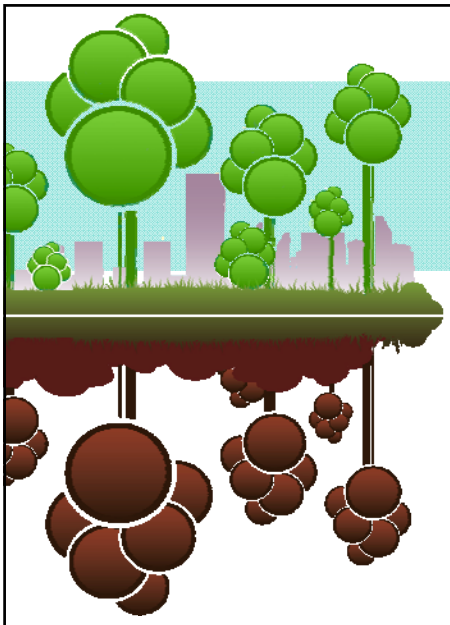

GREEN REMEDIATION 2009

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Decision Support Tools to support green remediation in a case study

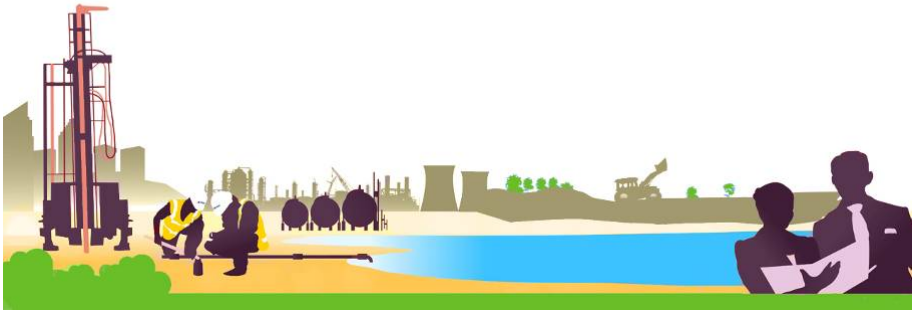
Dr Sarah MacKay,

WSP Environment & Energy

www.wspenvironmental.com

INTRODUCTION

Introduction to site and setting
Risk Drivers and context
Conventional analysis
Green Remediation Assessment
Revised framework



HISTORY

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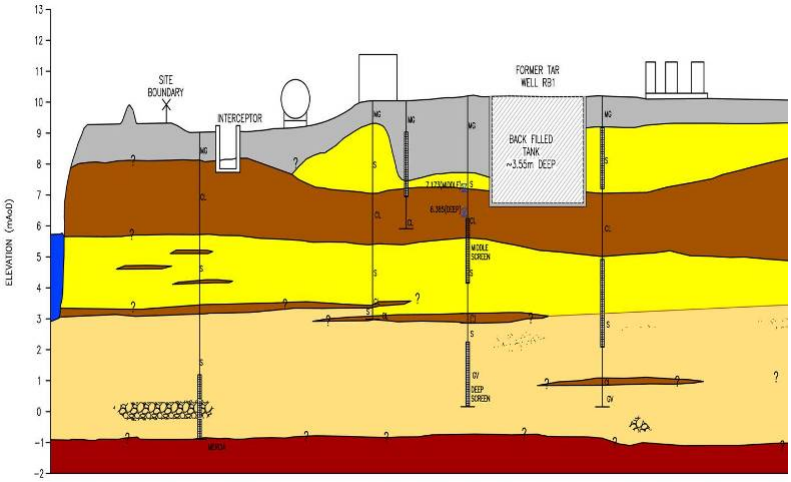
GEOLOGY



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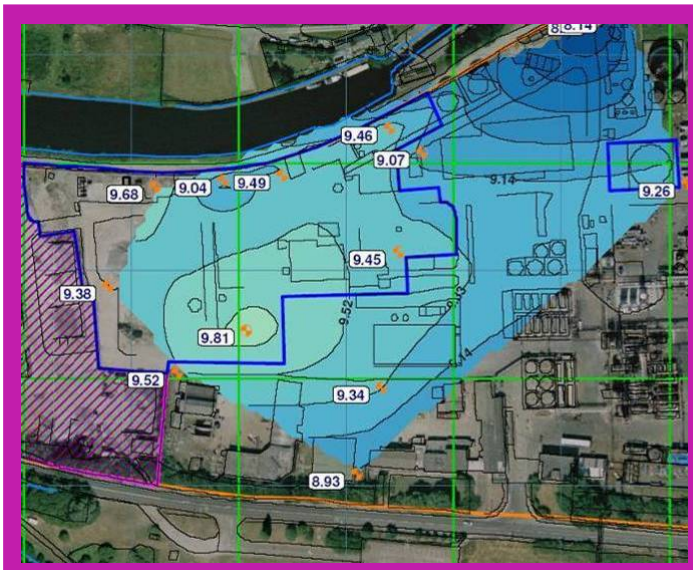
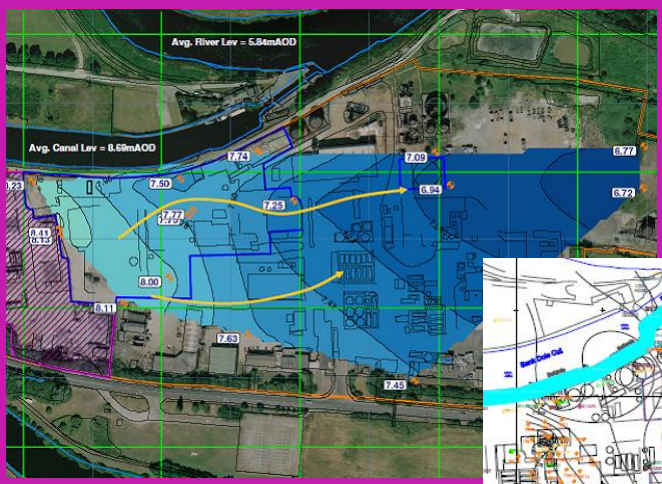


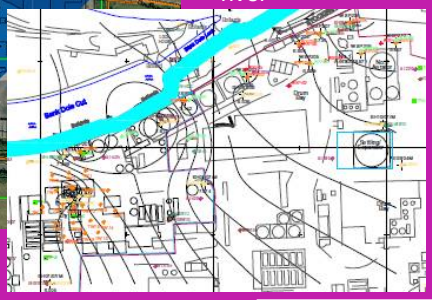
SHALLOW GW

- Unconfined
- Perched system
- Isolated

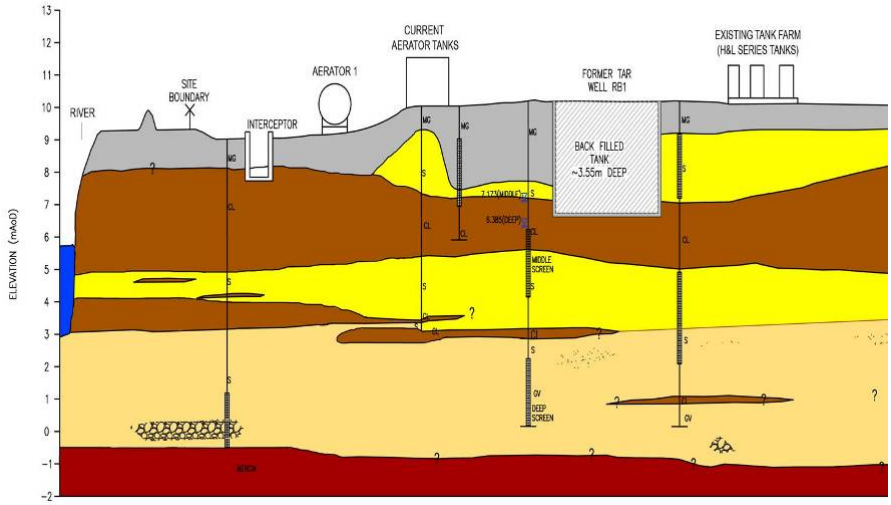


MIDDLE GW

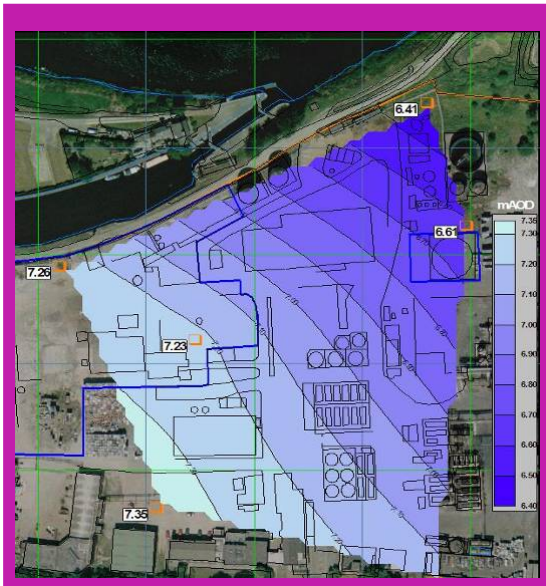
- Confined
- Silty Sand
- Lines of evidence of connection to river



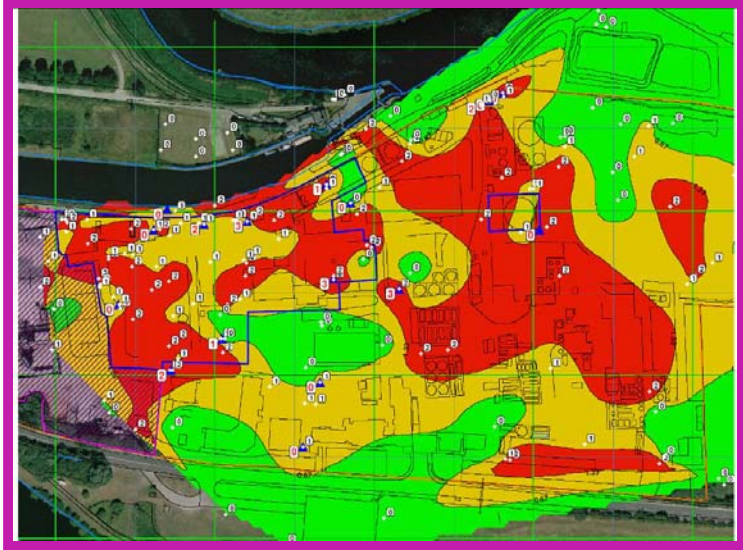
GEOLOGY



DEEP GW

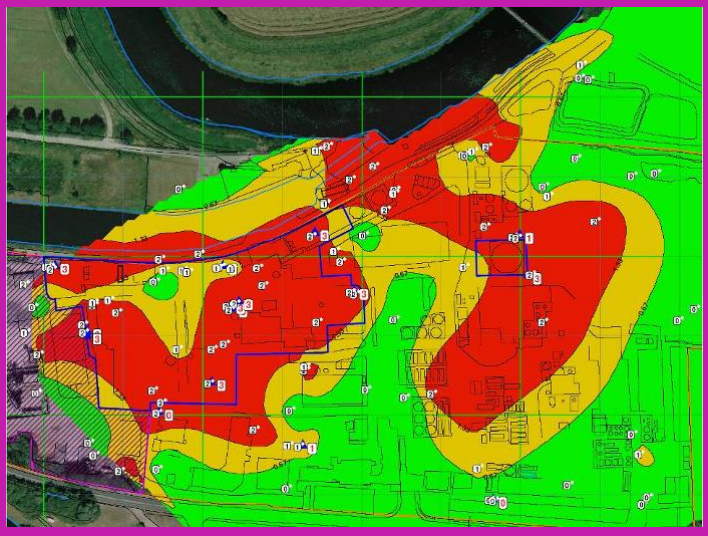


- Confined
- Some influence from River
- Also from basin wide recharge



NAPL Shallow

- DNAPL
- LNAPL
- Creosote
- Naphthalene



NAPL Middle

- DNAPL
- LNAPL
- Creosote
- Naphthalene

NAPL Deep

- little evidence for NAPL

RISK ASSESSMENT

- Human health – ongoing industrial use as a chemical works
- Controlled Water – minor observable impact to river in one location
- Sediments not impacted
- No discernible effects in river

Original Remedial Options Appraisal

Option 1 – Pump and treat from shallow groundwater, Multiphase extraction from middle aquifer, with polishing by groundwater recirculation,

Option 2 - containment wall and more limited extraction scheme

Option 3 – PRB, with pump and treat from Shallow

Option 4 – Ex-situ bio for shallow with MPV from middle

Agreed options with regulator

1600 tonnes of NAPL
82% in Middle Aquifer

<0.1% Dissolved Phase
8% Sorbed Phase
91% NAPL

Mass Reduction with Secondary Objectives

Permeable Reactive Barrier

Stage 1
Interceptor Trenches
Vacuum Treatment
Product Removal
DNAPL Recovery
Flow Path Management

Stage 2
Secondary Treatment
Enhanced Product Removal
(AS and SVE)

Stage 3
Groundwater Recirculation
Soil Washing

Post Remediation Monitoring to Closure

risk / opportunity review

Risk	Opportunity
Conservative remediation objectives	• Commence stage 1 works and renegotiate secondary targets • Establish mass reduction with iterative cost benefit analysis • Sustainability appraisal?
Time	• As above?
Product disposal costs	• Alternative fuel source?
Carbon use/reuse	• Consider biomass filters for initial treatment to reduce carbon consumption • Consider product removal only for initial phases followed by reinjection of “dirty” water

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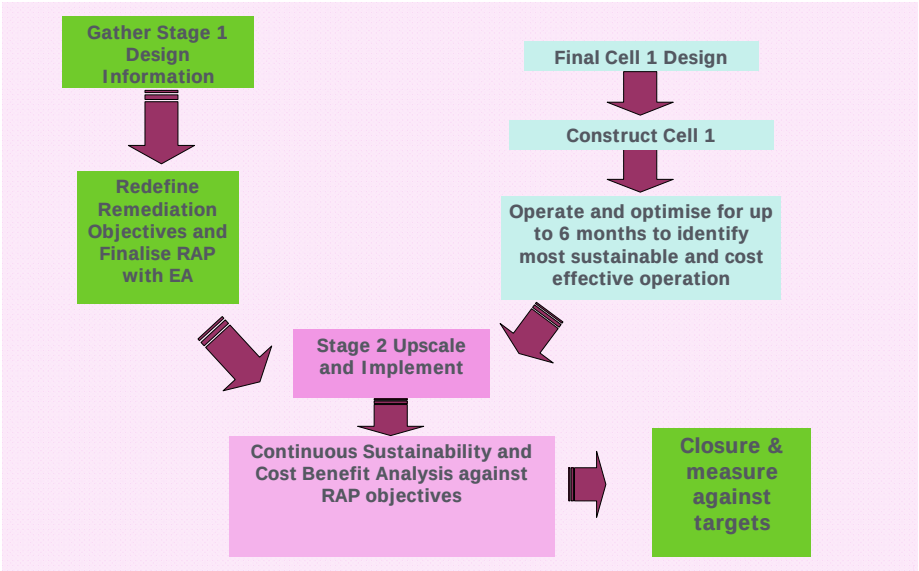

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Green Remediation Appraisal

- Mass Reduction
- Carbon Footprint
- Water Footprint
- Cost benefit

Current options appraised

Four Original Options

- Option 1 – Pump and treat from shallow groundwater, Multiphase extraction from middle aquifer, with polishing by groundwater recirculation,
- Option 2 - containment wall and more limited extraction scheme
- Option 3 – PRB, with pump and treat from Shallow
- Option 4 – Ex-situ bio for shallow with MPV from middle

Agreed Option

Option 5 - Shallow soil washing, MPV from middle with Polishing by recirc, PRB

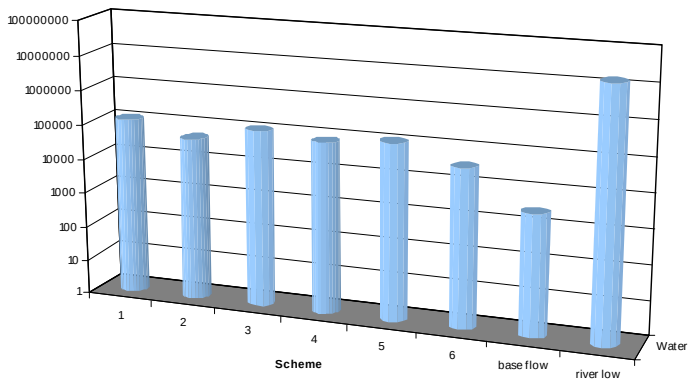
Green Remediation Option

Option 6 - Trenching for NAPL removal in shallow, NAPL extraction with flow path management and enhancements in middle

Mass reduction

scheme	1	2	3	4	5	6
mass reduction	51%	12%	69%	62%	64%	59%

Initial Water Footprint Analysis

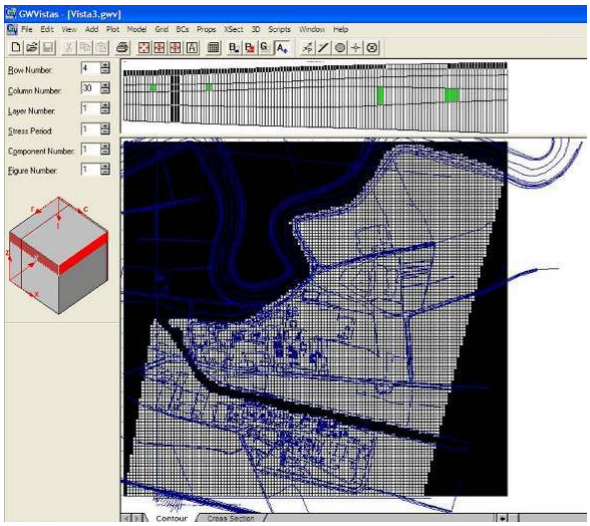


Water m3 / yr

Water Footprinting Tools

Modflow 5 layer model

- Area of impact
- Effect on baseflow
- Containment
- optimisation



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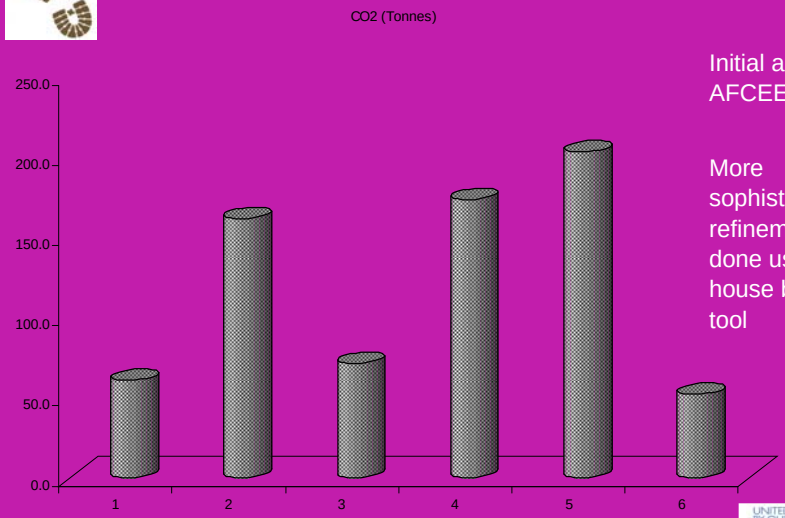
carbon

Initial assessment AFCEE SRT tool

More sophisticated refinements to be done using in house bespoke tool



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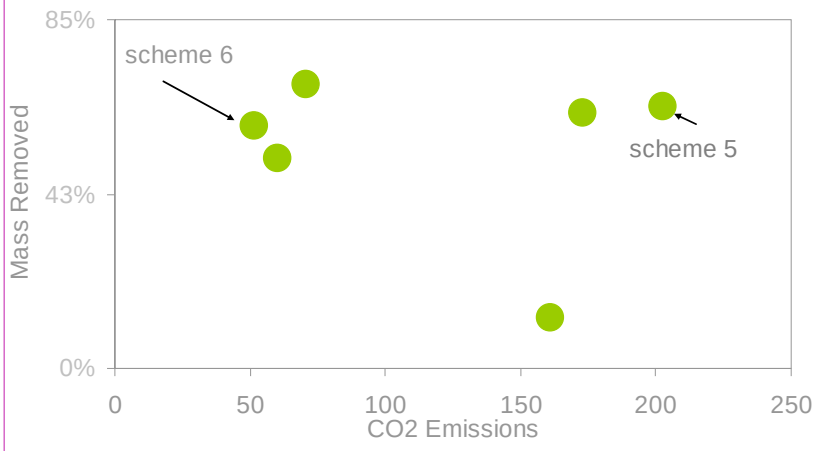
IMPACT VS BETTERMENT - CARBON



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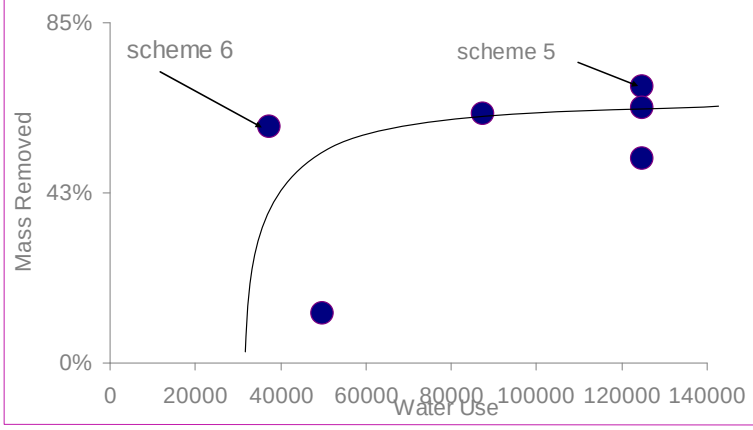
IMPACT VS BETTERMENT - WATER



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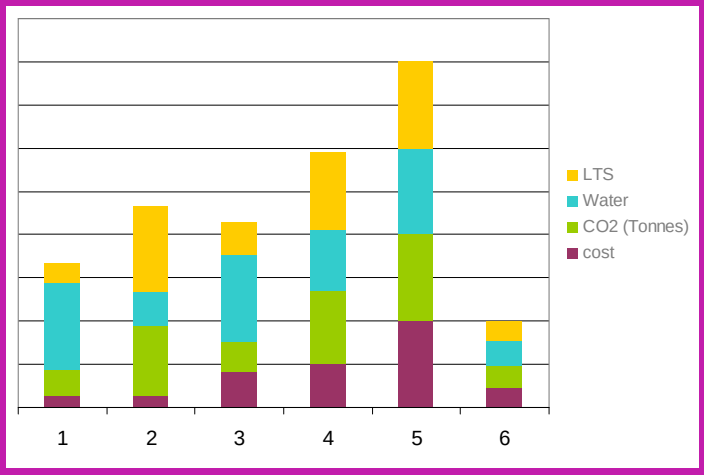
TOTAL FOOTPRINT



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Greening the remediation so far

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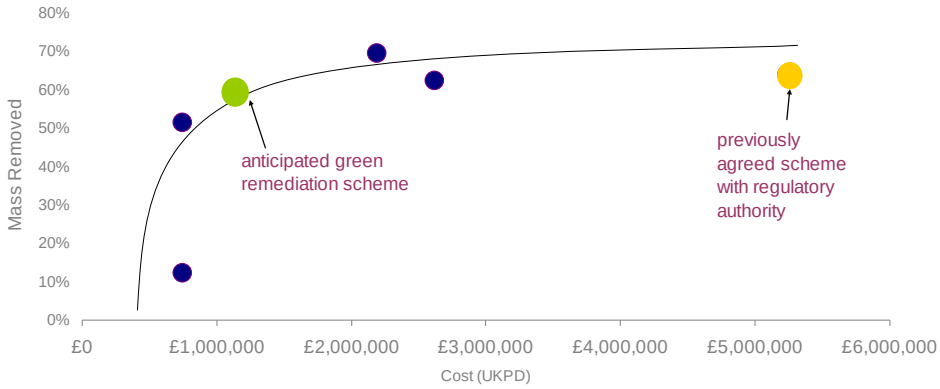
- Savings to water
- Savings in CO2
- Residual mass trade off….

COST BENEFIT



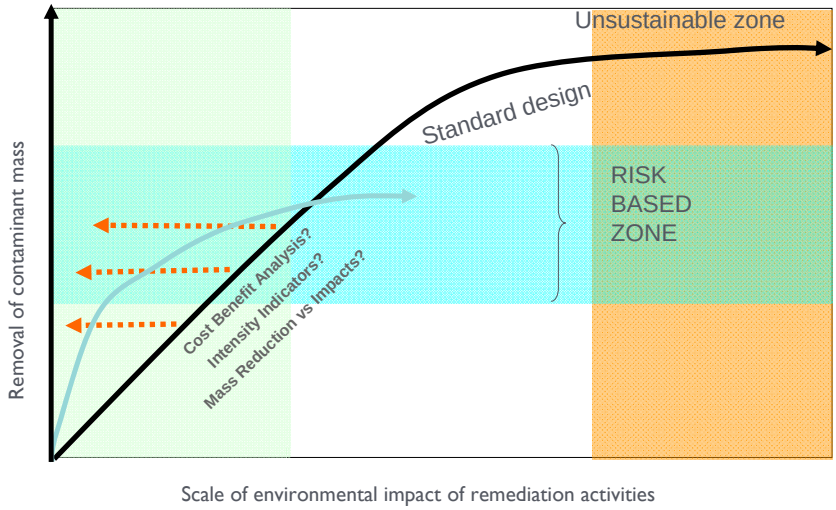
NEXT STEPS

Cell 1 implementing

- Mass recovery data
- Modflow model
- Carbon calculator
- Cost benefit analysis

- Concentrate on improving option 6, and sharing data with regulator as we go

Further greening the remediation scheme



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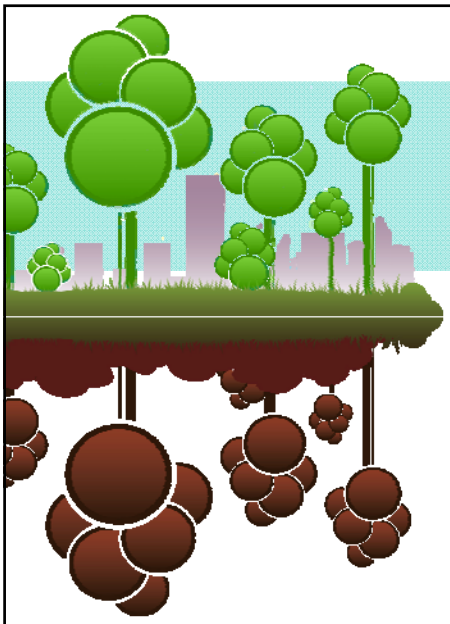

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Thank you

? Questions ?

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