	Transshipment port	**Industrial area for logistics hub**
Dry surface area (transit storage area for containers)	3 km^2	6.5 km^2
Wet surface area (area for ships to berth)	1.5 km^2	1 km^2
Access channel depth	min. 18 m	min. 15 m
Quay length (dock along which ships are loaded and unloaded)	3 km	2 km

*Shaded area totals 12 km^2 or approx. 3,000 acres

Potential sites in Jamaica

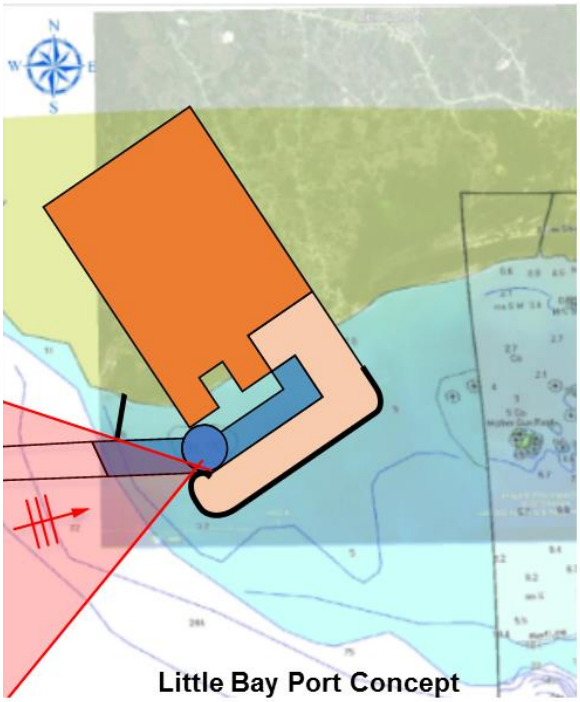
Once these parameters were established, sites around the island were evaluated. Some general considerations for the island of Jamaica in terms of port development include:

1. The north coast of the island has some areas and bays sheltered by offshore reefs but there is very limited coastal land available for development.
2. The south coast of the island, on the other hand, is mostly under-developed, but has fewer protective reefs offshore and is therefore more exposed to hurricanes. The areas worthy of further consideration were:
    i. St. Thomas: deep water is close to shore but the area is very exposed to hurricanes and there is limited flat land available; the close proximity of deep water means that while navigation channels may not require extensive dredging any breakwater structures will be very expensive.
    ii. Kingston Harbour: very protected and ideal for a port but there is limited land available for a major logistics hub. Possible areas where new land could be created (such as in Hunts Bay or west of Fort Augusta) do not have enough land area in any one location and may introduce other problems such as flooding and sedimentation from the Rio Cobre and Sandy Gully.
    iii. Portland Bight area (Old Harbour Bay area): protected from day-to-day waves but still exposed to hurricane waves. The area is also environmentally sensitive.
    iv. South Clarendon shoreline: relatively sheltered from daily waves but exposed to hurricanes; area is also far from deep water at some points.
    v. Black River: sheltered but has limited land space and the nearby morass is environmentally sensitive; sedimentation from the river would be an operational problem as well.
    vi. Savanna-la-Mar: sheltered from both day-to-day and hurricane waves, but the area is far from the island's main population centres of Kingston and St Catherine.

After these six areas were reviewed, four sites were short-listed for detailed analysis: i) Little Bay (just west of the town of Savanna-la-Mar; ii) Maccary Bay, Clarendon; iii) Jackson Bay, Clarendon; and iv) Goat Islands, St. Catherine. The students and SWI visited these four shortlisted sites, which are described below.

Little Bay

This area is some 10 km west of the town of Savanna la Mar. The area is relatively flat and unpopulated. More than 10 km^2 of mostly uninhabited land exists and, as such, no major reclamation would be required. The coastal area here sits on a shallow shelf that creates a sheltered wave environment. The shelf is quite narrow and a port would therefore be close to deep water. A concept plan of the port and logistics hub area is shown below, and a discussion of the advantages and disadvantages of this site follows.



Advantages:

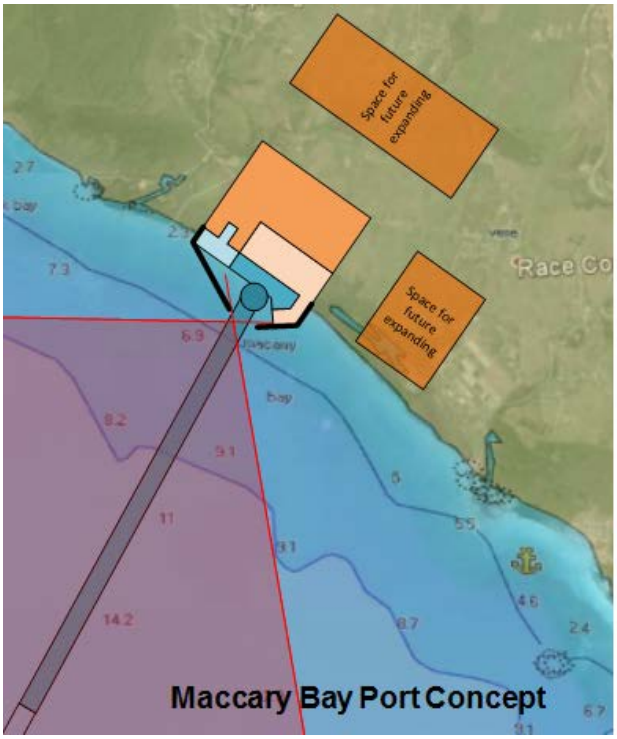
- Near deep water (1.3km) so only a small amount of dredging would be needed to create a short approach channel.
- The amount of dredged material would be just enough to reclaim an area that could double as both a container terminal and a breakwater. There would therefore be a limited surplus of dredged material.
- The port would be relatively well-sheltered from hurricane waves (with a breakwater in place).
- There is expansion potential towards the east in unoccupied lands, though some of these areas are wetlands.
- Expected low cost of development given the short approach channel and limited need for reclamation and breakwaters.

Disadvantages:

- The area is far from Jamaica's major population centres and although this would represent development for neighbouring rural communities, this is not ideal for the success of a logistics hub.
- The area is close to a community so there would be some social impacts (both positive and negative).
- The area is far from other industrial and commercial activity and is not connected to main transportation links (highways and railways).

Maccary Bay

This area is just 4 km south of the Vernamfield aerodrome and sits between Race Course and Milk River. The area is a large expanse of mostly unoccupied land that is now used mainly for sugar cane production. The area is relatively flat and is high above sea level and is therefore development-ready.



Advantages:

- There is more than 12 sq. km of unoccupied development-ready land. The land is flat and high above sea level so no reclamation is needed.
- There is expansion potential on lands to the northeast and southeast.
- The area is very close to the Vernamfield airstrip, which could be further developed as the airlift component of the logistics hub.
- There are relatively close mainland connections to the highway and railway.

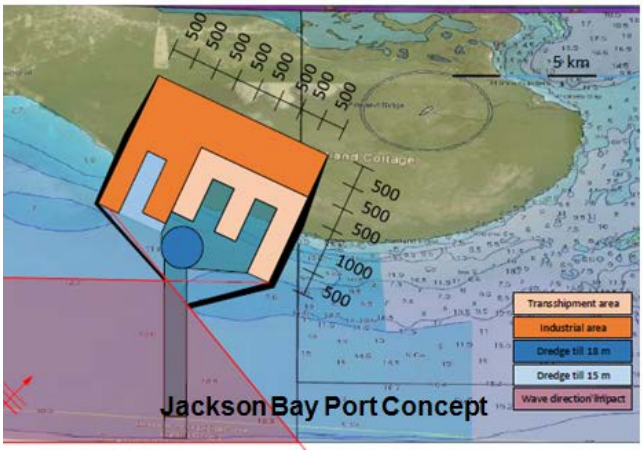
Disadvantages:

- A 12 km long approach channel is needed to reach deep water, so a significant amount of dredging will be needed. This will have environmental implications for the marine environment.
- Almost all the dredged material would be wasted since there is no need for reclamation at the site. This could be an opportunity to create land elsewhere, otherwise it would just be a major development cost.

- Breakwater structures are needed in depths of up to 5m to protect against hurricane waves, and this could get quite expensive.

Jackson Bay

This is a sheltered area south of the Portland Cottage area which itself is a low-lying flat area. Jackson Bay is a low-lying area that is regularly flooded even in mild storms. It is mostly uninhabited due to its flood potential and it has a wetland area.



Advantages:

- The area is well sheltered from day-to-day waves and requires a relatively short approach channel (4km) to reach deep water.
- The dredged material from creating the channel could be used to raise the low-lying flood zone on land.
- Highway and railway connections are in relatively nearby.

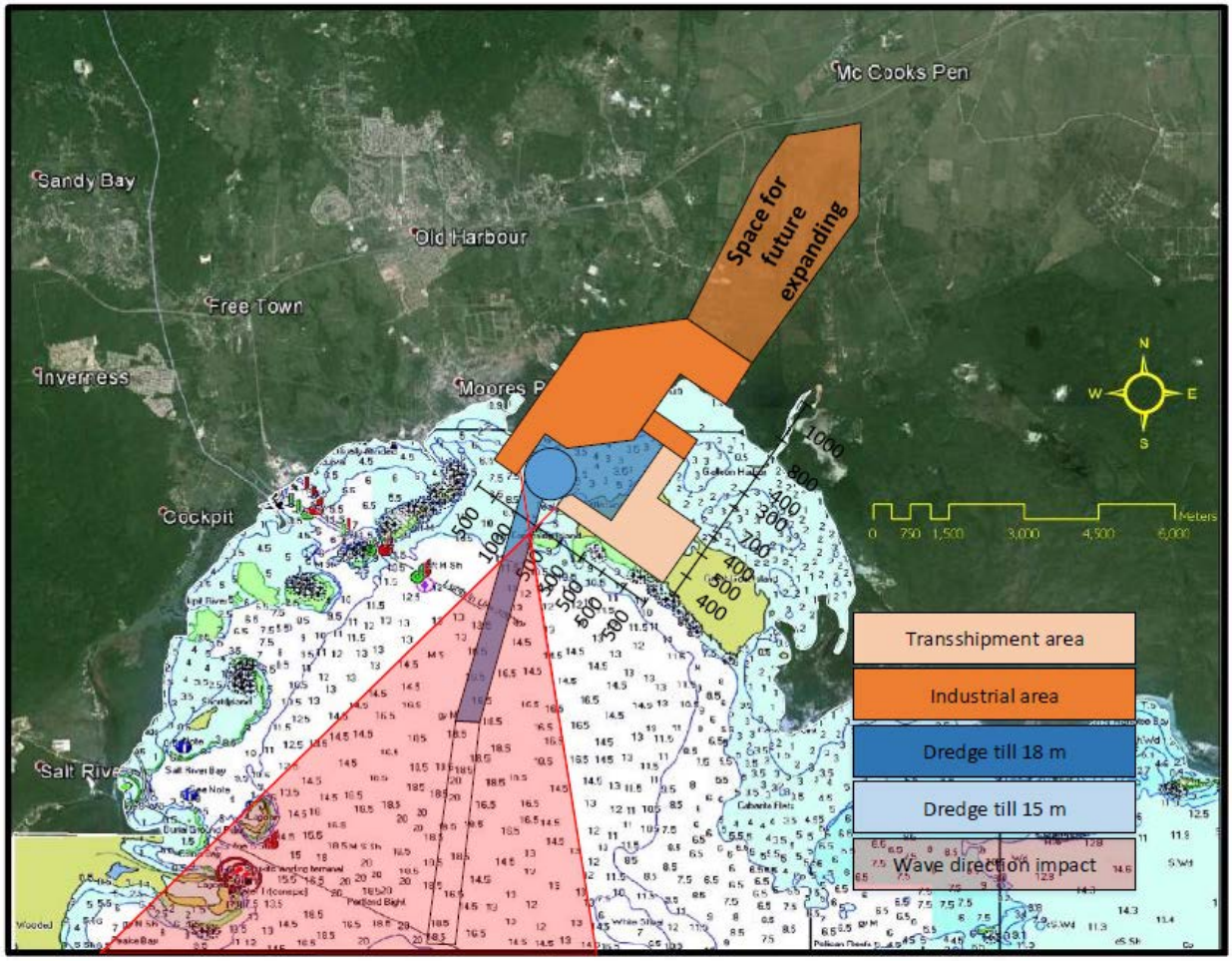
Disadvantages:

- A large area of reclamation is needed to create the amount of land required. This has to be done offshore and large breakwaters would also be required. This is a major cost to the development.
- Wetlands and mangroves are present and these environmentally sensitive habitats would be disturbed.
- There is not much land nearby for expansion.

Goat Islands

The environmental issues associated with this area have been widely discussed in the media and at various other fora. From a functional perspective, the area is well-sheltered and is a prime area for a port development. Historically, the Portland Bight area has been damaged by hurricanes such as Hurricane Ivan, so it's well-known that the area is not immune to storms. However, with a layout

that takes advantage of the physical site conditions, no breakwaters would be needed for a port development in this area. The islands are also relatively close to the 18m water depth and, as such, the dredged channel would not have to be very long. The area could be developed in many different ways, so that the options considered should not be constrained only to the development on the Goat Islands themselves with, for example, a causeway connecting to the mainland. In fact, many different configurations are possible, some of which could be encouraged for different reasons. For example, if the development is partially on the mainland there is a greater scope for expansion and connectivity with railways, highways and neighbouring communities. This could be more operationally efficient for a logistics hub than a more isolated development. With this in mind, five options were developed for this general location, all of which have their own set of pros and cons, but only the preferred layout is described.



Advantages:

- This proposed layout is mostly outside of the footprint of the fish sanctuary and avoids most of the wetlands.

- No breakwaters are required to provide sheltered berthing and the dredged channel would be approximately 6km long.

- The required dredging provides enough material to reclaim land and to raise the low-lying land on the mainland.

- The Great Goat Island is not disturbed and could be left alone or used in a future phase.

- The area has great expansion potential on the mainland and is the most easily connected to the highways and railways.

Disadvantages:

- The area is within the Portland Bight Protected Area and is home to a fish sanctuary, mangroves and wetlands. Regardless of how the development is done, and whether or not appropriate mitigation strategies are employed, there will be irreversible damage to the natural environment. The initial negative impacts will primarily be from construction activity in the dredging and reclamation works. The operational impacts will range from the change in the hydrodynamics (water circulation) of the area to the risk of oil spills and hazardous materials associated with any port or industrial activity. Although careful planning and management can minimize these impacts, it would be naïve to believe that the negative impacts will be avoided.

- Surrounding areas are already prone to flooding given the low-lying nature of the area. If drainage and storm surge mitigation plans for the port do not give due consideration to the surrounding communities, they could be made more vulnerable. This project could, however, be used as an opportunity to reduce the vulnerabilities of these communities.

Comparing all Sites

As discussed, all sites have their advantages and disadvantages. The question for our decision-makers is this: How do these sites stack up against each other? To answer that question, a multi-criteria analysis was done to give an accurate comparison. Five criteria, discussed earlier (proximity to population, expansion potential, connectivity, environmental sustainability and development costs). These criteria are all relevant to the success of a logistics hub from the point of view of both the developer and the client (the Government of Jamaica and the Jamaican people). While these criteria are not presumed to be all-encompassing, it should be noted that certain considerations such as the potential socio-economic benefits were considered in the "proximity to population" criterion. For each site, real development costs were estimated based on the amount of dredging needed to create the access channel, the extent of reclamation required and the cost of construction of the breakwaters. These would represent the main hard costs of developing the land for the transshipment hub. Of course there will be many other costs to consider but the ones considered in this analysis include the main baseline costs for high-level comparison. The results are shown in the following table.

	Proximity to Population	Expansion Potential	Connectivity	Environmental Sustainability	Development Cost
Little Bay	1	3	1	4	5
Maccary Bay	3	5	4	3	3
Jackson Bay	3	3	3	3	1
Goat Islands	4	4	4	1	3

*Scores are out of 5 for each criterion, with "1" being poorest and "5" being best.

The scoring highlights some interesting findings:

- Little Bay has the lowest cost of development but it scores poorly on connectivity and proximity to the main urban centers. Little Bay is therefore a great area for a port but not so much for a logistics hub.
- Maccary Bay is a good candidate for a logistics hub as it is already close to what could be developed into a major airport while still relatively close to the main urban areas. The area also has great potential for future expansion. The long access channel is, however, a problem. This has both environmental and economic costs for construction and operation. If the dredged material could be used to create new lands without significant environmental impacts, this negative could become a strong positive for this site.
- Jackson Bay would require the highest capital for development. The large breakwaters needed to provide sheltering are the major cost contributor to the development. This site would be more suitable for a smaller port development where less dredging and a smaller land area are required.
- Goat Islands gets the highest scores in its proximity to the main urban areas and its connectivity to inland transportation. These are both essential to maximizing efficiencies of the logistics hub and extracting the highest socio-economic benefits. The site also offers the most versatility for the port and logistics hub layout. With the right configuration, it does not

need any large breakwaters for sheltering against hurricanes, and the direct impacts on the fish sanctuary and wetlands can be reduced. The benefits to be gained will depend on how the development is configured, particularly how connected it is to the mainland. There is one major disadvantage to this site: A development in this area is likely to do the most damage to the natural environment, both during construction and operation.

A very important point of note is that the scores have not been totaled. This is because the criteria used here do not carry equal levels of importance and relevance, and some weighting must therefore be applied to these scores in the final analysis. The weighting to be applied may vary quite a bit depending on who is carrying out the assessment. What *is* important is that in making the decision to establish the relative weighting, the interest of *all* key stakeholders be incorporated. The Jamaican people are key stakeholders to this process, whether the debate is about the economy or the environment (which is a pointless argument since environmental preservation has proven to have significant long-term economic value). However, the interests of the Government of Jamaica, in its wish to accelerate economic progress, and of the developers, must also be brought into the balance, as a costly or inefficient logistics hub will not be viable for either.

We recognize that this analysis is neither thorough nor complete. It is not intended to promote or demote any particular site but rather to illustrate that a proper approach to developing the project is critical. There is much more work to be done to properly evaluate this kind of development. We do, however, hope that it provides a basis for more informed discussion on the subject. If Jamaica is to reap the long-term benefits of such a major development, the importance of conducting this kind of assessment cannot be overlooked.

Credit to: *Pim van den Akker, Marloes Brands, Wieger Buijs and Louise Hamilton of TU Delft, The Netherlands*

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