Environmental Nature-Based Remediation Practice

AECOM Delivering a better world

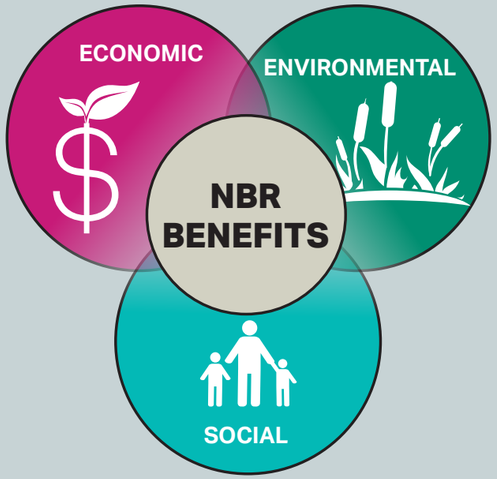
WHAT IS NBR?

Nature-based Remediation (NBR):

Remedial applications with net benefit to human health and the environment through judicious use of resources and a selection process considering effects on community, global society, and the environment by corrective action (ITRC).

WHY USE NBR?

- Gaining traction/acceptance over past decade
- National and International support
  - United Nations
  - European Commission
  - U.S. EPA
  - State agencies
- Potential Sites
  - >600,000, including Brownfields (USEPA, 2017)
  - >340,000 in Europe (EEA, 2014)
  - Tens of millions of hectares to be managed in China (MEP, 2014)
- To date, NBR has primarily been utilized to provide project cost / resource savings



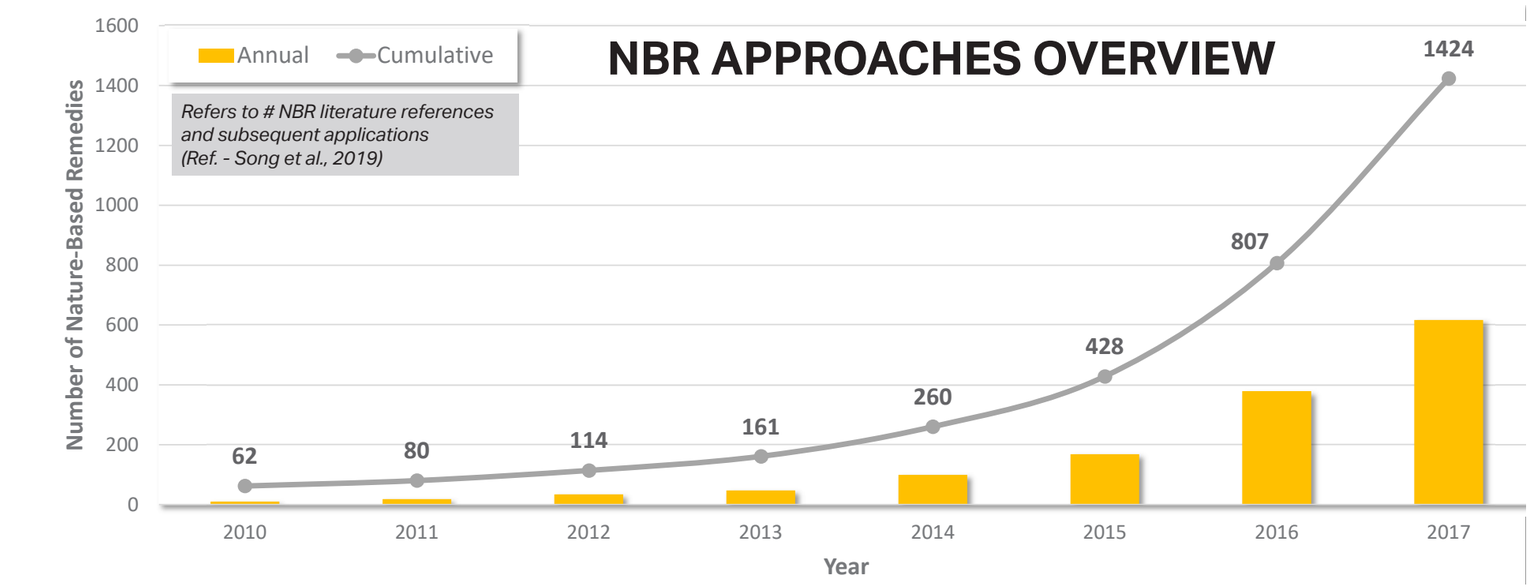
NBR BENEFITS

- Mitigates resource-intensive approaches
- Offers resilience to change
- Offers cost-effective alternatives
- Promotes long-term stewardship
- Reduces resource demand

NBR IMPLEMENTATION?

- Media-specific (i.e., soil, sediments, groundwater)
- NBR are focused in two areas:
  - In-situ implementation -subject of significant research
  - Ex-situ implementation - now being more deeply explored
- Beneficial re-use another important aspect of NBR
  - Notable example - Coal Combustible Residual (CCR) / Coal Ash

NBR APPROACHES OVERVIEW



IN-SITU NBR APPROACHES

MICROBIOLOGICAL (Primary & Co-metabolic)			CHEMICAL (Redox, Hydrolsis)		COMBINATION (Micro/Chem)	
Aerobic (Biostim.)	Aerobic (Biostim.)	Natural Microbial Activity	Reactive Mineral Placement	Reactive Mineral Harnessing	Reactive Mineral Formation	Low Temp. Heating
Reactive Zones Biobarriers	Reactive Zones Biobarriers	Natural Attentuation	Reactive Barriers or Gates	Enhanced Attenuation (Natural or Engineered)	Reactive Zones (Anaerobic)	Alternative Energy Sources

EX-SITU NBR APPROACHES

PHYTO / MYCO SYSTEMS			BIOREACTORS		NATURAL VEGETATION CONTROL	
Wetlands	Plants / Plantings	Fungi / Fungal Enzymes	Microbe Based	Algal Based	Grazing	Plant Selection
Varying Designs	Beneficial Plants, Trees, Grasses, etc.	Plant / Fungi Pairings	Varying Designs	Varying Designs	Farming Co-Beneft	Self Maintaining

Recent Projects

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PHYTO-CONSTRUCTED WETLANDS

First U.S. pilot, full-scale designed phytoremediation system, and active irrigation of 1,4 dioxane impacts impacts demonstrates successful remediation.

Managed a multi-disciplinary team from feasibility, design and implementation to all phases of concept, design, piloting and regulatory negotiation and presentation.

CLIENT ESG BENEFITS:

- Demonstrated how cost-effective long-term phytoremediation treatment alternatives can be fully sustainable for groundwater contaminants.
- Innovative treatment system mitigates high groundwater treatment system costs.
- Enhanced public/community relations with environmentally friendly solution.
- Natural system remedy approved by the State and will be implemented at full-scale.

COST SAVINGS:

Innovative phytoremediation approach, designed and oversaw installation of 35-acre combination deciduous/ coniferous phytoremediation system.

SEDIMENT, RIPARIAN HABITAT AND WETLAND RESTORATION

Prepared complete permitting package and restoration plan for removal of 10,000 yd^3 of MGP byproducts from 2-acre wetland/freshwater tidal river. Restored hydrology and associated wetland communities and restored riparian area, vegetated shallows in the tidal river, along with use of bio-engineered structures.

CLIENT ESG BENEFITS:

- Multi-disciplinary team prepared comprehensive environmental permitting documentation (dredging and wetland restoration design/oversight).
- Facilitated prompt/streamlined permitting negotiations for remediation/site closure.
- Eliminated third-party client liability through interim remedial measures at each parcel.
- Facilitated regulatory "No Further Action" letters parcel-by-parcel.

COST SAVINGS:

Reduced remedial costs and reduced potential human health threats at three neighboring properties that showed MGP residuals.

PHYTOREMEDIATION/CONSTRUCTED WETLANDS FEASIBILITY ANALYSIS

Establishments of poplar trees to promote aerobic degradation of polyaromatic hydrocarbons and hydraulic control. AECOM prepared an initial, in-depth feasibility study for constructed wetlands with select phytoremediation technologies for hydraulic control of groundwater and the passive treatment of PAHs, and BTEX compounds.

CLIENT ESG BENEFITS:

- Integrated innovative/environmentally friendly phytoremediation alternative to promote passive aerobic breakdown of site compounds.
- AECOM detailed site-specific study incorporated eco-friendly final treatment aspect combined with traditional measures for contaminant treatment of groundwater.

COST SAVINGS:

Innovative phytoremediation alternative resulted in reduced long-term cost for final treatment components compared to traditional costly mechanical aeration systems for contaminants.

CONSTRUCTED WETLANDS - BARRY, WALES

The client required a remedial solution to secure a closed, unlined landfill. AECOM delivered a series of investigation, monitoring and CSM reports, culminating in a Remedial Options Appraisal. The principal opportunities for sustainable/nature-based remediation included:
1) optimizing surface water drainage; 2) minimizing the need for imported soil volumes for landfill cap construction; and 3) enhancing/extending the biodiversity value of an adjacent nature area.

CLIENT ESG BENEFITS:

- Realization of a net CO_2 savings of ~1,440 tons through reduction in imported soil.
- Innovative eDNA sampling of Pond water to facilitate identification of invasive and non-native species.
- Clean surface water run-off rates attenuated by new wetland and incorporated existing oxbow lake and reed beds to retain/enhance biodiversity.

COST SAVINGS:

- $1.6M savings from reduction in 100,000m^3 of imported fill.
- $150K savings through use of polyethylene coated geosynthetic clay liner; resulted in additional 11,000m^3 reduction of imported soil.

MORE INFORMATION

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3. Horst et al., Groundwater Monitoring & Remediation 40, no. 1/ Winter 2020/pages 14–23.
4. USEPA, Green Remediation Best Practices: Overview of EPA's Methodology to Address the Environmental Footprint of Site Cleanup, EPA-542-F-12-023 March 2012