

Faculty Of Civil Engineering, University Of Zagreb
&
NOAH AS, Norway

REMEDIATION PLAN FOR THE FORMER FERROALLOY FACTORY IN DUGI RAT

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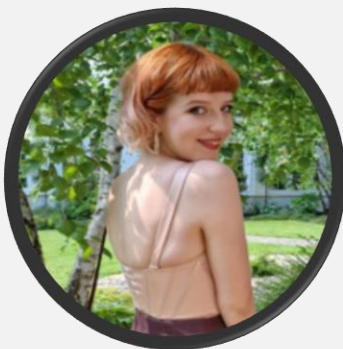
THE KVAZAR TEAM

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SUMMARY

The area covered is located on the peninsula in Dugi Rat. Years of pollution have left the area in an unusable state and thus damaged the visual, ecological, economic and social aspects of the entire municipality. The proposal for a solution is using contents relevant and useful for the area of Dugi Rat in such a way that all the previously mentioned aspects were considered. A sports and recreation center, landscaped green areas, a promenade, as well as an area intended for the construction of a kindergarten / home for the elderly are facilities that greatly help the development of tourism, the sociological image of the city, but also the relief of the city of Split, to which locals and tourists gravitate due to the lack of facilities in the municipality. The remediation plan was drawn up taking into account the most suitable ecological, technical, geological and protective regulations and needs.



“uvik dim, uvik prašina”

“always smoke, always dust”

“kilometrima bi mrlja išla prema Splitu”

“stain (of dust) would float miles towards Split”

“ujutro obrišete prašinu, navečer opet”

“you swipe the dust in the morning, you have to do it again in the evening”

What do you as a community need/want on that site?

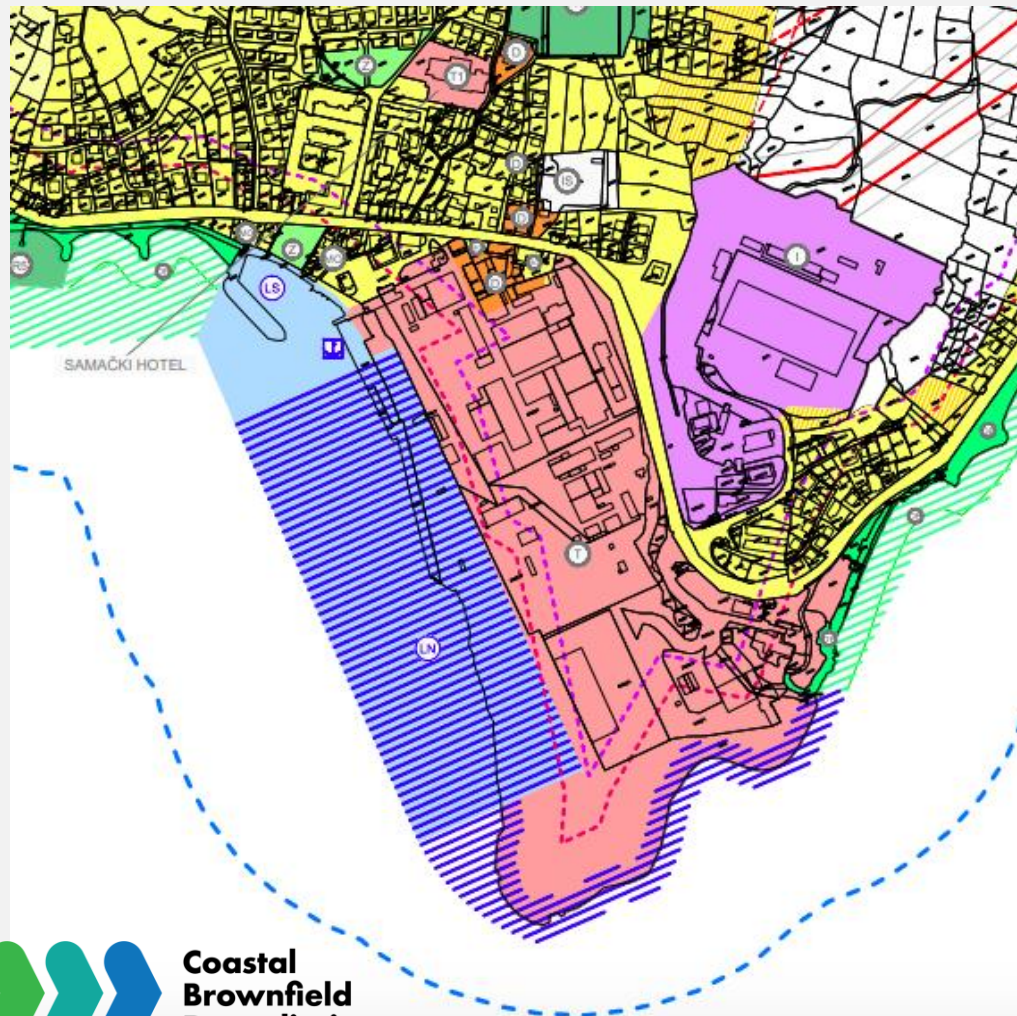
“hotel, marine, recreation center park, nursing home, kindergarten, promenade...”



Coastal
Brownfield
Remediation

SPATIAL PLAN

- economic purpose – tourisms
- sport marine
- port for special purposes
- coastal greenfield



JAVNE I ZELENE POVRŠINE U BLIZINI



1:6000



- ideas collected while talking to the residents
- the municipality in need of public spaces
- improvement of views
- feeling of a secure and tranquil place

- with the participation of people-choosing contents
- variety of contents
- improving tourism
- relieving the city of Split



STEP BY STEP TECHNICAL SOLUTION

1. Initial protection of slag heaps with geotextile
2. Additional ecological analysis for determining categories of pollution in accordance with Norwegian regulation
3. Construction of vertical impermeable barrier through entire length of artificial part of the cape
4. Artificial lake remediation and terrain levelling
5. Addition of horizontal impermeable barrier on the surface of artificial part of the cape
6. Landscaping the artificial part of the cape after it's been encapsulated - recommended to avoid building heavy structures on slag

STEP BY STEP TECHNICAL SOLUTION

7. Landscaping the natural part of the cape:
 - Terrain modulation
 - Slag heap separation into smaller heaps
 - Adding impermeable barriers under smaller heaps
 - Purification of the dirt under the initial heaps using clay...

8. Extra left over slag could be used as aggregate in asphalt production for paving tracks around the landscaped area:
 - Making a bike pump track or similar structures
 - Paving the promenade
 - Exporting

EXAMPLE PICTURES OF THE TECHNICAL SOLUTION



SAMPLING AND ANALYSIS

sea where the beach is

soil everywhere, various depths

Slag –
fractions

lake: various
depths +
sediment

- major place for geotech. research
- major places of taking chem. samples
- approx. area of artificial peninsula

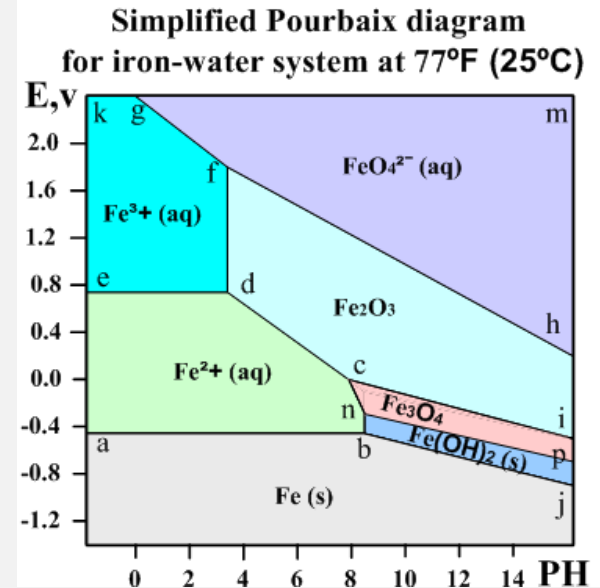
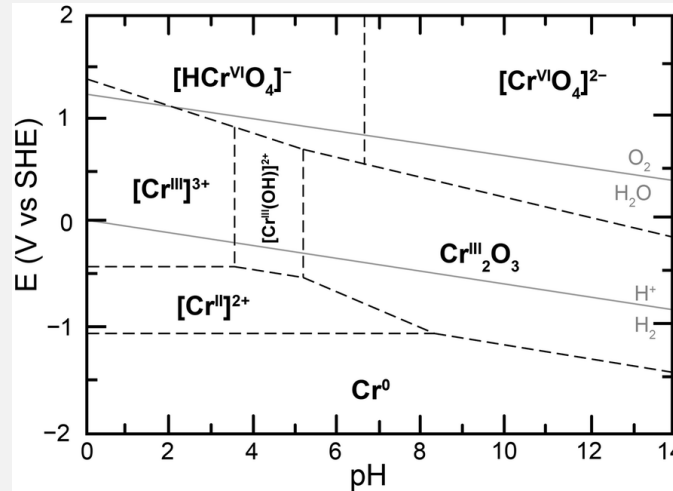
sea in 100 m range, all directions + sediment + sea organisms

REMEDICATION OF CONTAMINATED SOIL

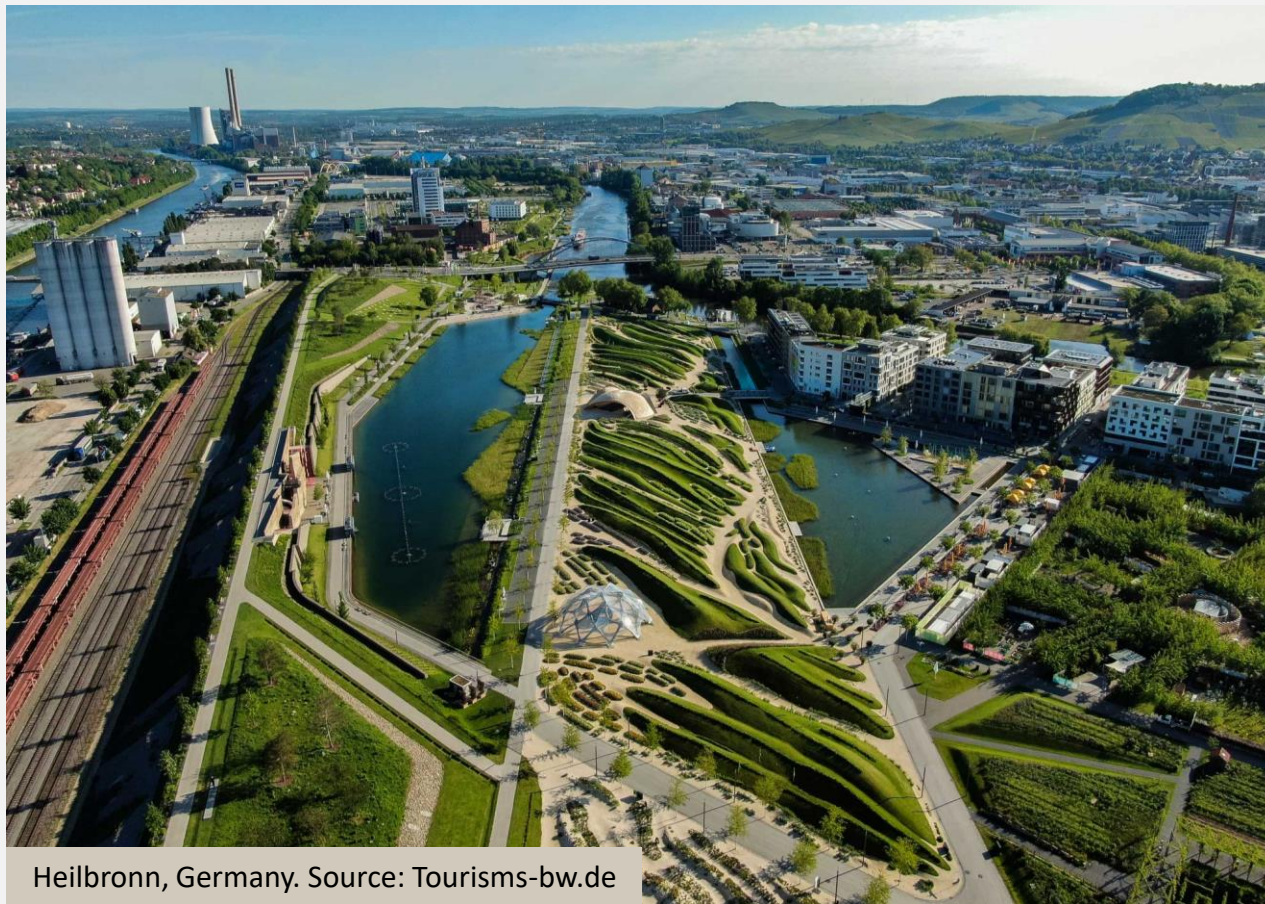
Layer of clay - ion exchange and encapsulation of heavy metals in clay

LAKE WASTEWATER TREATMENT

- Pourbaix diagrams
- Wastewater treatment plant in Omiš/Split



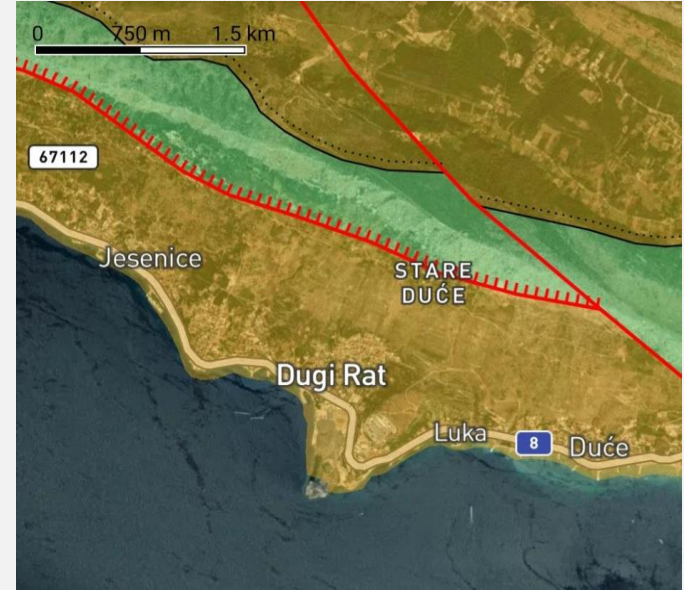
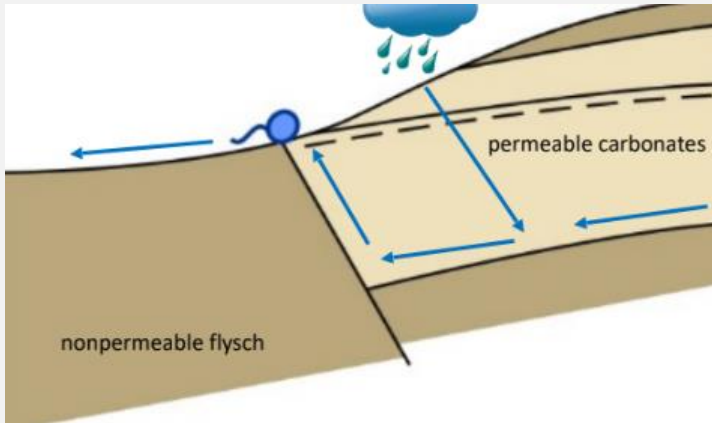
EXAMPLES OF GOOD PRACTICES



Heilbronn, Germany. Source: Tourisms-bw.de

LITHOLOGY & GEOMORPHOLOGY

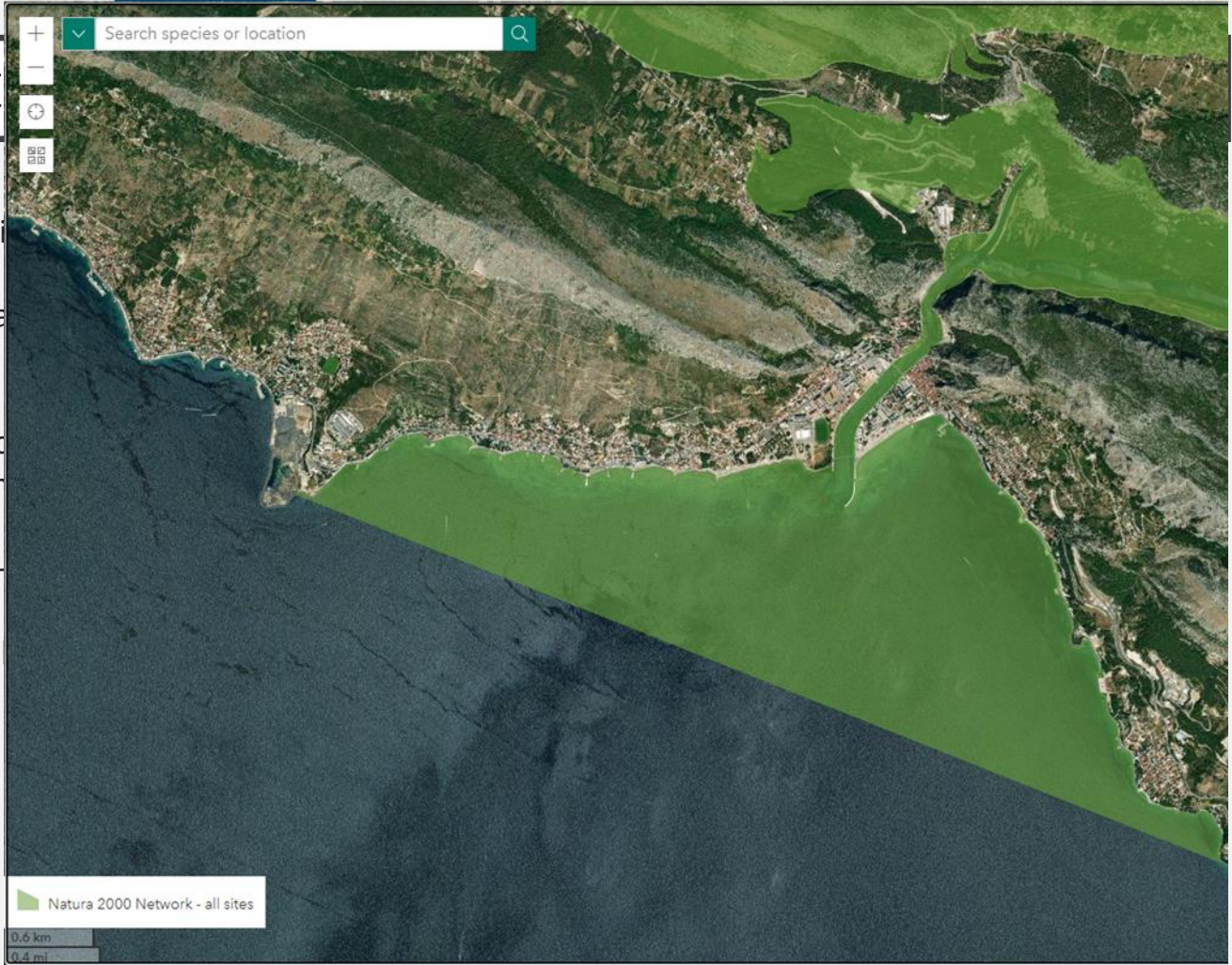
- eocene flysch, cretaceous limestones
- non-permeable, permeable
- groundwater springs located on geological boundary



- clay minerals in the sea - they adsorb heavy metals (Fe \longleftrightarrow Cr(IV))

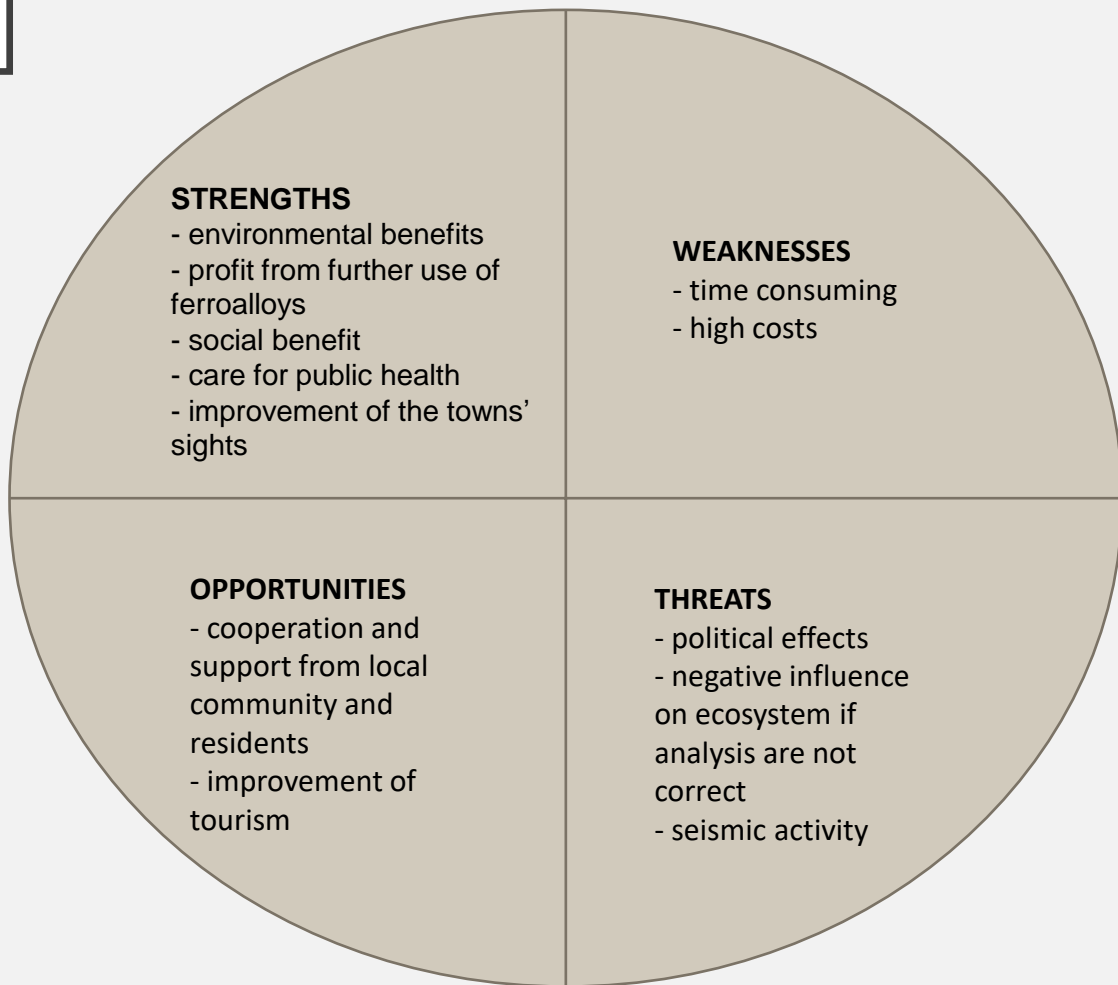
POSITIVE

- Monitoring (before, during procedure)!
- Samples of soil, slag, sea plasma
- Treating slag like landfill
- Microhabitat introduction
- Big parts of construction sea - habitats
- New vegetation cover - erosion
- Not in Natura2000 site, vicinity



ECONOMIC ASPECT

- Costs: 13,44 mil. € (for 251 171 tonnes of ferroalloy)
- Profit: selling the slag, reusing it and recycling it into products later used (making money selling it and saving it)



SOCIAL PARTICIPATION

- transparency
 - accessible on official sites
 - social media campaign
 - media and press
- public discussions including the inhabitants
- surveying around the municipality
- later including the residents in for example landscaping-sense of connection and belonging
- workshops and events



THANK YOU FOR YOUR ATTENTION!