

# PROJECT SHEET

**KHALIFA PORT AND INDUSTRIAL ZONE (KPIZ) PROJECT, ABU DHABI**  
MARINE ENVIRONMENTAL MONITORING /  
FEBRUARY 2008 – SEPTEMBER 2010

## INTRODUCTION

The overall KPIZ Project development includes the relocation of Port Zayed from central Abu Dhabi to Al Taweelah. The new port will be developed on an artificial island and a separate berth island located approximately 4.6 km from shore and connected to the land by causeways and bridges. KPMC is responsible for the design and construction of marine structures, dredging and reclamation for the new port. The dredging and reclamation works of the KPIZ Project, which are being executed by Boskalis, consist of dredging an approach channel and port basin (total dredging volume of 45 million m<sup>3</sup>). The dredged material is used for the construction of a port island and the accompanying causeways to the two bridges, covering a total area of approximately 3.3 km<sup>2</sup>. In addition, the port construction includes breakwaters (8.5 km), revetments (15 km) and quay walls (4.5 km), executed by Consortium partners Archirodon and Hyundai. Marine environmental setting of the port The Ras Ghanadah coral reef is located less than 1 km east of the project area. This area is of global significance and the largest most single pristine stretch of coral communities in the Gulf (Halcrow et al, 2006\*). A 7 km long environmental breakwater is under construction to protect the coral reef area, both during the construction and operational phases of the Port. In addition to the vulnerable coral reef, seagrass fields are located near the project site. They provide a habitat for various forms of marine life, including some protected species such as the dugong (*Dugong dugon*), green turtle (*Chelonia mydas*, photo c) and Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*).



## FEATURES

Client	Abu Dhabi Port Company (ADPC)
Location	Abu Dhabi, United Arab Emirates
Period	2008 / 2010
Contractor	Boskalis Middle East Ltd (dredging & reclamation) as part of Khalifa Port Marine Consortium (KPMC)



**A** Location map

**B** Coral reef in the Gulf region

**C** Seagrass fields are located near the project site, providing a habitat for various protected species such as the hawksbill turtle (*eretmochelys imbricata*). This particular turtle is being relocated from the project site to the seagrass fields

## MARINE ENVIRONMENTAL MONITORING PROGRAM

In order to monitor the impact of the construction works on water quality, which is directly related to the quality of the coral reef, an extensive monitoring program has been set up. The monitoring program is implemented to ensure the works comply with the water quality and sedimentation restrictions. The monitoring activities focus on different aspects:

- continuous real-time turbidity measurements at 14 permanent monitoring stations around the project and the environmentally sensitive areas
- daily mobile measurements of turbidity around all operations
- daily synoptic measurements of turbidity around work areas
- a three-monthly visual inspection of the coral reef area.



In addition, wave, current, tide and weather stations were installed to measure the hydrodynamic and meteorological background conditions for the site (photo d, next page). The marine monitoring program is set-up and executed by Hydronamic, the in-house engineering consultant of Boskalis.

### HYDRONAMIC'S ENVIRONMENTAL ENGINEERS

Over the past decade, Hydronamic has gained extensive experience in environmental monitoring around dredging works as the demand from clients to monitor the impact on the marine environment related to dredging works has increased. In collaboration with the Boskalis survey & electronics department, the IT department and the Boskalis Dolman laboratory, Hydronamic has further professionalized its environmental monitoring on the basis of experience from completed projects. During its environmental monitoring activities, Hydronamic plays a leading role in the preparation of environmental monitoring plans, and posts qualified and experienced Environmental Managers and Environmental Engineers to Boskalis dredging projects.

### PERMANENT MONITORING STATIONS

All permanent turbidity monitoring stations are equipped with sensors measuring turbidity (NTU). All real-time turbidity data collected at the fixed monitoring stations is transmitted to an onshore online database and is immediately available for both the contractor and the client via a web server. A detailed turbidity response procedure has been established in consultation with the client, allowing preventive measures to be taken swiftly if water

quality threatens to exceed limits. Given strict environmental standards and limits, immediate response requires monitoring day and night, 365 days a year (photos e and f).

### MOBILE MONITORING ACTIVITIES

Another measure to ensure that water quality limits at the sensitive receptors surrounding the project are not exceeded comprises daily mobile turbidity measurements downstream of dredging equipment and reclamation outlets to establish the footprint of any turbidity plumes. A dedicated monitoring vessel takes these measurements. Hydronamic also used the data measured around dredging equipment to validate the numerical plume model used to predict and mitigate sediment plumes in future construction phases (photos g and h).

### CORAL REEF SURVEY

Every three months, video and photographic surveys are conducted to inspect two fixed 1 km transects along the coral reef. A number of frames with sedimentation traps are positioned at different locations around coral patches on the coral reef to identify possible sedimentation of fine material and to identify any possible deterioration of the coral reef over time. During each monitoring campaign, the patch within the frame is photographed and the amount of deposited material is measured. This information is then compared with previous surveys to determine any significant changes in the coral reef.

### ADDITIONAL MONITORING

Water samples are taken weekly at all dredging and reclamation activities and analyzed for suspended solids concentrations [mg/l], particle size distribution and various chemical and biological parameters such as dissolved oxygen, biological oxygen demand and nutrients. An onsite laboratory was build up to carry out immediate analysis (photo i).

### CONCLUSIONS

The environmental monitoring program at the KPIZ project was successfully executed against the background of the extremely strict environmental requirements and limitations. Exceedance of water quality limits has been very limited and was always dealt with promptly and adequately. In addition, external surveys conducted throughout the execution of the project have shown that the impact on the sea grass and the coral reef has been minimal.



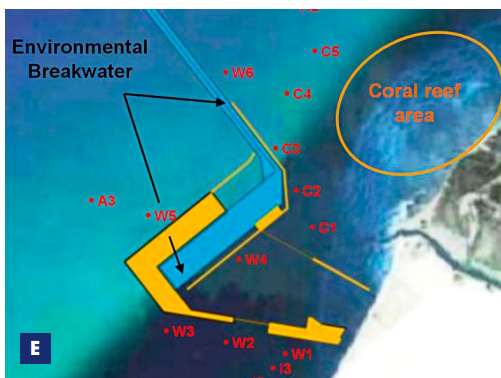
**D**



**F**



**G**



**E**

- D** Daily mobile turbidity measurements are taken downstream of dredging equipment and reclamation outlets to establish the footprint of eventual turbidity plumes.
- E** Wave, current, tide and weather stations were installed to measure the hydrodynamic and meteorological background conditions for the site.
- F** One of the permanent turbidity monitoring stations, equipped with sensors measuring turbidity (NTU).
- G** The measurements are taken with a dedicated monitoring vessel.

Royal Boskalis Westminster N.V.  
PO Box 43  
3350 AA Papendrecht  
The Netherlands  
T +31 78 69 69 000  
F +31 78 69 69 555  
royal@boskalis.com  
www.boskalis.com