

FACT SHEET

CREATING A SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE

WHAT IS MARINE AND FRESHWATER INFRASTRUCTURE?

Marine and freshwater infrastructure consists of structures built where land and water meet, constructed in relation to navigation channels and waterways, ports and harbours, levees and dikes, offshore energy production, and to nature-based infrastructure such as islands, beaches and dunes, wetlands, reefs and many other forms of habitat.

WHAT IS SUSTAINABILITY?

Sustainability in the context of infrastructure development and dredging can be defined by the following operational definition, in line with the definition proposed by Brundtland et al., 1987:

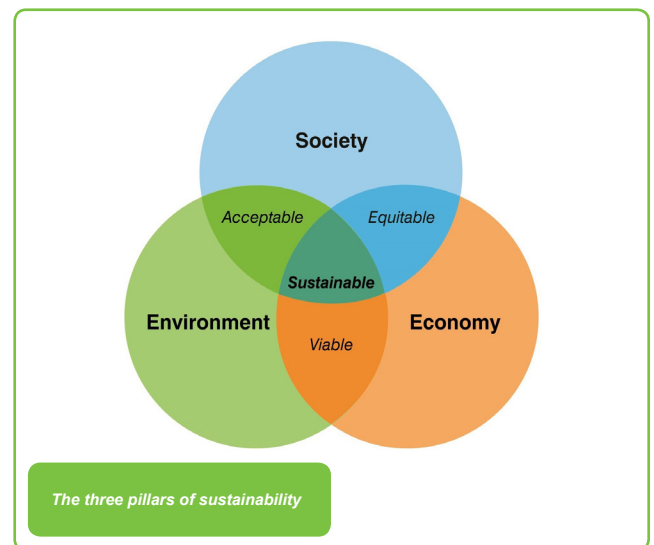
'Sustainability is achieved in the development of infrastructure by efficiently investing the resources needed to support the desired social, environmental, and economic services generated by infrastructure for the benefit of current and future generations.'

WHAT IS A SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE?

A project is considered sustainable when it is beneficial to People, Planet and Profit. A project developed in a manner that addresses these "Three Pillars of Sustainability" – also referred to as Society, Environment and Economy – is more inclusive of stakeholders' perspectives by engaging stakeholders early for value-added design and innovation. Through stakeholder engagement, values are created not only with regard to the primary motivation for the project – such as a particular set of economic outputs – but also to address stakeholder interests and values.

WHAT IS THE ROLE OF DREDGING IN THE REALISATION OF A SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE?

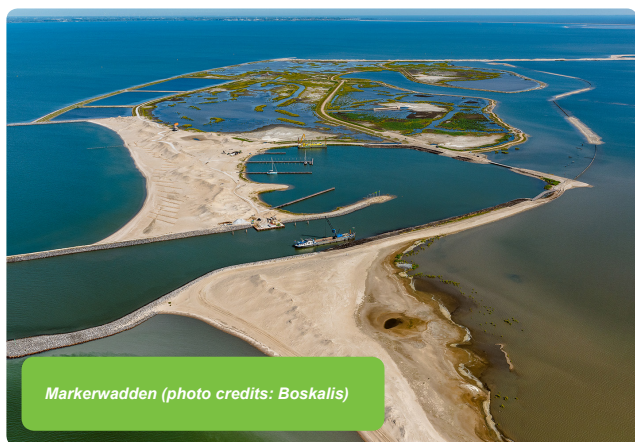
Dredging is vital to social and economic development. In particular, dredging is vital to the construction and the maintenance of much of the infrastructure upon which our economic prosperity and social well-being depend. From



the very beginnings of civilisation, people, equipment, materials and commodities have been transported by water. Ongoing technological developments and the need to improve cost effectiveness have resulted in larger, more efficient ships. This has resulted in the need to enlarge or deepen many of our rivers and canals, our "aquatic highways", in order to provide adequate access to ports and harbours. Nearly all the major ports in the world have at some time required new dredging works to enlarge and deepen access channels, provide turning basins and achieve appropriate water depths along waterside facilities.

Recent decades have also seen the increasing use of dredged materials in dealing with the implications of sea-level rise, e.g. by beach- or shoreline nourishment. These schemes are designed to prevent erosion or flooding. Such nourishment or recharge is achieved by placing dredged sand or gravel on eroding shorelines. This represents a "soft-engineering" solution, an important alternative to structural solutions such as rock armour or concrete walls. Dredging can furthermore be undertaken to benefit the environment in several ways. Dredged materials are frequently used to create or restore habitats. Another environmental use of dredging has been in initiatives

designed to remove contaminated sediments, thus improving water quality and restoring the health of aquatic ecosystems. The removed material may be treated and used afterwards, or disposed of under strict environmental controls.



Markerwadden (photo credits: Boskalis)

HOW CAN A SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE BE ATTAINED?

The world has given an increasing amount of attention to the concept of sustainability as an approach to informing social, environmental and economic development. A milestone in the global push towards sustainability took place in 2015 when the United Nations (2015) published 17 Sustainable Development Goals (SDGs) as a part of “The 2030 Agenda for Sustainable Development”. These SDGs encompass a very broad range of interests, values and objectives. In terms of developing water resources infrastructure, the relationship of dredging to each of the SDGs varies. For example, the use of dredging to construct efficient and productive navigation infrastructure is directly connected to SDGs 2, 6, 7, 8, 9, 10, 11, 14, and 15. As a tool used to provide coastal protection and infrastructure supporting flood risk management, dredging clearly supports SDGs 1, 3, 6, 9, 11, and 13, among others. The dredging and water infrastructure community aims to incorporate these goals into the infrastructure development process while effectively communicating how such projects support each of the SDGs.



In the past 10 to 15 years, the international dredging community has embraced the ‘Three Pillars of Sustainability’ and therefore, the approach to dredging has been transformed. In the past, project developments were designed, at best dealing with negative impacts in the project design and during the construction phase. Today, projects are developed implementing a more proactive approach, where water infrastructure projects are being considered as part of the natural and socio-economic system in which they are situated, and stakeholders are being engaged much earlier in the project development process to facilitate the search for opportunities to create added value.

In the last few decades, the understanding of what constitutes costs and benefits evolved substantially beyond the direct monetary costs of dredging and the direct monetary benefits of the projects created by dredging. In addition, environmental regulations were put in place to minimise negative impacts on ecosystems. In response to these regulations, today’s dredging industry has invested in sustainability: for example by utilising new, more efficient equipment which has larger capacities and produces lower emissions, as well as by researching and developing project construction methods which produce infrastructure with longer lifespans and require less maintenance.

WHAT IS THE DIFFERENCE BETWEEN TRADITIONAL AND SUSTAINABLE PROJECTS?

The concept of sustainable development recognises the need to consider the full range of benefits and impacts related to human actions and the distribution of these benefits and costs across the social, environmental and economic domains. The relationships among these value domains are reflected by the goal to take actions (e.g. develop projects) that will balance the distribution of benefits and costs so as to produce socially equitable, environmentally acceptable, and economically viable outcomes. This balance is achieved through proactive and consistent engagement with the stakeholders who will be affected by the proposed project, including government authorities, private sector interests, local/regional/national members of the public, and the special interest groups and perspectives that are relevant to the project.



Sandscaping Project Bacton, UK. (photo credits: Van Oord)

Marine and freshwater infrastructure projects, due to the amount of investment they require, are long-term propositions. While the state of scientific and engineering practice continues to advance, there will continue to be uncertainties regarding the behaviour of natural and engineered systems over the long-term. Nevertheless, pursuit of sustainable infrastructure requires taking a broad and long-term view of a project's life-cycle sustainability. Performing such sustainability analyses could mean that some proposed projects will not be built, or that existing projects will be decommissioned and abandoned in favour of more sustainable projects.

HOW CAN SUSTAINABILITY OF SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE PROJECTS BE INCREASED?

First, by increasing the overall value of the project through the range of services it provides. This may a.o. be achieved by early in the process engaging all stakeholders, investing more time and energy in up-front visioning to identify ways of creating more project value across all three of the pillars of sustainability. One element in this process is the objective to adapt projects to nature, rather than the reverse. This concept is actively enhanced by initiatives as 'Working / Engineering / Building with Nature'.

Second, by reducing costs associated with the project, where the word 'costs' is being used in the broadest sense to include all of the monetary and non-monetary (e.g. environmental impacts) costs and resources associated with executing the project and/or producing and operating the system over time. Understanding the full set of costs (and benefits) of a project requires taking a system-scale view of infrastructure and the functions and services that infrastructure provides.

Third, by balancing the distribution of the value and costs among the social, environmental and economic domains over time. This is why a holistic approach is being employed today which integrates values within the Three Pillars of Sustainability.

The benefits generated would include all the values, services, and positive outputs generated by the project and/or system over time, both in monetisable and non-monetisable terms. Thus, comprehensive consideration and analysis of the social, environmental and economic costs and benefits of a project should guide the development of sustainable infrastructure.

HOW CAN SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE BENEFIT SUSTAINABILITY GOALS AS A WHOLE?

Commitments to process improvement and innovation in the realisation of water infrastructure leads to conserving resources, maximising efficiency, increasing productivity, and extending the useful lifespan of assets and infrastructure. Innovations in technology, engineering and operational practice provide opportunities to reduce fuel and energy requirements related to dredging and the operation of infrastructure. These same innovations can provide the means to reduce emissions (including greenhouse gases and other constituents) and conserve water and other resources. By reducing the consumptive use of resources associated with dredging and infrastructure, the sustainability of projects is enhanced. In addition, using better technologies or improvements in operational practice in order to extend the useful lifespan and functional performance of an asset (e.g. a navigation channel, an offshore island that supports coastal resilience), in a manner that lowers overall life-cycle costs, will increase the sustainability of infrastructure.



WHICH KEY ENABLERS ARE INSTRUMENTAL FOR SUSTAINABLE INFRASTRUCTURE DEVELOPMENT?

Dealing with uncertainties is an inherent part of developing sustainable solutions for water infrastructure. A broad range of uncertainties can play a role in decision-making, including uncertainties on the future natural development of the solution (and hence its long-term effectiveness), on the social/institutional acceptability of innovative solutions and uncertainties related to project progress, policy development, interdisciplinary collaboration and procurement.

The following key enablers are instrumental in managing these uncertainties:

- Aim for 'added value through multi-disciplinary collaboration';
- Achieve 'stakeholder engagement';
- Align with 'legislation, regulations and institutional arrangements';
- Assure good 'contractual arrangements for design and realisation'.



WHY ADDED VALUE THROUGH MULTI-DISCIPLINARY COLLABORATION?

The development of sustainable infrastructure solutions with added value for nature and society involves interplay of physical, ecological and governance processes. The combination of these disciplines can yield new opportunities, which will improve the feasibility of hydraulic infrastructure projects (engineering perspective), in sensitive environments (ecologist perspective), while meeting societal wishes and legislative constraints (governance perspective). Setting up collaboration between representatives of these disciplines is already challenging of itself, yet it becomes even more challenging when one realises that the development and implementation of new, innovative solutions typically generates its own resistance.

WHY ACTIVELY INVOLVING STAKEHOLDERS?

Comprehensive stakeholder engagement and partnering are used to enhance project value. Stakeholder engagement plays an important, even critical, role in the governance of infrastructure projects. The level of investment and sophistication employed in the engagement process directly contributes to the degree of success achieved through the engagement. Early investment in stakeholder engagement should be used to inform the conception and design of a project. Such engagement will provide important information about the values of interest to stakeholders and how those values can be generated by the project, in respect to the three pillars of sustainability. Furthermore, early engagement can help identify project partners who are interested in making contributions or investments toward particular values the project could produce (e.g. partnering with an NGO to perform ecosystem restoration as a part of the project). Pursued in this manner, stakeholder engagement can produce opportunities to increase the overall value of a project and to diversify the benefits produced across all three pillars of sustainability.

By devoting more effort to identifying and developing positive social (e.g. recreational, educational, community resilience) and environmental (e.g. ecosystem services, habitat, natural resources) values at the onset of the project, dredging and infrastructure projects will be able to avoid unnecessary conflicts with stakeholders while simultaneously developing a larger number of project proponents, advocates and partners.

HOW CAN LEGISLATION SUPPORT WATER INFRASTRUCTURE IS MADE SUSTAINABLY?

As with any infrastructure development, sustainable solutions need to comply with local legislation and institutional arrangements to enable successful implementation in practice. This is not always trivial. The innovative character of sustainable solutions (such as the implementation of a natural foreshore to ensure safety against flooding instead of a traditional dike reinforcement scheme) may for instance not immediately align with existing assessment frameworks to evaluate the effectivity of the proposed solution. A proactive attitude is needed to meet any legal and institutional constraints imposed to the project.

Central to a successful permit application process is the early involvement of legislators in project initiation and design. By doing so, even if plans are only very premature and the contours of possible solutions are only very vague, possible impediments in existing legislation are identified at an early stage and consequently, there is time

available to undertake appropriate actions. Such actions can involve a variety of approaches, including an update of existing regulations, a critical review of the interpretation of existing regulations, re-consideration of the envisaged solution within the limitations imposed by law and, finally, commencement of a research programme to demonstrate compliance of the sustainable solution with regulations at hand. As regulators play a decisive role in all this, it is important to involve them throughout the entire project development process and maintain open communication channels.

HOW CAN GOOD CONTRACTUAL ARRANGEMENTS SUPPORT SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE DEVELOPMENT?

Application of sustainable development principles in hydraulic infrastructure projects can introduce new challenges for successful project procurement. Two key issues play a role in that respect:

1. *Evaluation of integral costs and benefits* – Sustainable solutions usually address more than one objective, and aim to include extra benefits for nature and society next to the primary function of the proposed infrastructure. This implies such solutions cannot be evaluated on the basis of monetary costs alone, but require a broader, more integral evaluation. Project contracting on the basis of Most Economically Advantageous Tender (MEAT) offers a good basis for that.
2. *Handling uncertainties* – As stated, sustainable solutions are inherently associated with uncertainties. These can cover a variety of issues, including uncertainties on future natural development, its operational effectiveness during the lifetime of the infrastructure, the outcome of the envisaged cost-benefit analysis and the societal acceptance of innovative, sustainable solutions. Whereas the more traditional arrangements (Build-only, Design and Construct) aim to assess and handle such uncertainties prior to contract award, new arrangements like alliance contracts (Public-Private Partnerships - PPPs) aim to settle these on the basis of increased knowledge and insights developed during project preparation, applying the concept of Adaptive Management. Setting up and operating an alliance contract relies on open collaboration and demands a different procurement process.

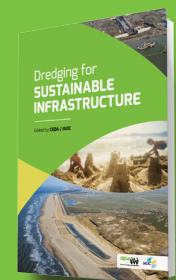
When investment decisions are being made on the basis of the overall sustainability of the project, then we will know that the concept of sustainability has been successfully incorporated into the governance of infrastructure systems.

HOW CAN PROJECT INITIATORS BECOME MORE INFORMED ABOUT REALISING SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE PROJECTS?

Project owners, regulators, consultants, designers and contractors looking for an up-to-date reference of solutions for designing, implementing and managing marine and freshwater infrastructure projects with a dredging component should find the guidebook *Dredging for Sustainable Infrastructure* to be an essential tool. The book translates the concept of sustainability into practical approaches for designing, evaluating, operating and monitoring water infrastructure projects involving dredging. The book's insights result from a wealth of knowledge pooled by a team of scientists and practicing industry experts which was moderated by an Editorial Board comprised of representatives from IADC and CEDA.

THIS FACT SHEET IS BASED ON THE BOOK *DREDGING FOR SUSTAINABLE INFRASTRUCTURE*

The book *Dredging for Sustainable Infrastructure* gives state-of-the-art guidance on how to design, implement and manage a water infrastructure project with a dredging component to project owners, regulators, consultants, designers and contractors.



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