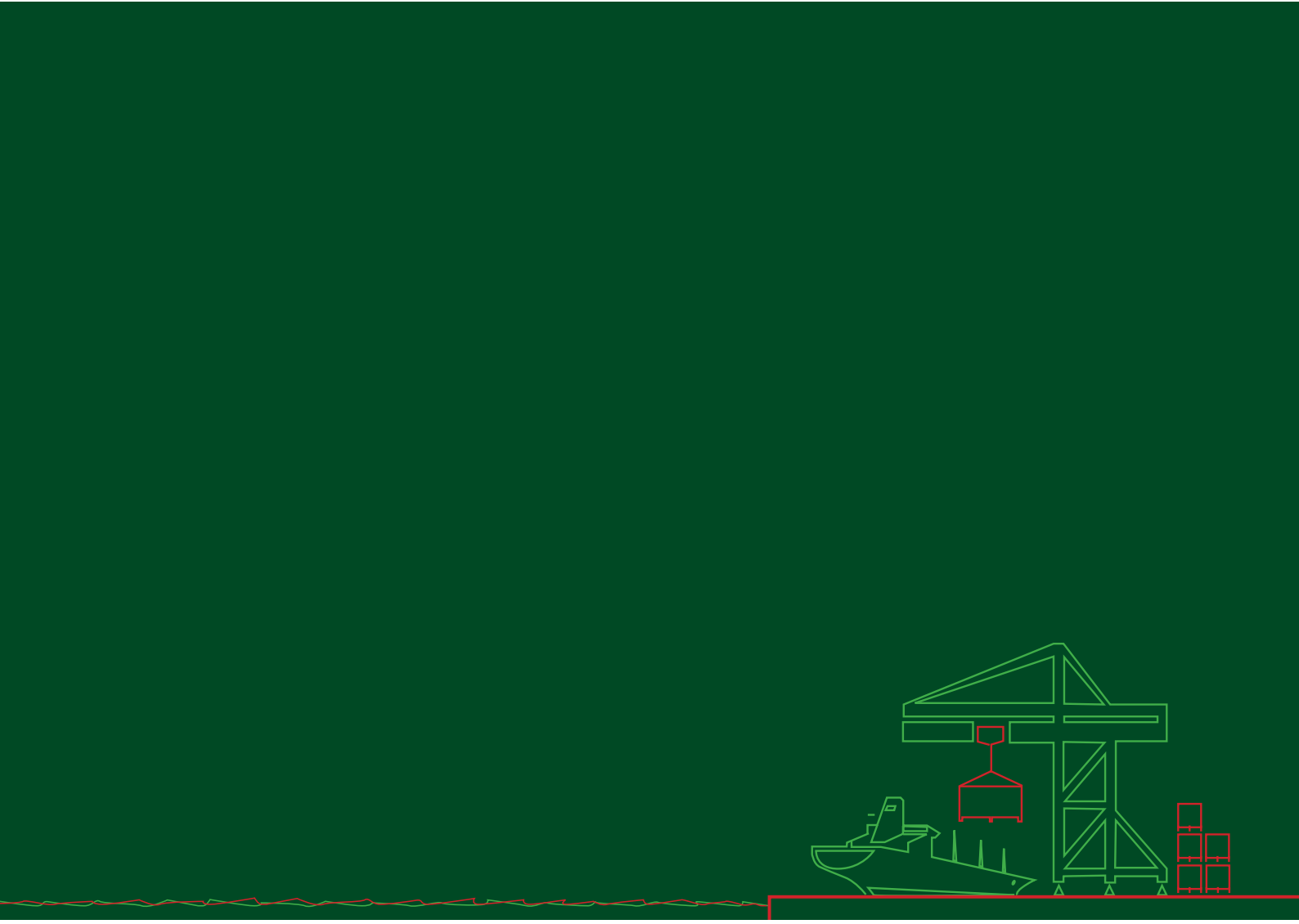


PORT OF BEIRUT'S CURRENT STATUS

HPC

CURRENT STATUS

Port of Beirut damage stocktaking

Vessel and equipment salvage

Because of the explosion, there are still five shipwrecks in the area of Quays 8 to 11 to be removed from their current positions:

- A sunken wreck inside the main breakwater (opposite Quay 8)
- The “Orient Queen” rolled over at Quay 11.
- Three floating wrecks

The salvage of the five wrecks is not contracted yet but considered urgent. The German based Harren & Partner Group of companies with its subsidiaries Combi Lift Projekt GmbH & Co. KG and CL Salvage GmbH & Co.KG, who are already in contact with Port of Beirut and the ship owners, would be prepared to salvage the wrecks including the removal of oil pollutants.

Furthermore, Combi Lift is currently preparing the removal of 52 containers already identified with hazardous goods, which were abandoned by their owners at the Beirut container terminal over the past years. As most of these containers cannot be moved anymore due to damages and advanced corrosion, this includes a rather high effort for re-packaging and removal as hazardous waste.

Another 185 containers spread all over the port are still to be scanned and removed as well. Combi Lift further reported a total of 30,000 tonnes of metal scrap and 50,000 tonnes of asbestos concentrated rubble to be removed from the port area. Lastly, also to be removed are a significant number of destroyed vehicles as well as the silo scrap, grain and concrete structures.

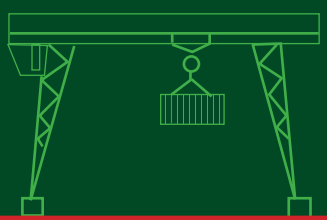
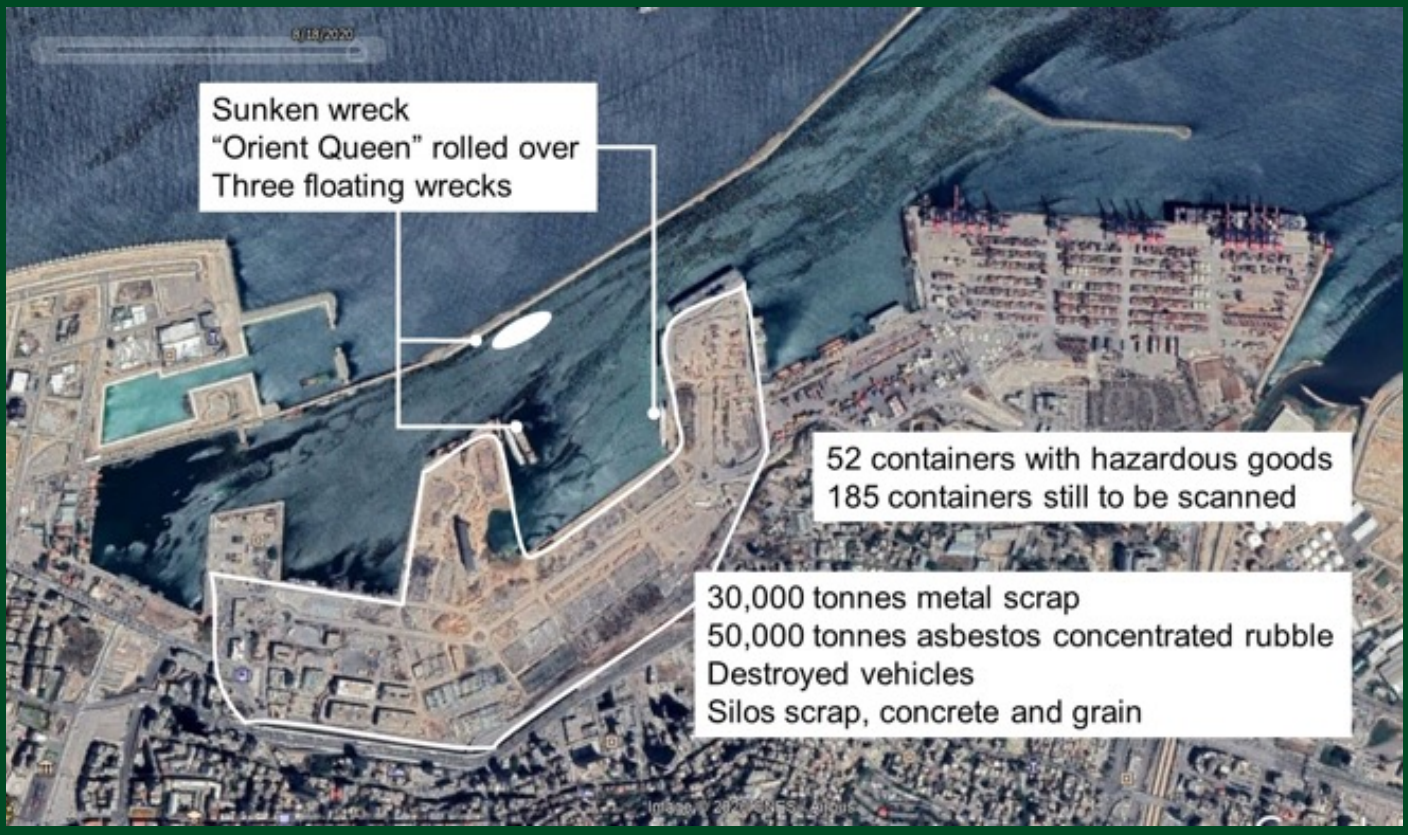


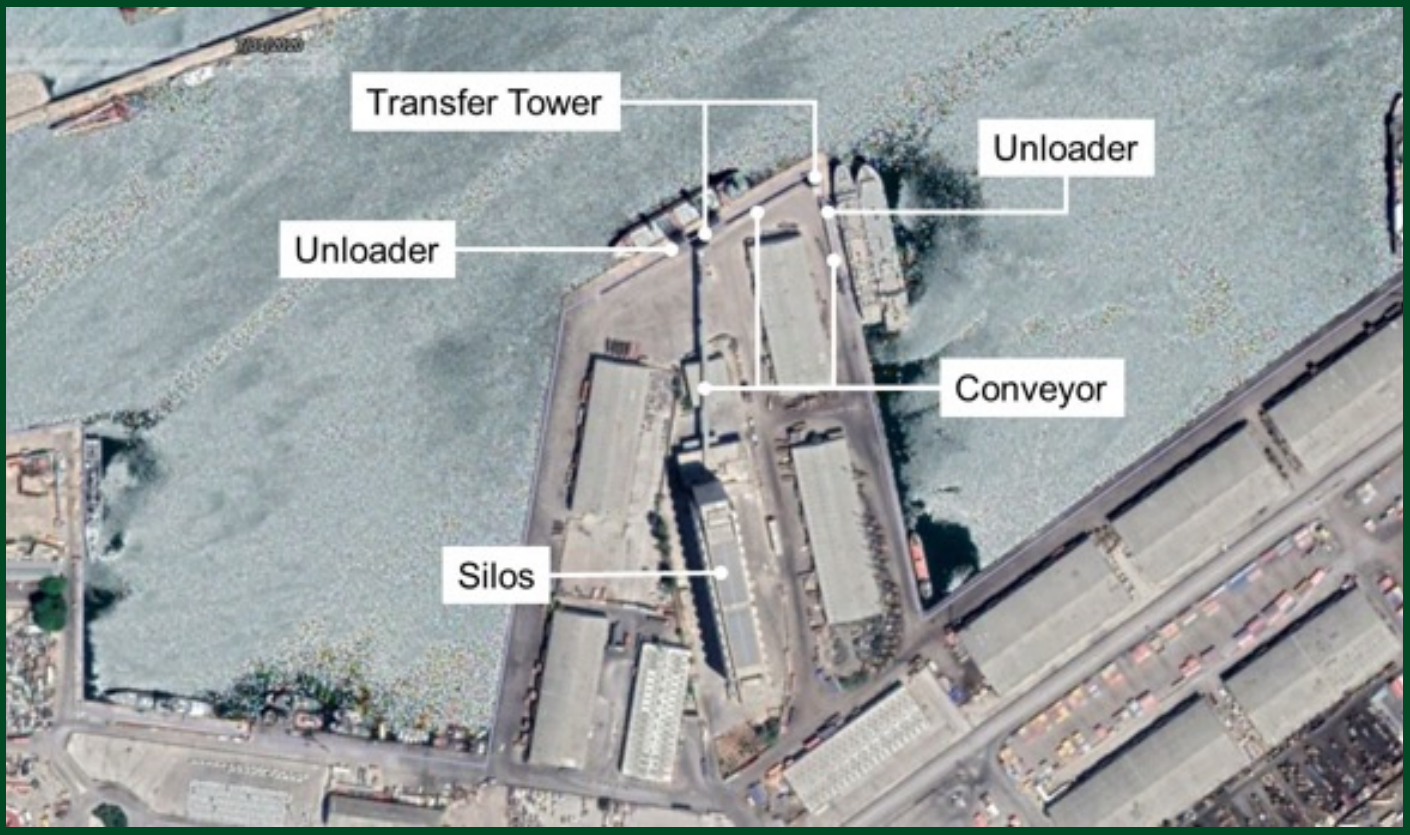
Figure 1: Port of Beirut salvage and removal



Source: HPC | Image: Google Earth

The grain import facility with equipment for unloading vessels as well as the Silos for storage of the imported grain were located in immediate proximity of the explosion, hence considered a total loss. The unloading equipment consisted of two suction units at Quay 8 and a third unit at Quay 9, a conveyor belt system at the quayside (length approx. 250 m), a conveyor belt between the quay and the silos (length approx. 170 m) and two transfer towers at the quayside. The silos had a capacity of 120,000 MT, divided in 48 cells 2,500 MT each, plus 50 smaller cells 500 MT each for emptying the large cells leaving room for a full vessel load. Loading onto trucks took place directly from the silos, in total four truck weigh bridges were also part of the facility.

Figure 2: Port of Beirut grain import facility



Source: HPC | Image: Google Earth

Given the fact that the facility, which was almost 40 years old, is completely destroyed and the vacuum and conveyor setup with a relatively low suction speed of 600 MT/hour caused the bulk discharge to be much slower and thus more expensive than it should be, it is recommended to develop a new state-of-the-art facility for future bulk operations. This new facility would be built at the most suited location within the port and will be dimensioned according to the forecasted volumes for grain import.

Civil infrastructure review

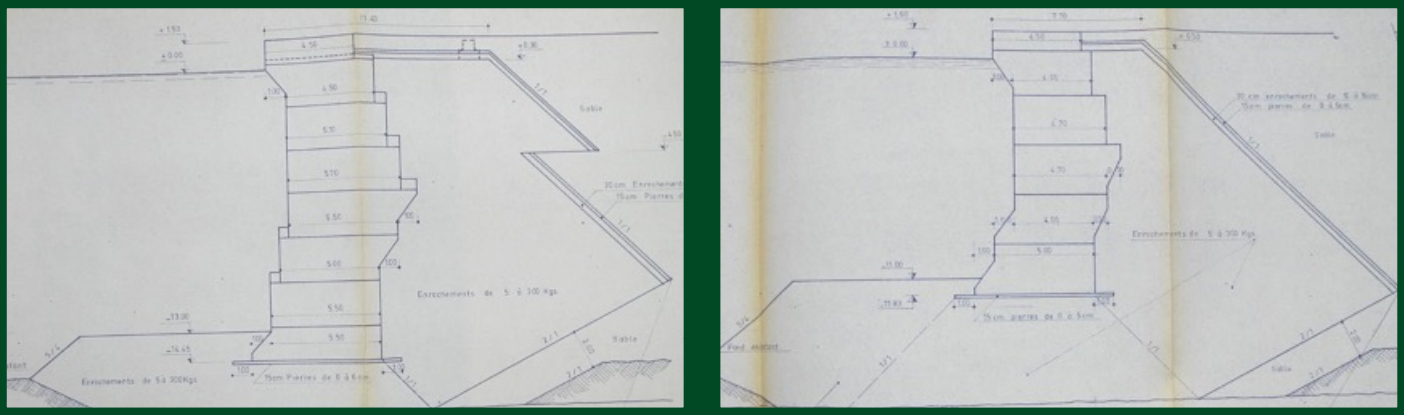
Introduction

The below chapters provide a general high-level description of the main civil infrastructure items within the Port of Beirut, particularly surrounding the explosion site, to understand the main facilities affected by the explosion and to provide initial ideas for consideration for further studies and investigations. The report prepared by the Management and Investment of the Port of Beirut, dated 24th of August 2020, was used as the basis for this stocktaking task, in particular for buildings and in addition to the use of Google Satellite imagery. It should be mentioned that the Consultant was unable to undertake a site visit to confirm the information provided within said report and therefore considers it as factual and accurate for the purposes of this high-level stocktaking task.

Quay walls

The Port of Beirut has 16 quays with varying lengths and depths. It is understood that the majority of the quays are constructed as concrete block walls type (see cross sections below) while the new extension at Quay 16 (approx. 500m) is constructed as a piled deck structure.

Figure 3: Cross sections at Quays 12 (left) and 13



Source: HPC

As apparent from the photography and satellite imagery, a large section of Quay 9 (approx. 160m of quay wall and adjacent apron/terminal area, approx. 1 ha) was completely destroyed. In order to correctly estimate the level of damage of this quay, extensive structural assessments are required to be undertaken both above and below the water level to determine the extent of damage and to accurately understand the options for the quays repair/rebuilding.

In addition to the obvious damage to Quay 9, it is strongly recommended that extensive structural assessments be undertaken on all quays in the direct vicinity of Quay 9 in order to determine if any damage has been caused by the catastrophic explosion and subsequent aftershock that occurred. It is not common practice that the structures would be designed to resist such a blast.

Therefore, the Consultant would strongly recommend that in-depth inspections are completed for these critical infrastructure items as soon as possible, in order to assess whether the explosion caused any changes in the structural integrity of the quays (shifting or damaging of blocks, foundations, etc.). Depending on the observed damages to the quays in the closest proximity to Quay 9, additional surveys may also be deemed necessary to the quays situated further from the blast radius.

In the case that major works is required for the repairs/rebuilding of quay walls, a general budget figure of quay wall construction between 50 - 90,000 USD per m of quay wall could be expected to provide an indication of possible cost implications. This figure serves only as an indication as the costs are dependant, amongst other things, on the type of construction, water depths, design loads, etc.

As previously stated, this item can have a major impact on the financial costs of rebuilding the port back to its previous state.

Pavement

Pavement structures are important to allow for safe and efficient travel of vehicles and equipment throughout a terminal. The Port of Beirut has various pavement structures varying from bitumen, concrete and block pavers throughout the terminal areas. The below figure shows an example of some pavement structures within the port taken from available as-built drawings.

Figure 4: Example of pavement structures

Source: HPC

No information was provided on the status of the pavements or its conditions, however due to the observed amount of debris in the provided photos, it can be assumed some pavement areas have been damaged to varying degrees. Visual surveys in conjunction with pavement testing should be undertaken to ensure the overall usability of the pavement.

To understand potential costs, as a general guide for the construction of pavement in a new construction, pavement structures are generally considered to be in the range of 50-100 USD per m depending on the type of use.

Utilities

Utilities (potable water, firefighting, sewage, electricity/IT and storm water drainage systems) are critical facilities of any port and logistic area. It is understood that utilities are provided throughout the different port areas with the use of underground or semi-buried concrete channels, pipes and cables ducts.

Following the explosion and subsequent shock wave, such services may have been damaged due to excessive vibrations and/or shifting of foundations, which in turn may have damaged the concrete channels, pipes or ducts.

No information was provided on the status of the networks or their observed conditions. However, as an example as seen in the figure adjacent (potable water network, blue lines), a section of the potable water network ran directly through the location of the explosion, thereby rendering through least this section of the network unusable.

Due to the importance of such services, it is highly recommended that the full extent of utility networks surrounding the explosion are surveyed for damage It also needs to be determined that their capacities are in line with their designs.

Facilities such as sewage treatment/pumping stations and electrical sub stations shall also be inspected as part of the utility systems. The following electrical and water facilities were recorded in the report prepared by the Management and Investment of the Port of Beirut (24th August 2020), with their associated damages:

Figure 5: Facilities condition

Facility	Condition
Electrical/Substations	
Power Plant	Minor damage
LT1	Unknown
LT2	Minor damage
LT3	Minor damage
LT4	Partial damage
LT5	Total loss
LT6	Total loss

Facility	Condition
Water/Water treatment	
SR1	Total loss
SR2	Total loss
SR3	Total loss
SR4	Total loss
SR5	Total loss
Main Water Tank	Various damages

Source: HPC

To understand potential costs, as a general guide for the construction of utilities (potable water, firefighting, sewage, electricity/IT network and storm water drainage systems), in a new construction, utilities are generally considered to be in the range of 30-60 USD per m^2.

Basins/water areas
Within the port there are 4 basins (basins 1-4), with depths ranging from -3 to -11 m. Following the explosion, much of the debris was scattered throughout the terminal. It is therefore recommended that hydrographic surveys are undertaken in each of the basins to ensure that major debris is not present, thereby ensuring that the basins, operational depths are guaranteed.

Buildings
Surrounding the explosion site, varying extents of damage are apparent to all the buildings within the port, with many buildings being considered a total loss/write off based on the available information provided within the report and examination of satellite imagery. The following tables provide a general summary of the major building structures based on the available data. The layout prepared by the Consultant aligns with the buildings listed below.

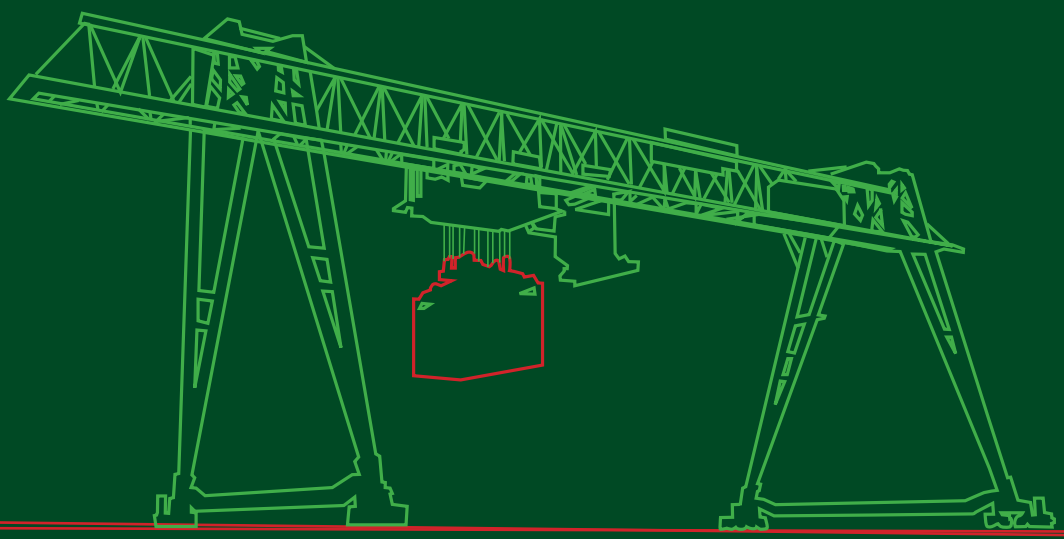


Figure 6: Buildings condition

General Warehouses

Warehouse	Approx. Size m	Condition
5	4070	Total loss
6	3510	Total loss
8	1909	Total loss
9	4400	Total loss
10	4400	Total loss
11	4400	Total loss
12	5200	Total loss
13	6720	Total loss
14	6720	Total loss
15	7840	Total loss
17	6600	Total loss
18	7700	Total loss
19	8250	Total loss
21	5200	Total loss
AR	7500	Total loss

Administration (CATAC) Buildings

Admin Buildings	Condition
CATAC A	Minor damages
CATAC B	Significant damage
CATAC C	Minor damages
CATAC D	Minor damages

Miscellaneous Buildings

Building	Condition
Silos	Total loss
Ferry Passenger Building	Unknown/unclear
Garage	Total loss
Lot G Building	Minor damages
Fire Station	Unknown/unclear
Misc. Building (1 Misc.)	Unknown/unclear

Source: HPC

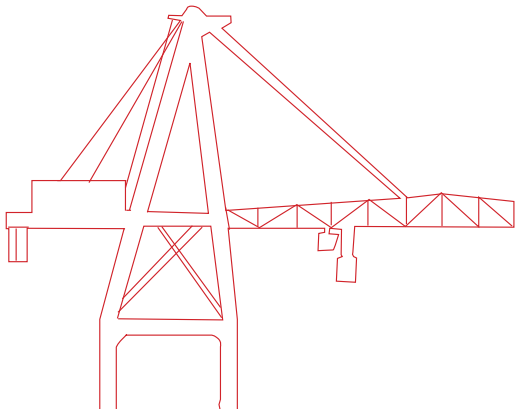


Figure 7: Free zone buildings condition

Free Zone Buildings	Approx. Size m^2	Condition
Building 2 (Free Zone Shop)[2] (2 FZ)	4000	Major damage
Building 3 (Carpet Bazaar) (3 FZ)	2800	Major damage
Building 4 (4 FZ)	3626	Total loss
Building 5 (5 FZ)	4000	Major damage
Building 6 (6 FZ)	4000	Major damage
Building 7 (7 FZ)	2500	Major damage/Total loss
Logistics Building 1 (1 FZL)	3600	Major damage/Total loss
Logistics Building 2 (2 FZL)	10600	Major damage/Total loss
Logistics Building 3 (3 FZL)	9000	Major damage/Total loss

Source: HPC

Buildings not considered a total loss should be thoroughly assessed by an experienced civil engineer to evaluate their structural integrity and to determine the most suitable rehabilitation measures.

Recommendation

Quay Walls
Quay walls should be thoroughly inspected to determine the extent of damages and the associated requirements for repair or replacements of quay wall sections. Extensive inspections should be undertaken in the closest proximity of the blast, with a decreasing level/frequency of tests being performed ad-hoc depending on the damage observed as the distance from the blast incidence zone is increased.

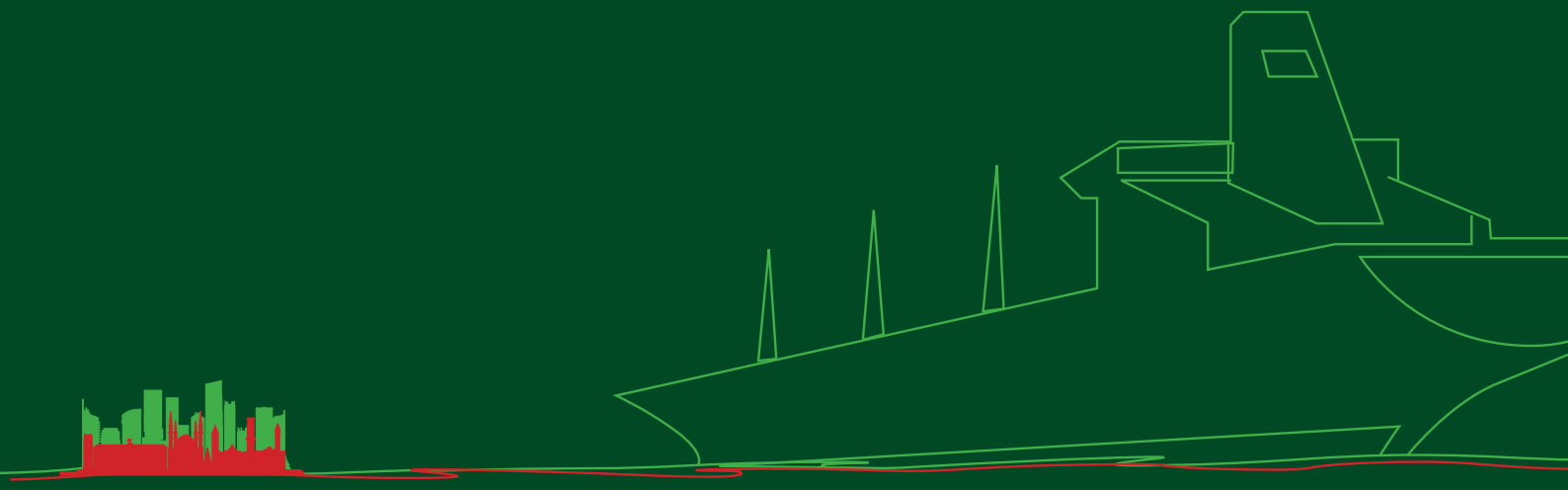
Preliminary inspections could include a visual assessment to observe any obvious shifting of blocks examining their alignment/position both over and above the water and to check for any visible damage in the quay blocks. In conjunction with the visual assessment to determine general alignment/position, topographic/bathymetric surveys may be completed along the quay walls to make a comparison with the as built drawings, thereby allowing an assessment of possible movements of the blocks and foundations. These preliminary checks should be completed by a detailed assessment of structural integrity of the quays with regard to any changes that may have been caused by the explosion (displacement of blocks, damages, etc.).

Utilities
Utility network functionality testing can be initially completed with a simple capacity check ensuring outputs align with their original designs (e.g. adequate water pressure for water network at taps/buildings). In the case of obvious discrepancies, or when a complete lack of delivery of a utility is observed, further detailed investigation will need to be undertaken which may involve excavation of sections to visually and physically test for leaks or disruptions in electrical or IT cabling.

Pavement
Pavement inspection can primarily be completed with a visual inspection to determine any major damages to areas. When more detailed information is deemed necessary, non-destructive testing e.g. deflection, GPR or profile testing, or destructive testing measures such as coring or DCP tests may be required for a more accurate determination of a pavements' residual strength.

Basins
Hydrographic surveys should be completed within the basins to ensure that they are free of debris resulting from the blast, thereby guaranteeing the stated basin depths and ensuring future vessels safe mooring areas.

Buildings
Buildings that still remain and are not classified as a total loss should be thoroughly assessed by an experienced structural assessment contractor to determine the full extent of damages, thereby allowing a comprehensive set of repair and rehab.



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