



Safely Managed Sanitation and the Blue Economy

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Surface
Runoff

Direct and Treated
Discharge

Groundwater
Infiltration



80%

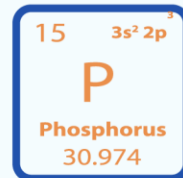
300-400 Million Tons

~80% of the world's industrial and municipal wastewater is discharged without treatment to surface waters, equaling about **300–400 million tons*** of pollution each year (IPBES, 2019; UNESCO, 2021). This proportion is even higher in developing countries due to a lack of infrastructure.



An estimated **4.3-7.1 million tons of nitrogen** from wastewater enter coastal environments every year, from both unsafely and safely managed sanitation (Wear et al., 2023).

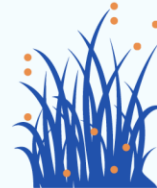
An estimated **1.5 million tons of phosphorus** from wastewater enter surface waters every year (Van Puijenbroek et al., 2019).



55%

Coral Reefs

55% of coral reefs are exposed to wastewater pollution (Tuholske et al., 2021), and ~15% of coral reefs are exposed to only wastewater pollution and no agricultural or sediment pollution (Andreello et al., 2022; Tuholske et al., 2021).



88%

Seagrass Ecosystems

An estimated **88% of all seagrass ecosystems** (both tropical and temperate) are exposed to wastewater pollution (Tuholske et al., 2021).



Wastewater pollution has been documented in **104 out of 108** coral reef regions with human populations present (Wear & Vega Thurber, 2015).



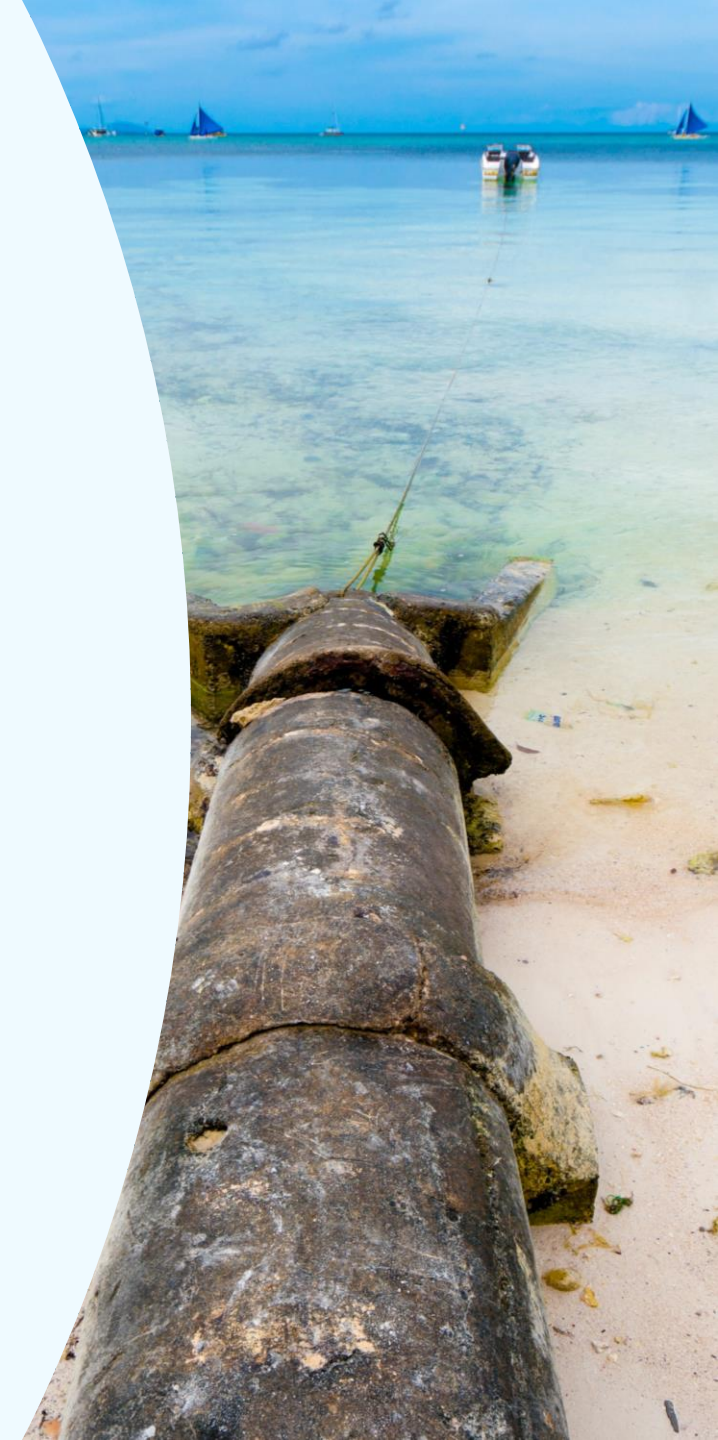
Globally, **26 classes of pharmaceutical drugs** have been recorded in the marine environment of **34 countries**, with several instances of bioaccumulation in a wide range of species, which is likely a vast underestimation of their prevalence (Dehm et al., 2021; Fabbri & Franzellitti, 2015; Greene, 2022; Madikizela et al., 2020; Madikizela & Ncube, 2022).

wcs.org/coral/coastal-health-guide



Wastewater pollution and coastal ecosystems

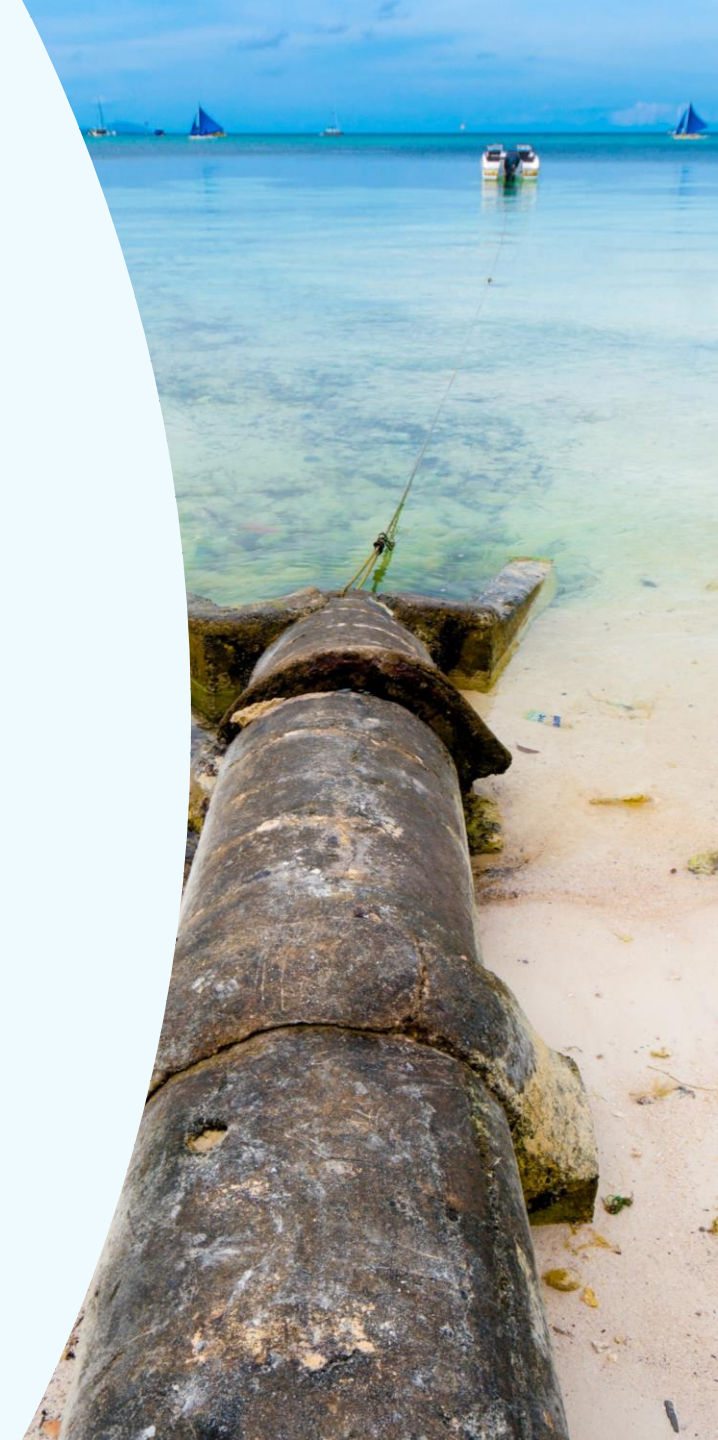
- Pathogens present in wastewater cause **coral disease and mortality**
- Nutrient pollution has **lethal and sub-lethal impacts** on mangroves, seagrass, and corals
- Wastewater pollution has caused **large scale fish mortality events**
- Pharmaceuticals significantly **alter fish behavior**





Wastewater pollution and climate change

- Wastewater pollution increases **the prevalence and severity of coral bleaching**.
- Wastewater pollution **inhibits the recovery of coral reefs** following bleaching events.
- Nutrient enrichment makes mangroves **more vulnerable to sea-level rise** and **more likely to die** from climate-related drought.
- Wastewater **reduces the ability of mangroves and seagrass to store carbon**, undermining blue carbon initiatives.



THE VICIOUS CYCLE BETWEEN CLIMATE CHANGE, UNSAFE SANITATION AND ECOSYSTEM LOSS

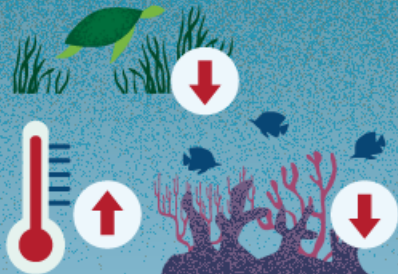
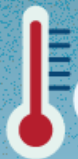


1 CLIMATE CHANGE IMPACTS ON SANITATION AND ECOSYSTEMS

Climate hazards like sea-level rise, increasing temperatures, and extreme weather events damage sanitation systems, threatening human health and leading to more wastewater pollution in the environment.



Climate hazards cause the loss of coastal ecosystems like mangrove forests, seagrass meadows, and coral reefs.



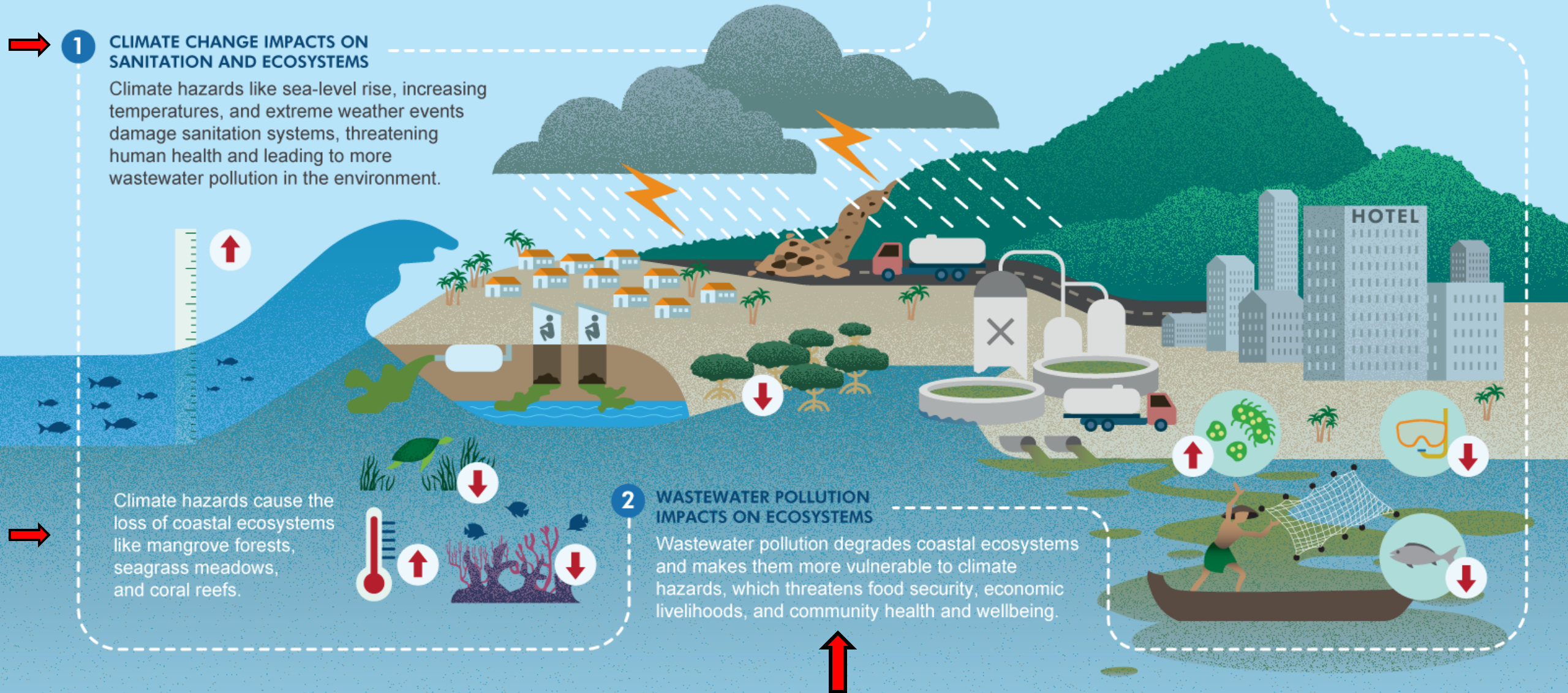
2 WASTEWATER POLLUTION IMPACTS ON ECOSYSTEMS

Wastewater pollution degrades coastal ecosystems and makes them more vulnerable to climate hazards, which threatens food security, economic livelihoods, and community health and wellbeing.



3 THE CYCLE REPEATS

The degradation and loss of coastal ecosystems makes sanitation systems and communities more vulnerable to climate hazards.





Surface
Runoff

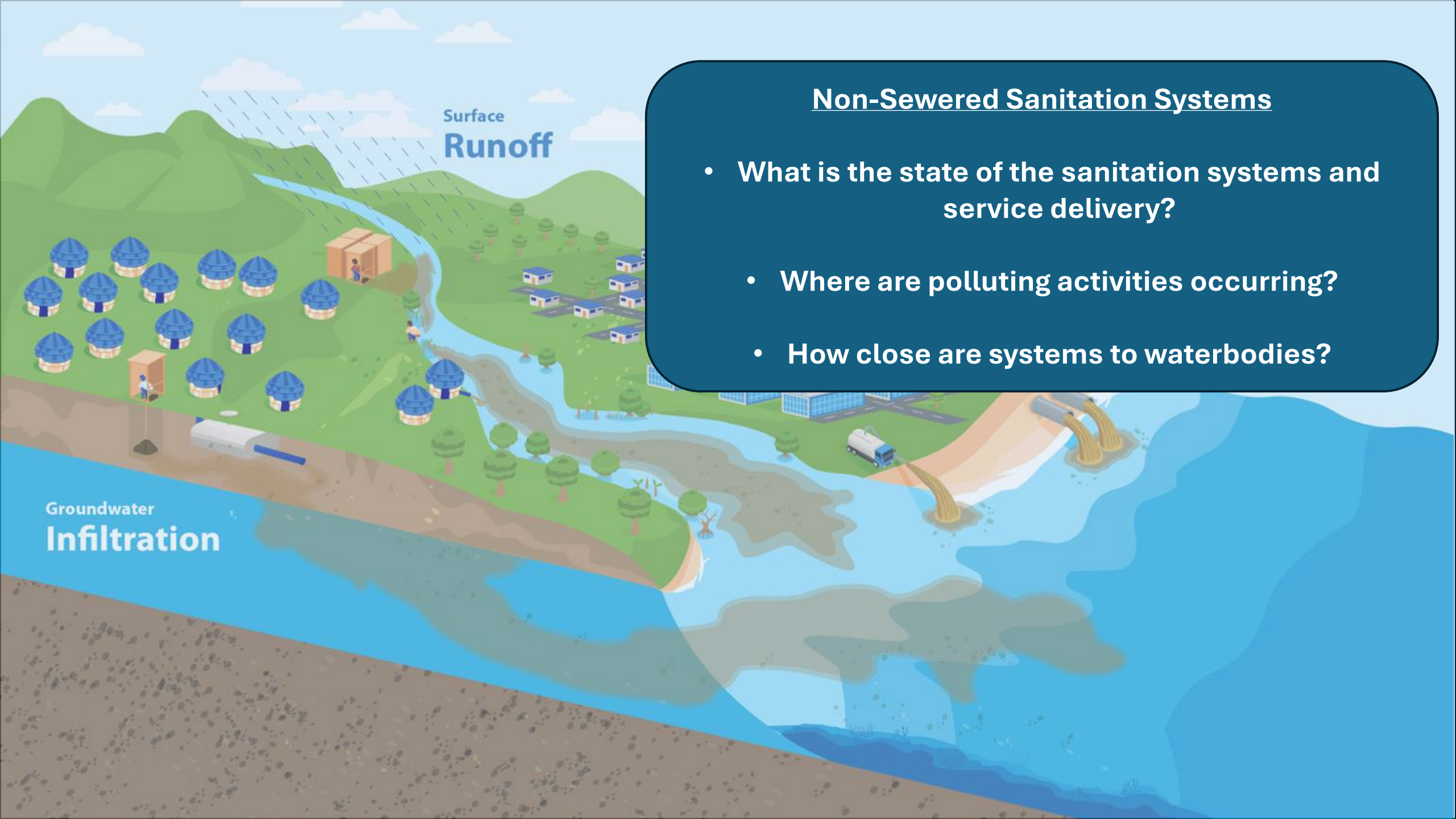
Direct and Treated
Discharge

Groundwater
Infiltration

Sewered Sanitation System

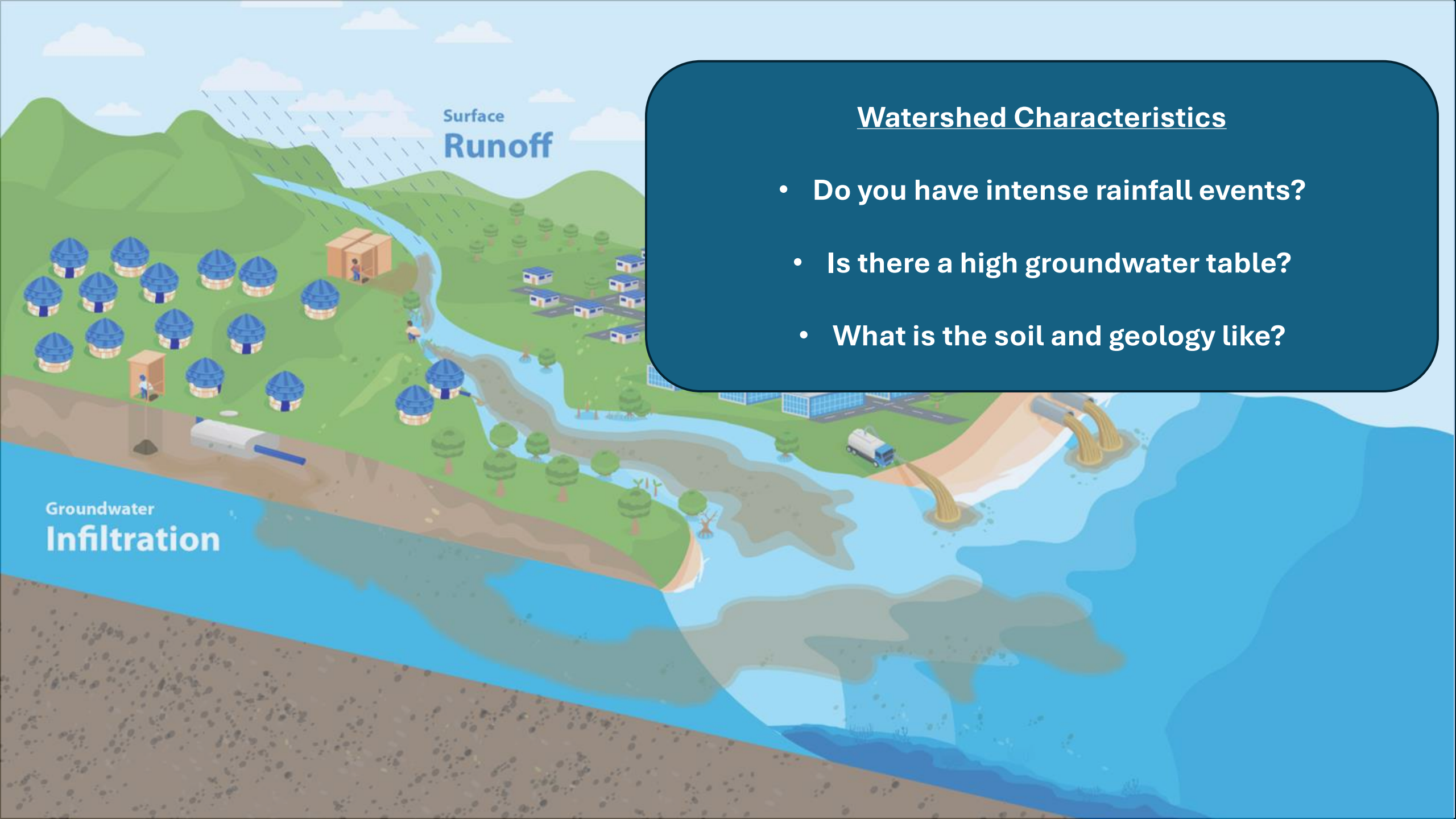
- Does the wastewater treatment plant discharge to an area of interest?
- What type of treatment is present?





Non-Sewered Sanitation Systems

- What is the state of the sanitation systems and service delivery?
- Where are polluting activities occurring?
- How close are systems to waterbodies?

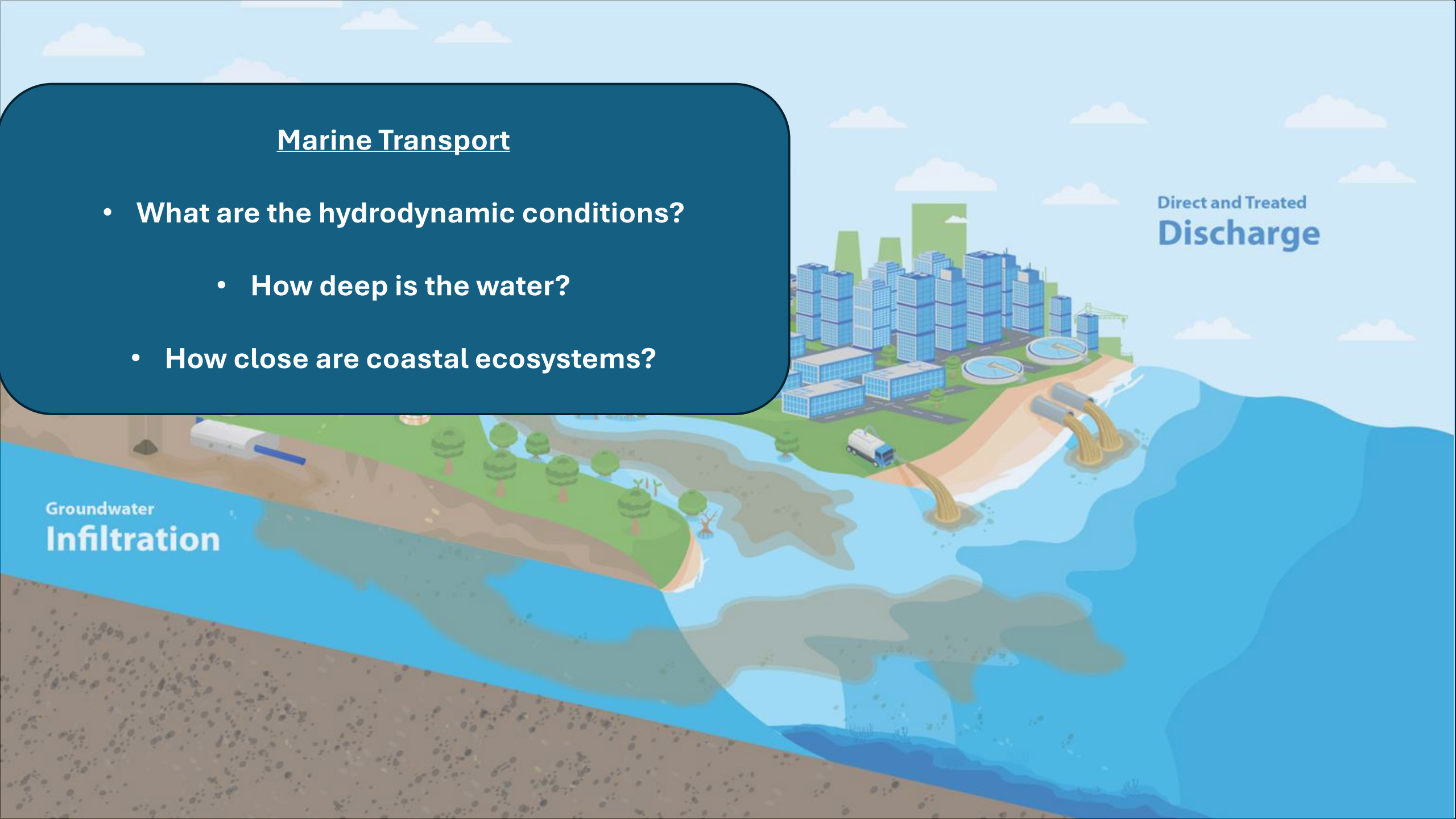


Watershed Characteristics

- Do you have intense rainfall events?
- Is there a high groundwater table?
- What is the soil and geology like?

Marine Transport

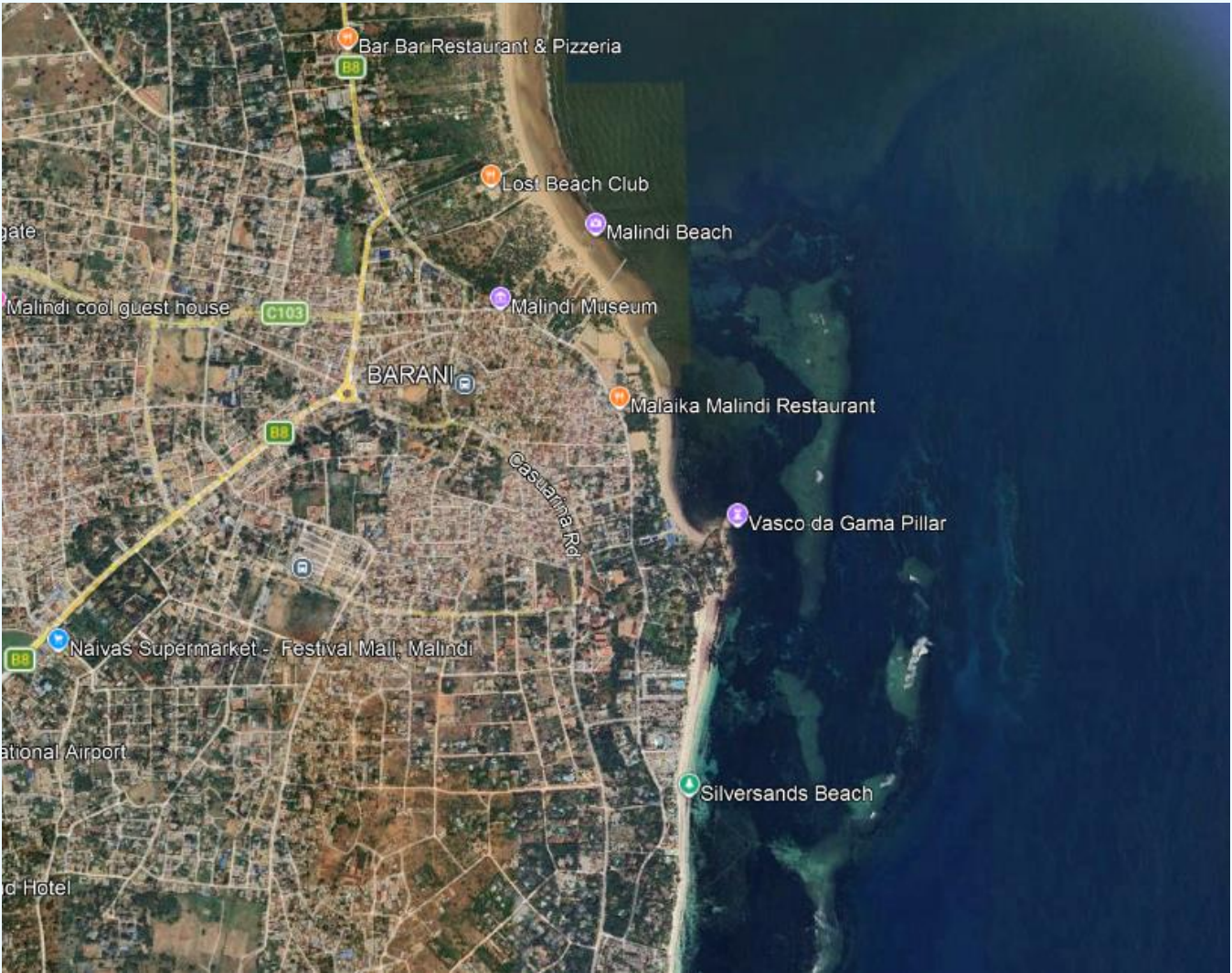
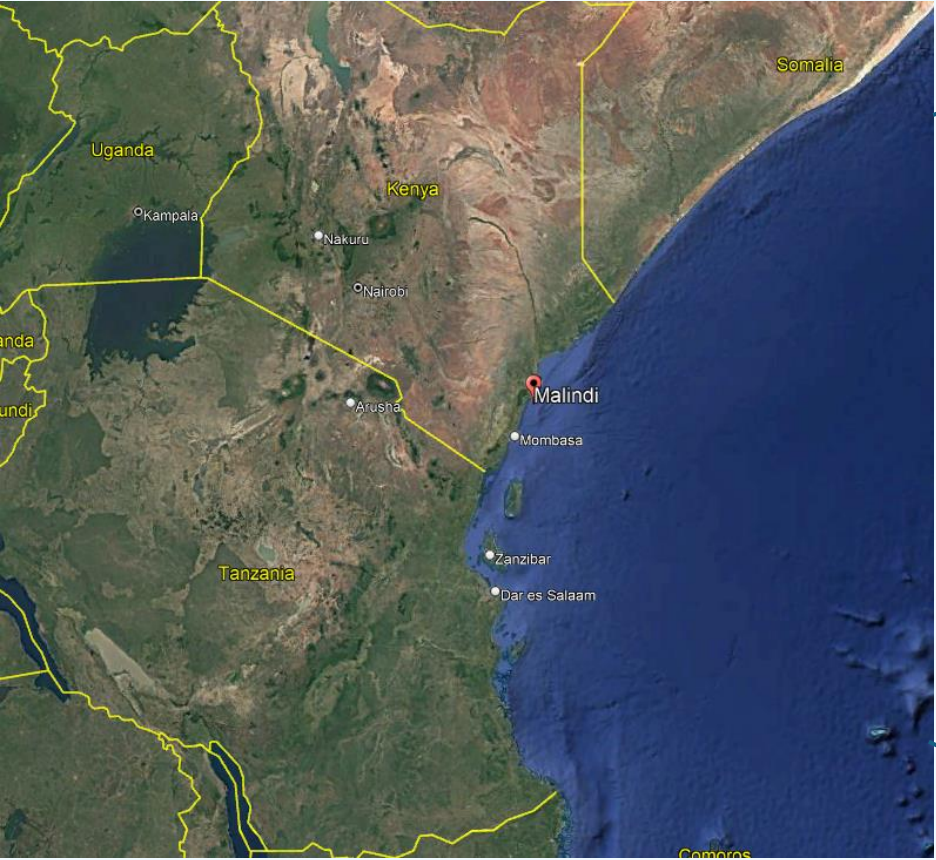
- What are the hydrodynamic conditions?
 - How deep is the water?
- How close are coastal ecosystems?







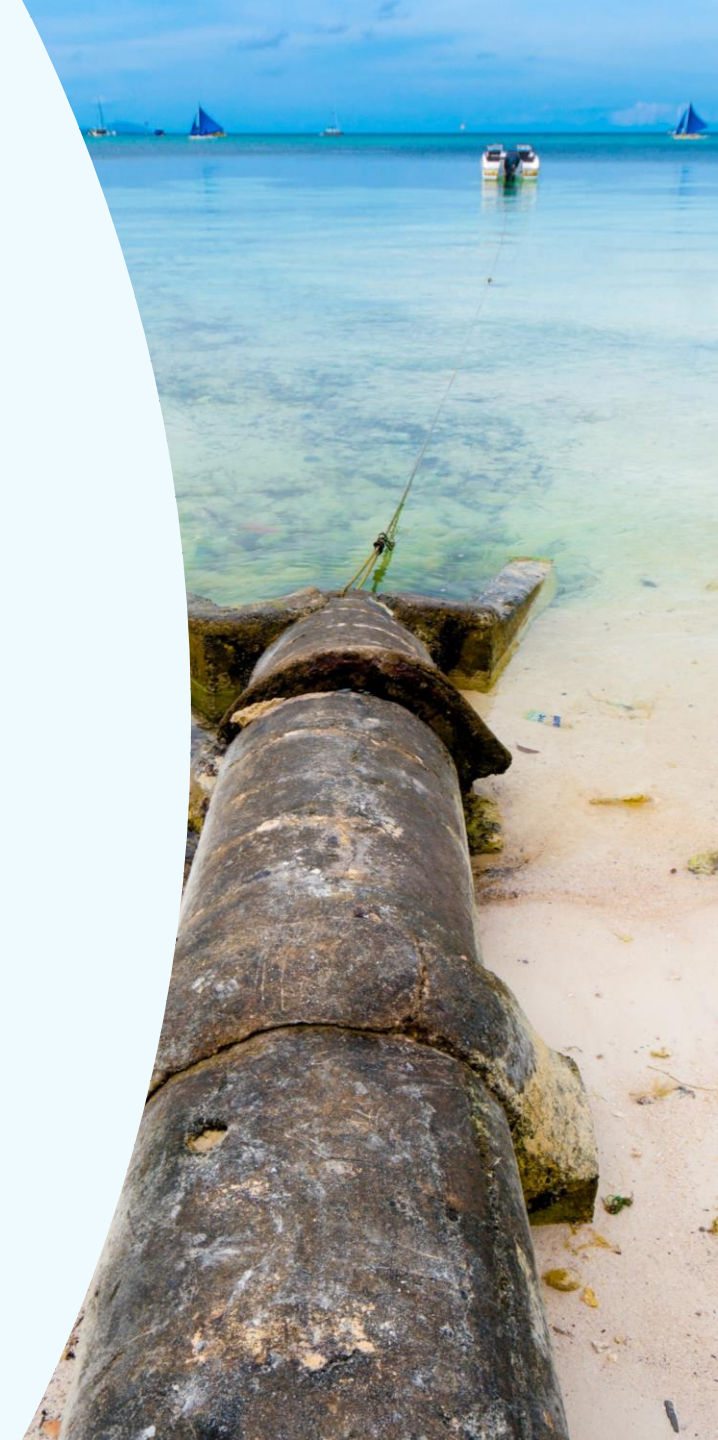
Malindi, Kenya





Malindi, Kenya

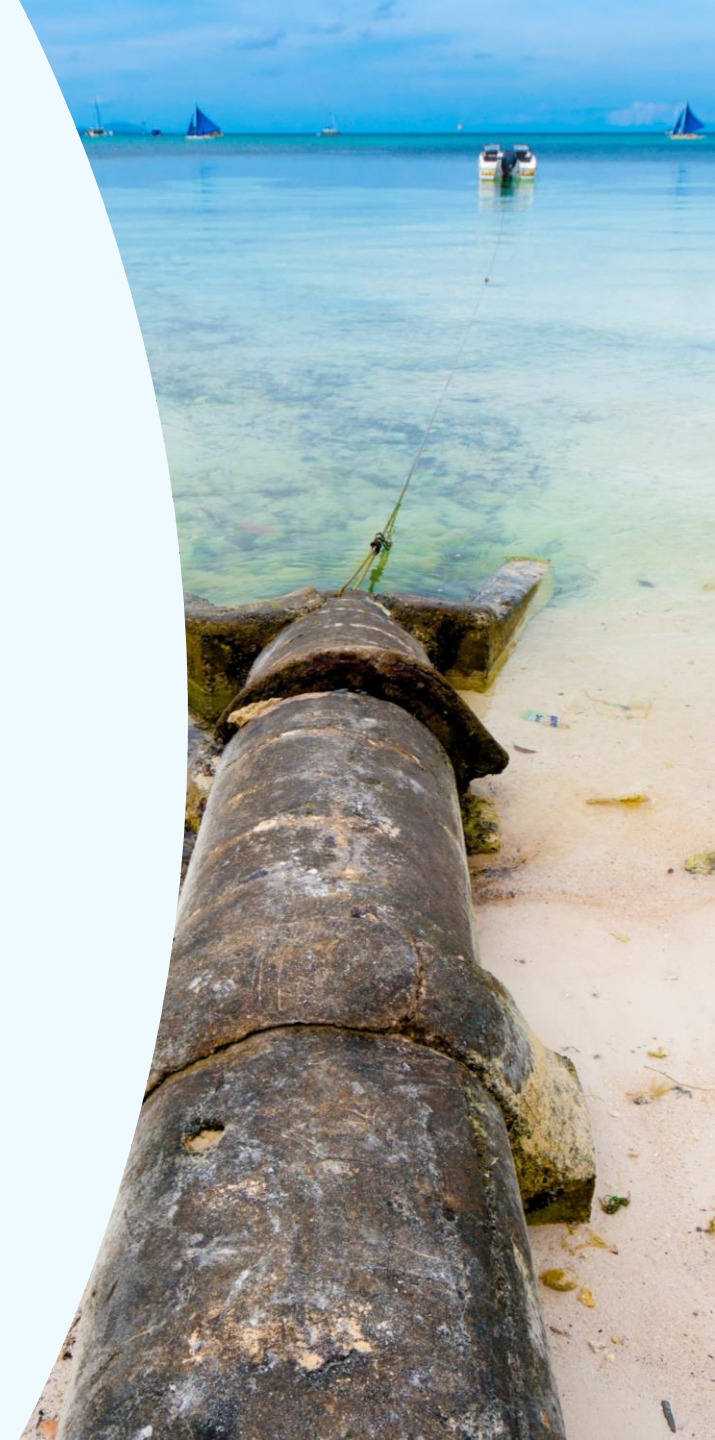
- Some of the oldest marine protected areas in Kenya
- A very popular tourism destination
- In 2006, it was awarded Kenya's cleanest coastal town





Malindi, Kenya

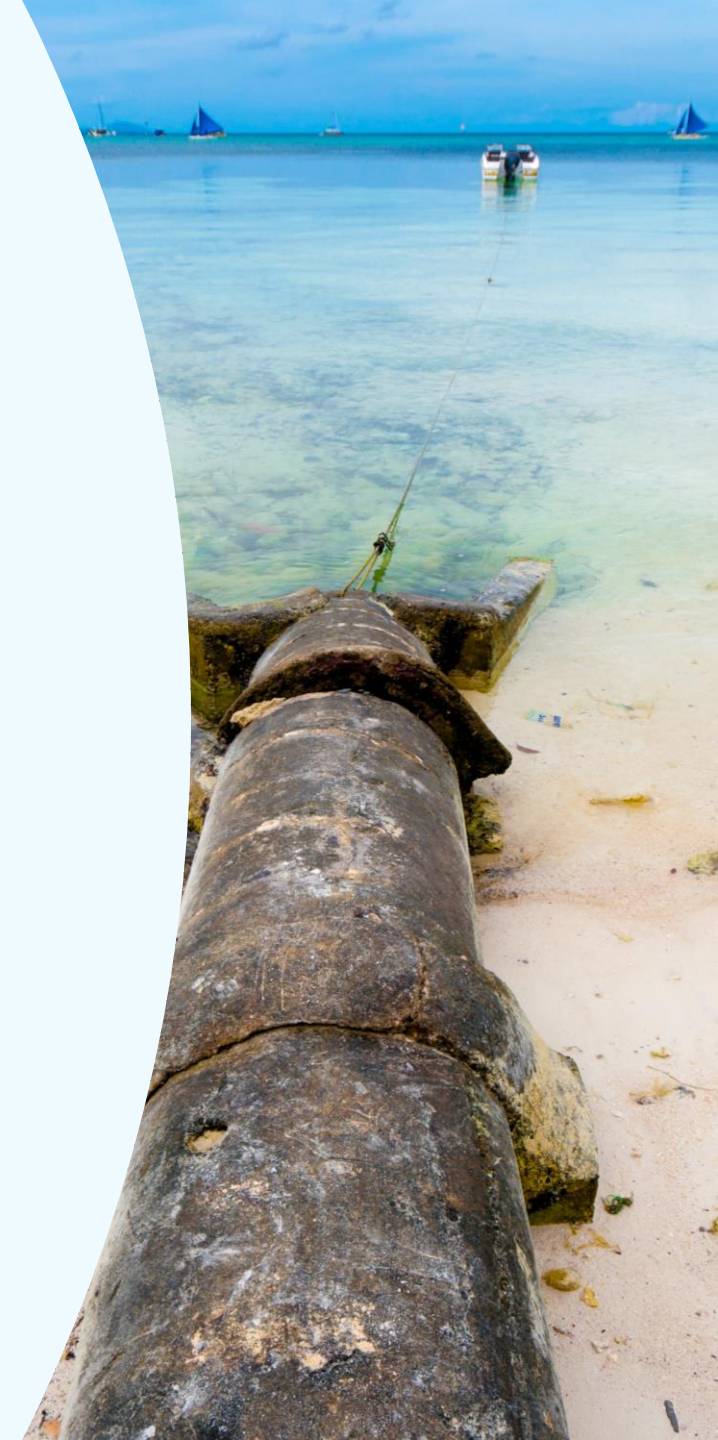
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Malindi, Kenya

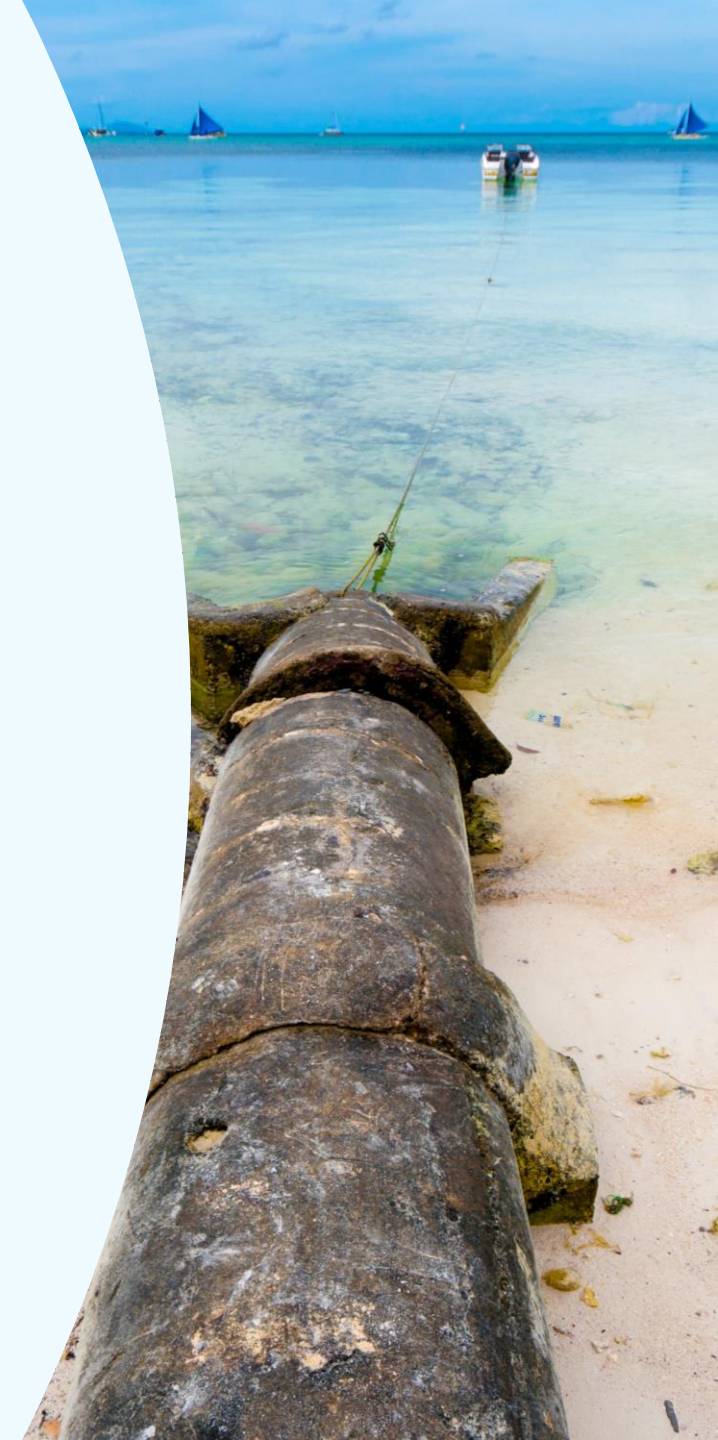
- Some of the oldest marine protected areas in Kenya
- A very popular tourism destination
- In 2006, it was awarded Kenya's cleanest coastal town
- There is no sewerage coverage and only ~25% of faecal sludge is safely treated





Malindi, Kenya

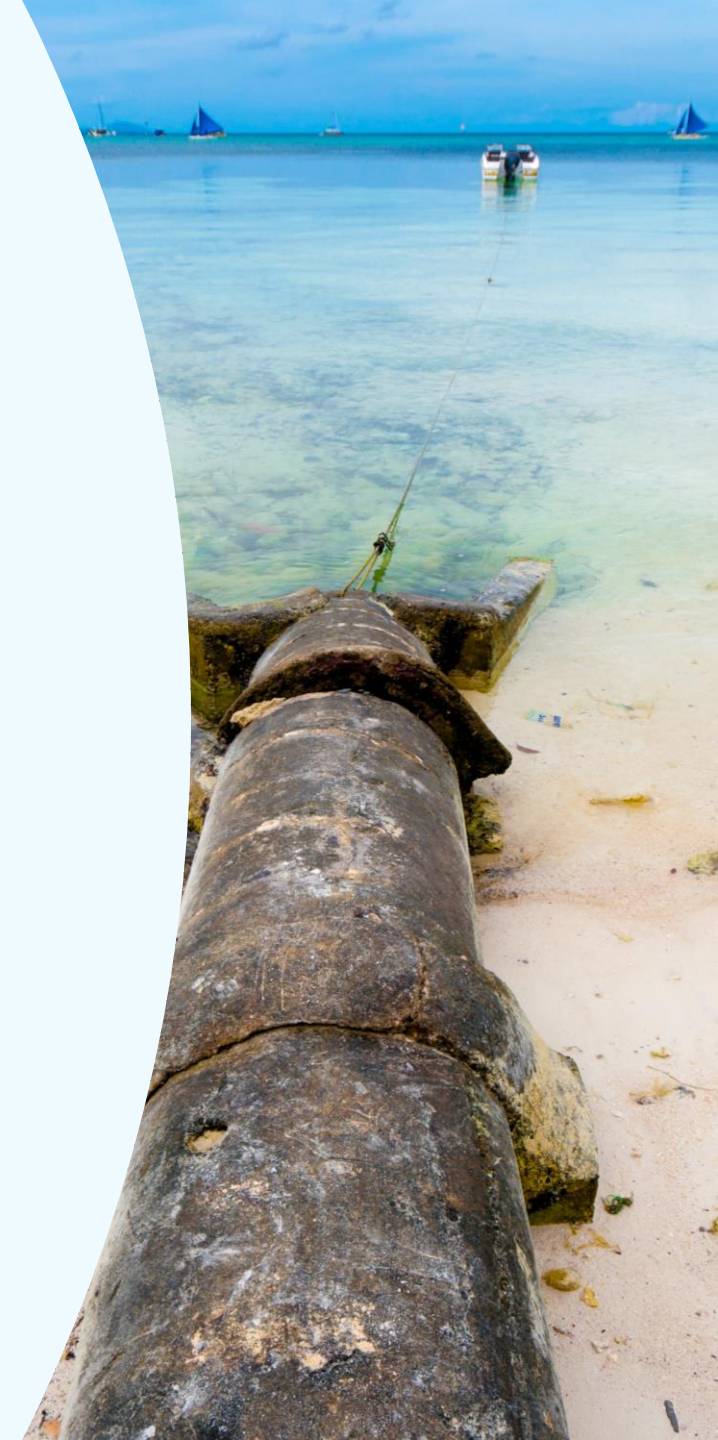
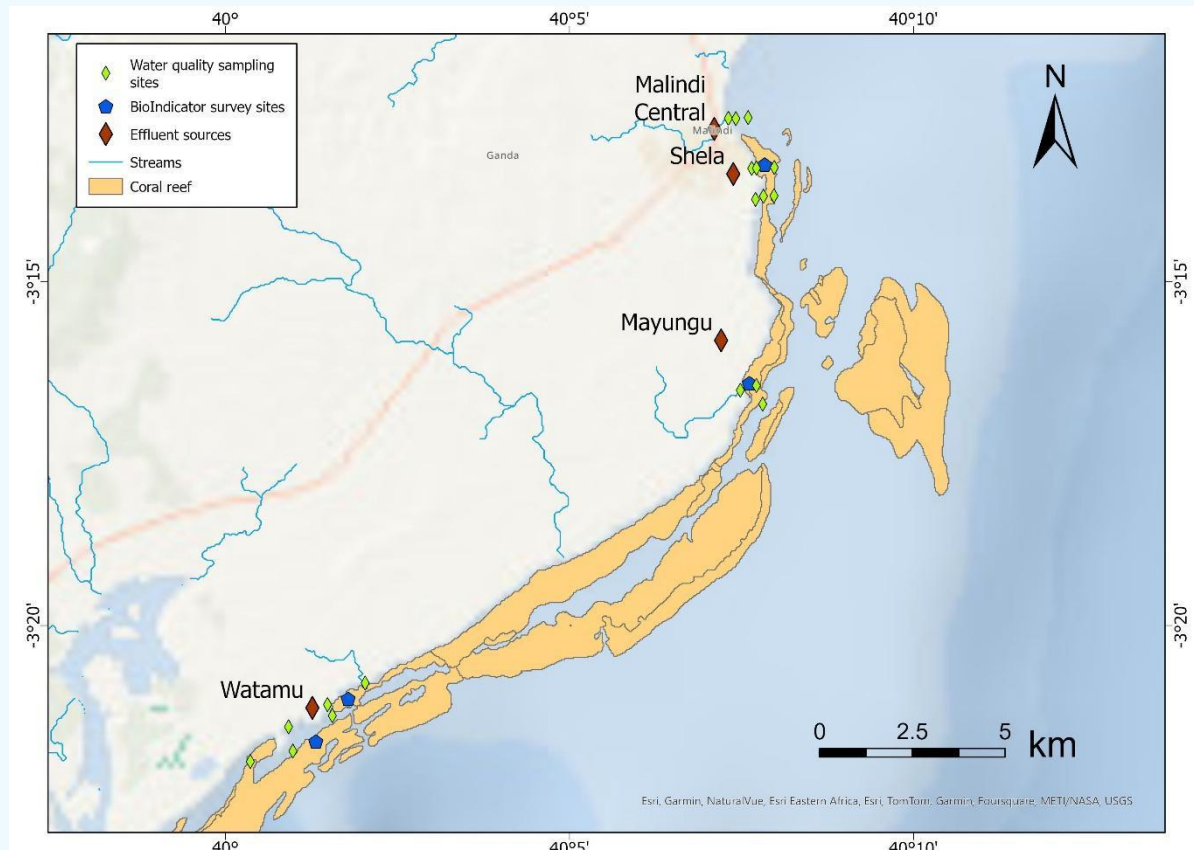
- Sanivation, a Kenyan sanitation company is partnering with the local government to develop a waste-to-resource faecal sludge treatment plant that convert sludge into fuel





Malindi, Kenya

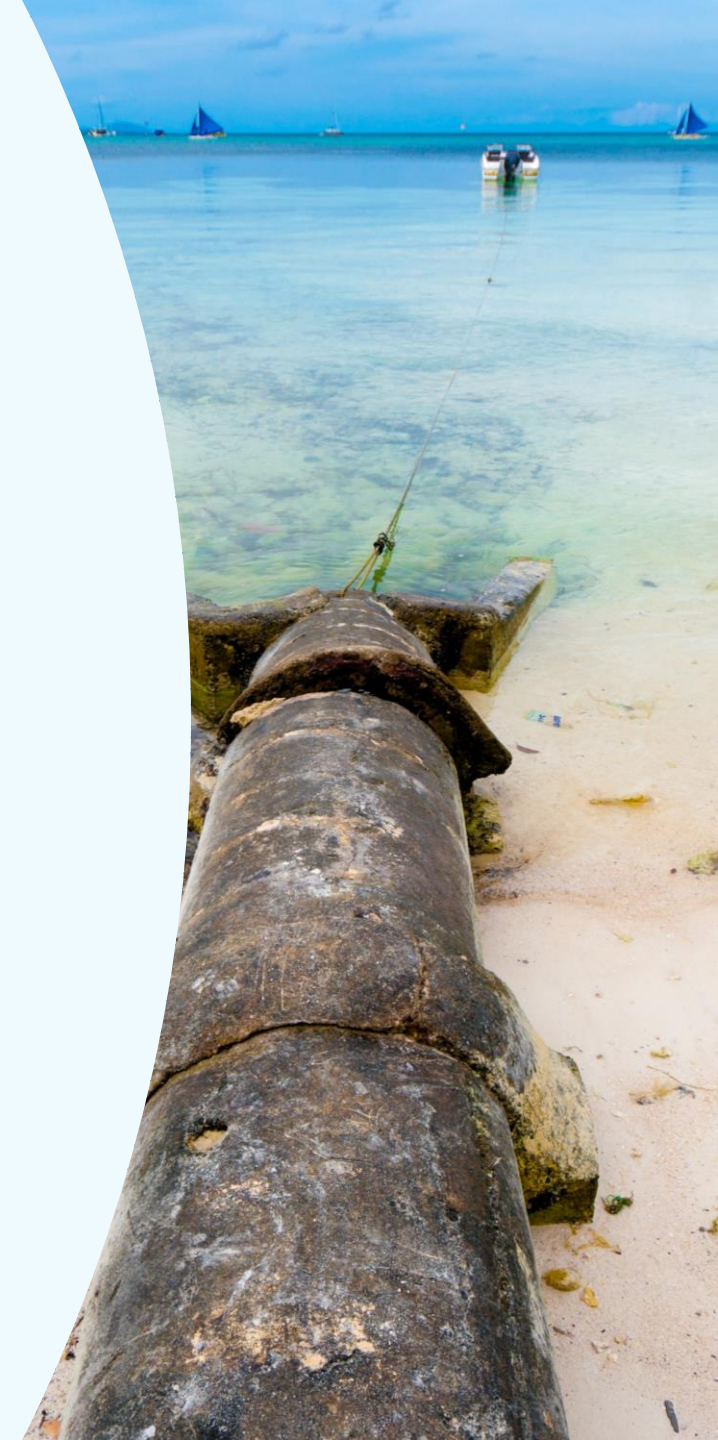
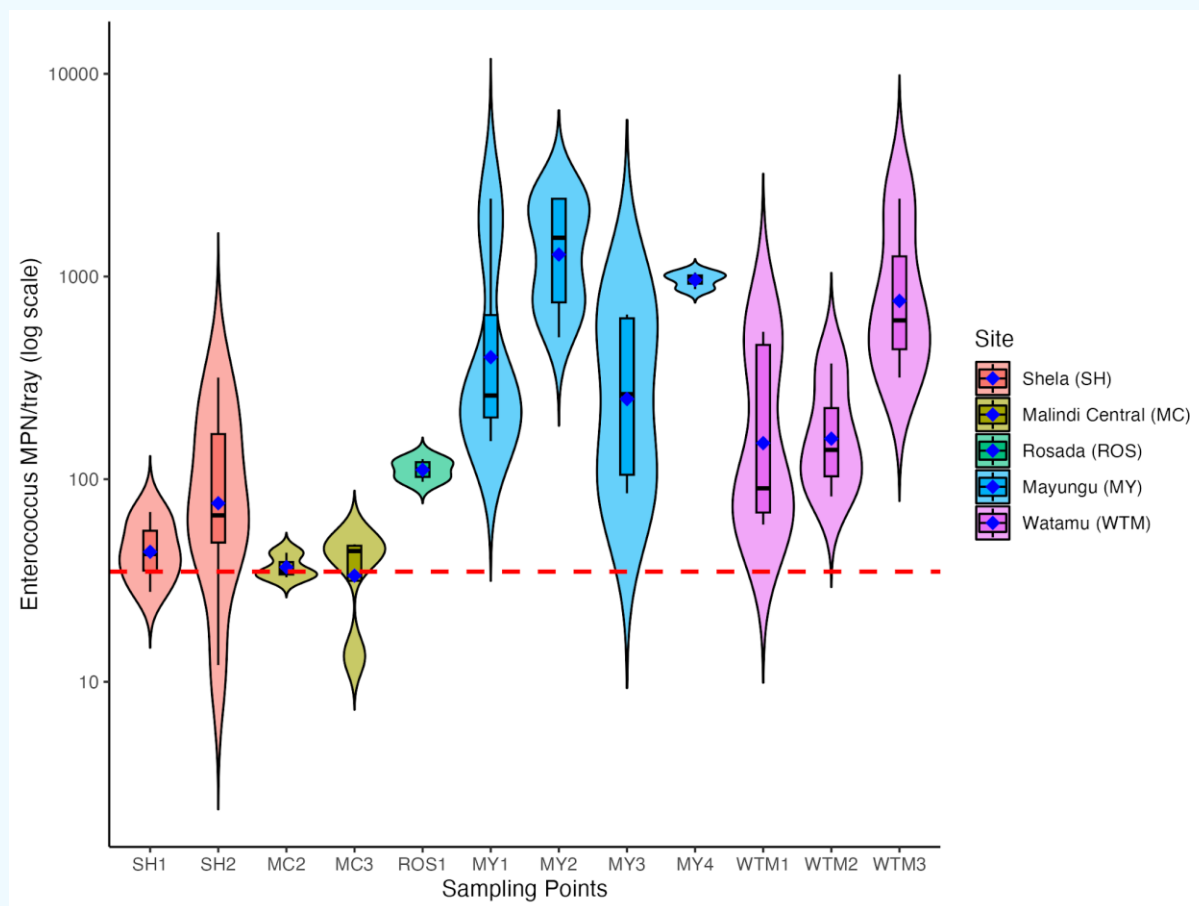
- WCS mapped areas where there were reports of saltwater intrusion into wells, suggesting pit latrines could also be influenced
- Mapped known illegal dumping sites
- Defined the hydrological connectivity of potential contamination sites, stream networks, and river outlets at the coast





Malindi, Kenya

- Every water sample contained *Enterococcus*
- All but two of the sites were above safe swimming guidelines





GLOBAL FUND FOR
CORAL REEFS

REEF+DiscoverCollaborate

Circular Economy & Pollution Management

Sanivation

Addressing wastewater pollution in MPAs using waste-to-value treatment plants

Drivers of Degradation Addressed

Land-Based Pollution

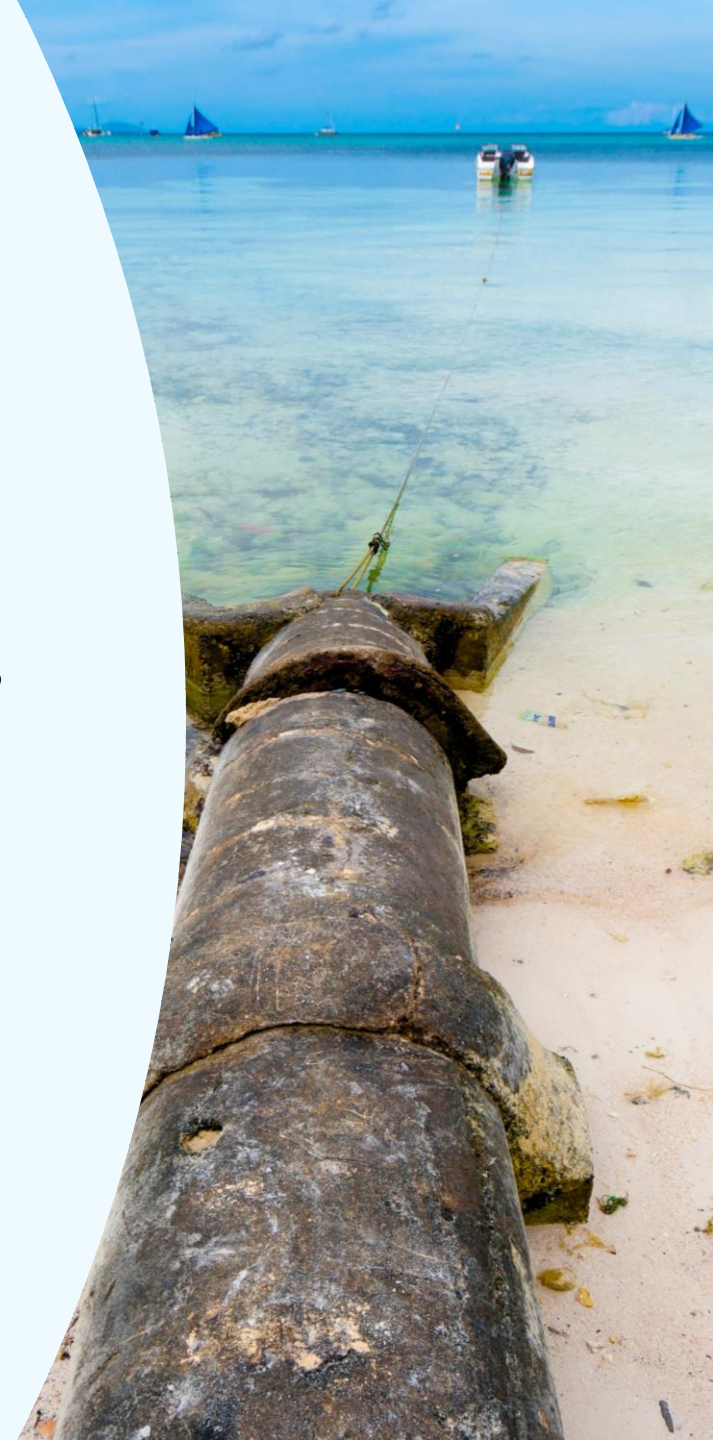
Wastewater

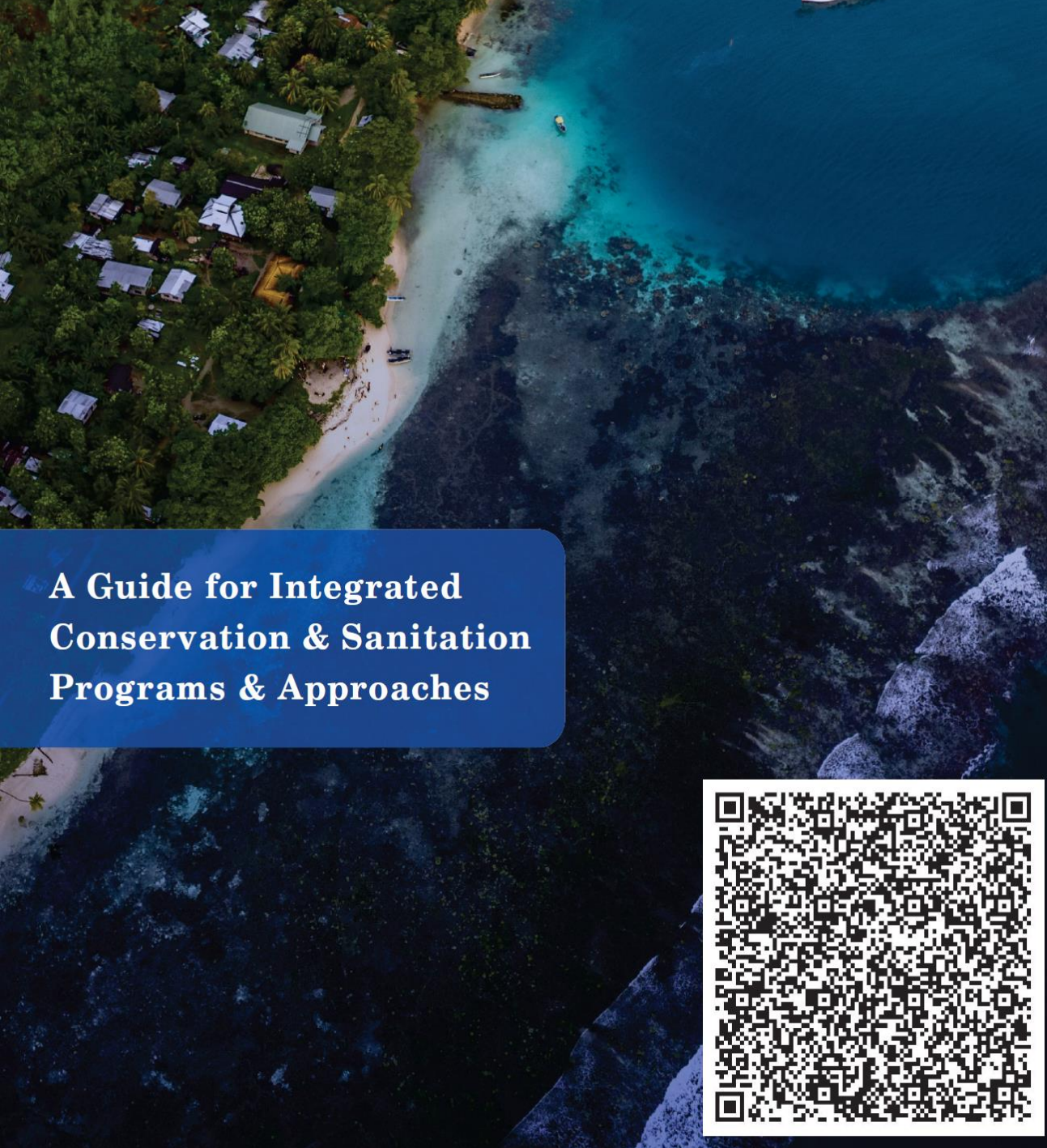




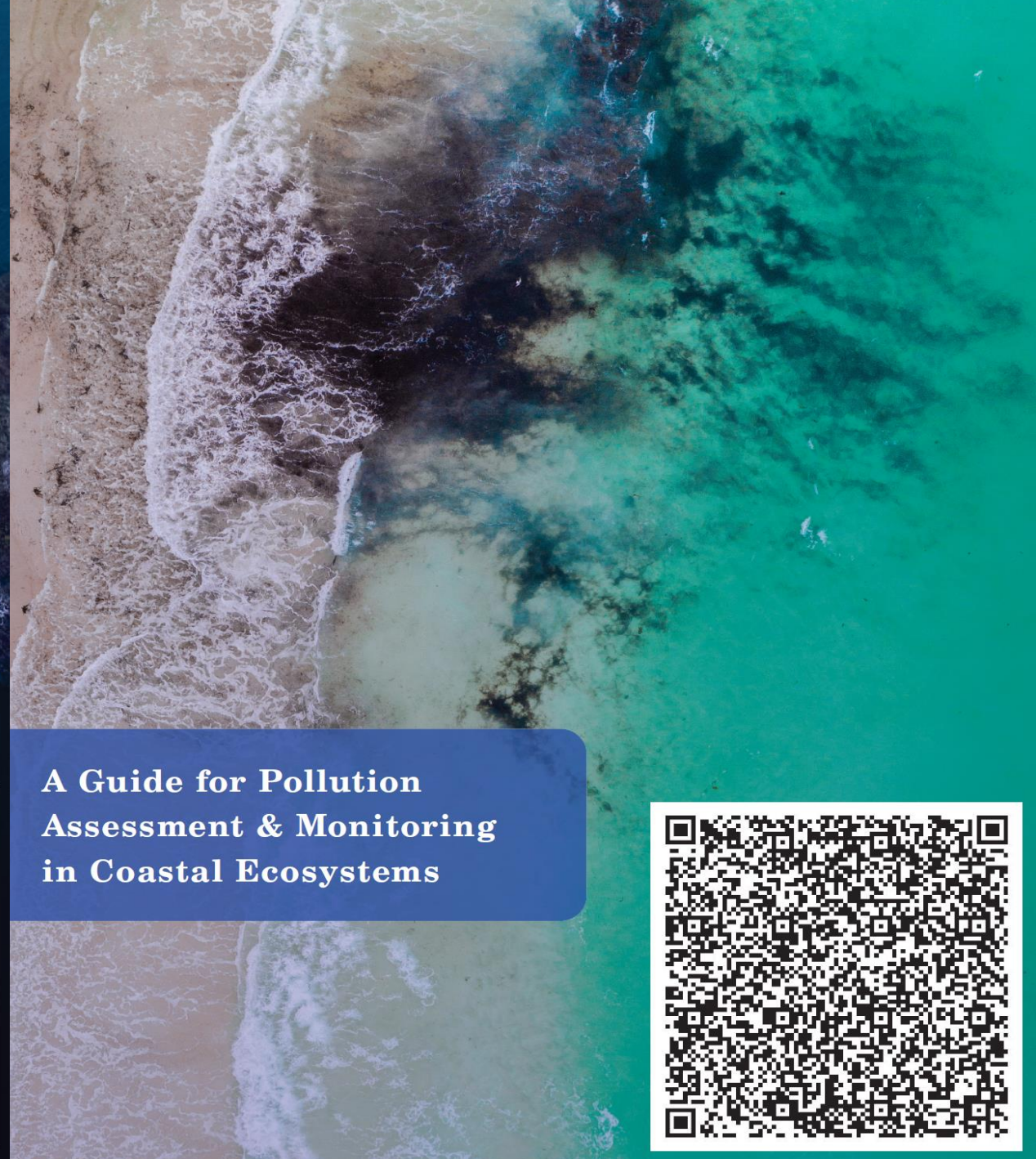
Innovative Finance Mechanisms for Sanitation

- **Global Fund For Coral Reefs** - deploys catalytic grants and investments to implement market-based solutions that address the causes of ecosystem stress and degradation
- **Ocean Risk and Resilience Action Alliance-** multi-sector collaboration connecting the international finance and insurance sectors, governments, multilateral organizations, civil society, and local partners to pioneer finance and insurance products that incentivize investment into coastal and ocean resilience,
- **Green Climate Fund** - Accelerates transformative climate action in developing countries through a country-owned partnership approach and use of flexible financing solutions and climate investment expertise.





**A Guide for Integrated
Conservation & Sanitation
Programs & Approaches**



**A Guide for Pollution
Assessment & Monitoring
in Coastal Ecosystems**





Thank you



WCS.ORG/WATER-POLLUTION