Realising responsibly the ocean's potential to develop a blue economy

Understanding the role of marine intakes and outfalls: A look at innovative solutions in support of economic development and water resilience in coastal areas.

Marine intake and outfall infrastructure play a strategic and important role in facilitating economic development in coastal environments. This is particularly the case in the water scarce regions where responsible management of water resources is a major priority.

Appropriate intake infrastructure contributes to water resilience in coastal cities, towns and settlements, as well as for coastal industries, by providing source water support to freshwater generation technologies such as desalination and technologies focused on combining desalination with water reuse. It also provides source water opportunities for power plant and thermal control in buildings. Outfall infrastructure, in turn, provides cost-effective alternatives for waste management for coastal industries, settlements and tourism facilities. Amongst others, this includes the management of waste heat from power generation, mining wastes, effluents from fish processing and mariculture facilities, municipal wastewater treatment works effluents and brine discharges from desalination facilities.

In the following Q&A, Marthinus Retief, Technical Director, Maritime, and Roy van Ballegooyen, Associate Maritime, WSP in South Africa, discuss challenges in the field of marine intakes and outfalls and innovations deployed to turn potential constraints into economic opportunities.

How does one go about promoting economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas?

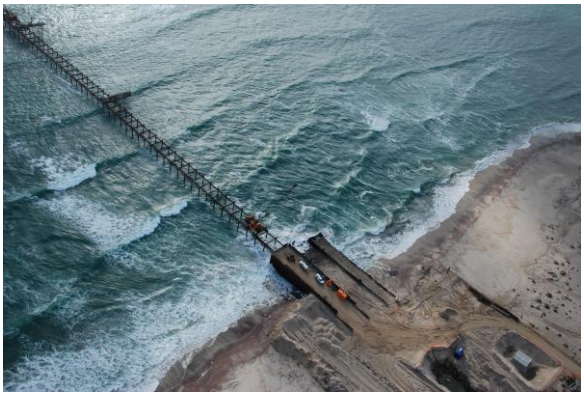
Roy van Ballegooyen: While these goals may seem incompatible, adopting a holistic and tailored approach early on in the project development serves to align these goals and reach the desired outcomes. This approach has three prongs.

The first one relates to developing a strategic context for the proposed development by evaluating how the UN's Sustainable Development Goals and the potential of blue economy and circular economy initiatives can serve as the project framework, whilst simultaneously being tailored to the local circumstances. This allows early identification of opportunities and constraints for consideration and inclusion in subsequent project planning and design.

When relevant national legislation and regulations are not yet in place to support emerging activities (such as deep-sea mining or discharges from coastal mining and aquaculture), consideration of industry or sector “best practice”, whist working collaboratively with local authorities, can help to address these gaps and find solutions.

The second prong relies on adopting a design framework that seamlessly integrates environmental and engineering imperatives throughout the project lifecycle (see figure on page 5). Scoping the project from engineering, environmental and regulatory perspectives from its inception along with continuous communication throughout the process, sets the foundation for the design and delivery of responsible marine intake and outfall infrastructure.

Marthinus Retief: The third prong, but not the least, is about continually monitoring all possible innovations that could be applied. These relate to the engineering design and environmental assessment, along with supporting technologies such as data measurement, modelling support for design and intake and outfall performance assessments, construction technologies and design and execution of environmental performance monitoring. These innovations can be developed by WSP or leveraged from our network partners. Examples include the provision of design condition for extreme events through tsunami and synthetic cyclone modelling, robust coupling of near- and far-field outfall models, novel and less intrusive marine construction techniques associated with for example directional drilling and subsurface systems, as well as seawater abstraction methods which reduce impact on marine life (van Ballegooyen et al, 2019).



How does one ensure waste is not a constraint to development?

Roy van Ballegooyen: Management of waste can be a constraint to economic development, however, if done responsibly, utilisation of the assimilative capacity of the ocean can be a great enabler for economic development in coastal regions and even beyond.

It is important to recognise opportunities in this regard, assess their viability and make recommendations on how to proceed. These opportunities can lie in large-scale projects such as power plants, desalination facilities, wastewater treatment works (WWTW) effluent disposal and management of mining wastes, but also in providing cost-effective waste management options for small to medium enterprises, e.g. mariculture and small scale desalination. The latter would help unlock the blue economy to smaller-scale operations and local communities.

Having a clear appreciation of the full development cycle of intake and outfall infrastructure allows potential constraints to development to be minimised or even eliminated. Typically, development options would assess rigorously both land-based and marine-based waste management options in terms of their economic, environmental and technical feasibility. This is particularly important

in the early stages of a project. Such an approach was taken when assessing options for effluents from WWTW in Buffalo City, South Africa.

Marthinus Retief: Such development options can include exploring synergies in the co-location of projects where aspects of the waste from one industry is partially or fully utilised by another co-located industry, for example, by combining desalination with a power plant, or salt works with a desalination plant. Another option for synergy is the leveraging of sharing infrastructure. A good example is the placement of oyster culture ponds upstream of a desalination plant. This also provides balancing of seawater intake flows during extreme oceanic conditions.

Appropriate intake and outfall infrastructure design by WSP enabled a remote mining operation to be considered feasible. The intake structures proposed a source of seawater to support mining activities while the outfall infrastructure allowed the assimilative capacity of the adjacent ocean to be used safely and responsibly to handle the majority of the mining wastes. An added advantage was that the shipping infrastructure (jetty) necessary to export the mining products was able to provide support for the intake infrastructure, resulting in significant cost savings.

How do we contribute to water resilience in environments where water is scarce?

Marthinus Retief: Where there is already optimal use of water from land-based sources, additional options for generation exist in terms of desalination and water recovery from waste streams. Under such circumstances, desalination as a staged capital cost solution, potentially is a more economical source of water than available land-based options.

More novel approaches include a combination of desalination and water recovery technologies where a combination of WWTW effluents and seawater are processed through the use of membrane technology to generate potable water. This technology substantially reduces the salinity of the reject brine (potentially to levels that all but eliminate the environmental impacts of the brine discharge), as well as increasing the efficiency of the membrane treatment processes, thereby lowering the overall costs of the potable water generated. In addition, precious water that would normally have been lost by the discharge into the ocean is recovered in the process. WSP was instrumental in the design of an appropriate intake and balance of plant infrastructure for just such a project for eThekwini Municipality, South Africa.

Roy van Ballegooyen: The opportunities are not only limited to generating water resilience in coastal regions. Processes cleaning up inland waters, such as those associated with acid mine drainage, often in themselves generate waste material that, if of acceptable nature, can be discharged through existing or even purpose-built marine outfall infrastructure. A recent project undertaken in Kwa-Zulu Natal indicated the feasibility and economic benefits of such an approach.

What value do marine intakes and outfalls bring to a blue economy development?

Marthinus Retief: Fundamentally, when done responsibly, marine intakes and outfalls can be the enablers, even amplifiers, of blue economy developments; rendering conventional less feasible and high environmental impact land-based projects into more feasible and lesser impact projects. Leveraging field-proven technologies available around the world and exploring synergies between complementary projects can lead to significant development opportunities in the blue economy. Well-designed intake and outfall infrastructure could maximise activities in constrained multi-user environments such as coastal embayments and coastal development nodes. Equally well, appropriate intake and outfall infrastructure could support and enable development (e.g. mining operations) in more remote locations, with typically more modest infrastructure, supporting development in smaller communities (e.g. mariculture). When the correct solution is applied, intakes and outfalls can enable development of small, medium and large-scale blue economy projects.

Roy van Ballegooyen: Such developments should only be considered when sufficiently rigorous assessment of the socio-economic benefits and environmental considerations indicate the developments to be desirable. However, the many innovations presently under consideration and those in the pipeline, suggest much greater opportunities than would have been the case in even the recent past.

References:

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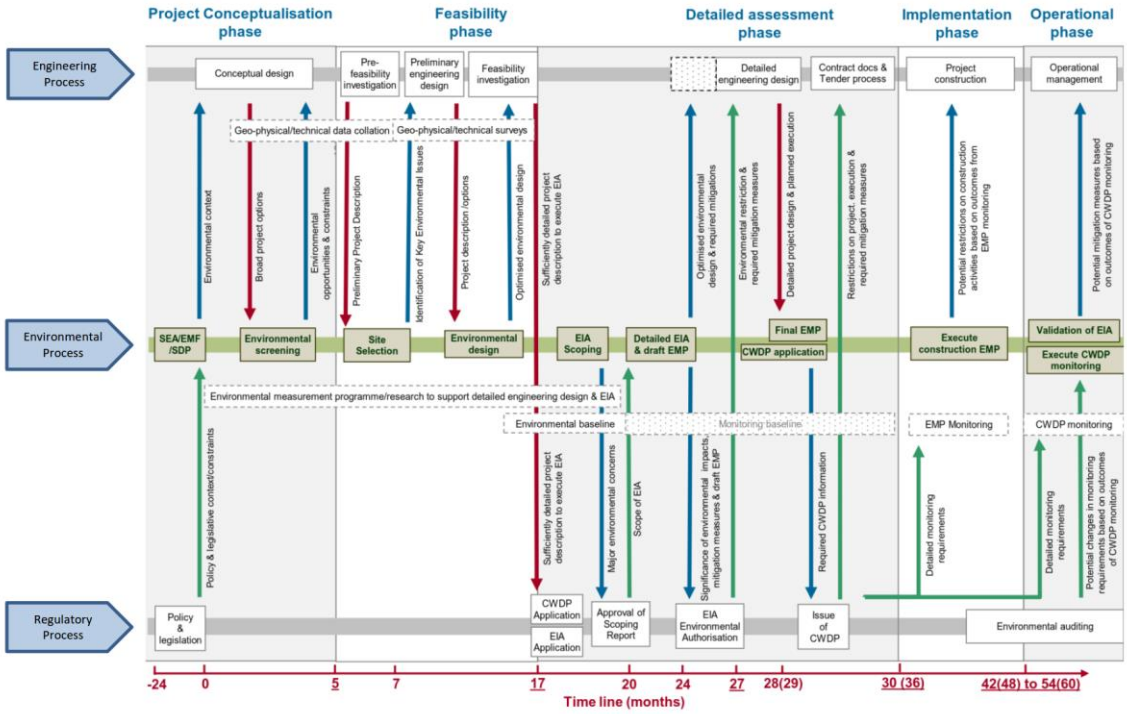

Project lifecycle associated with the development of intake and outfall infrastructure, highlighting the interdependency of engineering, environmental and regulatory processes and associated information flow requirements (after van Ballegooyen et al., 2016).

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