

SUMMARY

CoastalProtect Africa – Multi-purpose technology for an integrated solution to coastal erosion and sediment management for West Africa

Integral Consulting Inc. (Integral) is a leading environmental and engineering consultancy company based in Seattle, WA USA, with a global reputation for delivering successful, high value, multi-partner projects. We have formed a consortium of companies and individuals with a high level of integrity, and the technical and scientific expertise capable of executing the projects in our response to this Call for Innovation. Consortium members are from the United States, Senegal, Tunisia, and the Netherlands. Our Senegalese partners have been involved at all stages of our proposal, and through them we have received valuable feedback from Senegalese stakeholders.

No single remedy can sustainably resolve coastal erosion and sediment management issues in W. Africa – only an integrated combination of innovative infrastructure and management techniques can deliver much-needed coastal resiliency in the region. When our proposed projects are combined, their synergy greatly increases benefits for the entire region in terms of erosion mitigation and enhanced coastal resiliency. In responding to this Call for Innovation, we have provided a number of innovative and sustainable solutions and, for initial implementation, we focus on one **innovative green infrastructure** project, *CoastalProtect Africa*, as a keystone for our integrated solution.

In our *CoastalProtect Africa* project, we provide **a new and disruptive method of extracting wave energy to reduce erosion at the coast, while simultaneously providing much-needed desalinated water and electricity to nearby coastal communities.** *CoastalProtect Africa's* multi-purpose technology will have a clear and measurable reduction in coastal erosion, and is implementable within a 2-3 year timeframe. Highly scalable to other coasts in WACA countries of interest and beyond, *CoastalProtect Africa* will deliver much needed socio-economic and environmental co-benefits. The technology is proven and has undergone extensive testing over several years.

We have selected a site for possible implementation of our *CoastalProtect Africa* project, south of the proposed Port du Futur, Dakar Région, Senegal. We propose installation of a 26-module system that will mitigate coastal erosion down drift of the port development, while supplying 4000 m³ water per day (enough for 48,000 homes) at an estimated levelized cost of \$1.25/m³. Implementation will be in three stages: 1) Feasibility studies and capacity building; 2) Pilot plant deployment; 3) Commercial-scale deployment. Total Project costs are estimated at \$31MM. We envisage Development Funds and Public-Private partnerships (e.g. Green Bonds) as main funding mechanisms. Our partners, Resolute Marine, have already succeeded in raising AfDB funding for a pilot plant, leading to a full-scale development, where the main purpose is desalinated water production in Cape Verde. Further information including detailed cost estimates are provided in our Detailed Proposal.

See: <https://www.youtube.com/watch?v=bXEIFPHMGHU> for a brief overview of how the technology works.



Figure 1. (Left) Pilot *CoastProtect Africa* module testing in United States; (Right) Schematic of installed *CoastProtect Africa* system at Ndyane, Senegal

DAY 1 FULL PRESENTATION

An integrated solution to coastal erosion and sediment management for West Africa



Integral Consulting (U.S.)

Resolute Marine Energy (U.S.)

SAFEC (Senegal)

Samarcel (U.S.)

Medusa (Netherlands)

Oula Amrouni (Tunisia)



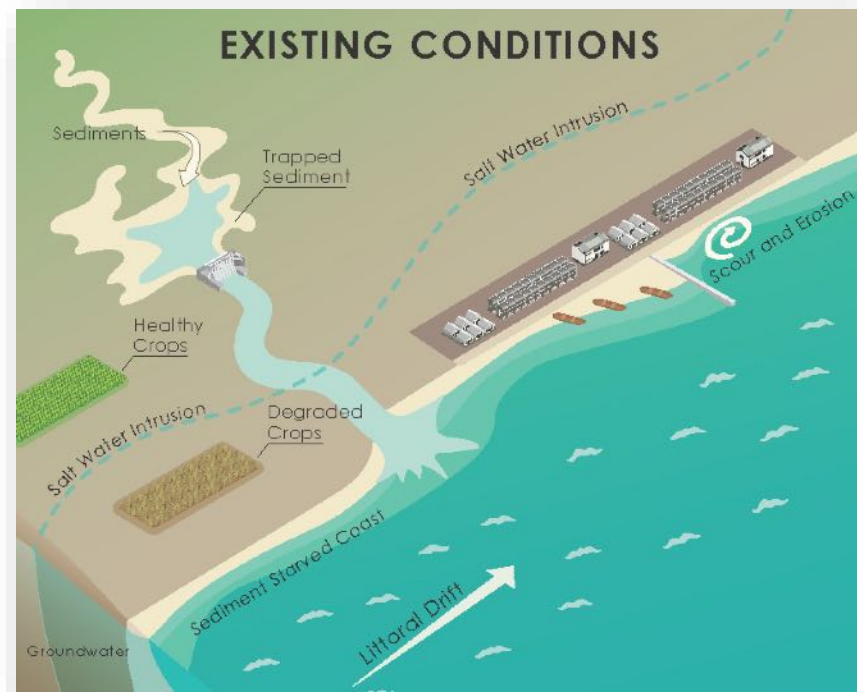
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Project Summary

- **West Africa is losing lives, livelihoods, and more than \$3.8 billion every year to coastal hazards (World Bank)**
- **Innovative, integrated, and sustainable solutions** to mitigate coastal erosion in WACA countries

- Wave energy conversion
- Beach and dune stabilization
- Improve sediment conveyance
- Beneficial reuse of sediment
- Groundwater management to reduce intrusion and erosion



Existing Challenges

- Erosion destroys property and livelihood
- Saline intrusion degrades water supply and agriculture
- Fisheries threatened by erosion and dam management
- All development hindered by lack of adaptation planning

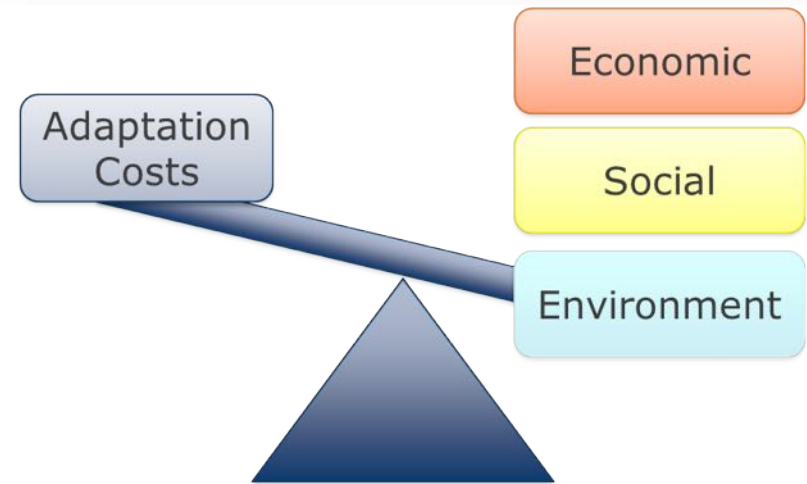
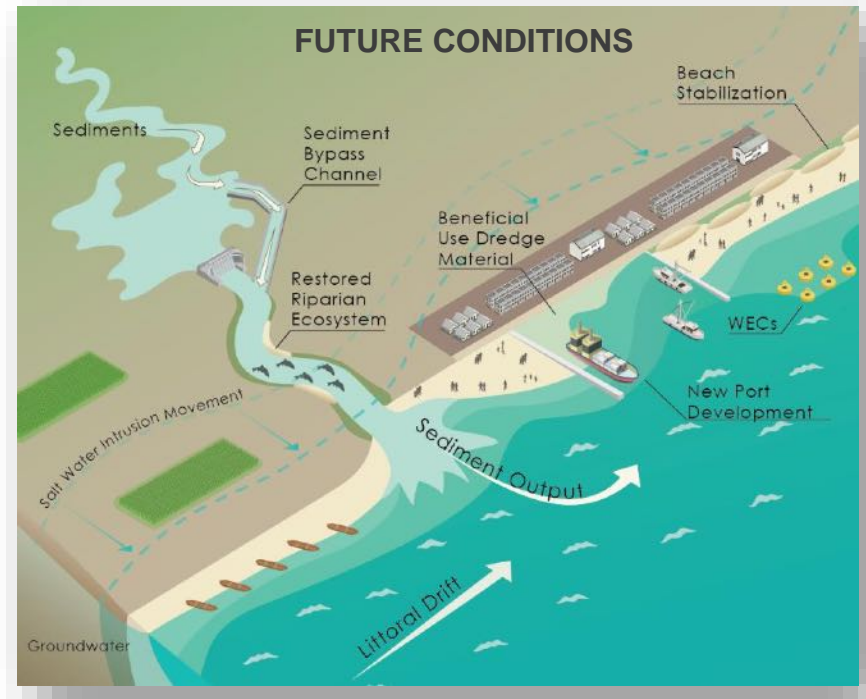
Project Benefits

Our projects will have a clear, measurable impact on coastal erosion enabling sustainability and resiliency

Project elements have a clear value proposition, with measurable success on 2 to 5 year timescale

> Benefits

- Protection of life and property from erosion
- Protect agriculture (19% of Senegal's GDP) and water supply
- Sustain increases in tourism (10% of Senegal's GDP)
- Enable growth of sustainable ports



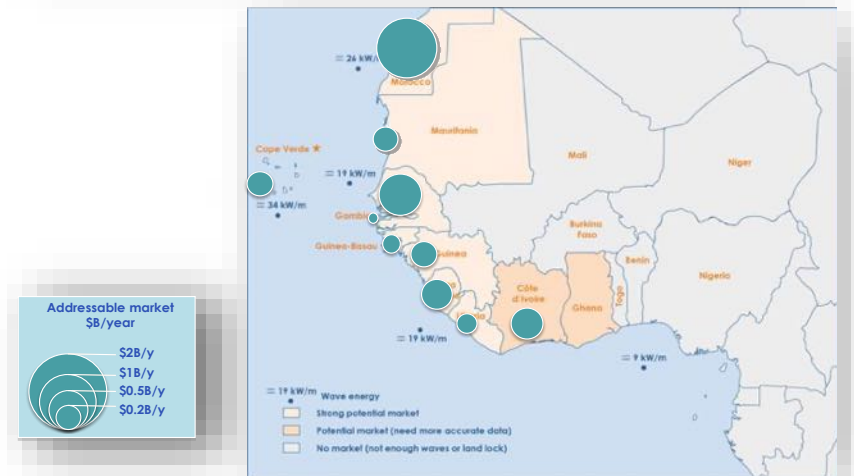
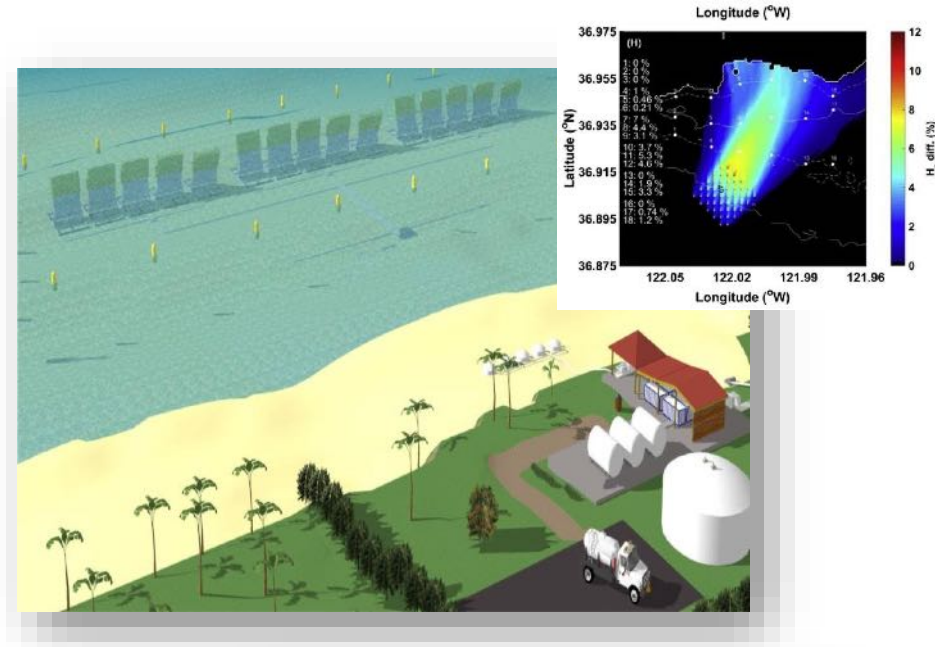
CoastProtect Africa Project

Project Benefits

- Wave energy and coastal hazard reduction
- Infrastructure and erosion protection
- Converts wave energy to fresh water and electricity
- Easily scalable to any coastal region

Local Project

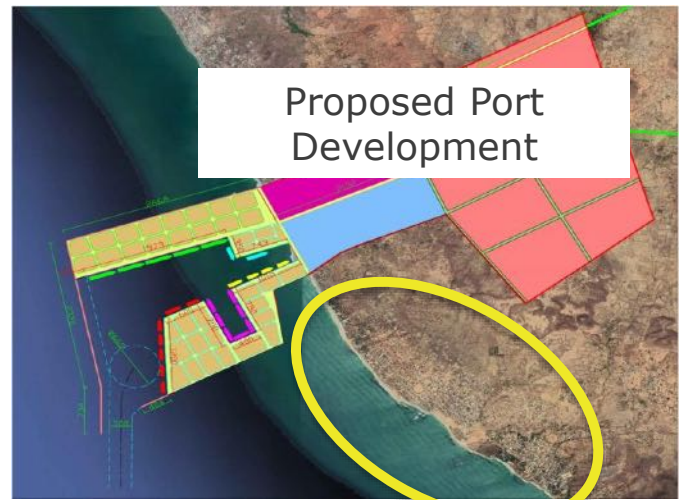
- Senegal – erosion mitigation near proposed Port du Futur, Ndyane development
- Estimated \$31MM
- Over \$1B/year addressable market



Project Implementation

> Stage 1 – Feasibility studies and capacity building

- **Wave Energy Assessment:** A detailed study of the wave resource at the selected site which provides data that guides the final design of the Wave20™ system
- **Bathymetric Survey and Geotechnical Analysis:** The bathymetric survey will identify deployment sites to be avoided, which include areas with uneven seabed, and underwater obstructions/hazards
- **Water Quality Assessment:** determine requirements for the filtration and pre-treatment system and to identify suitable locations
- **Environmental and Social Impact Assessment (ESIA) and Permitting:** This task involves conducting an environmental and social impact assessment of the system, surveying local compliance requirements and obtaining permits
- **Technical Feasibility:** Develop design specific to the local conditions including simulations, design of subsystems, development of local content
- **Approximate cost: \$850K**



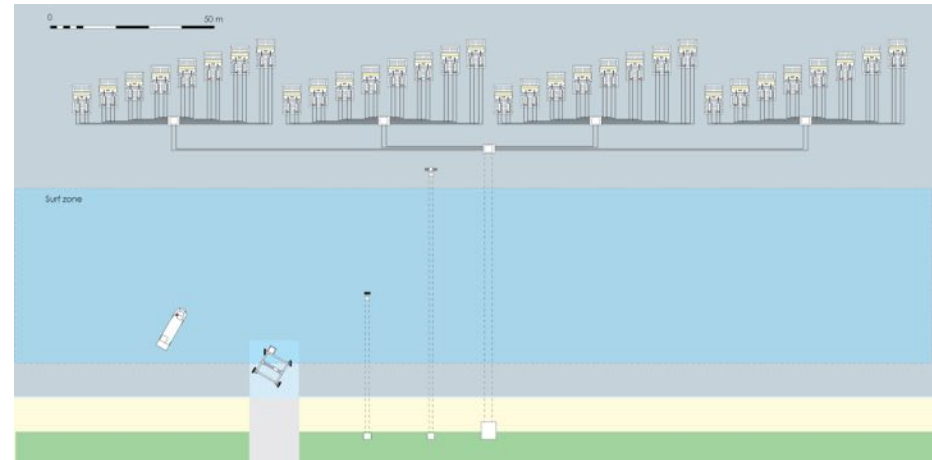
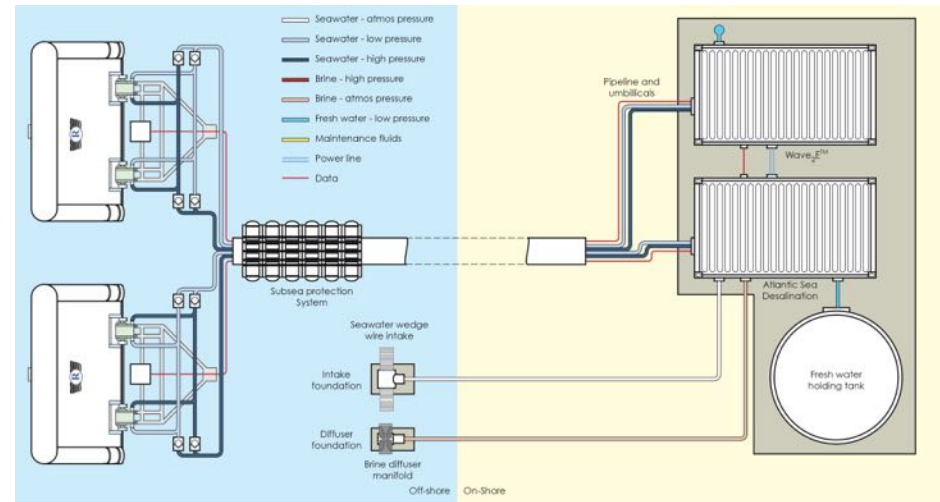
Project Implementation

› Stage 2 – Pilot system deployment

- Deployment and testing of a pilot-scale Wave₂O™ plant comprising one module of 500 m³/day production capacity and validate wave erosion reduction.

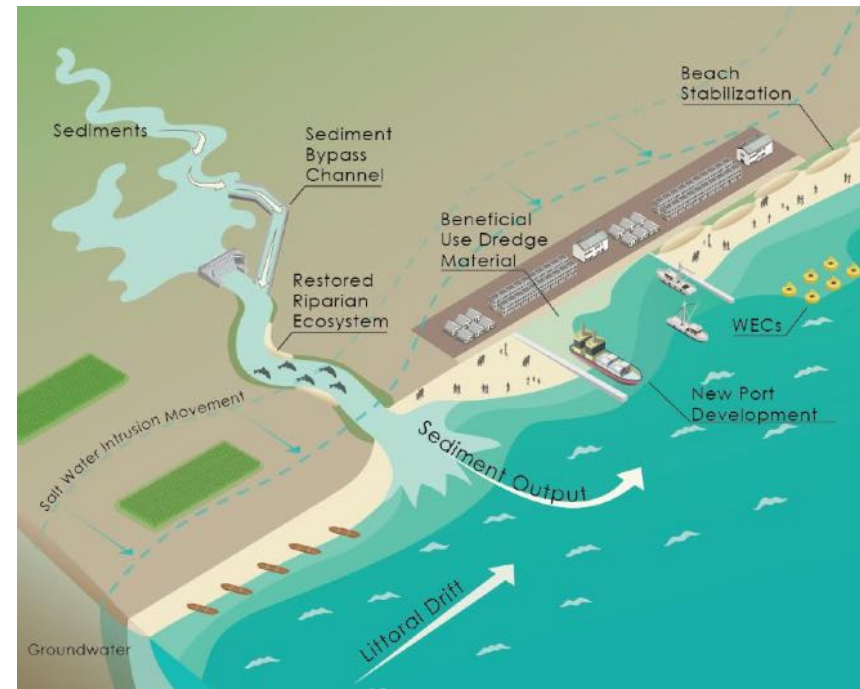
› Stage 3 – Commercial-scale system deployment

- Deployment of a full-scale plant (4,000 m³/day) consisting of 26 modules
- Approximate cost: \$30 MM



Why these projects?

- Projects will have a clear, measurable and sustainable impact on coastal sustainability and resiliency
- Supports sustainable green over gray infrastructure
 - **Green infrastructure** – natural shorelines **maintained locally by low-cost sustainable techniques**
 - **Gray infrastructure** – man made mitigation requires high-cost of maintenance and is temporary in the face of sea-level rise



Benefits

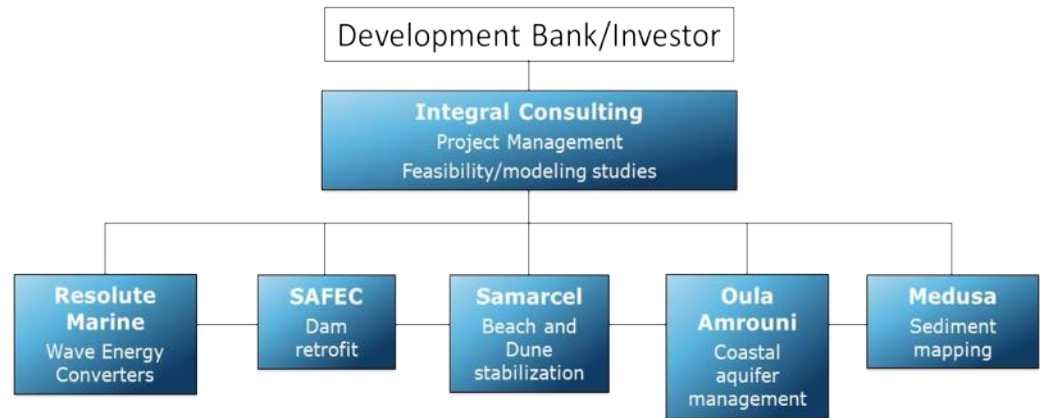
- Protection of life and property from coastal hazards
- Protect water supply and agriculture (19% of GDP)
- Sustain increases in tourism (10% of GDP)
- Enable growth of sustainable fishing industry (3% of GDP)

How do we accomplish this?

Integral has **substantial experience** managing multi-disciplinary coastal adaptation and engineering projects

Resolute projects are scalable with success

Significant opportunity for **local capacity building with SAFEC**



Funding mechanisms

- Development Funds (e.g., World Bank, AfDB, EBRD, IFC)
- Public-Private partnerships (e.g., Green Bonds – investor returns keyed to measurable positive outcomes)
- International Union for Conservation of Nature
- In-kind contributions in-country (e.g., Centre de Suivi Ecologique)

DAY 2 SHORT PRESENTATION

An integrated solution to coastal erosion and sediment management for West Africa



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CoastProtect Africa

Innovative, integrated, and sustainable solutions to mitigate coastal erosion in WACA countries

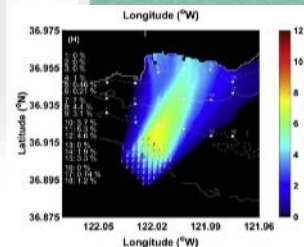
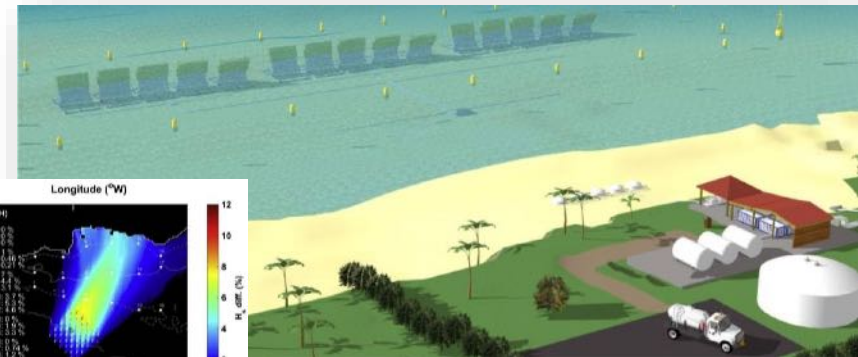
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Local Project

- Senegal – erosion mitigation near proposed Port du Futur, Ndyane development
- Estimated \$30MM
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Project Implementation

Stage 1 – Feasibility studies and capacity building

- Wave energy assessment and technical feasibility
- Bathymetric survey, geotechnical analysis, water quality assessment
- Environmental and Social Impact Assessment (ESIA) and permitting
- **Approximate cost: \$850K**

Stage 2 – Pilot plant deployment

- Deployment and testing of a pilot-scale Wave₂O™ plant comprising one module of 500 m³/day production capacity

Stage 3 – Commercial-scale plant deployment

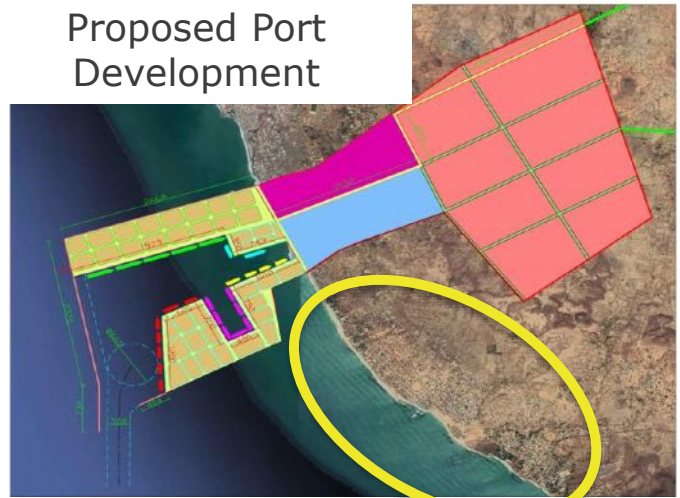
- Deployment of a full-scale plant (4,000 m³/day) consisting of 26 modules
- **Approximate cost: \$30 MM**
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Coastal Erosion and
Sea Level Rise
Risks



ADDITIONAL INFORMATION

1. Video submitted during EOI phase
https://youtu.be/_MQFXlcu8Jw

2. Detailed Proposal