IMDC

International Marine and Dredging Consultants (IMDC) is an engineering and consultancy company specialized in a vast range of water related projects. Our highly qualified staff offers advice based on recent research results of leading universities and research institutes and hands-on experience acquired throughout the years. One of IMDC's core activities is presented in this booklet: Integrating nature-based solutions in waterfront adaptive strategies.

More information can be found on our website www.imdc.be

Integrating Nature Based Solutions

Urbanisation is accelerating around the world and is expected to continue through the present century. About 60 % of the world's population live within 100 km of the coast. Climate change-related hazards combined with anthropogenic impacts affect hundreds of millions of people as well as important infrastructure and economic activity, and are responsible for substantial economic damage and loss. These impacts will continue to worsen with continued population growth and urbanisation.

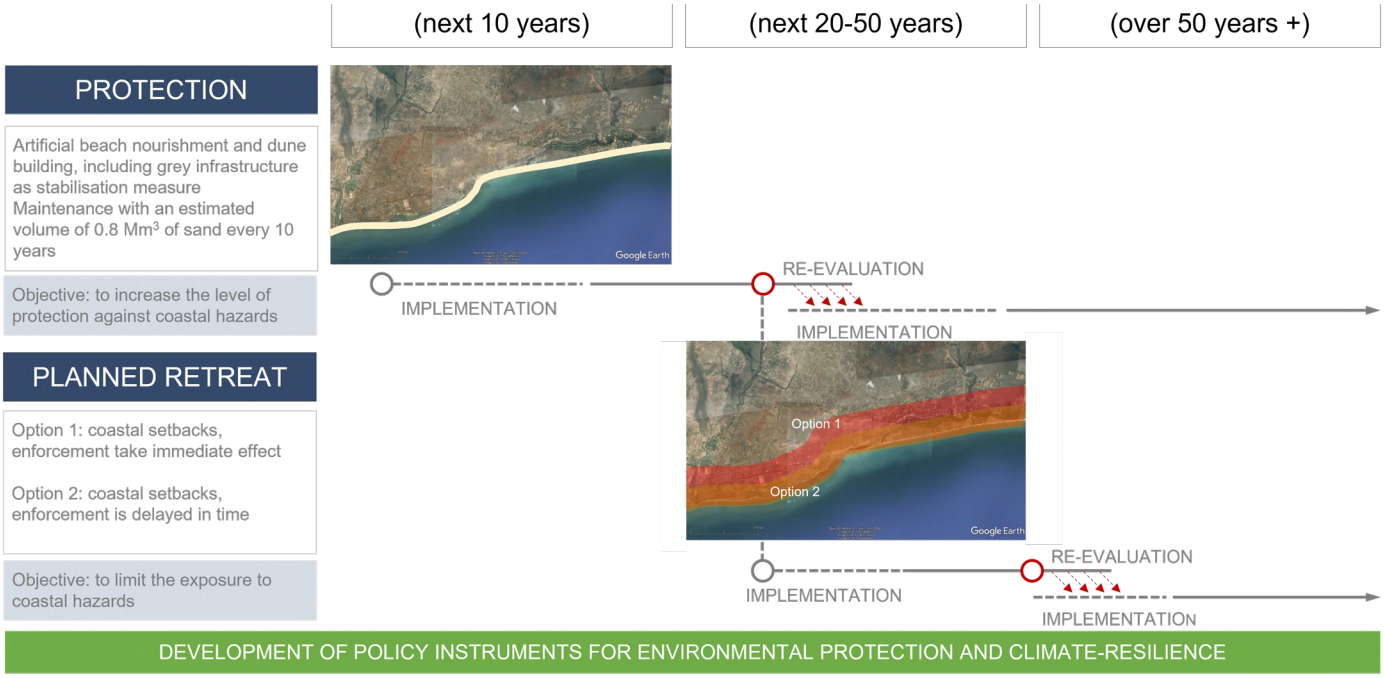
IMDC is committed to help create more resilient and liveable regions within coastal and inland areas vulnerable to climate change and anthropogenic impacts, by promoting the broad integration of nature-based solutions (NbS) with adaptive strategies. NbS can be used to provide multiple benefits such as water purification, biodiversity, clean air, or social effects such as improved public health and many more. This is especially important in the face of climate change and increasingly stronger flood, drought, and climatic hazards.

At IMDC, we define Nature-based Solutions as: *"Integrated approaches that work with and enhance natural systems to address societal challenges such as climate adaptation, water management, biodiversity loss, and coastal resilience. These solutions include the protection, restoration, and sustainable use of ecosystems, but also embrace engineered interventions that incorporate ecological principles, such as* ***Building with Nature*** *and* ***Nature Inclusive Design****. Our approach values co-benefits for nature and people, supports long-term resilience, and is tailored to local environmental and cultural contexts."*

The traditional approach to manage those risks has been the implementation of 'grey' infrastructure. However, this infrastructure is generally not easy to adapt to changes in environmental conditions and can still be vulnerable to low-frequency, high-impact hydro-meteorological events. It is now recognised that natural habitats such as dunes, wetlands, and mangroves can substantially reduce exposure and vulnerability. Additionally, if designed properly, they are also naturally adaptable to changing environmental conditions. On top of all that, utilising natural habitats can also provide additional ecosystem services beyond coastal protection, such as increasing biodiversity and carbon storage.

Starting from the basic premise that a living-built environment is more sustainable, potentially more affordable, and provides a more resilient protection, IMDC wants to consider in all its projects whether nature-based or hybrid solutions can play a role in hazard mitigation and risk reduction. Because of the uncertainty on how climate hazards may evolve from now through 2100 and our potential increasing vulnerability, a flexible, adaptive management, based on a process of continual monitoring, learning, and adjusting, seems to us the only way forward.

IMDC uses innovative solutions and multi-disciplinary expertise to dovetail with current policies e.g., the EU strategy on green and blue infrastructures, EU climate action and the international guidelines on natural and nature-based features for flood risk management.



Adaptation pathways, illustrative example from IMDC's project 'Cost of Coastal Environmental Degradation, Multi Hazard Risk Assessment and Cost Benefit Analysis'

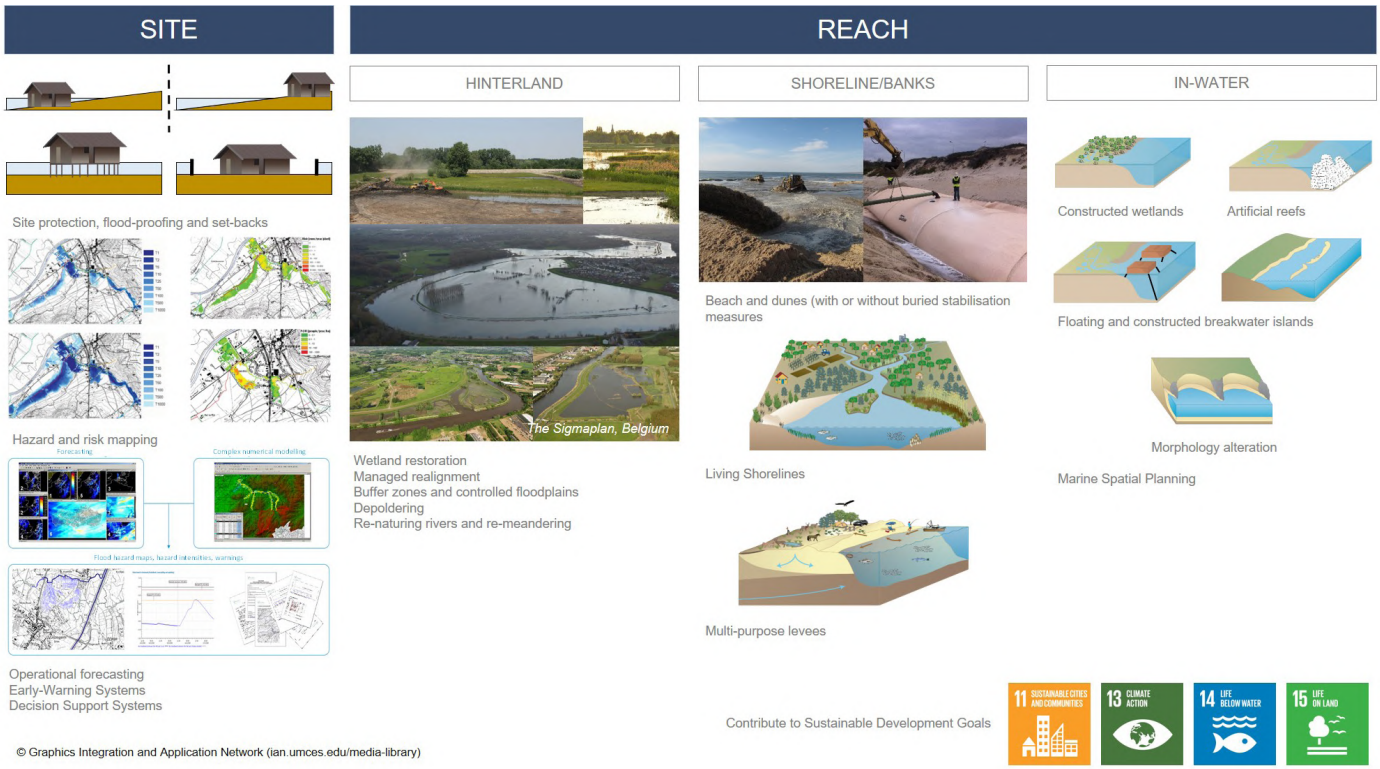
Services and Building Blocks

At IMDC, we offer a comprehensive suite of services to support the design, evaluation, and implementation of nature-based and hybrid engineering solutions across riverine, estuarine, and coastal systems. Our interdisciplinary approach combines in-depth knowledge of physical and ecological processes with hands-on engineering experience and advanced numerical modelling tools, enabling us to deliver sustainable and cost-effective solutions tailored to local needs.

We apply this expertise across the entire project lifecycle, from early-stage feasibility and spatial planning to detailed design, implementation, and post-construction monitoring.

Our services include:

- **Integrated assessments and feasibility studies**
  - Ecosystem, hazard, and risk assessments, including spatial mapping and ecosystem services evaluation.
  - Cost-benefit (CBA) and multi-criteria analyses (MCA) to assess the effectiveness and co-benefits of nature-based or hybrid adaptation options.
  - Maritime Spatial Planning (MSP) support to ensure that nature-based solutions are embedded within broader marine and coastal development frameworks, balancing ecological, social, and economic objectives.
- **Numerical modelling and predictive tools**
  - Development and application of hydrodynamic, morphodynamic, turbidity, sediment transport, and water quality models to assess the impacts and performance of nature-based solutions.
  - Modelling of wave attenuation, shoreline evolution, sediment dynamics, and the hydro-morphological impacts of interventions on ecosystems and infrastructure.
  - Use of scenario-based simulations to compare current versus future protection services provided by nature-based, grey, or hybrid systems under different climate and development conditions.
- **Nature-based risk management and strategy development**
  - Support in the formulation of nature-based risk management strategies, aligning with climate adaptation goals and international best practices.
  - Design of nature-inclusive infrastructure for coastal and offshore energy projects, such as offshore wind farms, enhancing ecological functionality while maintaining technical performance.
- **Design, implementation and monitoring**
  - Engineering design of nature-based or hybrid solutions, tailored to site-specific conditions and local capacity.
  - Development of implementation roadmaps, including permitting support, phasing, and stakeholder engagement.
  - Integration of monitoring frameworks, with measurable indicators and adaptive management triggers.
- **Measurement campaigns and environmental monitoring**
  - Field data collection campaigns to inform feasibility studies and environmental approvals.
  - Construction-phase monitoring, including sediment plume monitoring.
  - Use of sensor networks and remote data acquisition to feed into early warning systems and decision support tools for adaptive risk management.
  - Validation of nature-based solutions by monitoring its impact



Building blocks of waterfront adaptive strategies

Key references

Coastal Vision (Kustvisie) - Multiple Framework Agreement for Diverse Services

Year: *2017-2025*
Country: *Belgium*
Client: *Coastal Division, Flemish Ministry of Mobility and Public Works*

IMDC was selected for the multiple framework agreement for services and activities fitting within the exploration, investigation and implementation phases of the Complex Project Coastal Vision. The purpose was to explore various measures and alternatives to protect the Flemish coast in 2100 against the consequences of higher sea levels and stronger waves. IMDC provided expertise with regard to coastal processes and physical characteristics of the coastal systems, the effects of climate change on coastal safety, the evaluation and design of nature based coastal protection (where possible) and flood measures along the coast and in the ports, the design of alternatives for the future coastal protection of the Flemish coast, the assessment of the flood risk now and in the future, and the structural requirements for a multifunctional use of the coastal zone.

Sustainable Development Goals

Cassandra Feasibility study - Pilot site Nature Based Solutions

Year: *2022-2023*
Country: *Belgium*
Client: *De Blauwe Cluster VZW*

The CASSANDRA feasibility study prepared and brought together the missing links for the submission of an R&D project (O&O, ICON or European Project) to realize a large scale nature inclusive living lab for our sandy coastlines. The project was funded by VLAIO via the Blauwe Cluster organization. The overall objective was to assess the feasibility and define the boundaries, architecture, location(s) and long-term goals of a large scale pilot living lab that can act as a demonstrator of 'Nature-Based-Solutions' (NBS) to be applied for resilient coastlines and blue tourism for the Belgian North Sea in the future. This project allowed us to answer a number of open questions related to economic feasibility, as well as social acceptability (incl. blue and eco-tourism) and administrative (permits) feasibility. IMDC led the first work package on technical feasibility. Within this task we identified appropriate nature based solutions, selected appropriate sites, designed nature based solutions (including safety checks with Xbeach and ecological boundaries). Additionally IMDC supported other work packages for example by developing assessment of ecosystem services such as carbon accumulation potential. The integration of various stakes like coastal protection, tourism and recreation, ecosystem-development, resort urbanization, fresh-water management, carbon capture, were covered by this feasibility study.

Sustainable Development Goals

Master Plan Coastal safety (2007-2013)

Year: 2007 - 2013
Country: Belgium
Client: Coastal Division of Flemish Ministry of Mobility and Public Works (Afdeling Kust van Vlaams Ministerie van Mobiliteit en Openbare werken)

IMDC developed for the Coastal Division of the Flemish government the Master Plan for Coastal Safety for the Belgian coast, considering erosion and flooding risks on the long-term (till 2050, including sea level rise). During the elaboration of the EIAs, an ecological working group was organized to optimise the preferred ecological alternatives. More than 10 years later, the different measures foreseen in the master plan are still being implemented one by one.

Sustainable Development Goals

Modernization of the fairway Świnoujście Szczecinw waterway

Year: 2018 - 2020
Country: Poland
Client: Dredging International NV & Van Oord Dredging and Marine Contractors BV

IMDC worked in collaboration to build artificial islands, with the scope to serve as natural habitats, by re-using dredged material from the modernisation of the fairway. The primary function of the soft shoreline protection was to provide upland protection of the artificial islands. To achieve this, a wider beach was constructed to aid in dissipating wave energy and reducing storm damage. The soft shoreline protection also provided enhanced environmental benefits without compromising the level of safety to storm damage.

Sustainable Development Goals

Cost of Coastal Environmental Degradation, Multi Hazard Risk Assessment and Cost Benefit Analysis

Year: 2016 - 2017
Country: West Africa: Benin, Ghana, Ivory Coast and Togo
Client: The World Bank Group

IMDC developed a framework in order to study and quantify the coastal erosion and flood risk, to identify and rank hotspots along the coast in terms of hazards and vulnerability, to quantify the cost of coastal environmental degradation, and to compare possible Disaster Risk Reduction and Climate Change Adaptation measures in a Cost Benefit Analysis. The framework was applied to select hotspots and develop strategic investment plans for four pilot locations in Benin, Ghana, Ivory Coast and Togo.

Sustainable Development Goals

Ecosystem services and building with nature at our sandy coast in Belgium

Year: 2021
Country: Belgium
Client: Environmental Department (Department Omgeving), T.OP Coastalzone, GOP/DOMG

IMDC investigated which nature-based measures can be used along the Belgian coast to ensure coastal defences and additionally create a multitude of ecosystem services. The project consisted of two parts. The first part identified a long list of sites along the coast with potential for nature-based measures through hotspot mapping. The second part involved a detailed screening of ecosystem services for three nature-based coastal protection measures at two selected sites, including Coastal Safety Tool assessment. This research aimed to promote "building with nature" in the land-sea interaction zone to the policy makers of the coastal municipalities, as well as to promote to them the broad added value of these solutions.

Sustainable Development Goals

Sigmaplan

The updated Sigmaplan

Year: 2003 - 2018
Country: Belgium
Client: The Flemish Waterway, Flemish Ministry of Mobility and Public Works (De Vlaamse Waterweg nv, Vlaams Ministerie van Mobiliteit en Openbare werken)[2]

IMDC, in collaboration with Tractebel, supported De Vlaamse Waterweg nv (the Flemish waterway manager) in technical issues for the design of the adaptation measures and communication management during the preparation and realisation of the so-called Updated Sigmaplan for flood protection and nature development in Belgium. IMDC was responsible for the hydraulic and conceptual design of sluices for draining and flooding polders, pumping stations, overflow dikes and ring dikes. The process and communication management support focused on organising the consultation with the different stakeholders.

Sustainable Development Goals

Scan the QR for more information on Hydro-Environmental Services @IMDC