Restoration and Management of Marine Sediments in Bagnoli, Italy

Application of site-specific risk analysis to the marine sediment compound in Area of Relevant National Interest

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Background

The **Area of Relevant National Interest of Bagnoli-Coroglio (Naples, South of Italy)** was a complex and huge industrial site hosting the ILVA steel plant during the last century, whose industrial activity closed in 1993. The area is 250 hectares of land and 1450 hectares in the sea.

Invitalia is currently the owner of the asset and in charge of its **environmental remediation and urban regeneration program**, as addressed by the Italian Government.

As part of this project for the revamping of the Bagnoli Area, **Arcadis Italia:**

- Complete **Detailed Design** of the intervention, including **3D processing of the volume of the sediment tank** to be removed, the remediation of beaches, the restoration and management of marine sediments, comprising the **site-specific risk analysis** execution of the sediment compound
- Conduct the **Environmental Impact Assessment** of the designed intervention
- Support in the definition / execution / results elaboration of **pilot tests of treatment technologies on sediments**

This poster is focused on the site-specific risk analysis conducted to the sediment compound.

Approach

- Human Health and Environmental Risk Assessment **approach** was defined:
- **through technical meetings with competent agencies**
- **considering "not definitive" the previous emergency actions carried out in the north beach**
- **as a design support tool**, to verify the compliance of the residual concentrations to the recreational use of the areas, to contribute to reach the overall goal of the bathing, to manage in a sustainable way 3 millions of cubic meters of contaminated sediments

Methods

- Calculation equations mostly refer to the **Italian guidelines on risk analysis** for contaminated sites elaborated by competent agencies
- **Risk-Net software version 3.1.1 Pro** (official software adopted as per Italian guidelines) was used for numerical calculations from surfaced and submerged sediments
- As not all exposure/migration pathways are covered by nationally and internationally validated commercial software, some calculations were performed through **excel files built specifically for the purpose** using equations reported in manuals (e.g., BP-RISC Manual) and international scientific publications

Conclusions

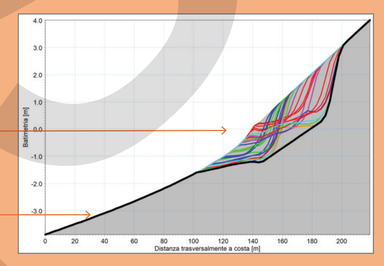
- The human health risk associated with the emerged and submerged sediments is acceptable
- The human health risk associated with seawater and the environmental risk associated with the contaminants in the sediment leached and transported to the sea, are correlated and limited, at the same time, by the current seawater contaminant concentration
- The planned remediation of the entire "dynamic" volume (planned dredging and beach nourishment) is supposed to have a reasonable effect on reducing the overall contaminant concentrations in the sea-sediment interaction zone
- The overall usability of the marine area can be considered accomplished with relation to the restoration goal of the emerged and submerged sediment compound

Risk Assessment Steps

1. Evolution assessment over time of sediments emerged and submerged (dynamic VS static volumes)

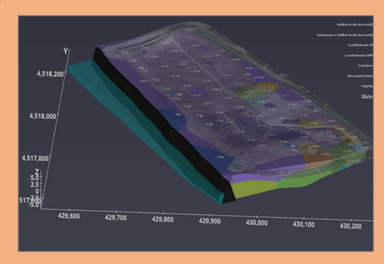
"static" volume: emerged / submerged beach volume that is not subject to movement even under the most severe wave conditions

"dynamic" volume: emerged / submerged beach volume that may be subject to movement due to wave action



2. Definition of the future scenario:

- Volume definition of the sediment tank (with EVS software) to be removed
- creation of new stable shoreline
- design of protective engineering works
- definition of excavation and dredging volumes
- definition of the beach nourishment material characteristics

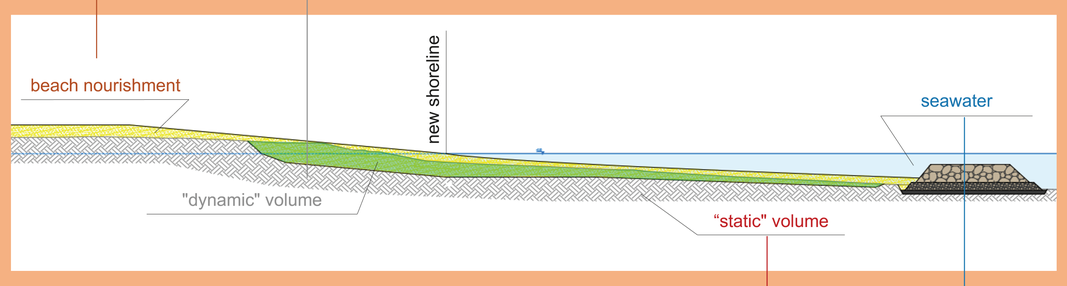


3. Application of site-specific risk analysis to the future scenario

Human Health Risk Assessment

New **beach nourishment** material will be complying with Italian limits for residential/green use
→ the **human health and environmental risks are automatically acceptable**

The **"dynamic" volume** will be replaced with new beach nourishment material complying with Italian limits for residential/green use
→ the **human health and environmental risks are automatically acceptable**



Exposure pathways considered: **outdoor vapor inhalation** from contaminants in **"static" volume**
Receptor considered: adult + child, exposure frequency 1-6 months/year
→ the **human health risk is acceptable**

Exposure pathways considered: **dermal contact, accidental ingestion and inhalation of vapors due to the presence of aerosols** during swimming in **seawater**
Approach: risk assessed by considering n. 5 "strips" parallel to the coastline with contaminant concentrations defined by analyses performed on seawater samples at monitoring transects at bathymetry -1÷-6 m asl
Receptor considered: adult + child, exposure frequency 1-6 months/year, swimming for 2.6 hours/day
→ the **human health risk due to inhalation of vapors due to the presence of aerosols is acceptable**

Environmental Risk Assessment

Migration pathways considered: l**eaching and seaward transport** of contaminants

Approach: comparation of the expected future concentrations in water with the current detected ones

→ it is **difficult** to establish the presence of a **clear pathway** of contamination sediment <-> seawater

→ **the planned remediation of the entire "dynamic" volume is supposed to have a reasonable effect in reducing overall contaminant concentrations in the sea-sediment interaction zone because the main contribute comes from the mobilization of contaminants rather than leaching due to meteoric inputs**