Investment Plan for the Development of Climate Resilient Fisheries Infrastructure in Grand Bahama Island

FINAL

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This report was prepared under the FAO - Government of the Commonwealth of the Bahamas Technical Cooperation Programme (TCP) project "Rebuilding fisheries livelihoods in Abaco and Grand Bahama islands following Hurricane Dorian" (TCP/BHA/3703). This project was implemented between December 2019 and December 2021, in a period with enhanced health security measures and restricted travel due to the Covid-19 pandemic.

The conclusions and recommendations given in this report are those considered appropriate at the time of its preparation, based on the consultants' findings. These may change in the light of further knowledge gained at subsequent stages of the evolution of the country's post hurricane and post pandemic recovery.

Contents

Acknowledgements

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Executive summary

The fisheries sector plays an important role in the Bahamian economy in terms of foreign currency earnings, food supply and employment. The commercial fisheries sector supplies 29 kg/capita/year of fish and fishery products to the population, generates some USD 80 million annually in export earnings and provides full-time employment to 9 300 commercial fishers and a few hundred persons working in vessel maintenance, fish processing, retail and trade. The fishing fleet is characterized as small-scale and counts approximately 4 000 fishing vessels ranging in length from 3 meters to 30 meters, but generally less than 7 meters in length.

Hurricane Dorian impacted The Bahamas on Sunday, 1 September 2019, for approximately 68 hours. Hurricane Dorian, a category 5 hurricane was the strongest hurricane in modern records to ever hit the archipelago. It devastated the islands of Abaco, Grand Bahama and the surrounding Cays. Winds reached 298 km/h (185 mph) with gusts up to 354 km/h (220 mph). The estimated rainfall was 305-381 mm/day (12-15 inches) and the storm surge was as high as 5.5-7 meters (18-23 feet) above sea level.

An FAO post-disaster needs assessment mission estimated that nearly 80% of the fishery sector in Grand Bahama and Abaco was either destroyed or significantly damaged as a result of Hurricane Dorian. Most of the fish buying stations were damaged beyond repair. Fish buying stations are essential in the seafood value chain. They provide cold storage and freezing of catch in order to maintain product quality.

On request of the Government, an investment plan for the development of climate resilient fisheries infrastructure in Grand Bahama Island has been prepared. This plan should ensure that resilience to climate change is built into all new fisheries infrastructure development by both the public and the private fisheries sectors active in Grand Bahama. Building back better must be the cornerstone of all development efforts especially for critical infrastructure, such as the buying stations.

A comparison of current and future risks identified areas where resilience can be improved or where existing assets need to be adapted or re-located. In order to achieve long-term resilience in the face of future storms it is recommended to change both the shape of the buying station buildings as well as the materials used for their construction.

This investment plan outlines the proposed changes to the design and the materials to be employed in the new buying stations being proposed, together with a breakdown of anticipated costs for the entire fisheries sector, including the slipways and piers. A draft version of this plan was discussed at a stakeholder meeting, which was held virtually on 25 November 2021 and was attended by 21 stakeholders.

This investment plan proposes two sites for the construction of new buying stations, both on Grand Bahama, one at West End and one at East End of the island. The site at East End is also known to interest fishermen from North Abaco.

Abbreviations

DMR	Department of Marine Resources
FAO	Food and Agriculture Organization of the United Nations
kg	Kilogram (weight) equivalent to 2.204 pounds
m^3	Cubic metre (volume) equivalent to 1.31 cubic yards
MAMR	Ministry of Agriculture, Marine Resources
PDNA	Post-Disaster Needs Assessment
psf	Pounds per square foot (pressure) equivalent to 0.0479 kPa
SWOT	Strengths, Weaknesses, Opportunities and Threats
TCP	Technical Cooperation Programme
USD	US Dollar

1. Introduction

The fisheries sector plays an important role in the Bahamian economy in terms of foreign currency earnings, food supply and employment. The commercial fisheries sector supplies 29 kg/capita/year of fish and fishery products to the population, generates some USD 80 million annually in export earnings and provides full-time employment to 9 300 commercial fishers and a few hundred more in vessel maintenance, fish processing, retail and trade. The fishing fleet is characterized as small-scale and counts approximately 4 000 fishing vessels ranging in length from 3 meters to 30 meters, but generally less than 7 meters in length (Moultrie et al., 2016).

The total commercial fisheries production of The Bahamas was estimated at nearly 12 000 tonnes in 2015. The total production fluctuated in recent years. Fluctuations are largely caused by the variations in landings of spiny lobster, which were nearly 10 000 tonnes in 2010 and 2012 and around 6 500 tonnes in 2015. Spiny lobster stocks in The Bahamas are being fully exploited, while queen conch, snappers and groupers are, like in the rest of the Caribbean, under heavy fishing pressure. Some stocks are probably overexploited. The major threats to the marine fisheries resources are coastal zone development, damage caused by boats and divers to the reefs, over-harvesting of commercial species and disturbance to sensitive fish habitats.

The recreational and sport fisheries subsector of the fisheries sector is also very important to the country contributes an estimated USD 500+ million annually to the national economy through related expenditures by tourists, and provides employment for some 18 000 Bahamians. The recreational and sport fisheries target game fish, such as marlins and sailfishes, as well as bone fish (FAO, 2016).

In 2017, exports of fish and fishery products amounted to USD 87.7 million. In the same year, imports were valued at USD 18.4 million and the country is therefore a net-exporter of fish. As such, the fisheries sector is a major contributor to reducing the trade deficit of The Bahamas.

Hurricane Dorian impacted The Bahamas from Sunday, September 1 to Tuesday, September 3, 2019, for approximately 68 hours. Hurricane Dorian, a category 5 hurricane was the strongest hurricane in modern records to ever hit the archipelago. It devastated the islands of Abaco, Grand Bahama and the surrounding Cays, with the southern eyewall remaining “stationary” for approximately 36 hours over Grand Bahama. At the peak of the storm, sustained winds reached 298 km/h (185 mph) with gusts up to 354 km/h (220 mph). The estimated rainfall was 305-381 mm/day (12-15 inches) and the storm surge was estimated as high as 5.5-7 meters (18-23 feet) above sea level.

The northernmost islands of The Bahamas (Grand Bahama and Abaco island and associated cays) are regularly exposed to hurricanes, which hit the islands approximately every three years. The islands are of low elevation, which makes the coastal communities vulnerable to flooding due to the storm surges associated with storms and hurricanes. The consequences of these hurricanes for the livelihood of the population and economy are significant. Their access to land is generally limited and their assets, in the form of boats and gear, are more exposed to natural hazards and hence more easily lost than land-based property. As a large part of the local population in Abaco and Grand Bahama depends on the fisheries sector for its livelihood, natural disasters such as hurricanes and tropical storms cause large-scale and prolonged uncertainty, instability and insecurity.

Seafood (including fish, lobster and conch) that is landed along the coasts of Grand Bahama and Abaco needs to be delivered and consumed while still fresh, unless it can be stored in cold storage or freezing facilities like those available at buying stations. These buying stations are strategically located along the coast of the two islands. Seafood landed along the coast is subsequently sold to middlemen operating buying stations with cold storage capacity (e.g. walk in freezers or smaller chest freezers). The middlemen are either owners of the buying stations or operate them for larger processors. The buying stations store the seafood until it is transported to the processing plants or to market. The infrastructure at fish landing sites mainly consists of:

1. concrete boat ramps, solid concrete quays or timber piled jetties;
2. buying station building with a freezer, scale, generator, ice machine;
3. packing containers; and
4. a fuel station.

Figure 1 – Buying station buildings (pictures taken after Hurricane Dorian)

The brunt of the storm damage was sustained by the buildings (de-roofed and flooded) and fuel stations on land due to their light construction in timber. The buying station buildings were inadequate to withstand the wind speeds experienced in the archipelago (see figure 1). Most marine infrastructure, like slipways, quays and jetties, suffered much less damage and did not impede post-hurricane landings. The damage to and loss of cold storage space severely curtailed the volume of landings in 2019 - 2021.

With climate change, the impacts of tropical storms and hurricanes in the Caribbean region are expected to increase in both intensity and frequency as the modelled tracks for a warmed climate indicate (Figure 2). The Bahamas will likely be faced with natural disasters of similar magnitude in the future. Thus ex-ante preparedness for recovery is a must. Timely and resilient recovery is needed to ensure business continuity of the private sector, which will also be to the benefit of the public sector.

The long-term recovery plan for the Bahamas needs to ensure that resilience to climate change is built into all new fisheries infrastructure development in both the public or private fisheries sectors. Building back better must be the cornerstone of all development efforts especially in critical infrastructure such as the buying stations.

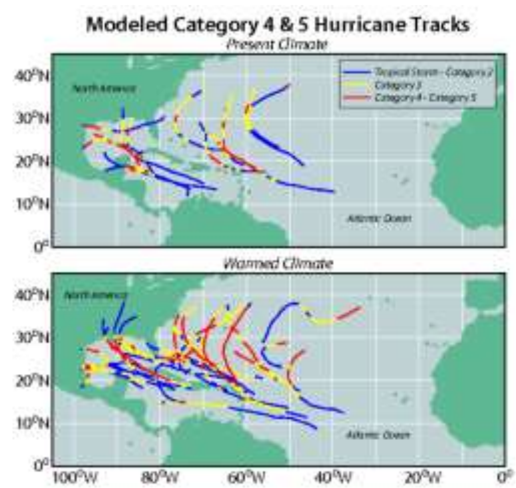


Figure 2 – Modelled hurricane tracks
www.gfdl.noaa.gov/21st-century-projections-of-intense-hurricanes

2. Fisheries on Grand Bahama and Abaco

In The Bahamas, commercial fishing takes place on the continental shelf, mainly on the Great Bahama Bank and the Little Bahama Bank. Grand Bahama and Abaco are located on the Little Bahama Bank. Grand Bahama and Abaco produce nearly 33% of the total catches of the spiny lobster and queen conch in The Bahamas and nearly 60% of the total annual catch of stone crab. Both islands and the nearby small islands and cays, coastal and shallow areas, contain important ecosystems such as mangroves, coral reefs and seagrass beds that are especially important for the lifecycle of the spiny lobster, queen conch and the stone crab. Fisheries is a seasonal activity due to changes in the availability of stocks, weather patterns and closed fishing seasons for spawning or reproduction of the stocks (Monnereau et al., 2020).



Figure 3 The most important fishery resources in Grand Bahama and Abaco from left to right: *Spiny lobster (Panulirus argus), queen conch (Strombus gigas) and stone crab (Menippe Mercenariea).*

In terms of their importance to the fisheries sector in The Bahamas, the Abaco and Grand Bahama islands come in third and fourth place after New Providence and Spanish Wells in their contribution to the overall catches. Spiny lobster is the most important species in terms of weight and in value with over 90 percent of the caught lobster being exported. Other important fishery resources include stone crab, snappers, Nassau grouper and various mackerel species. Conch and finfishes are mostly consumed locally in restaurants, hotels and homes. However, there are significant exports of these products as well.

Spiny lobster stocks in The Bahamas are being fully exploited, while conch, snappers and groupers are, like in the rest of the Caribbean, under heavy fishing pressure and some stocks are probably overexploited. The major threats to the marine fisheries resources are coastal zone development, boat and diver damage to the reefs, over-harvesting of commercial species, Illegal, Unreported and Unregulated (IUU) fishing and disturbance of sensitive fish habitats (Monnereau et al., 2020).

The fishery sector is important on the two affected islands as they produce approximately 40% Bahamian fishery production destined for exports. The sector is also crucial for food security of the local population. Moreover, many fishers on the island are also involved in recreational fisheries and connected to the tourist sector through direct sales.

Over the last years, the annual seafood production value was similar in Abaco and Grand Bahama. Abaco produced slightly more lobster tails than Grand Bahama, but Grand Bahama produced more of other target species. The bar plot in Figure 3 shows the average annual off-vessel value of seafood over the years 2014-2018. The average annual landed value of lobster tails was USD 8.6 million in Abaco and USD 7.4 million in Grand Bahama. For conch, the value was significantly lower with an amount of approximately USD 580 000 for Abaco and USD 770 000 for Grand Bahama annually.

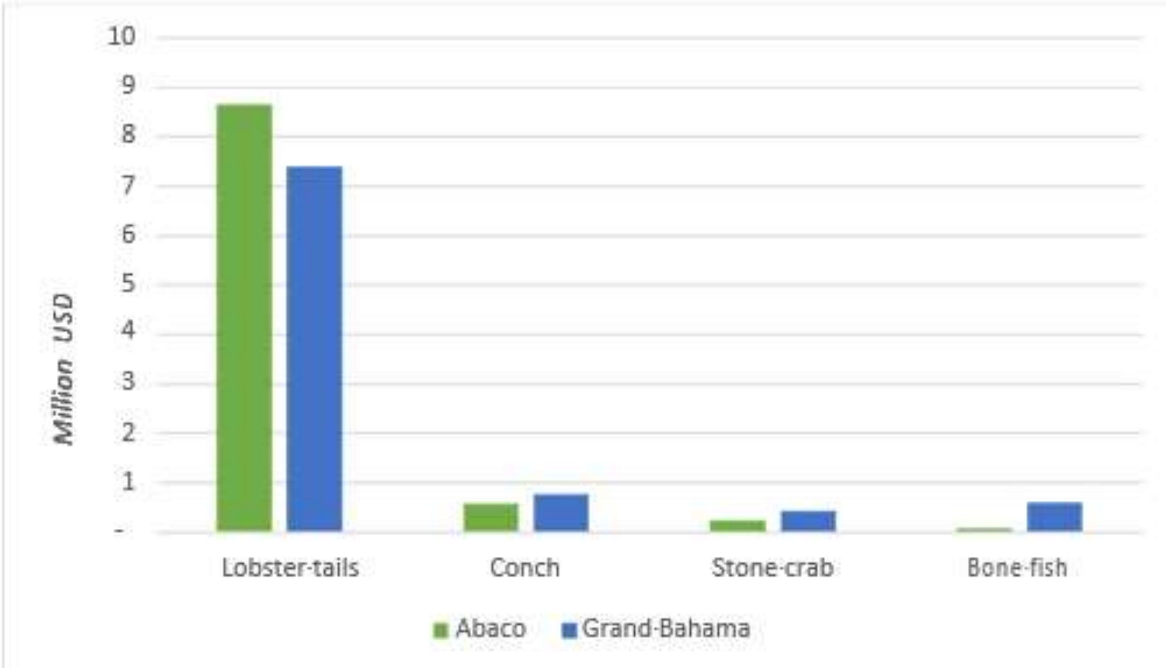


Figure 4 Average annual seafood production (recorded) value (in million USD) in Abaco and Grand Bahama 2014-2018. Source: Monnereau et al. (2020)

The recreational and sport fisheries sector is also very important to the country and contributes an estimated USD 500+ million annually to the national economy through related expenditures by tourists, and provides employment for some 18 000 Bahamians. The recreational and sport fisheries target game fish, such as marlins and sailfishes, as well as bone fish (FAO, 2016).

The landing statistics recorded officially are derived from the seafood processors. A similar amount of product which goes unrecorded is sold directly at the local markets to local consumers as well as directly to the tourism industry.

The Bahamas fishery is an open access fishery, as it is in most Caribbean countries. For most commercial fisheries activities no license or permit is required if authorized fishing gear is used. There is a license requirement for fishing with diving gear (using hookah). The Government is currently working on improving the fishers and vessels registration system. As a result, there is no official (up-to-date) dataset of the number of fishers and fishing vessels.

2.1 Fisheries strategic plan

: The Strategic Plan for fisheries and aquaculture development and management of The Bahamas (2017-2022) provides the strategic guide and operational direction to pursue the Vision set in the National Policy for Fisheries and Aquaculture of The Bahamas (2016). The Strategic Plan provides a holistic and integrated approach to development that seeks to maximize the contribution of the sector to the three pillars of sustainability- social, economic and environmental- to ensure food security and nutrition for the people. It describes and proposes ways to meet the challenges and constraints faced by the sector. In developing the Strategic Plan, a SWOT analysis was carried out of the post-harvest activities in The Bahamas using a consultative process, reflecting the views and experiences of the stakeholders of the fisheries sector.

To some extent, the 2016 National Policy for Fisheries and Aquaculture and the Strategic Plan have been created to respond to the issues identified by the SWOT analysis. The major weaknesses identified in the post-harvest sector were:

- High labor costs;
- Weak quality and safety inspections or controls in some Family Islands and fish landing sites;
- Poor (refrigerated) transport links for fish between certain islands;
- Flake ice supply for fishing vessels and transporters or middlemen is not available in most islands;
- Freshwater or tap water availability for fish processing is limited or lacking in various landing sites and markets;
- No proper traceability and labelling at retail level of fisheries and aquaculture products (origin, species names, expiry dates, etc. are not provided);
- Lack of education or knowledge of fishers on hygiene, fish quality, safety and value of byproducts and by catch (poor handling practices affect price and market opportunities);
- Market infrastructure for fresh fish is limited in some islands (no flake ice, no certified scales, only chest freezers, electricity failures).

The weaknesses and threats identified in the SWOT analysis are re-cast below into a list of constraints to give a better perspective of the challenges that confront the post-hurricane reconstruction of the fisheries sector:

- Disaster risk management (DRM) is not applied by the sector;
- Climate change variations are not being considered, hence adaptation efforts in the sector are minimal or non-existent;
- Infrastructure on various islands is inadequate or poorly maintained; Particularly the landing sites, cold storage facilities, ice plants, access roads, etc. Market infrastructure is also lacking;
- Logistics and costs of transporting fish to market in Nassau is high;
- The impact of recreational or sport fishing on fishery resources is unknown or undocumented;
- Illegal, unreported and unregulated (IUU) fishing has not been fully assessed to determine its full impact on the environment;
- The fisheries legal framework in place requires enforcement capacity.

2.2 Fisheries Act**:** Appropriate measures to tackle the weaknesses outlined above have been included in the Fisheries Act (2020). The major objectives of the Fisheries Act (2020) include (amongst others):

- promotion of sustainable exploitation, sustainable use and long-term conservation, management and sustainable development of fisheries resources and the ecosystems that support them;
- recognition of the need to utilise resources in order to achieve and promote food security, economic growth, social development, and employment, for the benefit of present and future generations.

Moreover, the Fisheries Act (2020) also seeks to promote sustainable trade in fish and fish products, including application of generally recognised international standards and rules on marketing, trade and sanitary and phytosanitary systems.

The Fisheries Act (2020) also contains requirements for fish and fish products processing and storage facilities. It specifies that the operator of any licensed fish and fish product processing plant, storage facility or holding station shall:

- comply with all relevant health, sanitation and environmental laws and standards of legislation of The Bahamas;
- not accept or buy fish from an establishment or person that does not hold a valid and applicable licence required pursuant to this Act or other legislation of The Bahamas;
- not accept, buy or sell fish where it is reasonable to believe that it has been caught as a result of illegal, unreported or unregulated fishing activities.

The current state of affairs at the buying stations does not meet the sanitary standards required under the Fisheries Act (2020). The buying stations therefore need to be replaced with modern structures with uninterrupted electricity and water supplies.

2.3 Public-Private Partnerships (PPP) policy:
Weak quality and safety inspections or controls prevalent in the Bahamas and identified as one of the major weaknesses in the post-harvest value chain need to be tackled at Government level via the Public-Private Partnerships policy of 2018. This Policy aims to ensure the potential benefits of using PPPs, to deliver public assets and services in a way that achieves value for money, both for the Government and the service users. It also aims to guide the private sector on what they can expect in developing and implementing PPP projects with the Government of The Bahamas. PPPs can help increase the availability, quality, and resilience of the fisheries infrastructure while reducing the risks to the Government.

3. Fisheries infrastructure inventory

The Bahamas is an archipelago of 700 islands and 2,400 cays, of which only 30 are inhabited. The Bahama Islands are the result of coral reefs which become dry land when the sea level dropped hundreds of centuries ago. The islands are mostly flat with kilometres of white and pink sandy beaches. The highest point in the country is Mount Alvernia on Cat Island which is 63 metres above sea level. The islands are surface projections of two oceanic Bahama Banks - the Little Bahama Bank and the Great Bahama Bank. The land on the Bahamas has a foundation of fossil coral, but much of the rock is oolitic limestone; the stone is derived from the disintegration of coral reefs and seashells. The land is primarily either rocky or mangrove swamp. Low scrub covers much of the surface area. On some of the southern islands, low-growing tropical hardwood flourishes. Although some soil is very fertile, it is also very thin. Only a few freshwater lakes and just one river, located on Andros Island, are found in The Bahamas.

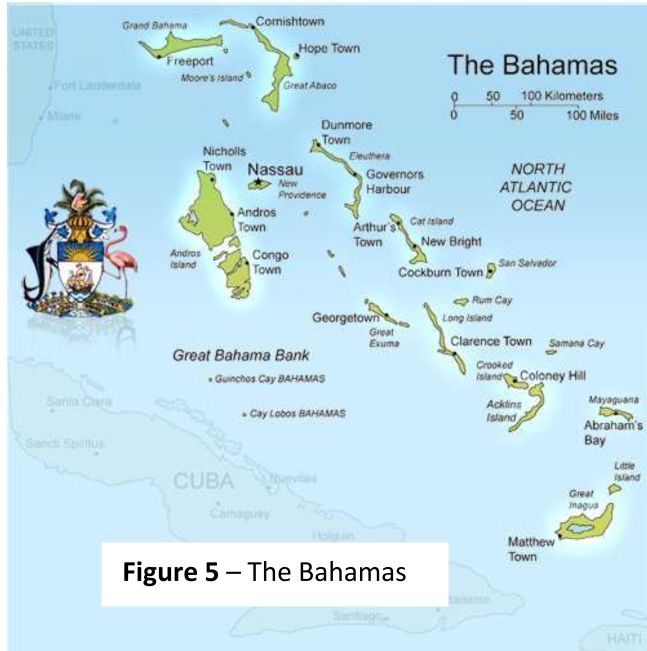


Figure 5 – The Bahamas

http://www.bahamas.gov.bs/wps/portal/public/About

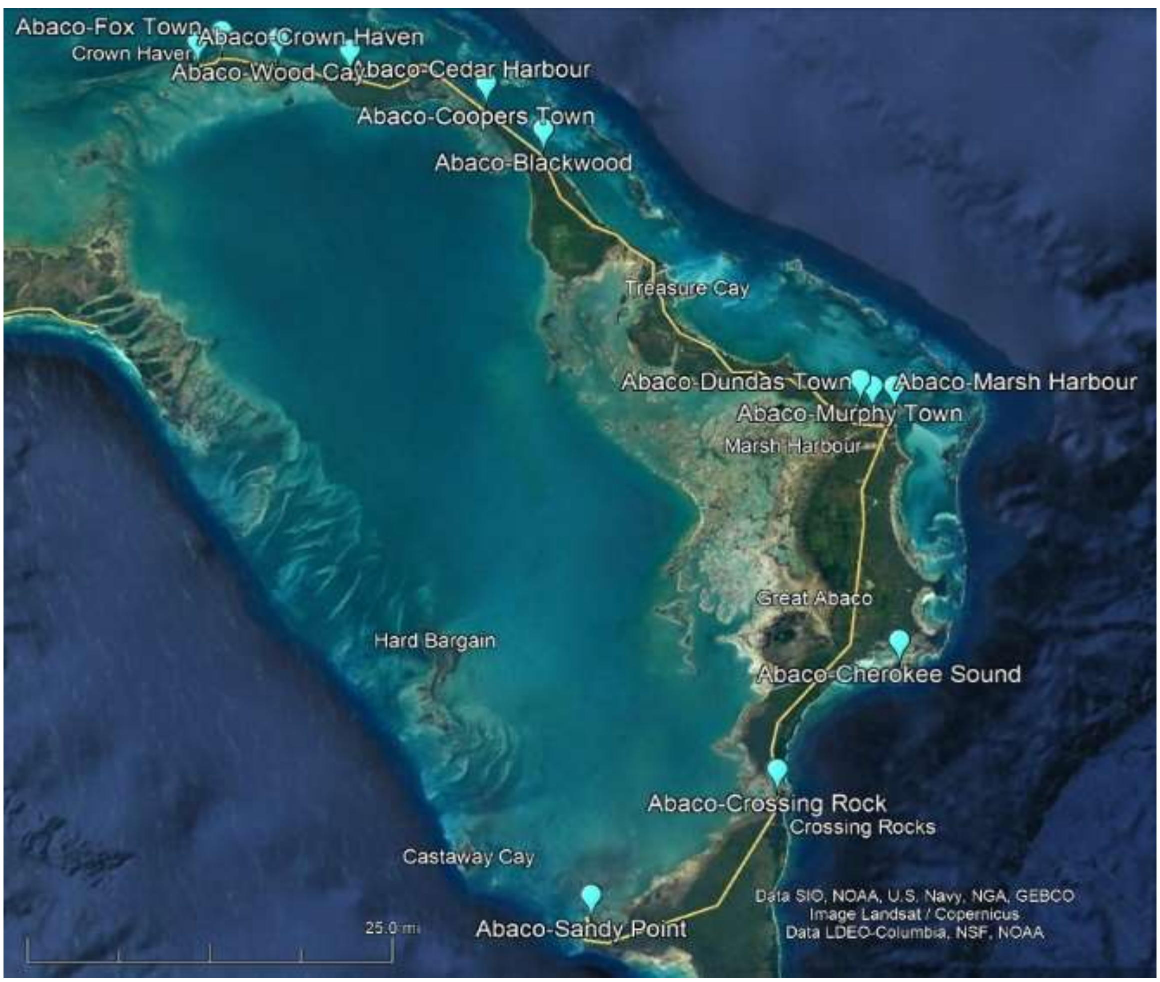
The fisheries infrastructure on the northernmost islands of Grand Bahama and Abaco Island consists mainly of very basic fish landing centres with simple mooring infrastructure, accompanied in some cases with fish buying stations and refuelling stations located on public land. Privately-owned processing and exporting facilities are mainly located on Grand Bahama at Freeport and on Abaco at Marsh Harbour.

Google Earth

Figure 6 The geographical distribution of fisheries infrastructure on Grand Bahama

GRAND BAHAMA				
	Community	**Name of site**	**Type of structure**	**Ownership**
West End	West End	Public Landing Area	Jetty/ sea wall (concrete pier)	Public
		Boardwalk Seafood	Jetty, Sea wall, Building, Processor	**Private**
Central	Freeport	Arma Import Export	Building, Processor	**Private**
		G & L Seafood	Building, Processor	**Private**
		Lightbourne Seafood	Building, Processor	**Private**
East End	Maclean's Town	Public Dock	Concrete pier, Buying station	Public
	Sweeting's Cay	Public Dock	Jetty, Sea wall (concrete quay)	Public
		Main Private Dock	Jetty, Slipway	**Private**
		N Roberts Buying Station	Building	**Private**

Table 1 List of fisheries infrastructure (public and private) on Grand Bahama.



Google Earth

Figure 7 The geographical distribution of fisheries infrastructure on Abaco.

ABACO				
	Community	**Name of site**	**Type of structure**	**Ownership**
Northern Communities	Crown Haven	Crown Haven	Wood jetty, concrete ramp	Public
	Fox Town	Fox Town	Wood jetty, concrete ramp	Public
	Mount Hope	Mount Hope	Wood jetty, concrete ramp	Public
	Wood Cay	Wood Cay	Concrete ramp	Public
	Cedar Harbour	Cedar Harbour	Wood jetty, conc ramp	Public
	Coopers Town	Coopers Town	Concrete ramp	Public
	Blackwood	Blackwood	Concrete ramp	Public
Central Communities	Marsh Harbour	Marsh Harbour	Concrete ramp	Public
	Murphy Town	Murphy Town	Wood jetty, conc ramp	Public
	Dundas Town	Dundas Town	Wood jetty, conc ramp	Public
Southern Communities	Cherokee Sound	Cherokee Sound	Wood jetty, conc ramp	Public
	Crossing Rocks	Crossing Rocks	Concrete jetty	Public
	Sandy Point	Sandy Point	Concrete ramp	Public

Table 2 List of fisheries infrastructure (public only) on Abaco.

Appendix 4 to this Investment Plan contains detailed information sheets of the Fishery Infrastructure Inventory of Grand Bahama and Abaco Islands[1], which were prepared with the use of the FAO-World Bank Fishery Infrastructure Assessment Tool (FIAT).

[1] Appendix 4 is available at: https://www.fao.org/fileadmin/user_upload/faoweb/FI/safetyatsea/Fishery_Infrastructure_Inventory_Grand_Bahama_Abaco_Islands.pdf

3.1 Types of fisheries infrastructure in the Bahamas

The public fisheries infrastructure on The Bahamas typically consists of:

1. Concrete piers;
2. Timber piers on piles;
3. Marginal quays at the shore line;
4. concrete slipways;
5. Fish buying stations.

Concrete piers

Fish buying stations

Marginal quays

Timber jetties

Concrete jetties

Slipways

Figure 8 – Typical fisheries infrastructure

The private fisheries infrastructure on The Bahamas consists mainly of fish processing centres where seafood destined for export is processed and packed.

Figure 9 - Privately-owned seafood processing facilities

4. Fisheries infrastructure needs

The Strategic Plan indicates that the post-harvest conditions in general suffer from weak quality and safety inspections at some fish landing sites, poor (refrigerated) transport links for fish between certain islands, lack of flake ice supply for fishing vessels and transporters or middlemen, lack of freshwater availability for fish processing and no proper traceability and labelling at retail level of fisheries and aquaculture products

From Section 3.1, the types of infrastructure present in the Bahamas are:

1. Concrete piers;
2. Timber or concrete piers on piles;
3. Marginal quays at the shore line;
4. concrete slipways;
5. Fish buying stations.

Of these, items 1 to 4 are more or less climate change resilient (see Table 3, Relative resilience of existing fisheries infrastructure). Item 5, the fish buying stations, have been rendered inoperative by hurricane Dorian and need replacing.

In the process of building back better, the new fish buying stations that will replace the traditional buying stations destroyed in the hurricane, will be considerably more expensive to build due to a wide range of factors, including climate change resilience over a design lifetime of 50 years and current national and international requirements for food handling infrastructure. This increase in cost makes it imperative to locate such structures in areas which will benefit most fishermen whilst at the same time are linked to the internal logistics network of the seafood processors that export the product from the existing export hubs of Freeport on Grand Bahama and Marsh Harbour on Abaco, Figure 10 opposite.

Figure 10 -Export hubs and internal trade flows

The processing and export hub at Freeport on Grand Bahama was rapidly reconstructed and is currently (2021) back in operation. It was quick to reply with feedback on the logistical set-up that brings seafood in to the processing facilities at Freeport, see Figures 10 and 11.

Figure 11 – Road network connects West End and McLean's town (circled) to Freeport

There are two productive areas on Grand Bahama from where seafood is sourced; West End and Sweetings Cay. Whereas West End is connected by road to Freeport (± 40 km), on the eastern side the road ends at Maclean's Town (78 km from Freeport).

Maclean's Town on August Cay is located only around 35 Km from Crown Haven on Abaco, and fishermen from Abaco are known to offload their catch at Maclean's Town. This means that a new buying station with good chilled storage and ice located at McLean's town has the potential to attract not only the fishermen from Sweetings Cay but also fishermen from Abaco. Maclean's Town should therefore be considered as a priority site for a buying station.

Figure 12 – Sailing distance to Crown Haven from Maclean's Town

Following recommendations from the processors at Freeport, two buying stations, one at West End and the other at Maclean's Town, would satisfy most of their needs and enable a programmed pick-up of the seafood in the knowledge that the product would not suffer in quality even if the seafood is picked up once a week. All the product would be fresh on ice and the introduction of an aerated holding tank would generate added value. Live lobsters and other life crustaceans generally obtain a higher market price.

The export hub on Abaco at Marsh Harbour, on the other hand, was totally devastated when Dorian passed over central Abaco from east to west. The hurricane had strengthened to Category 5 right before it struck the island and the storm surge had sent waves driving seawater on land ahead of the storm's eye passing over the island. A combination of extensive flooding and tremendous wind speed left the central processing plant at Marsh Harbour, *Exporters & Importers*, totally damaged and was not rebuilt. In the intervening months, a processor in Nassau, *Tropic Seafoods*, set up a holding and buying station on Abaco named *Starlight Seafoods*. No recommendations for new buying stations were made by stakeholders from Abaco at the time of preparing this plan.

5. Infrastructure climate change adaptation needs

Coastal communities around the world are experiencing temperature increases, rising sea levels and changes in seasonal atmospheric conditions. More frequent and severe storms (hurricanes, cyclones and the like) are associated with extremes in surges, wind speeds, precipitation and wave heights. Hence the impact of climate change on these parameters and processes will exacerbate existing risks and introduce new ones, including impacts associated with:

- changes in wind speed/strength, direction, or duration;
- changes in intensity and duration of precipitation;
- overwhelmed drainage systems or high groundwater levels resulting in flooding;
- overtopping and flooding due to high tide or storm surge;
- sea state changes (currents, extreme waves);
- drought leading to reduced ground water supply;
- changes in bathymetry or in sediment or debris transport, erosion or accretion;
- extremes of cold or heat or humidity (magnitude, duration or frequency);
- changes in water chemistry (acidity, salinity); and
- changes in the biological environment (vegetation growth, invasive species).

PIANC Climate Change Adaptation Planning for ports and inland waterways – Report 178 - 2020

An assessment of current and future risks will help to identify areas where resilience can be improved or where existing assets need to be adapted or re-located. Such a risk assessment should be based on an understanding of how the climate is expected to change as many of the climate-related changes that matter most are temperature-driven. However, there remains a great deal of uncertainty about how quickly temperature will change.

The level of uncertainty increases significantly beyond the statistical ten years from the present time and in order to develop a medium-to-long term strategy, a range of possible future climate scenarios needs to be considered.

5.1 Future climate scenarios

The existing fisheries infrastructure in The Bahamas may be impacted by the following climate change scenarios:

- Rise in sea level;
- Rise in extreme wind speeds and surge;
- Rise in extreme wave heights;
- Rise in precipitation;
- Fall in precipitation.

5.1.1 Rise in sea level: The rise in sea level is caused primarily by the water added from melting ice sheets and glaciers and the expansion of sea water as it warms. Figure 13 illustrates satellite data for the period 1993 to present, whereas Figure 14 illustrates ground data from 1870 to 2013. Most sites in the Bahamas are shallow beaches, and for every 100mm increase in sea level rise, the corresponding permanent loss of dry beach ranges from 3 to 6 times this value.

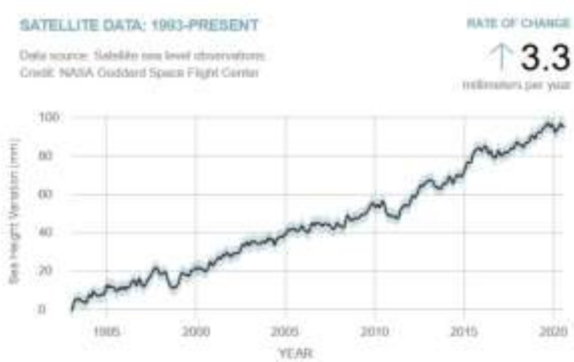
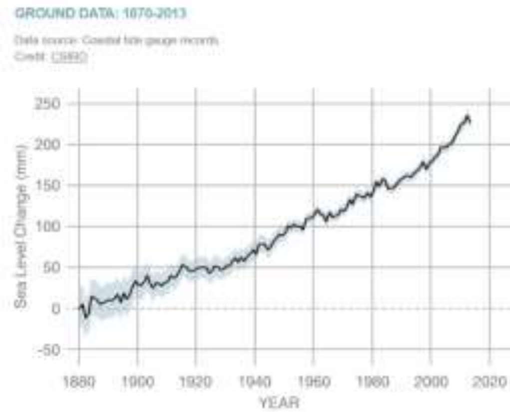


Figure 13 – Change in sea level since 1993
www.climate.nasa.gov/vital-signs/sea-level

This permanent loss of beach area is further exacerbated by simultaneous weather occurrences during storms.

5.1.2 Rise in extreme wind speeds: The predicted changes in wind speeds due to global warming are expected to be modest, but are large enough to cause damage to flimsy structures.

An analysis of wind speed records collected between 1978 and 2017 from more than 1,400 weather stations shows that wind speeds decreased by about 2.3% per decade, but since 2010 they have increased at a rate nearly three times faster (*www.weather.com/science/environment/news/2019-11-19-global-wind-speeds*).



www.climate.nasa.gov/vital-signs/sea-level

Figure 14 – Change in sea-level 1870-2013

In addition to the direct impact that wind speed has on structures, it also gives rise to storm surge. Storm surge should not be confused with storm tide, which is defined as the water level rise due to the combination of storm surge and the astronomical tide. This rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide. Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm. The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind. This combination of events often leads to loss of beach area through erosion phenomena, which, though distinct from the loss of beach area due to sea level rise alone, often accelerates the process. The storm surge during Hurricane Dorian was estimated as high as 5.5 to 7.0 meters above sea level and caused widespread flooding. The surge at Maclean's Town was 2.5 m.

5.1.3 Rise in extreme wave heights: The rise in sea level coupled to extreme weather conditions increases the instantaneous depth of water inshore. Deeper water translates into higher waves. Higher waves imply greater energy at the water line, which in turn means more sand movement (which may be longshore or offshore). Hence, besides the direct impact and/or overtopping of the waves against any structures along the shore line, this phenomenon also exposes sandy coastlines to erosion, thereby exacerbating the loss of beach area due to sea level rise alone.

5.1.4 Rise in precipitation: The rise in precipitation may be transient, such as a very heavy downpour in a storm, leading to flash flooding in areas where there is poor surface water drainage. A rise in precipitation, however, also has advantages: Rainwater harvesting becomes very economical.

5.1.5 Fall in precipitation: The fall in precipitation may manifest itself as a drought, and the longer the drought the more impact it has on the fresh water table. Sites that depend on borewells for fresh water may be impacted over the medium to long term and on small islands, it may also lead to a rise in salinity levels within the fresh water distribution system and increase the rate of corrosion of metallic components.

5.2 Infrastructure resilience: The resilience of the existing fisheries infrastructure differs from item to item. Concrete structures like quays and slipways built on rocky outcrops perform best and with simple capping in concrete are climate change resilient for the foreseeable future. Timber piers, although seemingly fragile, are also resilient as the deck planking may be dismantled prior to a major event, thus avoiding underside impact damage that leads to the collapse of the jetty. The worst performing structures are the traditional buying stations with a timber-trussed sheet roof and light brick walls. Under the impact of high wind speeds, the roof comes off first and this is followed by internal flooding of the station from the heavy precipitation that follows.

Table 3 – Relative resilience of existing fisheries infrastructure

ITEM	CLIMATE CHANGE SCENARIO OF MAJOR IMPORTANCE	MAJOR IMPACT	REMEDIATION	CLASSIFICATION OF EXISTING ITEM
1 Concrete piers built on rock	1. Sea level rise	1. Loss of freeboard above sea level	Deck level may be raised by adding new capping in concrete as the need arises	Climate Change Resilient
2a Timber piers on piles	1. Sea level rise 2. Rise in extreme wave heights	1. Loss of freeboard above sea level	1. The driven piles in timber cannot be extended and will need replacing 2. Deck planking removed before major events to reduce uplift loads on the jetty structure	Climate Change Resilient for the next 10 years
2b Concrete Piers on piles	1. Sea level rise 2. Rise in extreme Wave heights	2. Loss of deck planking or collapse of jetty		Not climate change resilient over next 50 years due to uncertainty of rate of increase in changes
3 Marginal quays at the shore line	1. Sea level rise	1. Loss of elevation above sea level	Cope level may be raised by adding a concrete capping	Climate Change Resilient
4 Concrete slipway	1. Sea level rise	1. Loss of elevation above sea level	Slipway crown level may be raised by extending concrete slab shoreward	Climate Change Resilient
5 Traditional fish buying stations	1. Rise in sea level; 2. Rise in extreme wind speeds; 3. Rise in extreme wave heights; 4. Rise in precipitation; 5. Fall in precipitation.	1. Flooding if too low above sea level; 2. Loss of traditional roof and flooding ; 3. Flooding if too close to shoreline; 4. Flooding if in low lying area; 5. Degraded borewell water if not on a town's mains.	Complete re-design of building	Not climate change resilient

5.3 Rise in sea level:
The design life of the proposed buying house structure in masonry is 50 years. A predicted 3.3mm sea level rise per year would be equivalent to 165mm over this period. Since about 1980 there have been consistent predictions of an imminent increase in the rate of mean sea level rise. The present consensus is that in future the rate of rise will probably increase to about 5mm/year, with some regional variations, although as yet there is no evidence that this acceleration has started. It is however recommended to use the latter figure and to assume that the sea level could rise to 250mm over the lifetime of the structure.

5.4 Rise in wind speeds:
The rise in wind speed associated with powerful hurricanes increases considerably the wind load on pitched roofs. The slope facing the wind direction is subjected to a positive pressure, whereas the lee side is subjected to a negative pressure or uplift. Under hurricane conditions, the uplift may be strong enough to lift or tear off the roofing material from its nails. The constant flexing of the roofing material due to the pressure differential also leads to fatigue failure of the roofing elements at the anchor points (the weakest part).

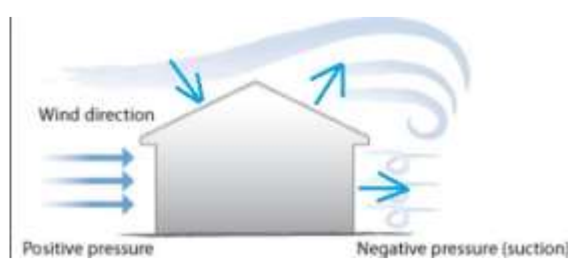


Figure 15 – Wind loads on a pitched roof building

In the Bahamas, hurricane Dorian destroyed some 13 000 homes and many other buildings with pitched roofs.

In order to achieve long-term resilience in the face of such storms it is necessary to change both the shape of the buildings as well as the materials used for construction. This is critical for infrastructure that cannot afford to be off-line for any length of time.

Figure 16 illustrates the typical wind loadings on different shaped buildings in a 90 miles per hour wind. The negative surface pressure on the flat roof is -15 psf (upward load). The areas of high negative pressure are limited to the corners of the building (negligible). Put into a layman's context, a square metre of normal concrete roof slab weighs in the region of 575 Kg (or half that if lightweight concrete is used) whereas the uplift is in the region of (15 x 0.0479 x 100) = 72 Kg, giving a net downward force of 500 kg against uplift.

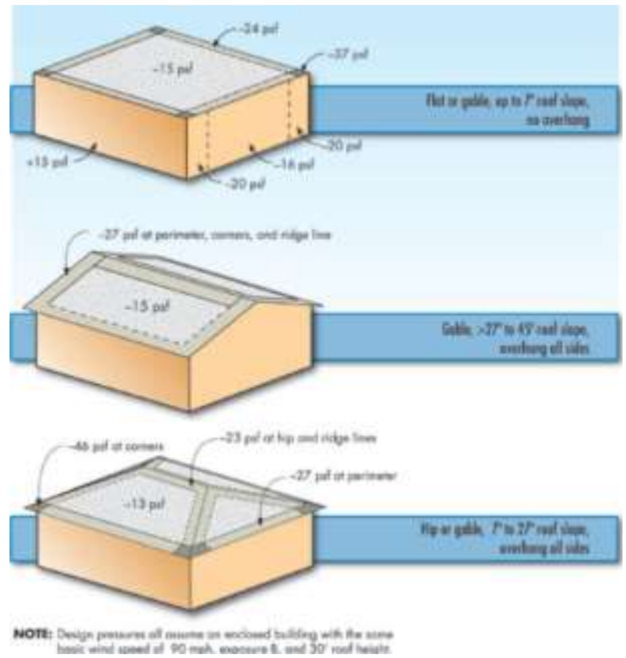


Figure 16 – The impact of the shape of the building on wind loading (generic example only)

In the pitched roof, the negative pressure goes up to 27 psf along the ridge line and the perimeter. This is equivalent to around 130 kg uplift per square metre, whereas 8 gauge sheeting weighs less than 10 kg per square metre and even clay tiles only weigh around 50 kg per square metre. The difference in the loading is taken by the nails holding the sheeting in place; hence the risk of the sheeting tearing off.

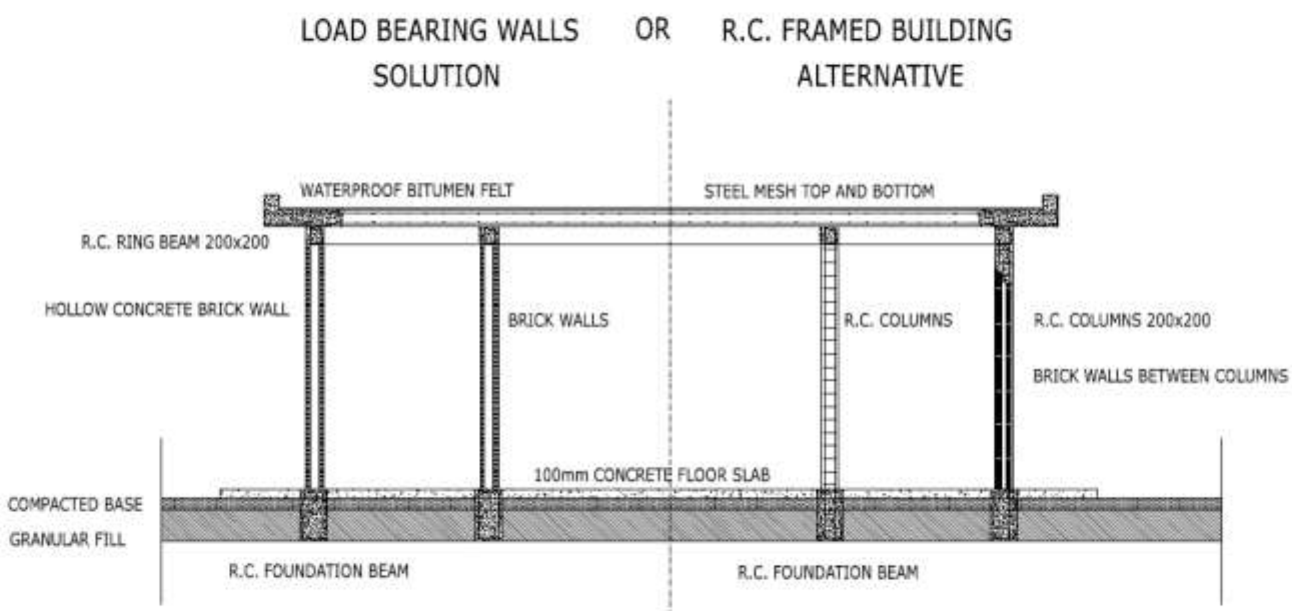


Figure 17 – Potential cross sections for a flat-roofed building

Figure 18 – Typical flat-roofed fish receiving building in masonry in Europe

Figure 17 above illustrates potential sectional details for an all-masonry building. Depending on the local building regulations (across the different Caribbean Island States) the building can either be in load bearing walls with a flat concrete slab roof (*left*) or reinforced concrete-framed with block walls between the columns (*right*). Both the foundation beam and the ring beam in the former need to be integral to provide rigidity.

5.4 Rise in extreme wave heights: The increase in wave height may not impact the structure directly unless it is located at the water's edge. However, storm surge may very well impact the structure even if it is located a few metres inland if the site is shallow and level with the beach. The structure should be located as far inland as is possible, on high ground or raised made-up ground if necessary and with good drainage characteristics to avoid ponding.

5.5 Rise in precipitation: The average precipitation in the Bahamas is illustrated in the figure below.

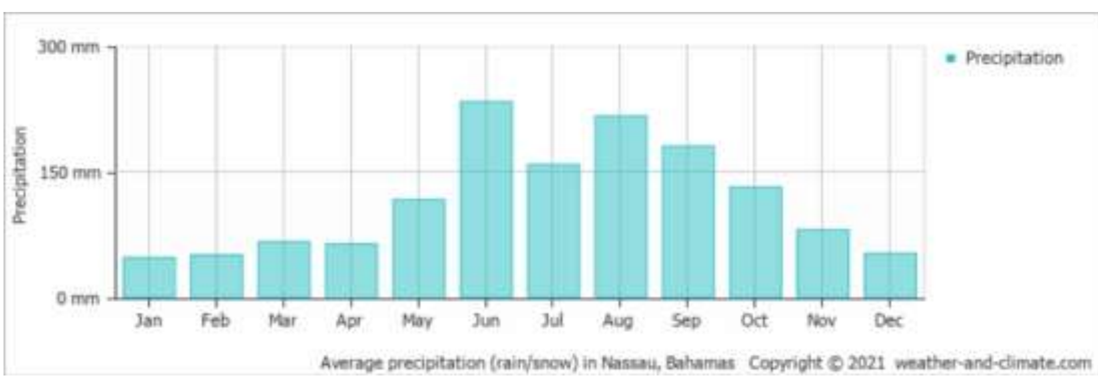


Figure 19 – Average rainfall in the Bahamas

An increase in normal precipitation is generally beneficial as investment in rain harvesting infrastructure becomes more viable. This increase only becomes problematic when it arrives as a strong downpour during a heavy storm. Hence the importance of locating the structure on high ground (natural or made-up) and away from potential watercourses or areas prone to ponding.

5.6 Fall in precipitation: A fall in precipitation only impacts the functioning of the buying station if the facility is not connected to the town's potable water main. However, even if it is connected to a water main, the rise in the cost of the water during periods of severe draught may be so high as to drastically curtail its use to the detriment of hygiene. In a normal fish buying building, water is required for the ice maker, the staff restroom and kitchenette (the septic tank needs fresh water to function), fish rinsing, fish box and utensils washing and the floor hose down at the end of every shift.

SERVICE	POTABLE WATER	BRACKISH	SEAWATER
Ice maker (normal ice, seawater ice or liquid ice)	✓	✓	✓
Restroom facilities and kitchenette	✓	✗	✗
Septic tank waste treatment	✓	✗	✗
Fish rinsing	✓	✓	✓
Fish box washing	✓	✓	✓
Floor hose-down	✓	✓	✓

Table 4 – Alternative water use management

As the above table illustrates, potable water (derived from a town's mains supply or chlorinated rainwater from the roof harvesting tank) is required only for the kitchenette and the restroom-septic tank assembly if seawater ice or slush is used for chilling fish. In this case the demand for fresh water reduces considerably.

2 Ton per day Ice maker	2,000 Lt/day
Hygiene facilities	50 Lt/day/pax
Kitchenette	5 Lt/day/pax

Assuming a staff of 5 persons (manager plus 4 packers) at peak season:

	Facility using fresh water ice	Facility using seawater ice and/or slush
Ice maker	2,000 Lt	0
Hygiene facilities	250 Lt	250 Lt
Kitchenette	25 Lt	25 Lt
Total Fresh water	**2,275 Lt per day**	**275 Lt per day**

Fish rinsing	1.0 Lt per kg of fish
Fish box washing	2.5 Lt per box
Hose down	2.5 Lt per square metre

Without accurate landing statistics (from number of fishermen, gear and seasonality) at any given location, a throughput of 1.50 Tons per day is assumed for the sake of completeness. The demand for seawater would be as follows:

Fish rinsing 1x1,500	1,500 Lt	
Fish box washing 50 x 2.5	125 Lt	
Hose down 95 m^2 x 2.5	237 Lt	
Total Seawater	**1,862 Lt per day**	**3,862 Lt per day**

5.7 Operational layout of buying station:

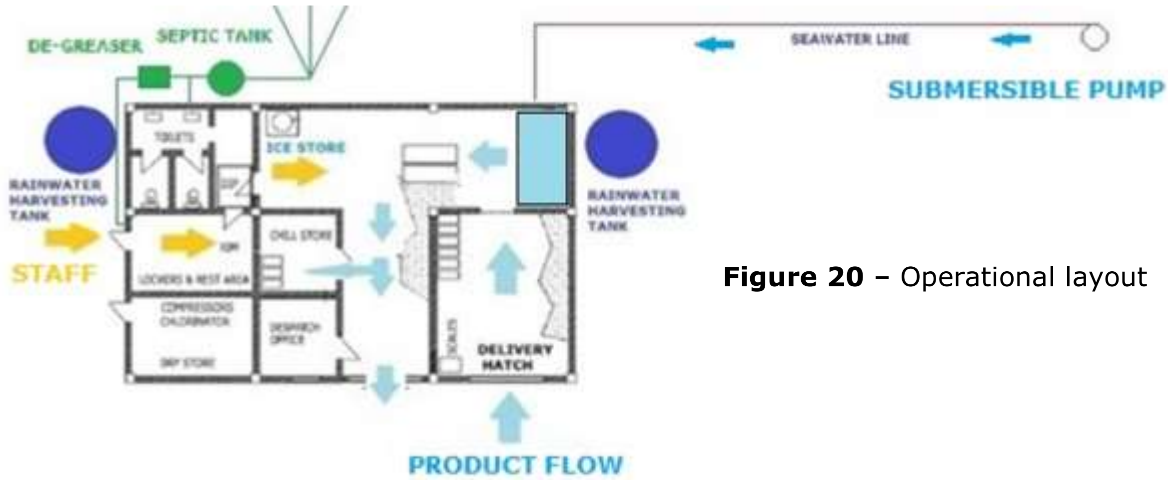


Figure 20 – Operational layout

Figure 20 above shows the operational layout of the proposed new buying station. The building as proposed will be in masonry with a concrete flat roof. The wet area will be paved in seamless epoxy grout as per international food hygiene regulations.

Fish and seafood will be delivered to the facility through a delivery hatch, which will be kept shut in between deliveries. The received fish will be sorted by species, rinsed, placed in a fish box, weighed and documented. The fish boxes will then be moved from the rinsing room to the fish packing area, where the fish will be sorted by size and packed on ice for transport. Live lobsters will be placed in the aerated holding tank. The full boxes will be stored in a chill room, fresh on ice, until picked up by the processor or middleman. All the service areas illustrated are preliminary and must be verified with actual landing data, especially the chill room size.

A staff of 5 people is envisaged at peak periods, but this can go down to 3 during the lean season. In all cases, a manager will be required to run the station. The manager must be a certified food handler with experience in food hygiene and conversant with HACCP. The station will be equipped with a change/relaxation room where staff can don work boots and head gear before proceeding to the packing area. This room will be equipped with personal lockers and a small kitchenette where snacks may be consumed. This room will lead to the restroom and/or the packing area via a chlorine dip.

The station must be constructed in an area where electricity is available in order to run the ice maker, chill room and air conditioning units. Solar PV panels mounted on the roof with storage batteries will provide power for the lights, laptops, solar pumps and security CCTV.

The fresh water supply will be augmented with a seawater supply line to conserve water for the strictly necessary services, i.e. the operation of the septic tank and the ice maker, if fresh water ice is preferred. The fresh water supply will also be integrated with a rain harvesting network able to store up to 10 000 litres of rain water. In all cases, the tanks will ensure at least a 3-day emergency supply. All the national food hygiene regulations for such establishments will be incorporated in the final design.

The liquid waste treatment from the restrooms will be treated via a prefabricated *plug-and-play* septic tank in polyethylene buried behind the station. The liquids from the wash hand basins and the kitchenette will first go through a de-greaser and then piped to the septic tank as well.

6. Preliminary infrastructure adaptation costs

The short term infrastructure adaptation costs (within the next 5 years), necessary for the fisheries sector to return to pre-Dorian levels consists of 2 new buying stations as described in Section 5.

The rest of the landing infrastructure may be climate-proofed over the course of the next 5 years or so (for a design peak of 50 years) following a detailed audit of the number, condition and size of the structures. Using a rule-of-thumb estimate for the other structures,

Timber Jetties	New piles with re-cycled deck	USD 500 000 each
Concrete slipways	3m wide x 2m extra x $1,100	USD 6 600 each
Concrete piers	5m wide x 10m x $1,100	USD 55 000 each
Marginal quays	20m long x $275	USD 5 500 each

Table 5 – Relative infrastructure investment costs over next 5 & 50 years

ITEM	MAJOR IMPACT	NEXT 5 YEARS	NEXT 50 YEARS	CLASSIFICATION(50yrs)
1 Concrete pier built on rock	Loss of freeboard above sea level	No additional costs envisaged	Deck level will need raising by 0.5m 0.5x0.5xU$1,100	Climate Change Resilient
Approximate cost			USD 550/m^2	
2 Timber piers on piles	Loss of freeboard above sea level Loss of deck planking or collapse of jetty	No additional costs envisaged if current maintenance level is maintained	The jetty structure will need replacing	Not Climate Change Resilient
Approximate cost			Design driven	
3 Marginal quays at the shore line	Loss of freeboard above sea level	No additional costs envisaged	Deck level will need raising by 0.5m	Climate Change Resilient
Approximate cost			USD 275/m	
4 Concrete slipway	Loss of freeboard above sea level	No additional costs envisaged	Top level will need raising by 0.5m 0.5x0.5xU$1,100	Climate Change Resilient
Approximate cost			USD 550/m^2	
5 Traditional fish buying stations	Loss of traditional roof and flooding ;	Total replacement with a new buying station	Maintenance costs	Climate Change Resilient
Approximate cost		USD 617 000 Each		

* The supply and placement of concrete inside a plane rectangular formwork is assumed to be USD 1,100 per cubic metre.
Raising the level of a plain concrete structure like a solid concrete pier entails placing a slab of concrete 0.50 m thick on the existing concrete. Hence cost of climate proofing an existing concrete pier or slipway for the next 50 years is 1.0x1.0x0.5x 1,100 or USD 550 per square metre of pier.

Raising the level of a plain concrete marginal quay with a cope that is 0.5 m wide entails placing a slab of concrete 0.50 m thick on the existing concrete cope. Hence cost of climate proofing a marginal quay for the next 50 years is 1.0x0.5x0.5x 1,100 or USD 275 per linear metre of quay. This excludes the backfilling in sand or gravel behind the raised level.

Table 6 below illustrates the total investment cost of climate proofing the selected infrastructure for the next 50 years on Grand Bahama and Abaco. These costs are outline costs and depend on the availability of the appropriate materials on the islands (this includes non-coralline aggregates) in question and the mobilisation of construction equipment from elsewhere. Unit rates may vary considerably from island to island.

STRUCTURE	NUMBER	UNIT COST In USD	OUTLINE COST TO CLIMATE PROOF ENTIRE FISHERIES SECTOR in USD
Concrete piers on rock	5	75 000	375 000
Timber piers on piles	7	600 000	4 200 000
Marginal Quays	2	25 500	51 000
Concrete Slipways on rock	11	26 600	292 600
Buying stations	2	670 000	1 340 000
			6 258 600

Table 6 – Preliminary outline infrastructure investment costs

The potential way forward for the entire fisheries sector may be as follows:

Buying stations implemented by 2023 with a total investment of circa USD 1.5 million
The rest of the infrastructure by 2025 with a total investment of circa USD 5 million
Total for development of new infrastructure and climate proofing USD 6.5 million

7. Benefits expected from fisheries infrastructure investments

The immediate benefits to be expected from an investment in the buying stations, run and maintained under a PPP agreement with private sector processors/middlemen, may be summarised as follows:

- Modern certifiable infrastructure facilities in line with the Fisheries Act (2020);
- Designed with Disaster Risk Management (DRM) in mind;
- Stronger quality inspections at major fish landing sites like the two sites prioritised in this document (to be validated by all stakeholders);
- Improved ice supply for fishing vessels and transporters or middlemen;
- Uninterrupted freshwater and seawater;
- Proper traceability and labelling starting from the landing sites;
- Improved handling and storage practices that prolong the freshness of the fishery products;
- Introduction of live lobster holding tanks that will increase the value of the landed product;
- Climate-proofed for the next 50 year life cycle.

The long-term benefits of the buying stations may be further enhanced by the additional investments in climate-proofing of the landing infrastructure over a number of years to ensure that the whole sector will be resilient.

8. Conclusions

Hurricane Dorian destroyed and damaged essential fishery infrastructure on Grand Bahama and Abaco in 2019. As a consequence, the fishers, fish processors and the Bahamian Government have lost millions of USD in income in the period 2019-2021. Climate change requires that destroyed fisheries infrastructure would be build back better. This investment plan provided insight in the current state of fisheries infrastructure on Grand Bahama and Abaco and where investments should be made to increase resilience of the sector to future natural disasters.

The DMR and private sector processors and middlemen on Grand Bahama provided inputs to this plan and comments on a draft version. General agreement from stakeholders was obtained in November 2021 to further investigate a potential public-private-partnership investment of approximately USD 1.3 million in the construction of two modern climate-resilient buying stations in Grand Bahama Island within 5 years. Moreover, a public sector investment of USD 5 million in climate resilient mooring infrastructure in the coming years would make the fisheries sector infrastructure on the island climate change resilient for an estimated 50 years. Climate proofing will enable the fisheries sector to operate more sustainably in line with the Government policies and the Fisheries Act (2020).

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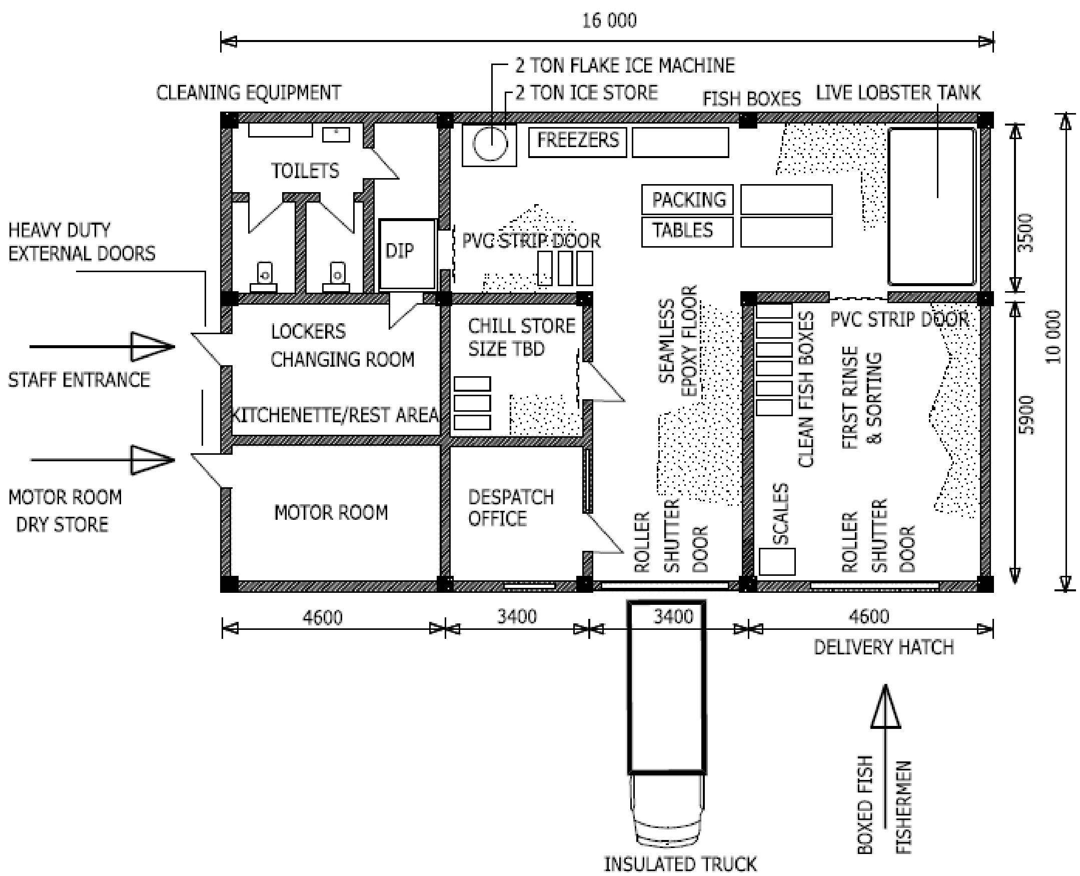
OUTLINE DRAWINGS



PROPOSED LAYOUT

ALL DIMENSIONS TO BE VERIFIED AT FINAL DESIGN STAGE

BASIC EQUIPMENT REQUIRED IN FISH HALL

- 2 Ton/Day FLAKE ICE MACHINE
- 2 Ton INSULATED ICE STORE
- DIGITAL WEIGHING SCALES
- COMMERCIAL FREEZER CABINETS
- 4 x FOOD GRADE STAINLESS STEEL TABLES
- 2 x FOOD GRADE STAINLESS STEEL TROLLIES
- 2 x 1000 Litre INSULATED ICE BOXES
- 50 X 15 Litre NESTABLE FISH BOXES
- 1 CHILL STORE (CHILLED FISH/SEAFOOD ON ICE)
- 10,000 Litre LIVE LOBSTER TANK IN GRP
- HIGH PRESSURE WASHER
- AIR CONDITIONING UNITS (WALL MOUNTED)

EQUIPMENT IN MOTOR ROOM

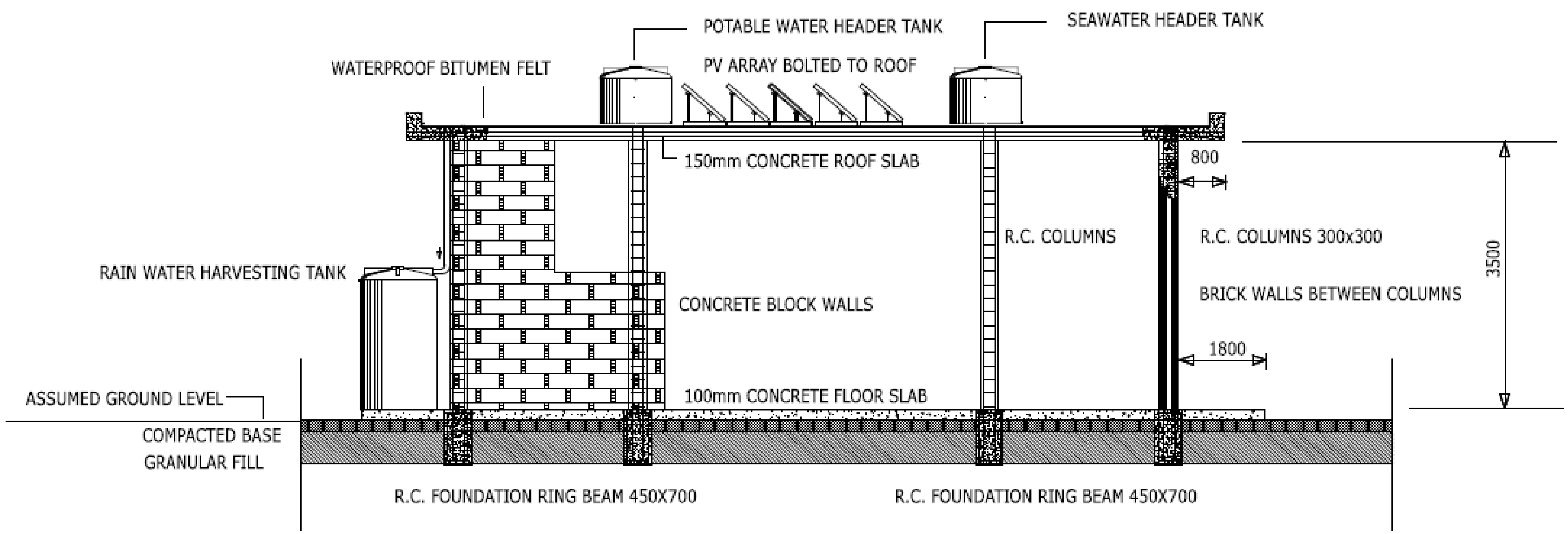
- MAIN ELECTRICAL SWITCHBOARD & METER
- SOLAR PV CONTROL PANEL
- DEEP CYCLE STORAGE BATTERIES
- AIR COMPRESSOR FOR LOBSTER TANK
- CHILL ROOM COMPRESOR
- IN-LINE CHLORINATOR
- FIRE EXTINGUISHERS

ADDITIONAL NOTES

BUILDING TO COMPLY WITH NATIONAL BUILDING AND FOOD HYGIENE REGULATIONS

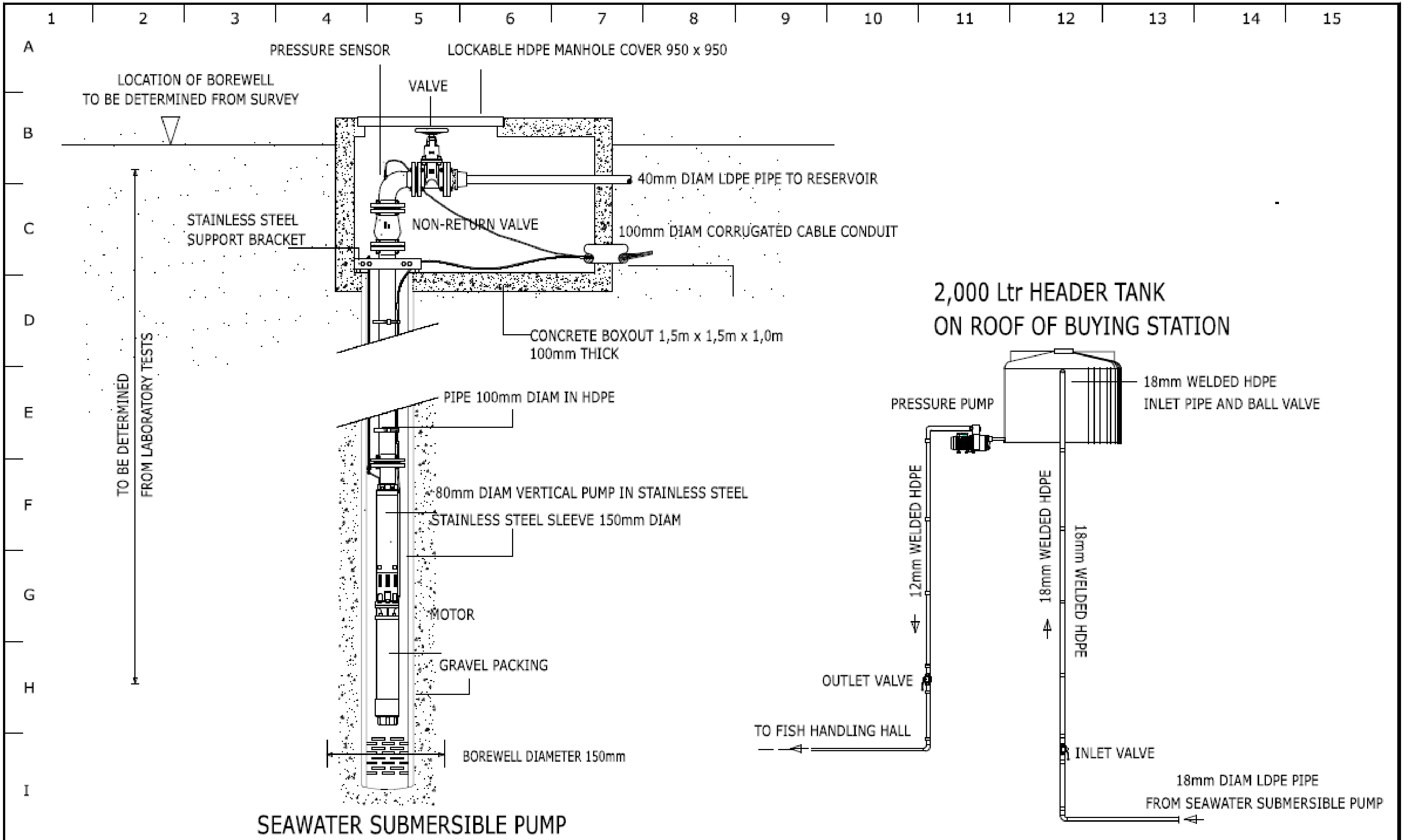
DRG No : BH-01	SCALE : 100	GOVERNMENT OF THE BAHAMAS MINISTRY OF AGRICULTURE AND MARINE RRSOURCES	J.A.SCIORTINO Ports Engineering Consultant www.monobarsystem.com jsciortino@monobarsystem.com
DATE : OCT 2021	REVISIONS	TITLE FISH BUYING STATION	

R.C. FRAMED BUILDING



TYPICAL SECTIONAL DETAILS OF BUILDING

DRG No : BH-02	SCALE : NO SCALE	GOVERNMENT OF THE BAHAMAS MINISTRY OF AGRICULTURE AND MARINE RRSOURCES	J.A.SCIORTINO Ports Engineering Consultant www.monobarsystem.com jsciortino@monobarsystem.com
DATE : OCT 2021	REVISIONS	TITLE TYPICAL CROSS SECTION	



DRG No : BH-03	SCALE : NO SCALE	GOVERNMENT OF THE BAHAMAS MINISTRY OF AGRICULTURE AND MARINE RRSOURCES	J.A.SCIORTINO Ports Engineering Consultant www.monobarsystem.com jsciortino@monobarsystem.com
DATE : OCT 2021	REVISIONS	TITLE SEA WATER SUPPLY	

PRELIMINARY BOQ

1 PREAMBLE

This preliminary Bill of Quantities shall be read in conjunction with the accompanying outline drawings of the proposed buying station and the specimen technical specifications.

The proposed buying station concept is intended for use throughout the Caribbean Region to receive freshly caught fish or seafood, which after weighing and rinsing with sea water, is packed into the appropriate fish boxes with flake ice and stored in a chill room at 3^{o}C until it is picked up by the appropriate processors or middlemen. No processing (gutting or filleting) will take place inside the buying station.

This preliminary layout has been drawn up on past experience only and is not based on actual seafood throughput at any location in the Bahamas or the Caribbean in general as no accurate landing data was available at the time of writing.

The preliminary design assumes that the building will be a reinforced concrete framed building with partition walls in between the columns. If national codes allow the use of load-bearing walls, the design may be adapted without the use of concrete columns. To the casual observer, the building and the specifications may look over-designed; however, the design takes into consideration not only harsher future climate change impacts but also the very corrosive saline environment of coastal locations and the use of seawater inside the building for certain operations.

The size of the chilled store is only indicative and may be increased or decreased depending on the rate of delivery and pick-up of the chilled product. Similarly for the size of the ice maker.

The design precludes the use of a generator and assumes that the buying station will be located near an electricity source due to the heavy load of the ice machine, chill store and air conditioning units that may set off at the same time. The supply of potable water, on the other hand, is not strictly necessary as the reservoir provided may be topped by a road tanker. Potable water is only utilised for the ice machine if fresh water ice is the preferred type and the restrooms and kitchenette. The rest of the operations will run on seawater.

The quantities given in the Bill of Quantities are estimated on the enclosed drawings and are given to provide a common basis for costing. The rates and prices should include plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes and duties together with all general risks, liabilities and obligations set out or implied in the construction contract.

2. GENERAL NOTES ON METHOD OF MEASUREMENT

2.1. EXCAVATION AND EARTHWORKS

The rates for excavation shall include for:

a. excavation in any material or consistency
b. pumping in any material or consistency performed above sea level or at low tide
c. disposal of the said material as directed by the Supervising Engineer

2.2 EARTHWORKS AND BACKFILL

The rates for concrete in earthworks and foundations shall include:

a. Hand-packing hardcore to form bedding for concrete structures where required
b. Hand-placing of concrete-filled jute bags as permanent shutter where required

2.3 CONCRETE WORK

The rate for concrete shall include for:

a. lean concrete blinding layer in trenches in any thickness or sectional area or volume
b. appropriate formwork
c. batching, conveying, placing and vibrating
d. curing of exposed surfaces with wet hessian mats for a minimum of 7 days
e. Testing as required by code

2.4 FLOOR, WALL AND CEILING FINISHINGS

The rates for floor, wall and ceiling finishes include for:

a. The fact that no distinction is made in classification of work and labour on internal and external surfaces.
b. The fact that work to walls, ceilings and floors in compartments not exceeding 4.0 m^2 on plan are not separated from those in wider areas.
c. The fact that work not exceeding 300mm wide are grouped together and described as in narrow widths.
d. The fact that work to sides and soffit of attached beams is not differentiated from work to ceiling and work to sides of attached columns is regarded as work to walls
e. External angles rounded internal and external angles of any radius.
f. Angles screed, casing and similar bends
g. Ends, angles, intersections and joints of new to existing work for items mentioned in clause
h. The fact that work to treads and risers are grouped together in square metres and described as in narrow widths
i. The fact that ends angles, ramped and weather corners shall not be measured separately but shall be deemed to be included in the work of strings and aprons
j. End's angles, intersections and outlets to work in channels and ends angles and ramps to skirting and kerbs
k. Fair joints to flush edges of existing finishes. Making good and labour finishing including pointing round steel joists, angles, trucking, ducting, floor springs, ventilators, pipes, tubes and the like. Working finishing into recessed covers shaped inserts and the like.
l. Corners, cutting to profile of openings and the like.

2.5 PAINTING AND DECORATING

The rates for painting and decorating shall include for:

a. The fact that work on isolated surfaces not exceeding 300mm girth shall be measured in square metres and described as in narrow widths.
b. Work in multi-colours
c. Cutting in edges on flush surfaces

2.6 ELECTRICAL INSTALLATIONS

The rates for electrical installation shall include for:

a. Bedding and pointing components or units of equipment ancillaries and the like, cutting and pinning ends of supports for equipment, ancillaries, fittings, trucking, tray and the like.
b. Cutting away for and making good (in new structures) after the electrician.

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM A – MOBILISATION & DEMOBILISATION

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
A1	Mobilisation of contractor to site, including setting up of site office, works safety perimeter hoarding, plant, equipment and all personal safety equipment.	Sum	--	--	10,000
A2	Excavation and/or demolition of all existing concrete and stone structures above ground, levelling ground to required level and loading excess rubble on to trucks and disposal in line with current Municipal regulations.	Sum	--	--	5,000
A3	Demolition of underground existing septic tank (if present) and in-filling the void with clean granular fill.	Sum	--	--	1,000
A4	Environmental and Social Management Plan, including all monitoring of required parameters and Health and Safety requirements.	Sum	--	--	30,000
A5	Post construction clean-up.	Sum	--	--	5,000
A6	Demobilisation of contractor, including cleaning of back of works area to the satisfaction of the supervising engineer.	Sum	--	--	5,000
A7					
A8					
				Total	**56,000**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM B – CIVIL WORKS – STATION BUILDING

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
B1	Excavation in existing ground of whatever consistency for the perimeter foundation beam and disposal of the material as directed. 90x0.5x0.7=31.5	m^3	32	80	2,560
B2	Grade 10 (*1,500 PSI*) lean concrete blinding under perimeter beam, 500 wide and 50 thick, including compaction of subgrade, conveying, depositing and levelling. 90x0.5=45	m^2	45	500	22,500
B3	Grade 25 (*3,500 PSI*) concrete in perimeter beam (450 wide x 700 deep), including shutters, conveying, depositing, vibrating and curing. 90x0.45x0.7=28.35	m^3	30	1,000	30,000
B4	HYS in Item B3, including cutting, bending and fixing (30kg per cubic metre).	Kg	900	10	9,000
B5	Backfilling inside the perimeter foundation beam with selected granular fill and topped by 100 thick compacted base as blinding. (16x10x0.7) – 30=82	m^3	82	40	3,280
B6	Grade 35 (5,000 psi) non-shrink concrete in floor slab, 100 thick, including fibre or mesh reinforcement, conveying, depositing, vibrating, floating and curing, to the levels and falls as specified. 19.6x13.6x0.1=26.6	m^3	27	1,100	29,700
B7	Grade 35 (5,000 psi) concrete in vertical columns (300x300x3500) including vertical shutters, conveying, depositing, vibrating, curing, to the levels specified in the drawing. 0.3x0.3x3.5x14=4.41	m^3	5	1,100	5,500
B8	HYS in Item B7, including cutting, bending and fixing. (80kg per cubic metre) 80x5=400	Kg	400	10	4,000
				Sub Total	**106,540**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM B – CIVIL WORKS – STATION BUILDING

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
B9	Grade 35 (5,000 psi) concrete in roof slab, including shutters, conveying, depositing, vibrating, floating and curing, to the levels specified in the drawing. [17.6x11.6x0.15] + [0.15x0.15x58.5]=31.9	m^3	32	1,100	C/F 106,540 35,200
B10	HYS mesh in Item B9, including cutting, bending and fixing. (100kg per cubic metre) 100x32=	Kg	3,200	5	16,000
B11	Supply and heat-weld waterproofing bitumen membrane, 5mm thick, including 100mm overlaps. [17.6x11.6] + [0.15x57.2]=212.74	m^2	215	60	12,900
B12	Supply and lay seamless epoxy resin flooring compound as per manufacturer's instructions over the floor slab as indicated on the drawing, including 150mm rise at column bases and walls. 11.4x10.0=114	m^2	114	110	12,540
B13	Erect external and internal walls in hollow concrete blocks, 200mm thick, for the formation of the building and service areas walls, including bedding mortar and pointing. 101.6x3.5=355.6	m^2	360	75	27,000
B14	Internal plastering, 3 layers on concrete brick walls, including plaster grounds and edge protections. [360x2] – 182=538	m^2	540	25	13,500
B15	External plastering, 3 layers on concrete brick walls, including plaster grounds and edge protections. [32+20]x3.5=182	m^2	182	45	8,190
B16	PVC window frames 1000 x 1000 complete with glazing and stainless steel fixings.	Each	2	1,000	2,000
				Sub Total	**233,870**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM B – CIVIL WORKS – STATION BUILDING

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
B17	Supply and install electrically operated, heavy duty aluminium roller shutter at loading bay door, 2000 wide by 2500 high.				C/F 233,870
		Each	1	6,000	6,000
B18	Supply and install electrically operated heavy duty aluminium roller shutter at fish receiving hatch, 2000 wide x 1500 high.	Each	1	4,000	4,000
B19	Supply and install heavy duty aluminium external doors 800 wide x 2000 high.	Each	2	1,200	2,400
B20	Supply and install aluminium internal doors 800 wide x 2000 high.	Each	5	800	4,000
B21	Supply and install PVC strip door 1200 wide x 2100 high, including suspension frame.	Each	3	1,000	3,000
B22	Porcelain low-flush (max 8 litres per flush) one-piece toilet with cistern, including all external flexible connections, pipes, valves, etc.	Each	2	700.0	1,400
B23	Porcelain wash hand basin, 600mm diameter, including wall suspension points and brackets, external flexible connections, valves, etc.	Each	1	500.0	500
B24	Toilet paper dispenser in stainless steel.	Each	2	15.0	30
				Sub Total	**255,200**

PRELIMINARY BILL OF QUANTITIES

ITEM B – CIVIL WORKS – STATION BUILDING

Page 5 of 12 **Date : Oct 2021**

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
B25	Liquid soap dispenser	Each	2	25.0	C/F 255,200 50.0
B26	Arm-operated, food standard single faucets, including all external flexible connections, valves, etc.	Each	2	150.0	300.0
B27	Cleaning and maintenance equipment	Sum	--	--	200.0
B28	Prefabricated liquid waste treatment system in LDPE consisting of a single stage de-oiler and a 3 stage biological digester, including pipework and percolation drains.	Sum	--	--	12,000
B29					
B30					
B31					
B32					
				Total	**267,750**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM C – POTABLE & RAIN WATER SUPPLY

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
C1	Grade 25 (3,500 psi) mass concrete in tank foundation slab, 1500x1500x150 thk, including conveyance, depositing, vibrating and curing. 1.5x1.5x.15=0.34	m^3	0.4	1,000	400
C2	Supply and install roto-moulded plastic water reservoir, capacity 5,000 litres, complete with clear glass level indicator, roof inlet, outlet connection to header pump and overflow connections.	Each	2	5,000	10,000
C3	Supply and install on roof of building roto-moulded plastic water header tank, capacity 2,000 litres, complete with inlet ball valve, drain and overflow connections.	Each	1	2,500	2,500
C4	Supply and install ½ HP stainless steel electric header pump, complete with cabling and limit switch.	Each	1	200.0	200
C5	Supply and install rigid 12mm HDPE water pipe between main reservoir and header tank, ice machine and toilet block, including heat welded elbows and plastic suspension fittings.	m	55	7.50	412
C6	Supply and install 150mm diam uPVC drain pipe from building roof to water reservoir, including all elbows, angles and plastic fixings.	Sum	--	--	100
C7	Supply and install automatic in-line chlorinator, including hypochlorite tank and dosimeter.	Sum	--	--	500
C8					
				Total	**14,112**

PRELIMINARY BILL OF QUANTITIES

ITEM D – SANITARY SEAWATER SUPPLY

 Date : Oct 2021

Item	D E S C R I P T I O N	Unit	Quantity	Rate US$	AMOUNT IN US$
D1	Drill and line 150mm diameter borewell in an area to be determined by the supervising engineer, to a depth to be determined by water sampling, in soil of any consistency, including a 100mm diameter stainless steel casing to AISI 316, packing with washed gravel and concrete seal.	m	10	1,250	12,500
D2	Retrieval of seawater sample in appropriate 1000cc sterile containers, transport by air to overseas laboratory and testing for contamination.	Each	1	800	800
D3	Grade 25 (3,500 psi) concrete in submersible pump head housing, including formwork, conveyance, depositing, vibrating and curing, as illustrated in the drawing.	m^3	1.70	300.0	510
D4	HYS mesh in Items in D3.	Kg	20	5.0	100
D5	Supply and install on building roof a roto-moulded plastic water reservoir, capacity 2,000 litres, complete with ball valve inlet, non-return valve and overflow connections.	Each	1	2,500	2,500
D6	Supply and install 3" diameter solar-powered stainless steel (AISI 316) submersible electric sea water pump, with a max flow of 9 m^3/hour and 1.5 kW electric motor.	Each	1	2,000	2,000
D7	Supply and lay 100mm diameter corrugated cable duct in **LDPE** from borewell head to pump control board inside dry storage area of building, including trenching and bedding sand.	m	50	35	1,750
D8	Supply and lay 18mm diameter flanged rigid **HDPE** pipe from submersible pump to seawater reservoir, including flanges, bolts, elbows, trenching and bedding sand.	m	22	70.0	1,540
				Sub Total	**21,700**

PRELIMNARY BILL OF QUANTITIES

ITEM D – SANITARY SEAWATER SUPPLY

 Date : Oct 2021

Item	DESCRIPTION	Unit	Quantity	Rate US$	AMOUNT IN US$
D9	Supply and install pump fittings (rigid flanged HDPE pipe sections, 90° elbow, non-return valve, pressure sensor, HDPE butterfly valve, and flow meter), including all electrical cabling between pump head and control room, remote displays and wall mounted control panel.	Sum	--	--	C/F 21,700 6,000.0
D10	Supply and suspend from building roof rigid 25mm diameter HDPE seawater network, including plastic strap supports drilled into roof ceiling.	m	30	15.0	450
D11	Supply and suspend from roof 10mm diam food grade shower trigger-operated faucets over fish washing area, including reducer Tees (20x10x25) and flexible hose.	Each	4	150.0	600
D12	Supply and install against columns, 600mm above ground, 10mm diam ball valve water taps for floor rinse and fish box washing, including 10 metres of plastic water hose for each tap with tap coupling anchored to column.	Each	3	150.0	450
D13	Supply and install pressurising pump to provide adequate pressure for the overhead shower faucets.	Sum	--	--	500
D14					
D15					
D16					
				Total	**29,700**

PRELIMINARY BILL OF QUANTITIES

ITEM E FISHERIES EQUIPMENT

 Date : Oct 2021

Item	D E S C R I P T I O N	Unit	Quantity	Rate US$	AMOUNT IN US$
E1	Supply food grade stainless steel work benches, 800mm wide, 1500mm long and 600mm high.	Each	4	800	3,200
E2	Supply food grade stainless steel pedestal mounted weighing scales with digital display, 0-1000 Kg, connected electrically to dispatch office computer.	Each	1	1,500	1,500
E3	Supply of 25 litre HDPE fish boxes	Each	50	25.0	1,250
E4	Supply jumbo polyethylene cool boxes, minimum internal volume 1,000 litres. The lids shall be fitted with double rubber gaskets for a perfect seal and provided with padlock holes.	Each	2	1,500	3,000
E4	Supply rubber-tired food grade stainless steel trolley for the handling of fish boxes and cooler boxes with ice.	Each	2	1,000	2,000
E6	Supply fire extinguishers for the electrical control panel room (dry store) and office.	Each	4	150.0	600
E7	Supply mobile pressure washer, 200 bar operating pressure, adjustable water flow 150/300 Lt/hr, electric motor, single Phase, suitable for sea water operations.	Each	1	1,500	1,500
E8	Supply one bank of lockers for changing area with 5 individual lockable compartments.	Each	1	1,500	1,500
				Sub Total	**14,550**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM E FISHERIES EQUIPMENT

 Date : Oct 2021

Item	D E S C R I P T I O N	Unit	Quantity	Rate US$	AMOUNT IN US$
					C/F 14,550
E9	Supply and install 2 Ton per day flake ice machine.	Sum	--	--	20,000
E10	2 Ton insulated flake ice store in stainless steel.	Sum	--	--	5,000
E11	Chill room, including insulation panels, blowers, compressor and insulated door with temperature control.	Sum	--	2	10,000
E12	Supply and install lobster holding tank 10,000 litre capacity.	Sum	--	--	5,000
E13	Personal Protection Equipment sets, each consisting of coat, head gear and rubber boots.	Each	5	200	1,000
E14	Supply steel desk, complete with lockable steel drawer cabinet and chair.	Each	2	1,000	2,000
E15	Supply office furniture.	Sum	--	--	2,000
E16					
				Total	**59,550**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM F ELECTRICAL FITTINGS

 Date : Oct 2021

Item	D E S C R I P T I O N	Unit	Quantity	Rate US$	AMOUNT IN US$
F1	Supply and install pole-mounted 415V - 70 kVA step-down transformer complete, including supports, cable ducts and connectors.	Sum	1	6500	6,500
F2	Supply, install indoor steel distribution cabinet including distribution board and general circuit breakers, meter etc. inside motor room.	Sum	1	1950	1,950.0
F3	Supply and install an Equipment Grounding Conductor in copper, aluminium, or copper-clad aluminium to the required impedance.	Sum	1	1000	1,000
F4	Supply and install air compressor for lobster holding tank, including compressed air line and diffusers.	Sum	--	--	2,500.0
F5	Install wall-mounted standard electric power sockets throughout building (120 V), wiring and protection breaker included.	Each	4	25.0	100
F6	Install wall-mounted standard electric power sockets throughout building (120 V), wiring and protection breaker included.	Each	12	25.0	300
F7	Split-type air conditioning units 12,000 BTUs, total cooling power to be determined at final design stage.	Each	5	1,500	7,500
F8	Supply and install on building roof a PV System of 3 KW with 1 AC inverters of 3KW for lighting system throughout building and solar pumps.	Sum	--	--	25,000
				Sub Total	**44,850**

PROPOSED FISH-BUYING STATION

PRELIMINARY BILL OF QUANTITIES

ITEM F ELECTRICAL FITTINGS

 Date : Oct 2021

Item	D E S C R I P T I O N	Unit	Quantity	Rate US$	AMOUNT IN US$
F9	Deep-cycle Storage batteries for LED lights and security CCTV system only.	Each	4	500	C/F 44,850 2,000
F10	LED strip lights 1x50 w equivalent with polycarbonate diffuser, including wiring and protection circuit.	Each	14	195	2,400
F11	CCTV system for night time security.	Each	1	2,000	2,000
F12	Testing, commissioning and certification of electricity supply, including PV panels, battery and inverter.	Sum	--	3,000	3,000
F13					
F14					
F15					
F16					
				Total	**54,250**

SUMMARY

ITEM	ESTIMATED COST
ITEM A – Mobilization & demobilization of contractor	56,000
ITEM B – Civil works - Building	267,750
ITEM C – Civil works – Potable water supply	14,112
ITEM D – Civil works – Sanitary sea water supply	29,700
ITEM E – Fisheries equipment	59,550
ITEM F – Electrical fittings	54,250
Final design costs	80,000
Supervision	25,000
Sub Total	586,362
Contingency 5%	30,000
Total Estimated Cost	**616,362**

TYPICAL EQUIPMENT SPECIFICATIONS

SPECIMEN EQUIPMENT SPECIFICATIONS

1 SEAWATER SUBMERSIBLE PUMP AND FITTINGS

Maximum external diameter	3" or 80mm
Impeller type	Multistage
Impeller and housing	stainless steel AISI 316L or Noryl resin
Maximum flow	9 m^3 per hour
Maximum operating pressure	150 bar
Maximum water temperature	40^o C
Electric motor	1 to 3 kW

The pump shall be equipped with an integrated dry running protection, with over and under voltage protection and soft start.

The pump shall come equipped with a remote control unit for the remote constant monitoring of the pump and energy consumption.

2 SEAWATER PRESSURE PUMP

In-line pressure with pressure sensor

Impeller and pump housing	Resin or Stainless steel AISI 316L
Maximum flow	2.5 m^3 per hour
Maximum operating pressure	40 m
Maximum water temperature	40^o C
Electric motor	0.50 kW
Operating voltage	220-240 V
Electric motor IP protection	Min 44

The pump shall be suitable for continuous duty and be thermally protected.

3 POTABLE WATER HEADER PUMP

Intermediate pump from reservoir to header tank

Impeller and pump housing	Resin or Stainless steel AISI 316L
Maximum flow	2.5 m^3 per hour
Maximum operating pressure	40 m
Maximum water temperature	40^o C
Electric motor	0.50 kW
Operating voltage	220-240 V
Electric motor IP protection	Min 44

The pump shall be suitable for continuous duty and be thermally protected.

4 WATER RESERVOIRS IN POLYETHYLENE

The water tanks shall be vertical cylindrical tanks in black roto polyethylene with a carbon black (CB) content exceeding 2.3%.
The 2,000 litre tank shall have a height not exceeding 1000 mm.
The 5,000 litre tank shall have a diameter not exceeding 1600 mm with a height not exceeding 2800 mm.

5 FLAKE ICE MAKER

The size (output) to be determined according to the peak daily landing plus any extra sale to middlemen or fishermen.

The exact choice of the type of ice (fresh water or seawater) and size will depend on the landed product, ambient temperature and relative humidity.

6 INSULATED ICE STORE

Stainless steel insulated ice storage bin.
Minimum capacity should not be less than 2 tons.

7 CHILL ROOM (+3°C)

The size of the chill room and the cooling capacity to be determined according to the peak daily landing and the number of days between collection of the fish boxes by the processors.

For iced fish, the stowage capacity is approximately 280 kg per square metre. For bulky seafood, the stowage rate may be less.

8 POLYETHYLENE FISH BOXES

The fish boxes shall be standard fish boxes in blue food grade high-density polyethylene (HDPE), external dimensions approximately 800 x 400 x 225 mm with a nominal capacity of 40 litres.

The boxes shall be robust and durable and the weight of each box shall be in the range of 2.50 to 3 kg. The boxes shall be nestable with a draining hole to drain away melt water.

9 JUMBO POLYETHYLENE COOL BOXES

The jumbo polyethylene cool boxes shall be UV-stabilised roto-moulded HDPE cool boxes in food grade polyethylene with an internal capacity not inferior to 1,000 litres.

The lids shall be equipped with a double fridge seal and lockable. 2 units shall fit side-by-side on the back of a pick-up.

The cool boxes shall weigh between 80 and 100 Kg with a drain plug.

10 STAINLESS STEEL WORK BENCHES

MODEL	As illustrated opposite or similar
EXTRAS	Intermediate shelf
WIDTH	600 – 800mm
LENGTH	1500mm
HEIGHT	600mm
MATERIAL	Food Grade AISI 314

11 STAINLESS STEEL TROLLEY

MODEL	As illustrated opposite or similar
WIDTH	Max 800mm
LENGTH	1500mm
HEIGHT	100mm
MATERIAL	Food Grade AISI 314

12 FLOOR DRAIN

The floor drain in the rinse and packing areas shall be a stainless steel sanitary one-piece seamless body in food grade AISI 314.
The drain shall be equipped with an internal removable perforated basket strainer. The cover plate shall be a bar grate cover.

13 ROOF-MOUNTED RINSE FAUCETS

The roof mounted rinse faucets over the work tables shall be in food grade stainless steel with no lead-containing inserts or components. They shall be fixed to a triple-ply flexible hose and the flow shall not exceed 10 litres per minute.

The hose shall be inside a flexible stainless steel spring.

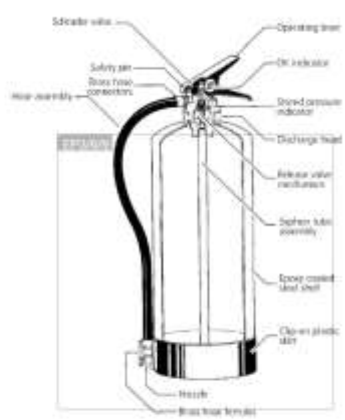
The 10mm diameter hose shall be screwed to the overhead welded HDPE sea line via a stainless steel reducer in AISI 316L.

14 FLOOR WEIGHING SCALES

The weighing scales shall be of the square platform type, dimensions approximately 1000 x 1000 mm with a height not exceeding 100mm. The scales shall be manufactured from food grade stainless steel. The top plate shall be in a chequered thread design to provide traction under wet conditions. The load cells shall be sealed solid to protect against water and debris to IP 67 (hose proof). The minimum load capacity required is 1000 Kg in 0.5 Kg increments. The performance shall meet the requirements of EN 45501: 1992 accuracy class III. The floor weighing scales shall be cabled to a pedestal-mounted digital read-out sealed to IP67-NEMA4x, for wet applications. The LED display shall be easily seen in dim environments.

15 FIRE EXTINGUISHERS

The fire extinguishers shall be the dry powder type manufactured to BS EN3-7 (2004) with clear labelling of contents to BS EN3. The capacity shall not be inferior to 6 Kg of dry powder and with an operating pressure of 15 bar at 20°C, the minimum discharge time shall exceed 15 seconds. The full weight shall not exceed 10 Kg. The fire rating shall be 34A-233B.



16 MANHOLE COVERS

The manhole covers over the septic tank and the seawater well head shall be lockable covers in engineered plastics composite material for lightweight handling.

The covers shall have clear internal dimensions of 750x750 mm and designed for pedestrian loading only.

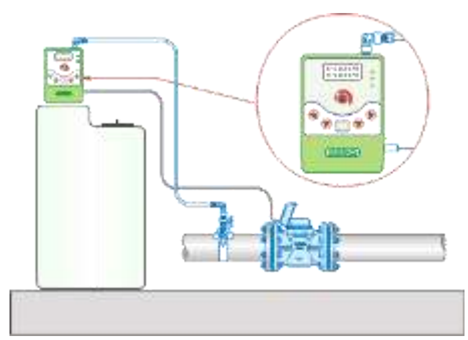
17 PIPEWORK

The small diameter pipes (25mm) shall be in rigid polypropylene with a minimum wall thickness of 2.5 mm. All joints shall be heat welded.
The larger diameter water pipes (40mm) shall be in LDPE and submersible outlet pipe in HDPE and flanged as necessary. All flange bolts shall be in AISI 316L stainless steel.

18 Valves

The sea water and potable water valves shall be ball valves of the type illustrated. The body and ball shall be in stainless steel to AISI 316 or ASTM A-351 CF8M. The ball seat shall be in Teflon.

19 IN-LINE CHLORINATOR



20 HIGH PRESSURE WASHER

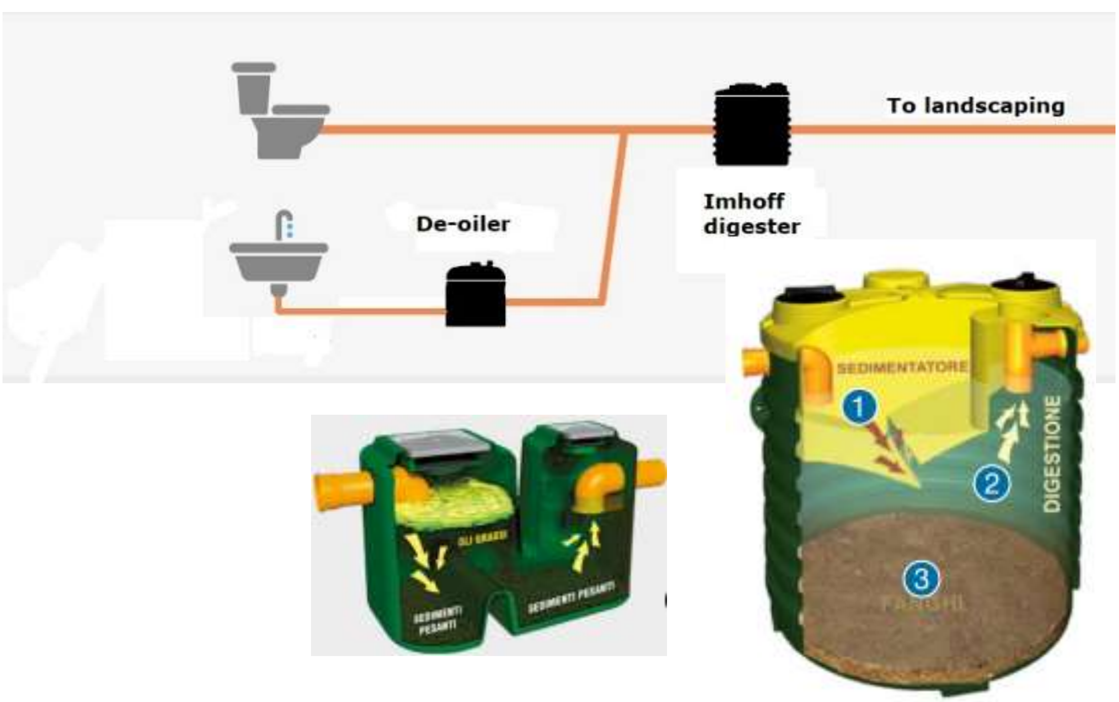
The pressure cleaner shall be a mobile cold-water-only unit with a maximum adjustable pressure: 200 bar and an adjustable water flow of 150/300 l/h at 1450 rpm.
The motor shall be a single phase, 120V electric motor with a power consumption not exceeding 1.5 kW. The entire unit should not weigh more than 20 kg and must include a lance and 10m pressure hose and detergent dispenser. The cover should be in UV stabilised plastic.

21 PVC STRIP DOORS, LOCKERS, HANDS-FREE FAUCETS AND SOAP DISPENSERS

21 PERSONAL PROTECTION EQUIPMENT (PPE)

22 LIQUID WASTE TREATMENT

Prefabricated *plug and play* liquid waste treatment system.



FISHERIES INFRASTRUCTURE INVENTORY OF GRAND BAHAMA AND ABACO

SEE SEPARATE APPENDIX TO THIS REPORT

TERMS OF REFERENCE FOR THE FINAL DESIGN & SUPERVISION OF THE NEW BUYING STATIONS

FOOD AND AGRICULTURE ORGANIZATION
of the UNITED NATIONS

Rebuilding fisheries livelihoods in Abaco and Grand Bahama islands following Hurricane Dorian

Terms of Reference

CONSULTANCY SERVICES TO DESIGN A CLIMATE RESILIENT FISH AND SEAFOOD BUYING STATION BUILDING

1. Project Background

The northernmost islands of The Bahamas (Grand Bahama and Abaco), are regularly exposed to hurricanes. The islands are of low elevation, which makes the communities vulnerable to flooding due to the storm surges associated with storms and hurricanes. Although the communities prepare themselves each year for the storm season, the consequences of these hurricanes for the livelihoods of the population and the economy of the islands are significant. A large part of the local population depends on fisheries for its livelihood, and natural disasters such as hurricanes and tropical storms cause large-scale and prolonged instability. Grand Bahama is the second-most populous island in The Bahamas with an area of 1,373 km^2 and over 50 000 inhabitants. A significant number of people on Grand Bahama depend on fisheries or related activities, particularly in the largest town "Freeport". Abaco has a smaller population with just under 18 000 inhabitants but has a larger land area of 2,009 km^2. Abaco is also very dependent on fisheries and related activities. The largest community in Abaco is Marsh Harbour, with a population of over 6 000 inhabitants. Both islands and the nearby small islands, coastal and shallow areas contain important ecosystems such as mangroves, coral reefs and seagrass beds. These are especially important for the lifecycle of the main target species of the fishery, the spiny lobster (*Panulirus argus*). In the Bahamas, commercial fishing takes place on the continental shelf, mainly on the Great Bahama Bank and Little Bahama Bank. Grand Bahama and Abaco are located on the Little Bahama Bank. As a result, Grand Bahama and Abaco produce nearly 33 percent of the total catches of the spiny lobster and Queen Conch (*Strombus gigas*) in The Bahamas and nearly 60 percent of the total annual catch of stone crab (Menippe mercenaria).

Major Hurricane Dorian impacted Grand Bahama and Abaco from Sunday, September 1 to Tuesday, September 3, 2019, for approximately 68 hours. Hurricane Dorian, of category V, devastated Abaco, Grand Bahama and the surrounding Cays, with the southern eye-wall remaining "stationary" for approximately 36 hours over Grand Bahama. At the peak of the storm, sustained winds reached 298 km/h (185 mph) with gusts up to 354 km/h (220 mph). The estimated rainfall was 305-381 mm/day (12-15 inches) and the storm surge has been estimated as high as 5.5-7meters (18-23 feet) above sea level. All the fish buying stations suffered damage, ranging from torn roofs to entire buildings damaged by floods. Most of the equipment inside the de-roofed buildings was damaged beyond repair by water.

The FAO – Government of The Bahamas technical cooperation programme (TCP) project on Rebuilding fisheries livelihoods in Abaco and Grand Bahama islands following Hurricane Dorian TCP/BHA/3703 (E) aimed to improve the resilience of fishers and their families through a restart of Fisheries activities and contribution to rebuilding of the fishery infrastructure in the affected communities of Abaco and Grand Bahama. Some Dorian affected fishers received equipment support to restart their lobster fishing activities, others received spare parts for repair outboard motors, fish trap materials or freezers. The project also foresees the preparation of an Investment Plan for the development of climate resilience fisheries infrastructure in Grand Bahama and Abaco islands. This assignment contributes to the development of the Investment Plan.

2. Scope of the Assignment

The project envisages that the Investment Plan will include the construction of modern climate-proofed all-masonry buying-station buildings with a cast in-situ reinforced concrete roof to avoid problems associated with pitched roofs. The selected consultant shall be required to:

- Develop the concept design illustrated in Appendix 1;
- Prepare the architectural drawings, structural design, electro-mechanical drawings, bidding documents and Bill of Quantities for the buying station building.

3. Scope of the Consultant's services

The scope of the consultant's services is:

- To verify with selected stakeholders the size of the footprint of the proposed building which should be large enough for the following work and service spaces:

    a. Seafood receiving area (first rinse, weighing and sorting);
    b. 350 cubic foot live lobster holding tank;
    c. Seafood boxing and packaging area (tables and flake ice machine with ice store);
    d. Chill store (iced seafood in fish boxes);
    e. Manager and dispatcher's office (hall manager/assistant);
    f. Male/Female toilets;
    g. Break/locker room with kitchenette;
    h. Motor room (electricity meter, PV inverter, batteries, compressors, etc.);
    i. Prefabricated liquid waste treatment in low density polyethylene.

- To prepare the architectural design to fit the agreed layout. The design shall take into consideration the planning regulatory requirement specific to The Bahamas for building approval purposes before validation of the layout design with the stakeholders;
- To prepare the structural engineering drawings to accommodate the proposed building at a sandy bottom/coral rock location so as to ensure that the building is structurally fit for purpose (topography, ground conditions, access and surface water drainage). The overall design shall take into account the rise in sea level, storm surge in water levels, the rise in extreme wind speeds and the rise in precipitation and associated potential flooding;
- To prepare the electro-mechanical services drawings, including green infrastructure such as rain water harvesting, seawater fish rinsing circuit (solar driven borewell), roof-mounted solar panels, LED lighting throughout and security CCTV;
- To prepare the building and equipment specifications, see Appendix 2;
- To prepare the Bill of Quantities;
- To prepare the tender documents for contract bidding.

The tender documents shall be organised in 5 volumes:

1. **Vol. 1**:Instruction to Tenderers (Prepared by the Client, with relevant technical inputs from the Consultant);
2. **Vol. 2**: Conditions of Contract: General Conditions of Contract. *Standard document not to be changed*
3. **Vol. 3**: Technical Specifications as per Section 2 above;
4. **Vol. 4**: Drawings;
5. **Vol. 5**: Bill of Quantities.

4. Expected outputs and deliverables

The deliverables for the design shall comprise:

Document *(English)*	Hard copy Number	Electronic copy 1 No.
Design Basis Report	1	PDF
Topographic Survey (cadastral documents)	1	PDF
Geotechnical Report including borewell location for seawater line	1	PDF
Preliminary Design Presentation, including 3-D rendering of building and outline costs	-	PPT
Draft Detailed Design Drawings	-	ACAD
Final Design report	1	PDF
Final Detailed Design Drawings	*As required*	PDF
Technical Specifications	*Ditto*	PDF
Bills of Quantities	*Ditto*	PDF
Priced Bills of Quantities	*Ditto*	DOCX
Tender Documents Vols. 1-5	*Ditto*	PDF/ACAD

Table 1 – Deliverables

5. Supervision

Upon award of the contract for the execution of civil works, the consultant architect shall perform the job of works supervisor of all construction works (construction of premises, electricity and water supply, security and safety installations, etc.) fully in line with the national legislation and Project requirements.

6. Qualifications

The Consultant shall be a suitably qualified and experienced civil engineer or architect. The Consultant must, in addition to relevant technical background, also have broad-based experience in the design of food processing structures.

He/She should have at least a Bachelor's degree or Equivalent in Civil Engineering or Architecture with minimum of 10 years of general experience plus three (3) years of specific experience on food processing projects. Experience in developing countries is a plus and specific experience in the Caribbean is a must. The Consultant must be a member of a recognized Civil Engineering or Architectural Institution.

7 Input provided by the Client

The Client is unable to provide technical input other than that contained in this document. The Client will assist the Consultant with the organization of one or more meetings (as required) with selected stakeholders.

8.0 Reporting obligations and payments

Documents & Reports	Submission Date	%age Payment
Contract signing	Contract signing Date	10 %
[1] Design Basis Report	Latest 1 week after signing	
[2] Stakeholder consultation Report	Latest 2 weeks after signing	
[3] Preliminary Design Presentation	Latest 4 weeks after signing	20%
[4] Draft Detailed Design drawings	Latest 6 weeks after signing	20%
[5] Final Design Report	Latest 8 weeks after signing	
[6] Detailed Design Drawings	Latest 12 weeks after signing	
[7] Technical Specifications	Latest 12 weeks after signing	
[8] Bills of Quantity (priced & unpriced)	Latest 13 weeks after singing	40%
[9] Tender Documents Vols. 1-5	Latest 14 weeks after signing	10%
	Total	100%

Table 2 – Reporting milestones