RemPlex Global Summit
Nov. 13-17, 2023
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Ensuring Sustainability and Resiliency of Remediation Projects: Challenges for long-term management at complex industrial, nuclear, and other, sites

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- Complex sites: sites with range of former uses, and complex (inorganic, organic, radioactive?) “suite” of residual contaminants
- Or: *“site where remedial approaches are not anticipated to bring the site to closure or facilitate transitioning to sustainable long-term management within a reasonable time frame”* (ITRC)
- Require a disproportionate amount of resources for environmental remediation and long timeframes to achieve remediation (Price, 2017): **Remediation may involve intensive and large-scale engineering, industrial and stakeholder engagement activities that extend over decades**

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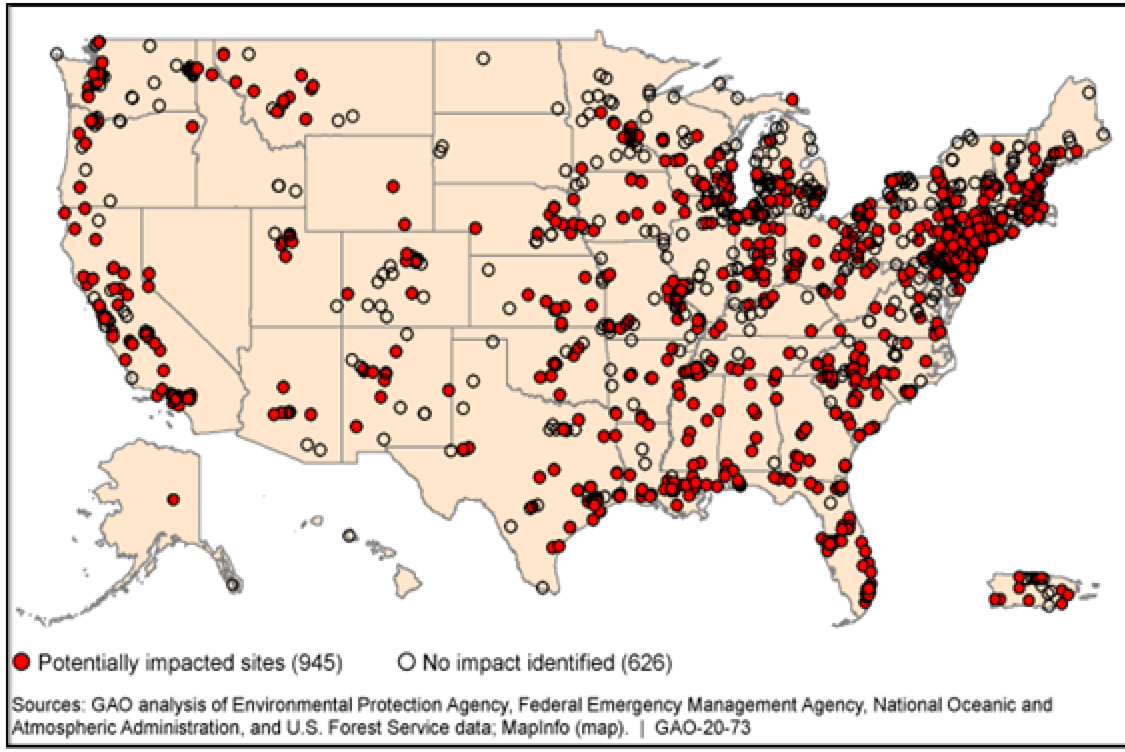
As we enter a period of increasing climatic extremes and uncertainties (including major global heating-related challenges such as flooding and enhanced sea-level rise, increased wildfire frequency, and extended drought periods), longer-term risk management and remediation projects need to be future-proofed and resilient.

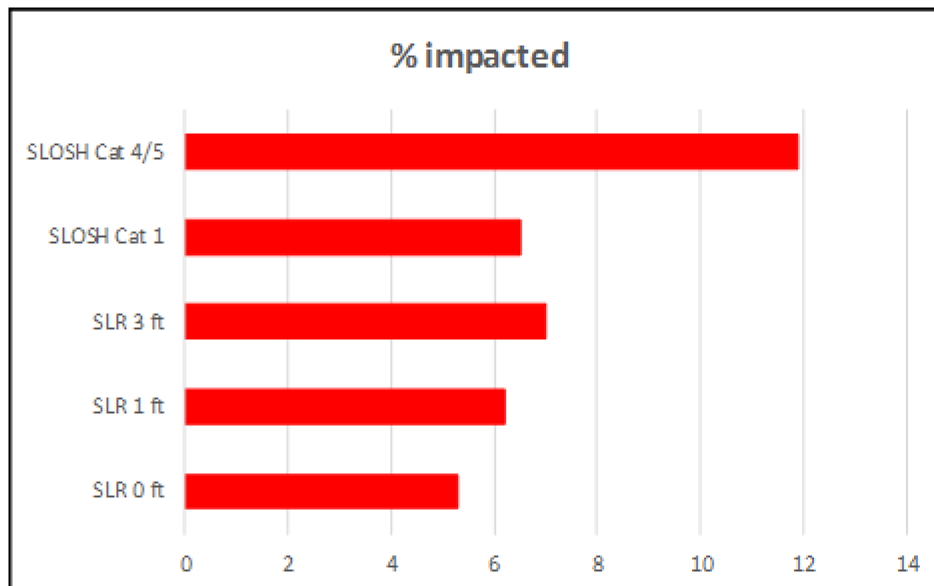
They also need to balance the economic, environmental and societal impacts, costs and benefits associated with the remediation of a site, and its return to a desired end-state or alternative use.

Climate resiliency:

Source: Reuters, BBC



Superfund sites located in areas that may be impacted by flooding, storm surge, wildfires, or sea level rise (top).



Bottom graph shows (from top) percentage of sites impacted by Sea, Lake, and Overland Surges by Hurricanes (SLOSH) of category 4 or 5, and category 1, and those expected to be inundated by a sea-level rise of 3, 1, and 0 ft *(source: U.S. Government Accountability Office [GAO], 2019), Figure from Bardos et al., 2020)*.

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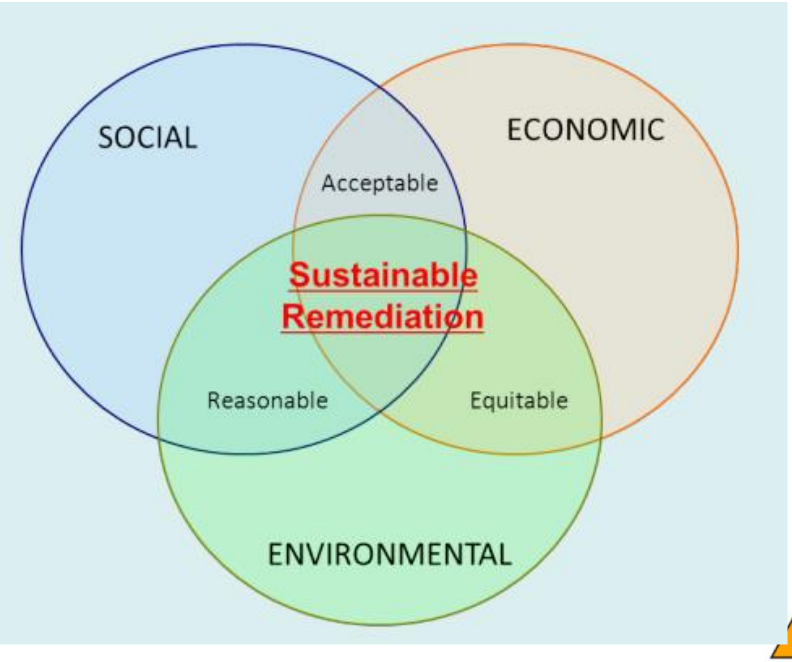
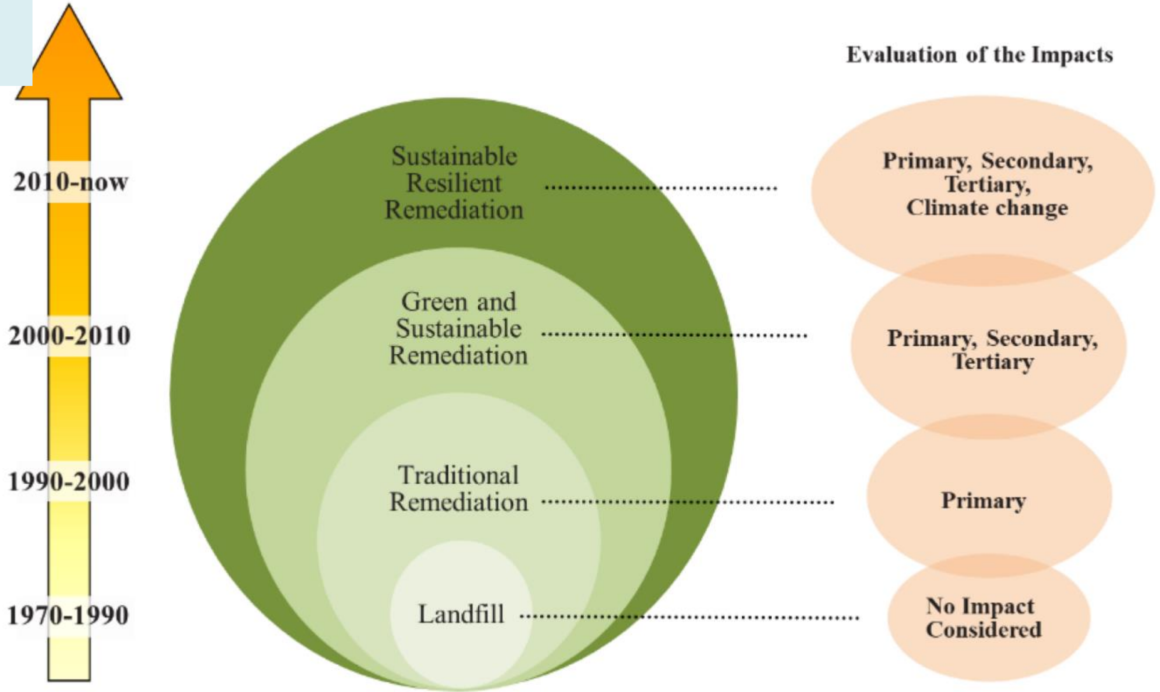
Balancing impacts, costs and benefits:



Source: esaa.org

SuRF Canada 2012: Sustainable Remediation considers the environmental, social, economic impacts of a project to ensure an optimal outcome, while being protective of human and environmental health, both at a local level and for the larger community

Source: Grifoni et al., 2022



ISO 18504:2017: elimination and/or control of unacceptable risks in a safe and timely manner whilst optimising the environmental, social and economic value of the work.

Example

Straz Pod Ralskem (Cz)

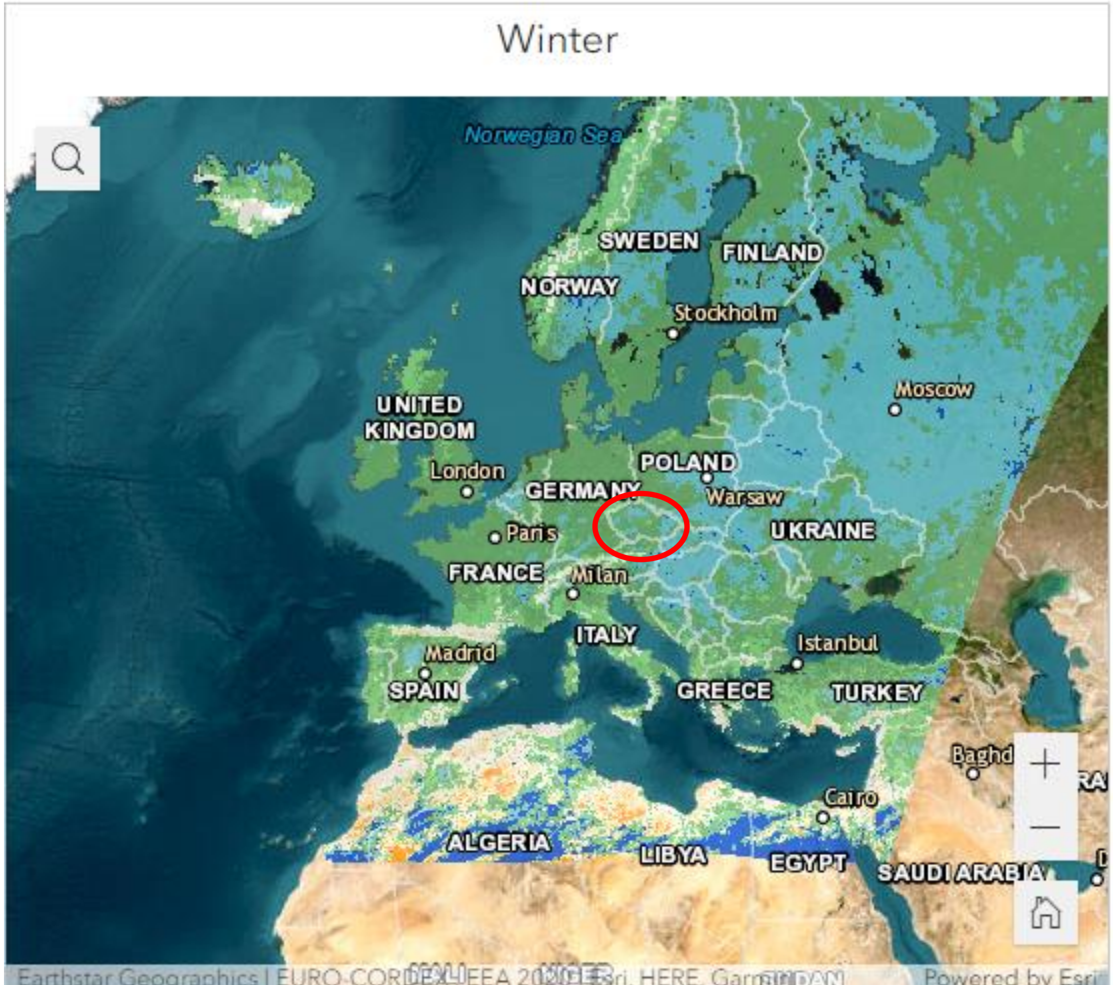
- Soviet-era *in situ* acid leach (and undergound) mining of Cretaceous sandstone-hosted U deposit
- Area of leaching fields: 628ha
- Between 1967 and 2000 the mine produced over 16 000 tonnes U via injection of 4.1 million tonnes of sulphuric acid, 315 000 t of nitric acid, 112 000 t of ammonia, 26 000 t of hydrofluoric acid, and 1400 t of hydrochloric acid

Now: Groundwater protection (P&T), coupled with U separation and storage or sale. Target end-date: 2037?

Remediation goal (*ca*. 2 billion Euro): restore leaching fields and protect upper Turonian aquifer (plus sustainably risk manage treatment residues)

Example

Straz Pod Ralskem (Cz)



< -25 | -25 to -15 | -15 to -5 | -5 to 5 | 5 to 15 | 15 to 25 | 25 to 35 | > 35

Change in heavy rain (%)

Heavy rain is defined as 95th percentile intensity of total rain events

Implications of climate change over treatment period?

25 – 35% increase in heavy rainfall events?

Implications for groundwater dynamics?

Projected changes in the magnitude of heavy rain in winter in the period 2071-2100, compared with 1971-2000 for a high emissions scenario (source: EEA)

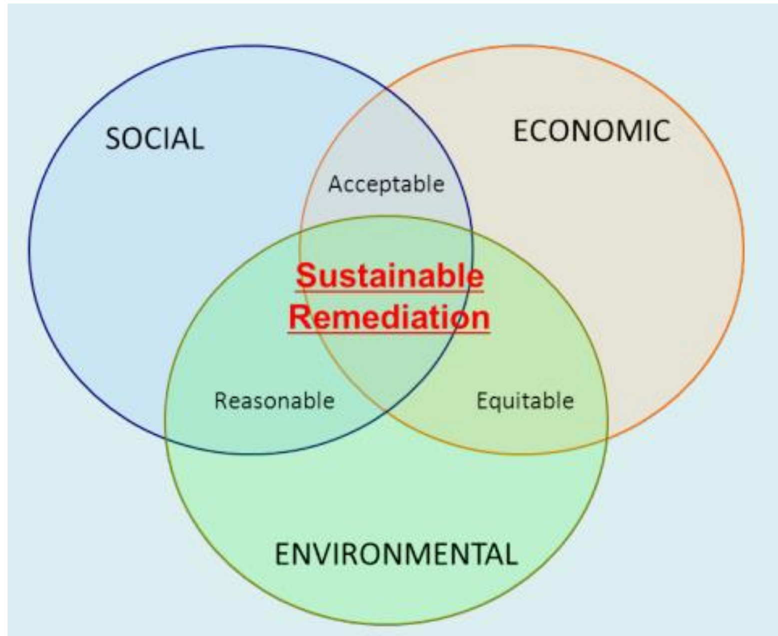
Key issues: (a) assessing and balancing the different dimensions of sustainability, and applying or adapting sustainable remediation concepts, practice, tools and approaches to site rehabilitation or decommissioning.

- Does sustainability mean the same everywhere?

- Which tools and approaches to use *(simple (sustainable or best management) practices vs complex)* ?

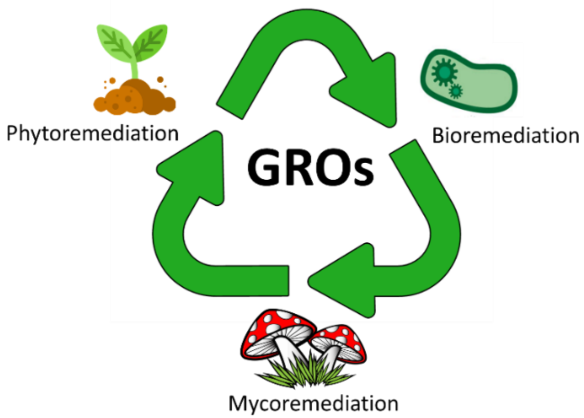
- Can these tools support flexible decision making over long timescales, and incorporate changing conditions *(resiliency, to changing climate and to possible resource scarcity)* ?

- What are the technical capacity needs?

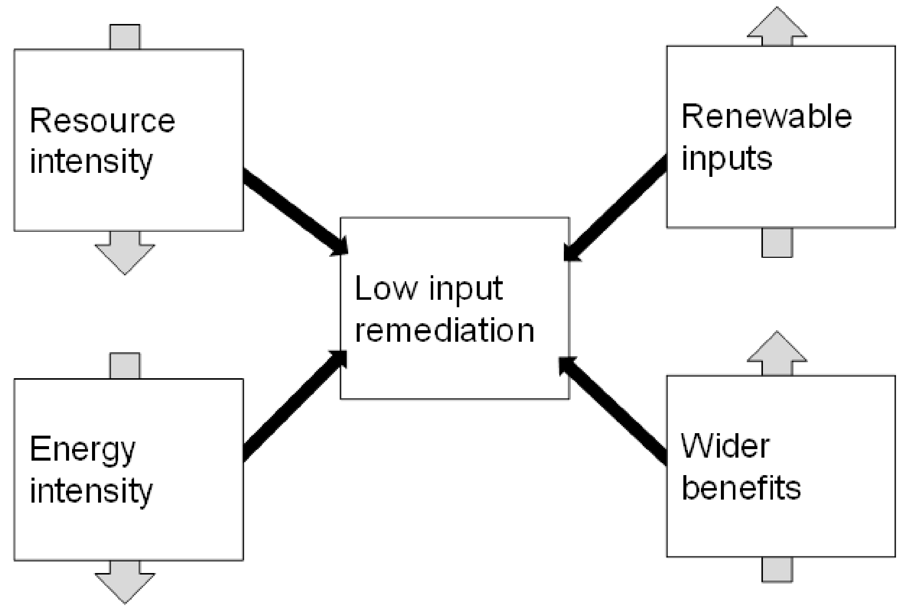


Source: esaa.org

Key issues: (b) implementing low input remediation strategies, and working with nature to realise wider benefits, enhance resilience and support end-state management.



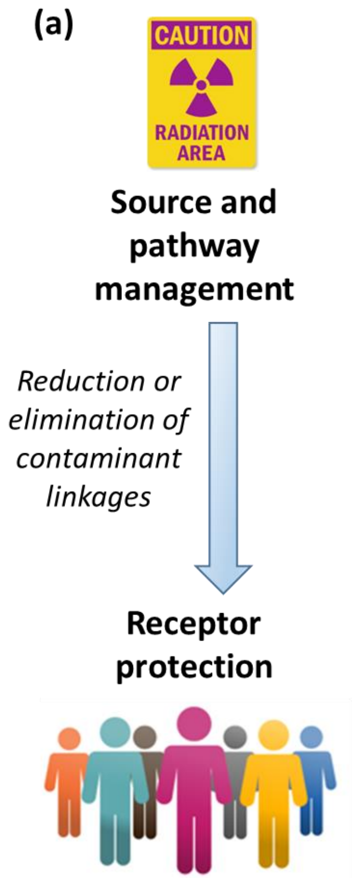
Source: Cundy et al., 2016; Purkis et al., 2022

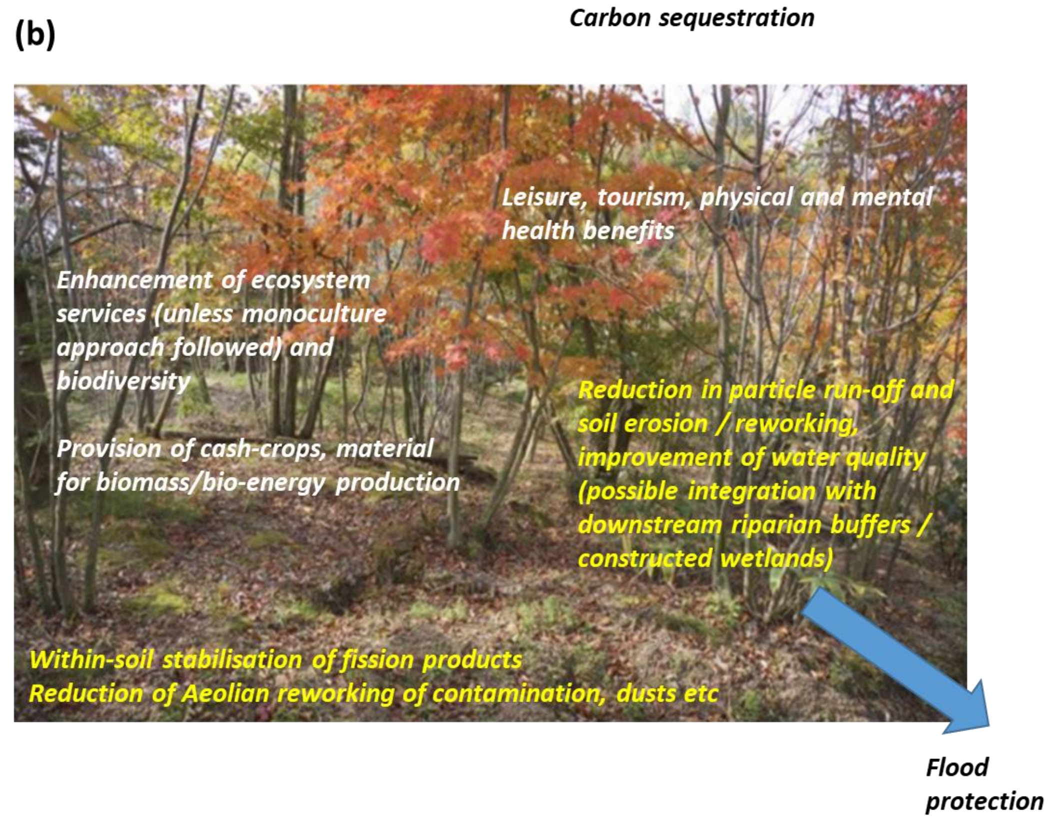


- **Nature-based solutions** and **Gentle Remediation Options (GRO)**: Integration with "hard" engineering / decommissioning approaches, via "green" cover barriers to stabilise waste / soil piles or wastes disposal areas; airflow buffers or intercepting hedgerows for dusts; or as run-off or leachate capturing constructed wetlands or reed beds etc?
- Lower cost, with enhanced resiliency? (flood control, heating abatement etc)

Key issues: (b) implementing low input remediation strategies, and working with nature to realise wider benefits, enhance resilience and support end-state management.

Source: Purkis et al., 2022, large area MLFP contamination scenario





- With decarbonisation and 'net-zero' targets, use of NBS/GROs as interim 'holding' strategies to sequester or stabilise contaminated materials pending final care and maintenance strategies, or final site clearance?
- Support transition to "green" end-states?

Key issues: (c) working with communities to ensure long-term effectiveness, balanced approaches, and support the spiralling up of community capital.

- How to ensure meaningful community engagement at sites which have been historically closed / inaccessible
- Involvement of marginalised or excluded groups (including where land ownership or legal liabilities are contested)
- Ensuring end-states which are co-developed with stakeholders to balance social, environmental and economic needs, and build on community assets

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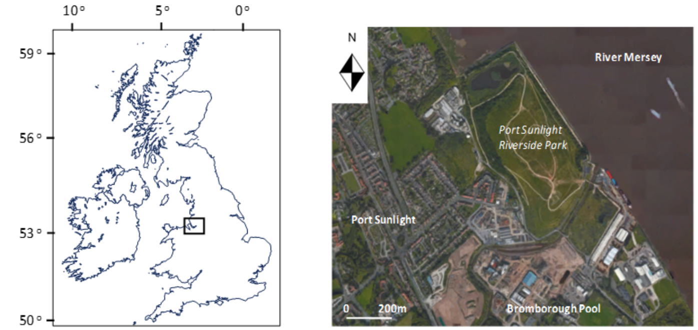
?

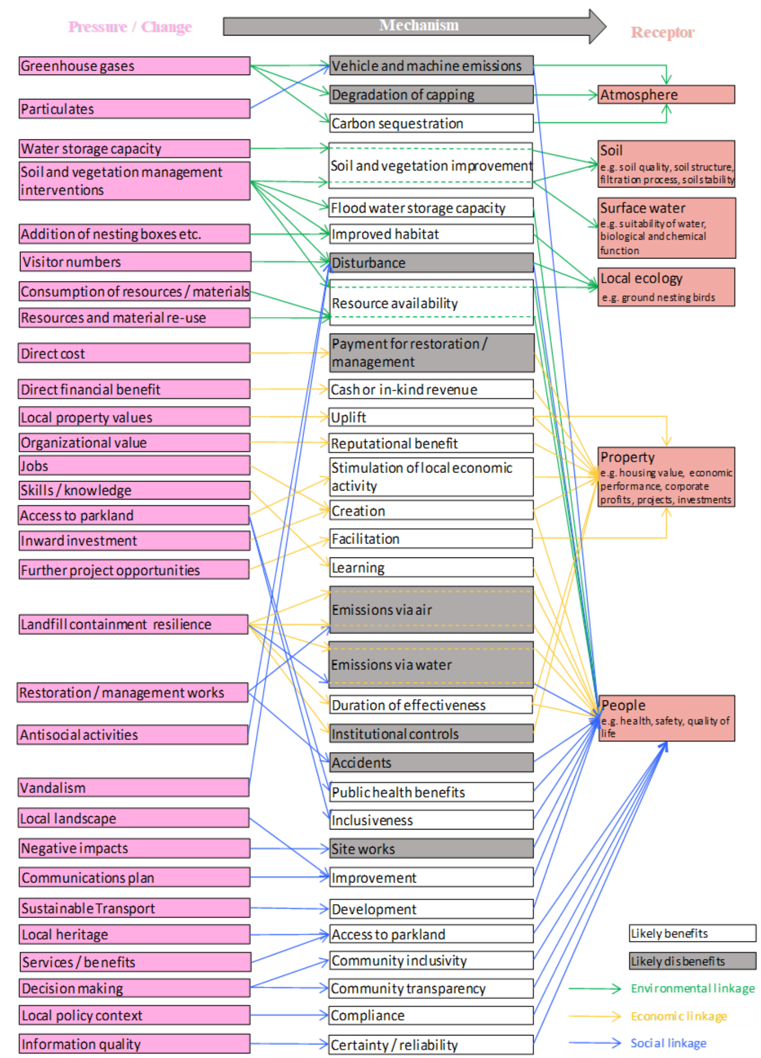
Key issues: (d) assessing and quantifying (where appropriate) sustainability-related benefits over longer timescales, to inform end-states and future site use.

How do we assess and capture the value of wider benefits (including societal and ecosystem benefits)?

How do we accommodate changing values and desires over time?

How do we build this into end-state planning?



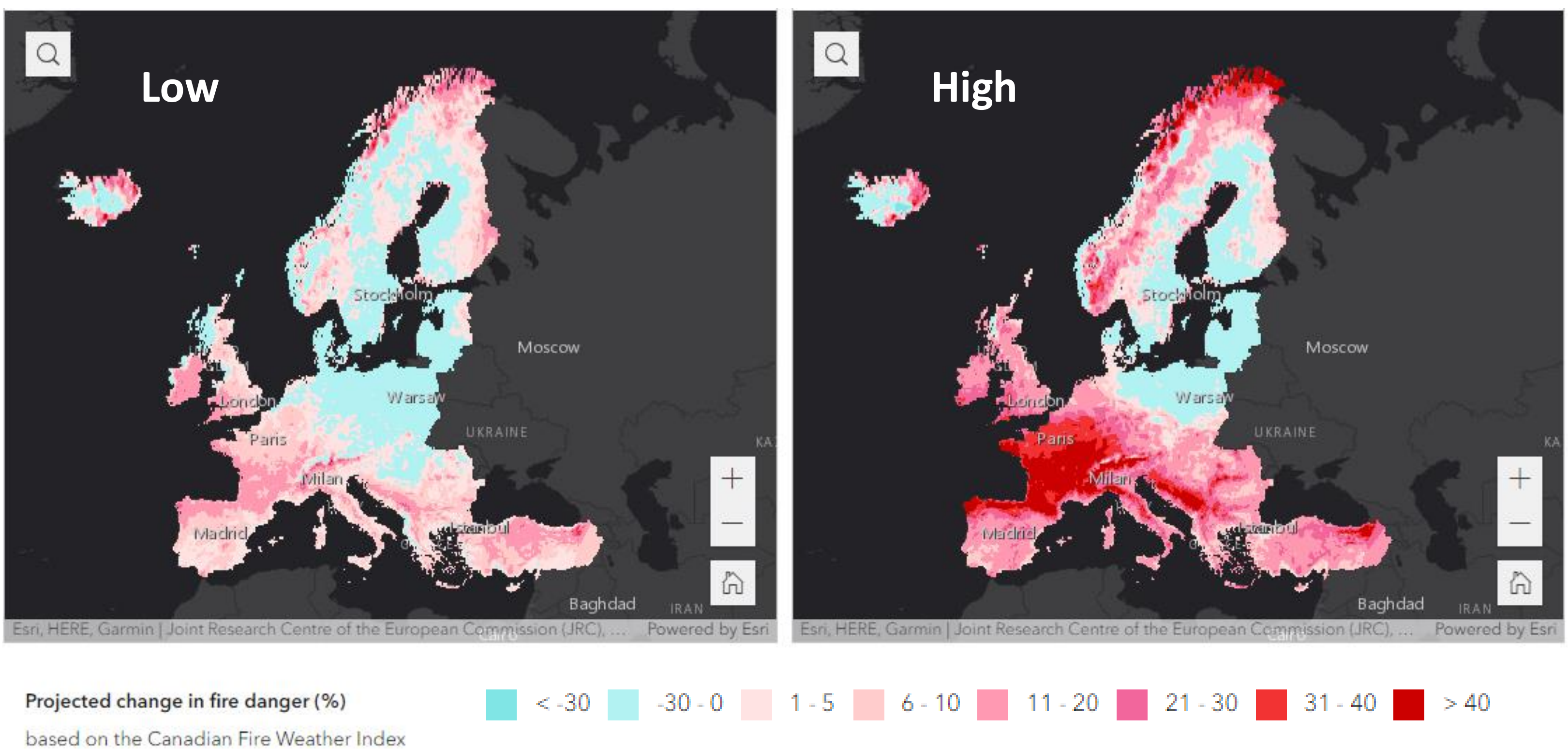


Source: Li et al., 2019; Bardos et al., 2020

Key issues: (e) building resilience and long-term sustainability into remediation and site end-states.

Coping with climatic shifts and uncertainties, and managing impacts on end-states: will intended end-states (including “green” end-states) still be feasible?, impact on possible “leave-in-place” (*in-situ* disposal) strategies, etc.

Projected change in meteorological forest fire danger by the late 21st century for two emissions scenarios, compared with the period 1981-2010



Source: EEA

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This session

Explore the many facets of sustainability and resiliency as they relate to such considerations as stakeholder goals for future use of a site, resource conservation, carbon footprint reduction, cost containment, and vulnerability to climate-driven changes

Focus on complex sites; site end-states; tools and methods supporting decisions; vulnerability assessment and resilience planning; social sustainability; and incorporating sustainability principles into decision-making processes

Panel session explores Advancing Sustainability and Resiliency in Remediated Sites Worldwide

Thank you
Any questions?

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