

# CAPABILITY SHEET

## UNDERWATER SOUND

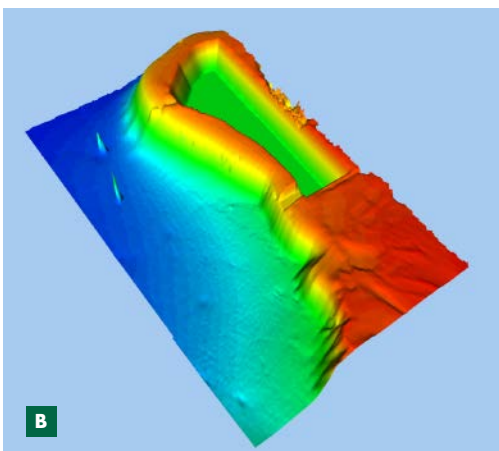
AN OVERVIEW OF THE EXPERTISE AND EXPERIENCE OF BOSKALIS WITH UNDERWATER SOUND

### LOUDER OCEANS

Underwater sound is a rapidly developing field in the maritime world, fueled by legislator and public concerns on impacts of operations on marine mammals. These concerns become evident in guidelines from the World Bank and regulation emerging in the EU from the Marine Strategy Framework Directive. Limits and monitoring requirements are becoming a reality for many off-shore projects. While scientists commonly agree sound impacts originate from short, intensive operations such as blasting and offshore piling, longer continuous operations such as dredging sounds can occasionally disturb marine mammal populations as well. With more than a decade of experience with underwater sound impact and mitigation Boskalis understands the concerns and is committed to execute projects while protecting the environment in the most effective manner.

### BOSKALIS APPROACH

Following the Building with Nature guidelines Boskalis aims to incorporate environmental opportunities and concerns in the early stages of project development to enhance project design, realize integral benefits and streamline permit application processes. Understanding mammal behavior (e.g. migration patterns or seasonal changes) can greatly reduce the impacts of underwater sound and minimize unnecessary and costly mitigation measures. As the underlying processes are highly site specific and not always fully understood, adaptive strategies can be implemented to effectively manage sound impacts and mitigation measures, based on the monitoring of sound levels and possible behavioral changes of marine mammals in the area.



**A** Humpback Whales in Gabon

### ADAPTIVE MANAGEMENT OF BLASTING OPERATIONS

Boskalis owned subsidiary(s) Rockfall and Terramare have more than a decade of experience in adaptive underwater sound monitoring and management. For projects the sound levels and pressure waves related to impacts from blasting prior to the execution are estimated. Depending on the outcome the blasting techniques are amended to the local environment and to minimize impacts on sensitive receivers. Sound levels are frequently monitored during the execution and used to validate estimations and to adjust work methods both during the project execution and knowledge input for future projects.

### ADAPTIVE PROJECT PLANNING & DESIGN

The same concept is used for dredging. Conducting sand mining for a new fertilizer plant in Gabon the design of the project area was adapted to contain the majority of the underwater sound produced by the cutter suction dredger. This adapted project design in combination with project planning minimized the impact on the breeding humpback whale population of Port Gentil Bay and ensured no exceedances of the limits enforced by the International Finance Corporation who financed the project.

**B** Dredging design 3D

*In Gabon the deep natural harbor provided a key Humpback nursery area, allowing the whales to protect their young from predators. A lagoon was dredged (right side of picture) to ensure that the natural side of the bay was maintained between the dredger and the whales. This reduced the noise levels underwater below the expected impact levels for the whales. During the season the whales arrived during dredging and stayed in the area.*

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### ACTION IN THE FIELD

When in areas important to marine mammals our vessels have Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) onboard. This allows us the capability to see and hear marine mammals in the work area. If work threatens the mammals, it is stopped until they have safely left the area. This mitigation technique is regularly used on our fallpipe vessels, such as recently on the Kintyre-Hunterston project.

### IN-HOUSE KNOWLEDGE DEVELOPMENT

In-house underwater sound monitoring of different vessels and modus of operation, together with strategic collaboration with leading experts in the field has enabled us to develop unique insight in local sound impacts and the effectivity of mitigation measures. Recent measurements in Qatar during a channel deepening project with newly designed dredging equipment



**D** Sam Cheeseman Subacoustech conducting sound monitoring

*Boskalis works with our partners in the industry for more than a decade not only for best practice but also for research and development. Here Sam Cheeseman from Subacoustech is measuring and monitoring the sound from the dredger, to ensure the safety of the whales in Gabon.*

**C** Short Beaked Common Dolphin IS during MMO

*Scotland is rich in marine life and marine mammals are a major concern for Boskalis. Here one of our Marine Mammal Observers catches a picture of a Short Beaked Common Dolphin from the Rockpiper. The Observer(s) carefully use their authority to stop the work to ensure, pictures like these are a thing of the future.*

demonstrated rock up to 90 MPa can be dredged without increased underwater sound levels.

Boskalis in the Joint Venture Offshore Wind Force (OWF) has growing experience in mitigation of underwater noise on offshore windfarm piling both with monopole and jacket foundations. Work method design and mitigating measures are subject to continuous improvement. These include but are not limited to the use of bubble screens, hydro sound dampers and low energy high frequency pile driving. These mitigation techniques are actively implemented on the offshore windfarm projects Wikingen and Veja Mate. Noise generated by our activities are actively monitored and results fed back to the installation vessels for further fine tuning our piling operations and into the choice of mitigation measures applied.

### FUTURE TRENDS

The demand of the industry for more accurate impact predictions of underwater sound has inspired the development of a variety of sound propagation models by monitoring companies and consultancies. Boskalis is improving these models by keeping strong ties with these parties, contributing monitoring data and providing measurement opportunities to validate data.

While significant progress is made on the quantitative assessment of source levels for an increasing number of vessels and operations, the behavioral impact of marine mammals and fish remains relatively unknown. Ideally, the latter forms the basis for the definition of effective sound management protocols during maritime operations. To accomplish this Boskalis is actively promoting research in this field together with partners in industry and research institutes.