APPLYING SUSTAINABILITY PRINCIPLES IN EVALUATING ALTERNATIVES FOR REMEDIATION PROJECTS IN SOUTH AFRICA

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Talk Breakdown

- Introduction
- Sustainable Remediation terminology and evolution
- Bringing it back to site
- Treatment options for dissolved phase BTEX
- Granular Activated Carbon vs Biofiltration technology
- Framing comparison and setting boundaries
- Qualitative comparison and illustration of a scenario process
- Applicability in the SA context
- Summary and closing

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Introduction to GeoRem

- Provides turnkey remediation services throughout Southern and Eat Africa
- Full cycle service, including remedial design, system construction site installation and operation
- Staffing includes Environmental Geologists, Hydrogeologists, Engineering and Technical teams
- Locally designed system utilising world class equipment
- Remediation technologies include
  – Pump & Treat
  – Vacuum Enhanced Recovery (VER) and Multiphase Recovery (MPE)
  – In Situ Chemical Oxidation ISCO and ISCR (Reductive)
  – Thermal remediation
  – Permeable Reactive Barriers
  – Landfarming and in situ bioremediation

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Introduction to green or sustainable remediation

- Concepts and terminology have grown through the use of life cycle assessment principles in evaluating environmental impacts associated with the remediation of contaminated sites
- Assessment of wider environmental impacts that may be associated with resource use or knock-on effects
- Maximizing the net environmental benefit of remedial activities, while ensuring that remedial goals and targets can be met

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"The practice of demonstrating, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process."

SuRF-UK

Green remediation reduces the demand placed on the environment during cleanup actions, otherwise known as the "footprint" of remediation, and avoids the potential for collateral environmental damage.

US EPA 2008 - Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites

Evolution of sustainable remediation concepts

- Initial understanding was that remediation would by default be sustainable as the purpose is to remove or mitigate environmental contamination impacts
- Significant focus on technical performance in terms of project planning and deliverables
- Impacts on resources, broader economics and society not always considered as a critical factor
- As the technical understanding of remediation activities became better, questions in terms of the broader impact are being asked
- Finally developing into guidelines and tools to evaluate sustainability and include it in evaluation and planning
- Differences between Green and Sustainable remediation

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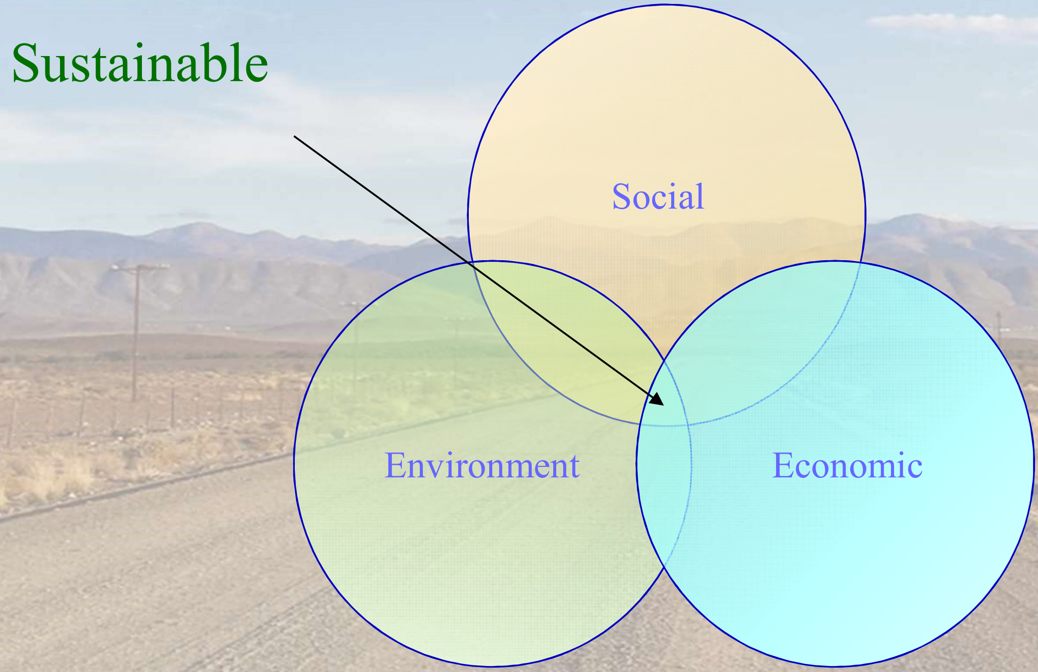
Bringing it back to site

- Sustainability concepts now have a broad understanding at a planning and strategic levels
- How do we bring some of it back to site specifics and technical decision making?



Site Specifics – A Remote site

- A significant portion of remediation sites are located in remote locations
- Remediation using Pump & Treat, Multiphase extraction are often the initial options to deal with fuel contamination in fractured bedrock aquifers as in SA
- Evaluation of alternatives necessary for the effluent treatment portion of the remediation system
- Effluent treatment will usually be evaluated in terms of ability to reach goals, reliability, cost, footprint and operational requirements
- How can we incorporate sustainability criteria at this stage into decision making ?

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Liquid Effluent Treatment Options

- Free-phase LNAPL to be separated using a coalescing oil water separator, leaving the dissolved phase fraction VOC's for the next step:
- Options considered:
  - Air stripper to volatilise VOC's and emit to atmosphere or further treatment
  - Granular Activated Carbon (GAC) treatment is used to adsorb hydrocarbons to the media
  - Advanced Oxidation Process – Utilize an activated oxidant to break down contaminants of concern
  - Active Bed Biofiltration
  - Combined approach of GAC and Biofiltration

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GAC – The reliable water treatment option ?

- GAC is widely used for dissolved phase hydrocarbon treatment due to its excellent adsorptive capabilities for BTEX
- Simple installation with limited infrastructure required and well understood treatment mechanism
- Once saturated it needs to be regenerated or disposed
- Limited infrastructure and logistics leads to the bulk of GAC utilised in SA to be disposed

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The contender – Biofiltration

- Based on the use of a bioreactor, utilising microorganisms in the liquid or vapour phase to degrade hydrocarbons
- A variety of implementation techniques that allow for fixed bed, floating bed or biofilm reactors
- Well established use in the wastewater industry with growing base in environmental remediation
- Function requires a colony of microorganisms to mineralize hydrocarbons primarily primarily using aerobic processes
- A variety of site-specific factors that need to be considered, including operating temperatures, feedstock concentrations and flow
- No waste generated, questions on by products and residuals that need to be answered on a site-specific basis
- Can be used in a batch or flow-through process

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Weighing up options

- Logical, defensible and documented process required
- Identify stakeholders
- Frame the assessment, set scope, boundaries and define uncertainties before comparison
- SuRF-UK developed a list or set of indicators that can be used for comparative analysis as a basis
- Provides a benchmark for decision making and evaluation purposes
- Indicators that are applicable to the scenario are selected by the stakeholders

The SuRF Indicator Set

Social	Economic	Environmental
Human Health & Safety	Direct Economic Costs & Benefits	Air
Ethics & Equality	Indirect Economic Costs & Benefits	Soil & Groundwater conditions
Neighbourhood & Locality	Employment & Employment Capital	Groundwater & Surface Water
Communities & Community Involvement	Induced Economic Costs & Benefits	Ecology
Uncertainty & Evidence	Project Lifespan & Flexibility	Natural resources & Waste

Weighing it up – Framing and Boundaries

Boundary Aspect	Inclusions/Exclusions
Timing	Same timeline requirements for both options
Targets	Same target levels for both technology options that need to be considered
System Boundries	On site and external or down-stream environmental impacts or effect
Level Detail	Looking only at logistics, use and consumption within the project, not manufacturing of the technology
Locality	Consider dealing with local vs larger area

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Assessment criteria	Remediation Options for Assessment		Justification of Scores (refer to 'Execution Supporting' Tab for more detail)
	GAC	Biofilter	
Environmental			
Emissions to air	Tied	Tied	Similar impact
Soil and ground conditions	Tied	Tied	Similar impact
Groundwater and surface water	Tied	Tied	Similar impact
Ecology	Tied	Tied	Similar impact
Natural resources and waste	Worst	Best	GAC use will lead to more waste generation and more transport to and from site
Economic			
Direct economic costs and benefits	Worst	Best	GAC will be cheaper for the initial installation of filters, but Biofilters over the total life cycle of the project is more economic
Indirect economic costs and benefits	Tied	Tied	Indirect costs and benefits of either tehnology are considered similar at this level of comparison
Employment and employment capital	Worst	Best	Increase in know how and exposure to new technology
Induced economic costs and benefits	Tied	Tied	No difference in induced costs
Project lifespan and flexibility	Worst	Best	Either option can be modified during the project lifespan. due to its lower maintenance requirement is considered better over the project life. Biofilters will have better resilience to higher contaminant loading
Social			
Human health and safety	Worst	Best	GAC changeouts will result in additional heavy vehicle trips over a significant distance to deliver material to site. Changeout is associated with large mass of material to be handled and lifted. Biofilters will only require yearly media exchange
Ethics and equality	Tied	Tied	Difficult to define. From an ethical perspective the option with the least waste generated is likely considered more ethical
Neighbourhoods and locality	Worst	Best	Biofilter Maintenance requires significantly less road traffic and large vehicles potentialy obstructing traffic
Communities and community involvement	Tied	Tied	No difference
Uncertainty and evidence	Best	Worst	GAC provides a high certainty of treatment efficiency and operational requirements. Biofilters have been used less in similar situations leading to a higher uncertainty. The site specific efficiency of biofilter and variables that may affect its performance to be bench or pilot tested
Total "BEST" Count	1	6	

Illustrating the comparison - Environmental

Environmental			
Emissions to air	**Tied**	**Tied**	Similar impact
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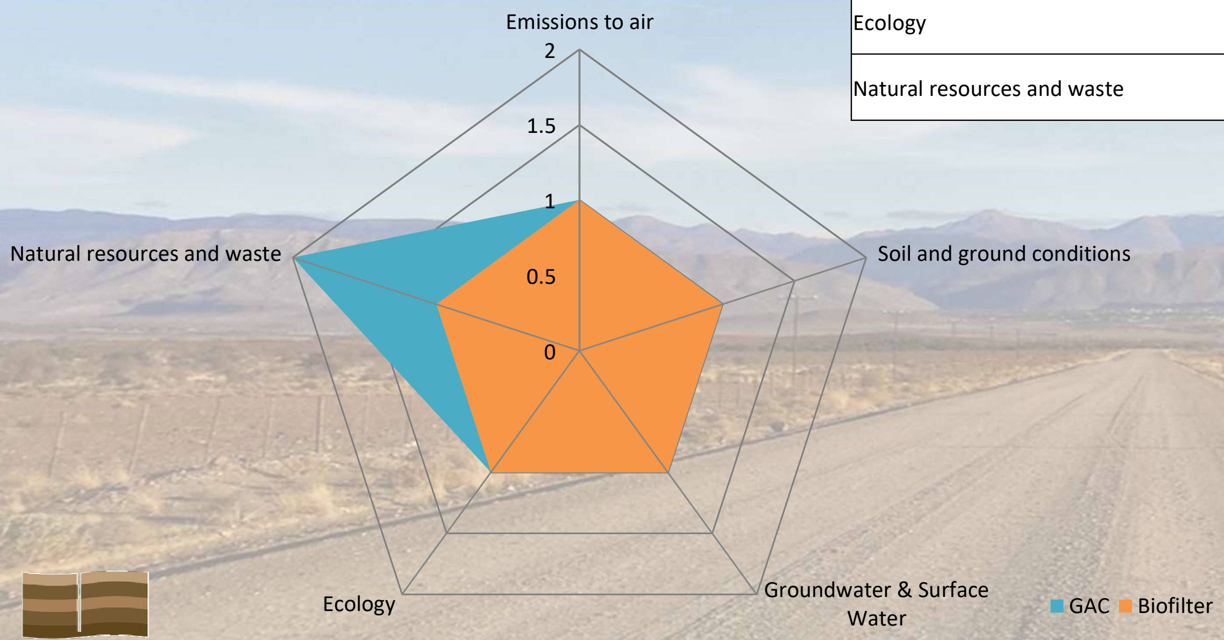

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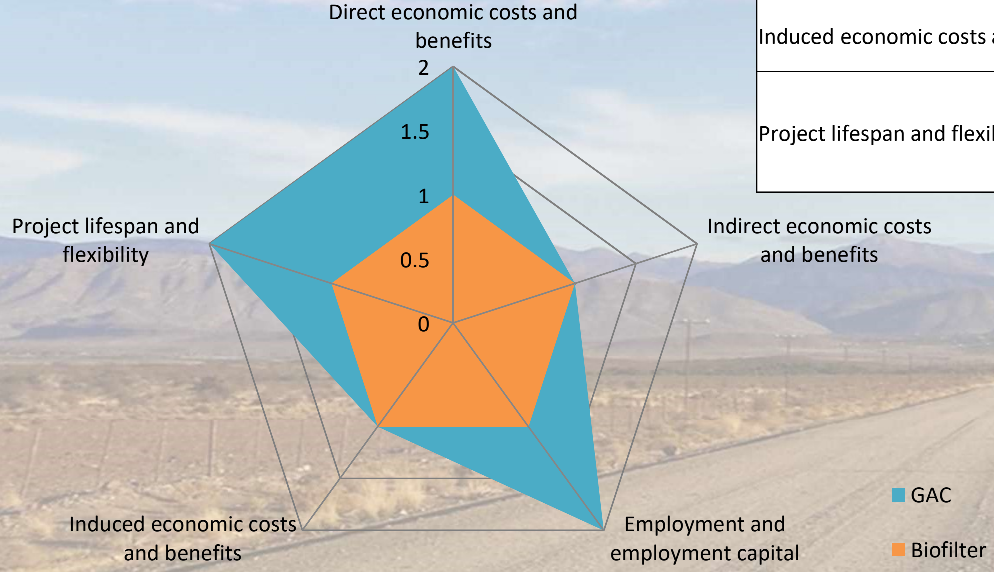

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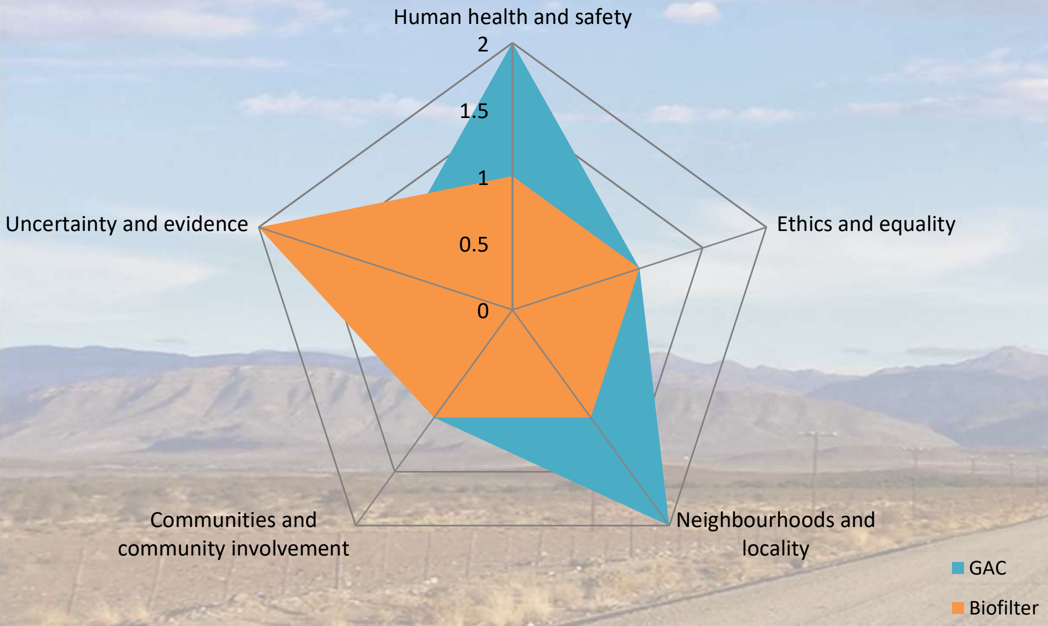
Illustrating the comparison - Social



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Applicability of the SuRF process in the South African context

- Provides a consistent approach to guide decision making
- Insight into the decision-making process and factors affecting it
- Transparent process with documented reasoning
- Can be scaled from a simple technology comparison as in this case up to a larger remediation project
- The same broad indicators can be used in a local context with the additional consideration of local factors where applicable

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To Summarise

- There are always options, technology will keep on evolving
- When do we consider new or alternative technologies?
- Site context will affect decisions on applicable technologies
- Critical to understand local conditions and broader environmental, social and economic situation
- With limited effort, qualitative assessments can be undertaken to guide decision making
- Within performance criteria there are often no right or wrong decisions, but certain options may be a better fit for your site
- A documented, transparent process will be beneficial when interacting with stakeholders

Thank you

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