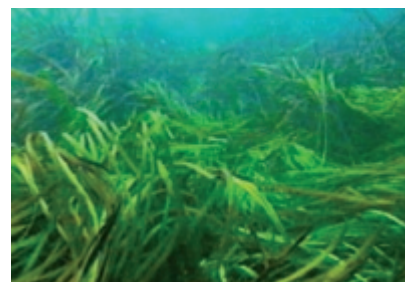


#### Haddrah fishing

Up to 81 haddrahs may be affected by the project.

Impacts such as *habitat loss*, *coastal morphology*, *noise* and *air pollution* and *groundwater* were also assessed.

*Effect of sediment spill  
from dredging on seagrass.  
Before and after...*



*Seagrass beds near the causeway*

## Mitigation Measures

#### Regional Mitigation

##### "Zero solution"

It was decided to adopt a so-called "zero solution", i.e. the causeway should not affect the exchange of water and salt between the Arabian Gulf and Dahwat Salwa. Numerical modelling showed that this could be achieved with 22 km of bridges and the dredging of two shipping channels.

#### Culverts for shrimp larvae

Culverts were introduced into some of the long embankments to improve the migration of shrimp larvae from north to south.



*Marine monitoring*

#### Local Mitigation

##### Sediment spill

Constraints will be placed on the dredging operations and choice of dredging equipment to minimise the temporary impacts.

##### Reclamation

Sediment spill at reclamations can cause serious impacts and it was decided to reduce the spill to a minimum level by making all reclamations behind encircling bunds.

##### Environmental Enhancement

Not all impacts are negative. For example, bridge piers and rock bunds act as artificial reefs and attract fish, crustaceans and shell-fish. Also, reclaimed areas can become attractive to birds for feeding, resting and nesting.

#### Environmental Management Plan

An Environmental Management Plan was established to ensure that the construction contractor followed the environmental protection requirements which were defined in the EIA. The plan includes detailed marine monitoring.

Project period:  
2001 – 2002

Client:  
Ministry of Municipal Affairs and  
Agriculture, Qatar

#### COWI

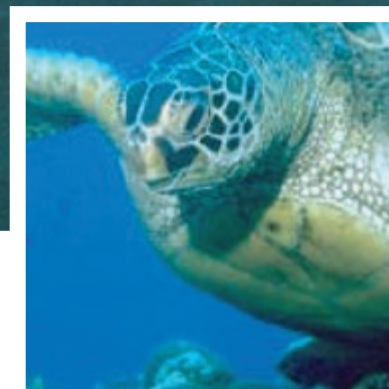
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0214-1301-003e-00a / COWIprint

## Environmental Impact Assessment Qatar – Bahrain Causeway



Support to the entire process, from  
reference study to approval by the  
environmental authorities.

# COWI

in association with

**DHI**  
WATER & ENVIRONMENT





The governments of Qatar and Bahrain have investigated the construction of a causeway between the two countries. It is a major civil engineering project consisting of 40 km of high and low bridges and embankments, shipping channels and customs and immigration facilities.



## Reference Study

The present state of the environment is described in the reference study and forms the basis for assessment of the environmental impacts of the project.

### Hydrography

New, accurate soundings of the area were made along with recordings of water levels, currents, wind, waves, temperature and salinity. The flow in the strait between Qatar and Bahrain is dominated by the tide.

### Water quality

Water samples were taken at 44 stations and analysed for nutrients, dis-

solved oxygen and biological and chemical oxygen demand.

### Marine ecology

The marine surveys revealed extensive beds of seagrass which act as nursery areas for shrimp larvae and feeding grounds for dugong. Surveys were also made of macro algae, coral and other benthic flora and fauna.

### Terrestrial ecology

The landfall areas for the highway are desert with sparse vegetation and animal life, all of which are common in the region.

### Birds

Over 40 species of birds were identified including the Socotra Cormorant which, although not on the “red list” of endangered species, is classified as “vulnerable”.



Socotra Cormorant

## Important Environmental Issues

The major regional environmental concerns are the possible reduction of the exchange of water and salt between the Arabian Gulf and Dahwat Salwa, which could have far-reaching impacts on the marine ecology, and the possible impact on the shrimp fishing industry.

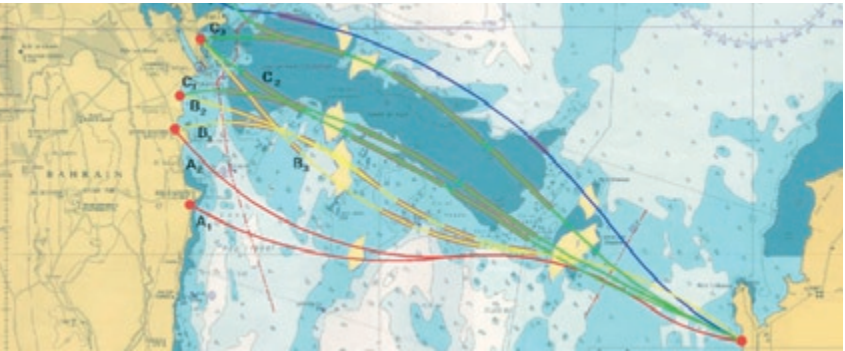
Local concerns are centred on the impact of sediment spill from dredging and reclamation on seagrass and coral.

### Protected areas and historical/archaeological sites

The highway on the Qatar side is close to some protected conservation areas and the archaeological site of old Zubara town. The route was chosen to avoid these areas, with the exception of the Oryx Sanctuary which will be moved to another location.

### Fisheries

Shrimp fishing is an important commercial activity on the Bahrain side with catches in the order of 2,000 tons per year. Up to 7,000 tons of fish are also caught each year in traps (gargoor and haddrah) and nets.



Alternative alignments studied



Gargoor fisherman

### Comparison of Alternatives

10 possible alignments were originally proposed for investigation. These were compared using a score-card technique in which environmental considerations were the most heavily weighted. A single alignment was chosen for the detailed EIA.

## Assessment of Impacts

### Regional Impacts

#### Blocking of flow

Numerical modelling of the tidal and wind driven hydrodynamics was carried out to analyse the changes in the exchange of water and salt between the Arabian Gulf and Dahwat Salwa due to the construction of the causeway. Various combinations of bridges, embankments, shipping channels and compensation dredging were studied and

gave reductions in exchange up to 1.4%, but also an increase up to 1%.

#### Shrimp larvae

The shrimp spawning grounds are north of the causeway, and after hatching, the larvae are transported south by the tide to the nursery areas. Model calculations showed that the transport, and subsequent catch, would be reduced by 1-2%.

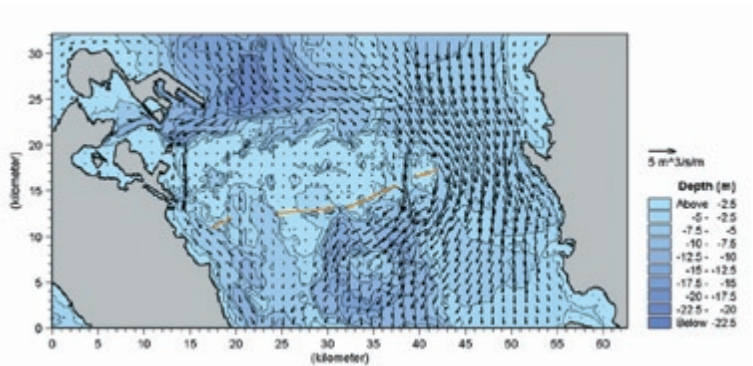
### Local Impacts

#### Sediment spill

The sediment spill during dredging and reclamation can cause by far the most serious impacts during construction. Modelling studies showed that coral communities may be affected and seagrass in an area of 4-5 km<sup>2</sup> around the dredging sites will be impoverished.



Green Tiger Shrimp



Modelled flow (m³/s) at maximum south going current with causeway and shipping channels