APPLICATION OF A REMEDIAL OPTIONS SUSTAINABILITY EVALUATION TOOL (ROSET) TO CASE STUDIES IN EUROPE

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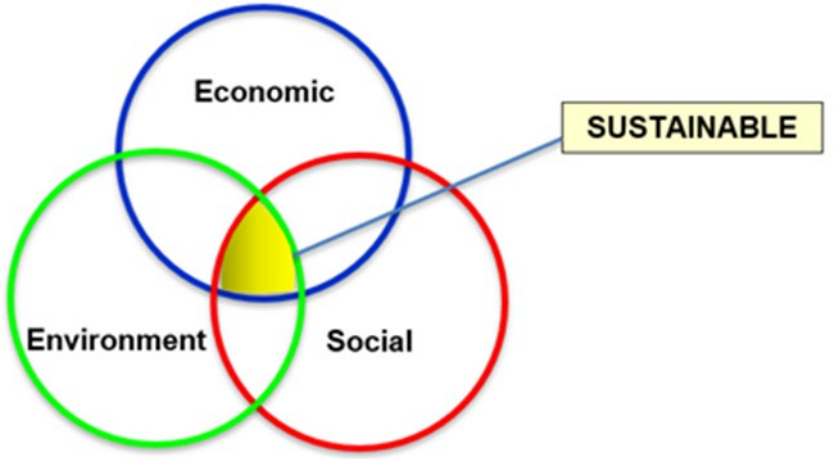
APPLICATION OF A REMEDIAL OPTIONS SUSTAINABILITY EVALUATION TOOL (ROSET) TO CASE STUDIES IN EUROPE

- Background to development of ROSET
- Application to three case studies:
  - Operational manufacturing site (Western Europe)
  - Former vehicle maintenance facility (UK)
  - Fire pond (Sweden)



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GUIDANCE USED TO DEVELOP ROSET

SuRF
SUSTAINABLE REMEDIATION FORUM UK

NICOLE
Network for Industrially Co-ordinated Sustainable Land Management in Europe

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SURF –UK GUIDANCE TO SUSTAINABILITY ASSESSMENT

- Underpins the basis of ROSET
- Advocates a Tiered approach to assessing sustainability of remedial options – 3 levels:
  - Tier 1 – Qualitative: (URS Spreadsheet publicly available on CL:AIRE)
  - Tier 2 – Semi –quantitative (ROSET)
  - Tier 3 - Quantitative
- Recommends that the level of assessment should be 'proportionate' : *"……..decisions should be based on the simplest sustainability assessment approach, as long as the information it provides is seen as robust and acceptable by the various stakeholders involved in the decision-making process"*
- Consistent with ISO 18504:2017(E) – which also identifies need for 'Project Framing'

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ROSET DEVELOPED AS A TIER 2 MODEL DIRECTLY FROM THE TIER 1 SPREADSHEET AVAILABLE ON CL:AIRE WEBSITE

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Tier 1- Qualitative Assessment

Tier 1 "entry level" sustainability assessment is based on simple tables using qualitative categories. The SuRF-UK Brief Case provides a slide deck procedure to follow with a series of checklists to help ensure that the framing is adequate for the sustainability assessment required. It is recommended to read the Project Framing guidance before or in parallel with the Tier 1 Sustainability Assessment slide deck.

Download the SuRF UK Briefcase Tier 1 Final

Download the SuRF-UK Tier 1 Briefcase Logbook v4

A 'Project Framing and Tier 1 Sustainable Remediation Assessment Spreadsheet' has been developed by URS to be compatible with the SuRF-UK Assessment Framing and Tier 1 Briefcase documents. It is made freely available to others here. SuRF-UK are grateful to URS to providing this spreadsheet. Neither CL:AIRE, SuRF-UK nor URS offer any warrantee or technical support for this spreadsheet.

Download the Tier 1 Sustainability Assessment for SuRF UK

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https://www.claire.co.uk/projects-and-initiatives/surf-uk/21-executing-sustainable-remediation/86-tier-1-qualitative-assessment

SURF UK HEADLINE CATEGORIES OF INDICATORS

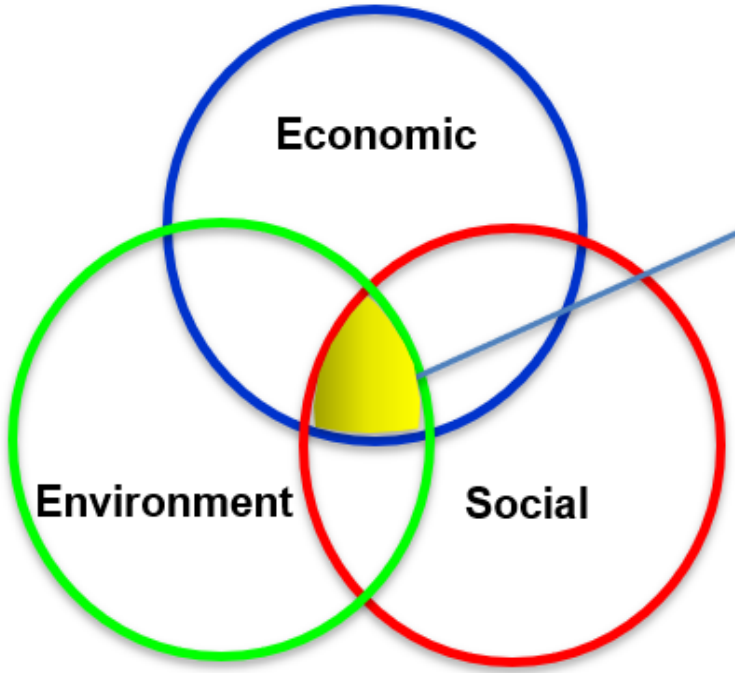
Emissions to air

Soil and ground conditions

Groundwater & Surface Water

Ecology

Natural resources and waste



SUSTAINABLE

Direct economic costs and benefits

Indirect economic costs and benefits

Employment and employment capital

Induced economic costs and benefits

Project lifespan and flexibility

Human health and safety
Ethics and equality

Neighbourhoods and locality

Communities and community involvement

Uncertainty and evidence

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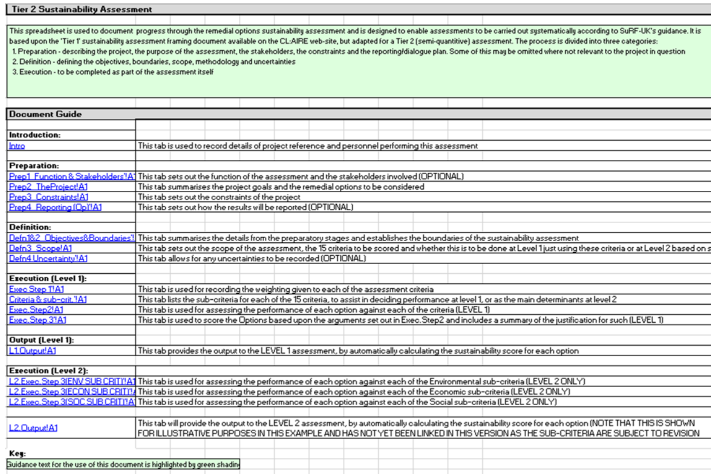
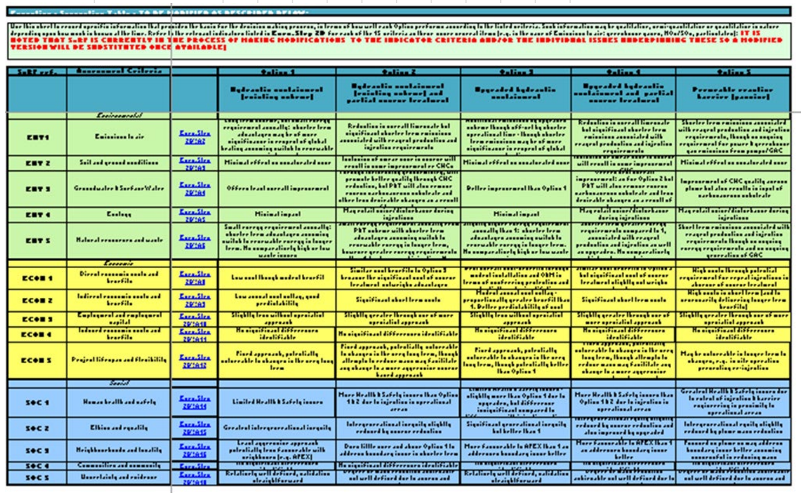
ROSET - SUMMARY

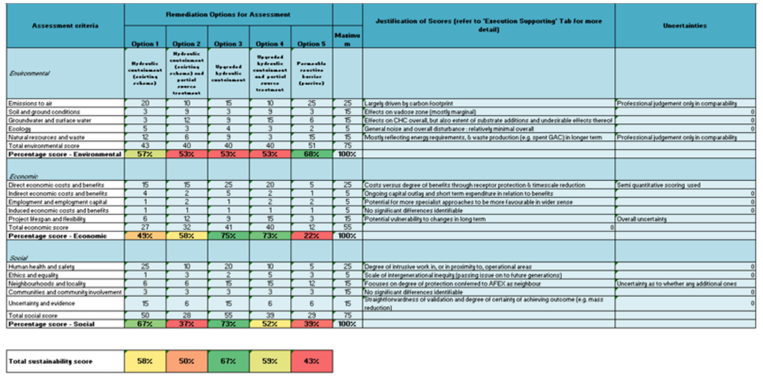
- Pre-determined short-list of options (3 -6) for assessment
- Framing document – why, how, who, what?
- Can choose level of detail for the criteria used:
  - Level 1: Assessment based on 15 Headline Indicator categories established by SuRF UK: 5 Economic, 5 Environmental, 5 Social

  OR, for more detail:

  - Level 2: Assessment based on individual indicators within each of these 15 categories
- Weight these criteria in importance (1,3,5)
- Evaluate and score each option against these (1 – 5)
- Compare total weighted, normalised scores for Environmental, Economic, Social domains and Total Score







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SUSTAINABILITY OF OPTIONS CAN BE ASSESSED AT TWO KEY STAGES

- Both NICOLE Road Map & SuRF identify key stages of decision making where sustainability assessments can apply
- SuRF UK Framework can be brought to bear at:
  - Stage A: The Planning Stage (Plan/Project Design)
  - Stage B: Remediation Implementation
- Manufacturing facility & Brownfield site represent Stage B
- Swedish pond is an example of using ROSET at Stage A

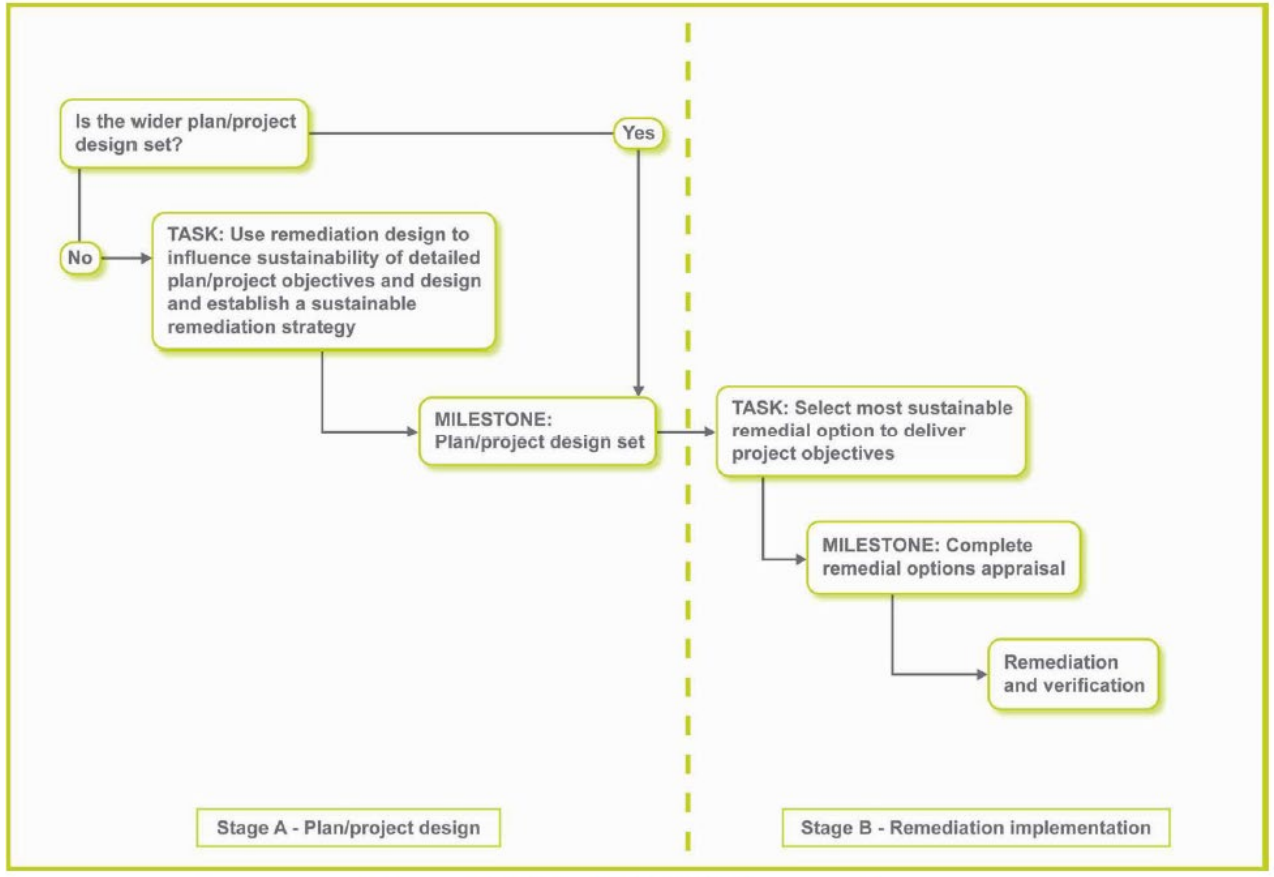

Figure 3.1: The SuRF-UK Framework.

CASE STUDY 1:

ACTIVE MANUFACTURING SITE

APPLICATION OF ROSET AT STAGE B

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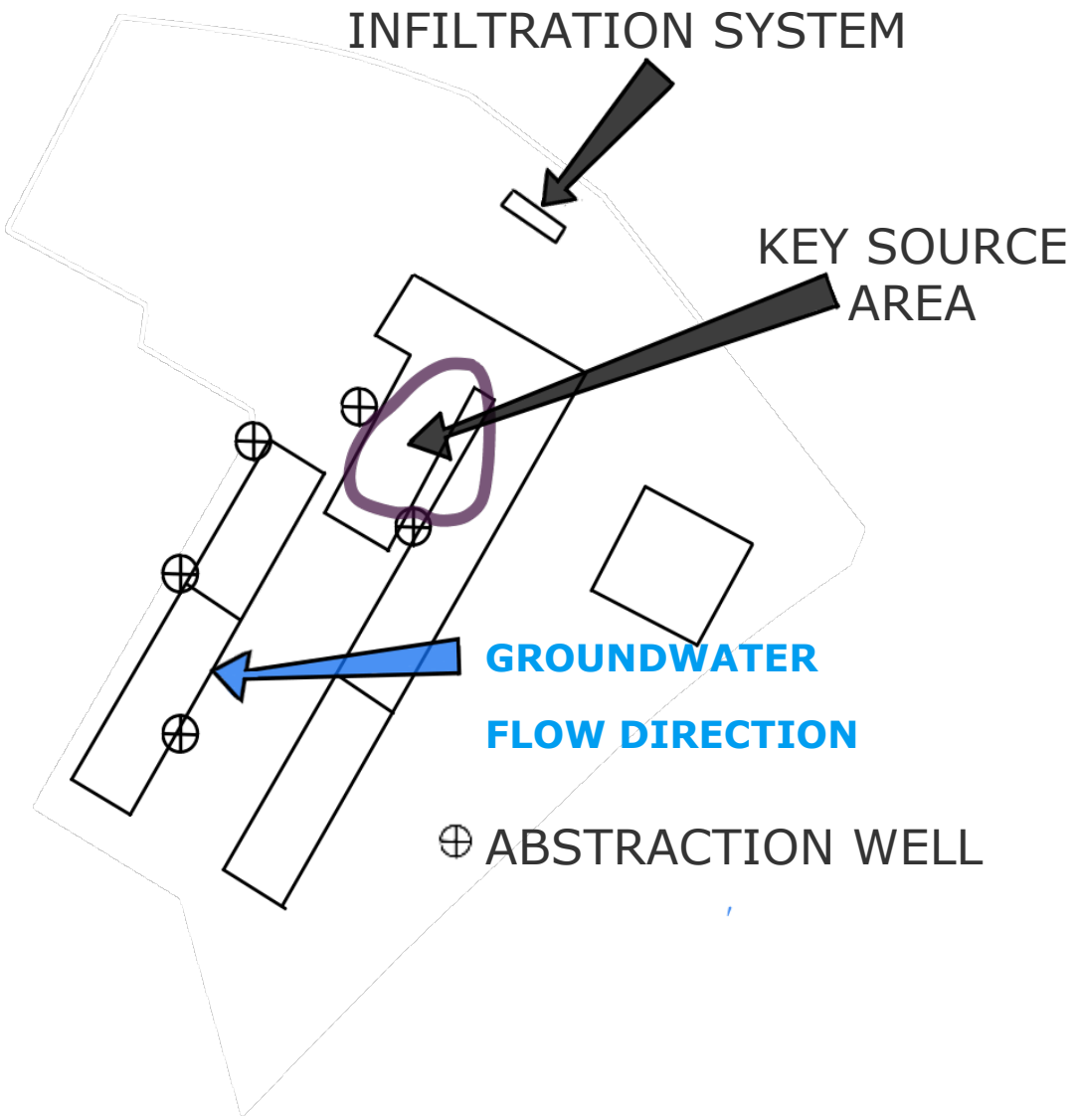
1) OPERATIONAL MANUFACTURING FACILITY

- Operational manufacturing facility with historic chlorinated solvent (CHC) contamination, previously undergone remediation by SVE and hydraulic confinement (Pump & Treat)
- Residual CHC contamination within source area below water table – in operational area
- Source area characterised by less permeable geology - CHC adsorbed to silts & clays
- Hydraulic confinement scheme operated since 1996 – to achieve compliance at site boundary
- Sustainability assessment to evaluate short-listed options – continue with current scheme and/or consider alternatives?



SHORT-LISTED REMEDIAL OPTIONS

1. Continuation of existing hydraulic confinement scheme
2. Continuation of existing hydraulic confinement scheme & partial source treatment (where practicable)
3. Upgrade of existing hydraulic confinement system
4. Upgrade of existing hydraulic confinement scheme & partial source treatment (where practicable)

REJECTED (Low practicability & limited effectiveness):

5. Permeable Reactive Barrier

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ROSET EXECUTION - STEP 1: CRITERIA WEIGHTING

Assessment criteria	Weighting (1 - 5)	Justification for weighting	Driving issues identifiable for site
Environmental			
Emissions to air	5	Global heating	
Soil and ground conditions	3	Wider issues of soil quality of moderate importance to site, given end use	
Groundwater and surface water	3	Wider issues of groundwater quality may be of significance but in longer term	Local water resources
Ecology	1	Industrial site, limited impact on local ecological systems	
Natural resources and waste	3	Potential importance in indirect issues related to global heating etc	Energy usage, waste generation not major issue
Economic			
Direct economic costs and benefits	5	Cost/benefit significant for corporate planning	Whether any source treatment is worth undertaking if containment system continues to run
Indirect economic costs and benefits	1	Less significant for subject site	
Employment and employment capital	1	Low significance for site	
Induced economic costs and benefits	1	Not significant for subject site	
Project lifespan and flexibility	3	Flexibility may be of significance	Change in end use through potential future divestment
Social			
Human health and safety	5	Significant issue from corporate standpoint & acceptability to site	Site management of importance
Ethics and equality	1	Not a major issue for subject site as scenario assumes continued operation	Intergenerational equity
Neighbourhoods and locality	3	Potential stakeholder concerns	AFEX
Communities and community involvement	3	Potential stakeholder concerns	
Uncertainty and evidence	3	Requirement for certainty in validation of significance	Ability to judge success of any source treatment

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ROSET EXECUTION, STEP 2: ASSESSMENT

SuRF ref.	Assessment Criteria	Option 1.1	Option 1.2	Option 1.3	Option 1.4
		Hydraulic confinement (existing scheme)	Hydraulic confinement (existing scheme) and partial source treatment	Upgraded hydraulic confinement	Upgraded hydraulic confinement and partial source treatment
	Environmental				
ENV1	Emissions to air	Small energy requirement annually: shorter term advantages may be of more significance in respect of global heating assuming switch to renewable energy in longer term	Small energy requirement annually but significant shorter term emissions associated with reagent production and injection requirements	Additional emissions by upgraded scheme through longer term operation though shorter term emissions may be of more significance in respect of global heating, assuming switch to renewable energy later	Additional emissions by upgraded scheme through longer term operation and significant shorter term emissions associated with reagent production and injection requirements
ENV 2	Soil and ground conditions	Minimal effect on unsaturated zone	Inclusion of smear zone in source will result in some improvement re CHCs	Minimal effect on unsaturated zone	Inclusion of smear zone in source will result in some improvement re CHCs
ENV 3	Groundwater & Surface Water	Offers least overall improvement	Through influencing geochemistry, will promote better quality through CHC reduction, but P&T will also remove excess carbonaceous substrate and other less desirable changes as a result of lower redox	Better improvement than Option 1	Offers best overall improvement: as for Option 2 but P&T will also remove excess carbonaceous substrate and less desirable changes as a result of lower redox
ENV 4	Ecology	Minimal impact	May entail noise/disturbance during injections	Minimal impact	May entail noise/disturbance during
ENV 5	Natural resources and waste	Small energy requirement annually: shorter term advantages assuming switch to renewable energy in longer term. No comparatively high or low waste issues	Sm...		
	Economic				
ECON 1	Direct economic costs and benefits	Intermediate cost(comparatively), though modest benefit	H		
ECON 2	Indirect economic costs and benefits	Low annual cost outlay, good predictability			
ECON 3	Employment and employment capital	Slightly less without specialist approach			
ECON 4	Induced economic costs and benefits	No significant differences identifiable			
ECON 5	Project lifespan and flexibility	Fixed approach, potentially vulnerable to changes in the very long term	Fi... th... ma...		
	Social				
SOC 1	Human health and safety	Limited Health & Safety issues	Mo...		
SOC 2	Ethics and equality	Significant intergenerational inequity	Int...		
SOC 3	Neighbourhoods and locality	Least aggressive approach potentially less favourable with neighbours			
SOC 4	Communities and community involvement	No significant differences identifiable			
SOC 5	Uncertainty and evidence	Relatively well defined, validation straightforward	De...		

SuRF ref.	Assessment Criteria	Option 1	Option 2
		Hydraulic confinement (existing scheme)	Hydraulic confinement (existing scheme) and partial source treatment
	Environmental		
ENV1	Emissions to air	Small energy requirement annually: shorter term advantages may be of more significance in respect of global heating assuming switch to renewable energy in longer term	Small energy requirement annually but significant shorter term emissions associated with reagent production and injection requirements
ENV 2	Soil and ground conditions	Minimal effect on unsaturated zone	Inclusion of smear zone in source will result in some improvement re CHCs
			Through influencing geochemistry

ROSET EXECUTION, STEP 3 – SCORE AGAINST CRITERIA

Assessment criteria	Remediation Options for Assessment					Justification of Scores	Uncertainties
	1	2	3	4	Maximum		
	Hydraulic confinement (existing scheme)	Hydraulic confinement (existing scheme) and partial source treatment	Upgraded hydraulic confinement	Upgraded hydraulic confinement and partial source treatment			
Environmental							
Emissions to air	4	2	3	1	5	Largely driven by carbon footprint, especially in short term (assuming longer term shift to	Professional judgement only in
Soil and ground conditions	1	3	1	3	5	Effects on vadose zone (mostly marginal)	
Groundwater and surface water	1	4	3	5	5	Effects on CHC overall, but also extent of substrate additions and undesirable effects thereof	
Ecology	5	3	4	3	5	General noise and overall disturbance : relatively minimal overall	
Natural resources and waste	4	3	2	1	5	Mostly reflecting energy requirements, & waste production (e.g. spent GAC) in longer term	Professional judgement only in
Economic							
Direct economic costs and benefits	2	2	5	4	5	Costs versus degree of benefits through receptor protection & timescale reduction	Semi quantitative scoring used
Indirect economic costs and benefits	4	2	5	2	5	Ongoing capital outlay and short term expenditure in relation to benefits	
Employment and employment capital	1	2	1	2	5	Potential for more specialist approaches to be more favourable in wider sense	
Induced economic costs and benefits	1	1	1	1	5	No significant differences identifiable	
Project lifespan and flexibility	2	4	3	5	5	Potential vulnerability to changes in long term	Overall uncertainty
Social							
Human health and safety	5	2	4	2	5	Degree of intrusive work in, or in proximity to, operational areas	
Ethics and equality	1	2	1	2	5	Scale of intergenerational inequity (passing issue on to future generations)	
Neighbourhoods and locality	2	2	5	5	5	Focuses on degree of protection conferred to neighbour	Uncertainty as to whether any
Communities and community involvement	1	1	1	1	5	No significant differences identifiable	
Uncertainty and evidence	5	2	5	2	5	Straightforwardness of validation and degree of certainty of achieving outcome (e.g. mass	

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ROSET: SUSTAINABILITY ASSESSMENT OUTPUT FOR MANUFACTURING FACILITY

	Remediation Options for Assessment			
	1	2	3	4
	Hydraulic confinement (existing scheme)	Hydraulic confinement (existing scheme) & partial source treatment	Upgraded hydraulic confinement	Upgraded hydraulic confinement & partial source treatment
Percentage score - Environmental	57%	57%	49%	47%
Percentage score - Economic	40%	49%	75%	73%
Percentage score - Social	67%	36%	72%	48%
Total sustainability score	55%	47%	65%	56%

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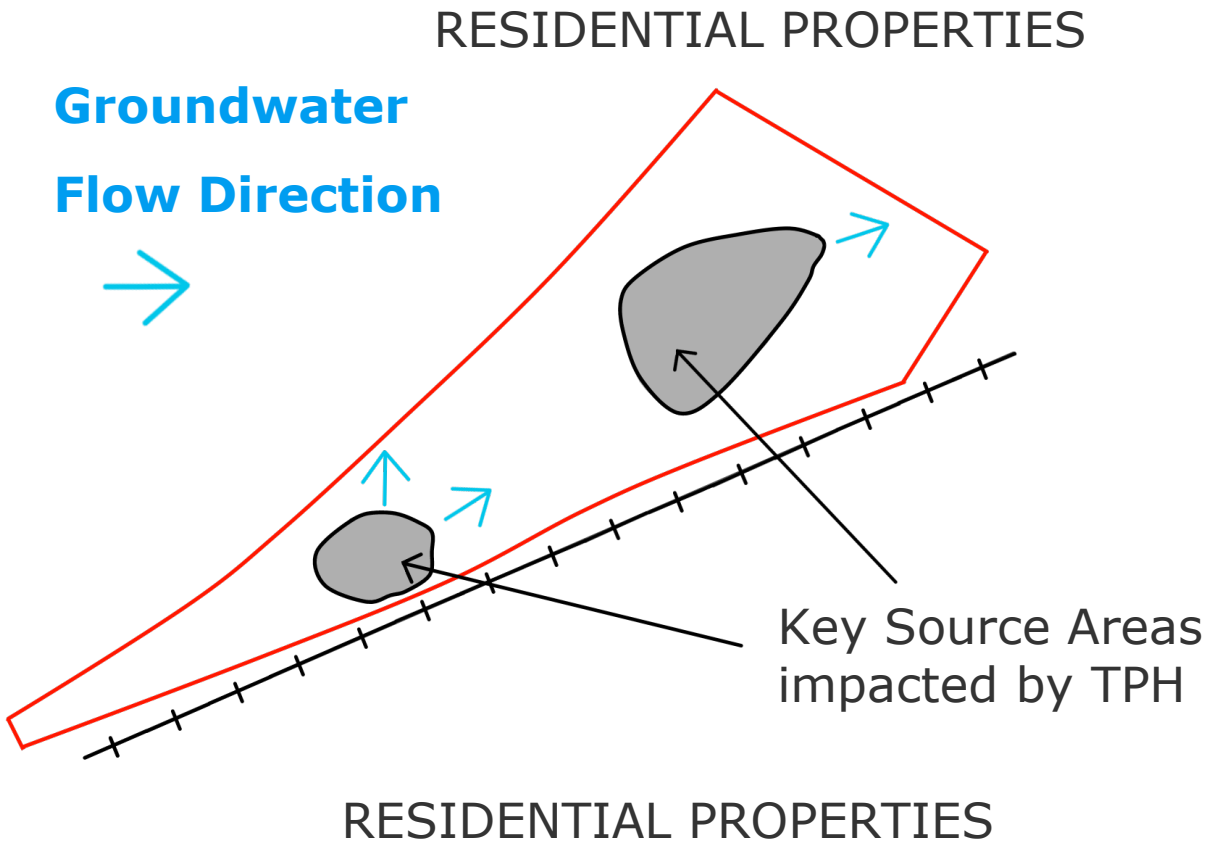
CASE STUDY 2:

BROWNFIELD SITE IN UK

APPLICATION OF ROSET AT STAGE B

2) BROWNFIELD SITE (FORMER VEHICLE MAINTENANCE FACILITY), UK

- Former vehicle maintenance & car showroom to be developed for mixed use (school, housing, commercial)
- Historical contamination of soils & sand/gravel aquifer by TPH over 40 years.
- Made ground with TPH, PAH, heavy metals & asbestos
- Sustainability assessment required for remedial option selection to develop strategy



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BROWNFIELD SITE: SHORTLISTED REMEDIAL OPTIONS

Matrix	Options				
	1	2	3	4	5
Made ground (asbestos & heavy metals)	Excavation & disposal	Containment	Excavation & disposal	Containment	Excavation & disposal
TPH impacted soil		Ex situ bio	Ex situ bio	In situ bio (proprietary-Gypsum & GAC)	In situ bio (proprietary-Gypsum & GAC)
LNAPL	Skimmer/ absorbent	Skimmer/ absorbent	Skimmer/ absorbent		
Groundwater	In situ bio/chem	In situ bio/chem	In situ bio/chem		

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BROWNFIELD SITE: SUSTAINABILITY ASSESSMENT OUTPUT

Remediation Options for Assessment					
Matrix	**1**	**2**	**3**	**4**	**5**
Made ground (asbestos & metals)	Excavation & disposal	Containm.	Excavation & disposal	Containm.	Excavation & disposal
Hydrocarbon impacted areas		Ex situ bio	Ex situ bio	In situ bio proprietary	In situ bio proprietary
LNAPL	Skim./ absorb.	Skim. / absorb.	Skim. / absorb.		
Groundwater	In situ bio/chem	In situ bio/chem	In situ bio/chem		
% score - Environmental	48%	76%	54%	75%	53%
% score - Economic	60%	67%	45%	40%	27%
% score - Social	41%	75%	53%	72%	49%
Total sustainability score	50%	73%	51%	62%	43%

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CASE STUDY 3:

FIRE POND IN SWEDEN

APPLICATION OF ROSET AT STAGE A

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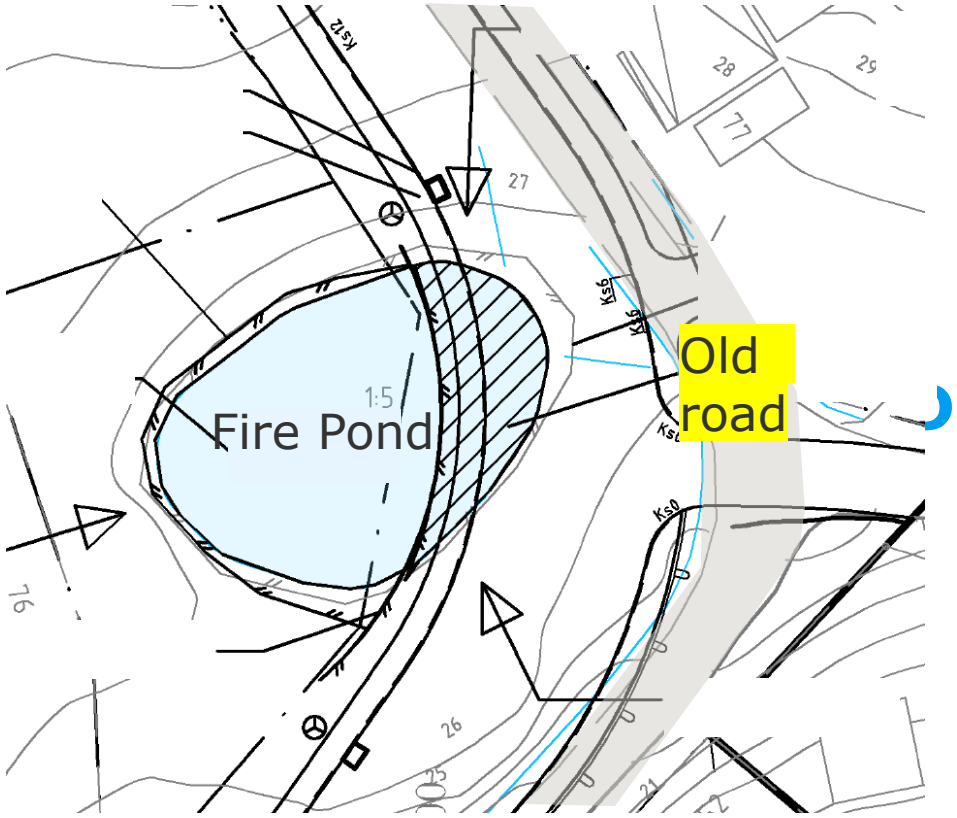
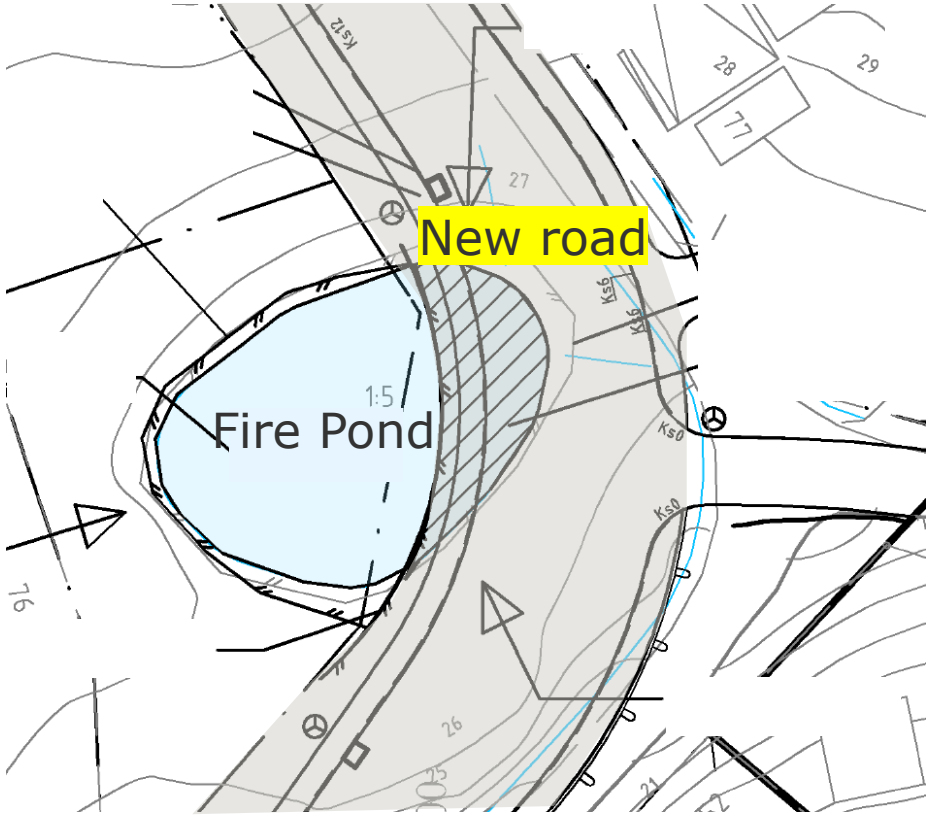
3) FIRE POND IN SWEDEN

- Site located in city of Nacka, (East of Stockholm)
- Sediment of pond contaminated with heavy metals (Zn, Pb & Cd) and PAHs

PLANNED CONSTRUCTION WORKS

Half of the pond area was planned to be used in the widening of a road for bus traffic





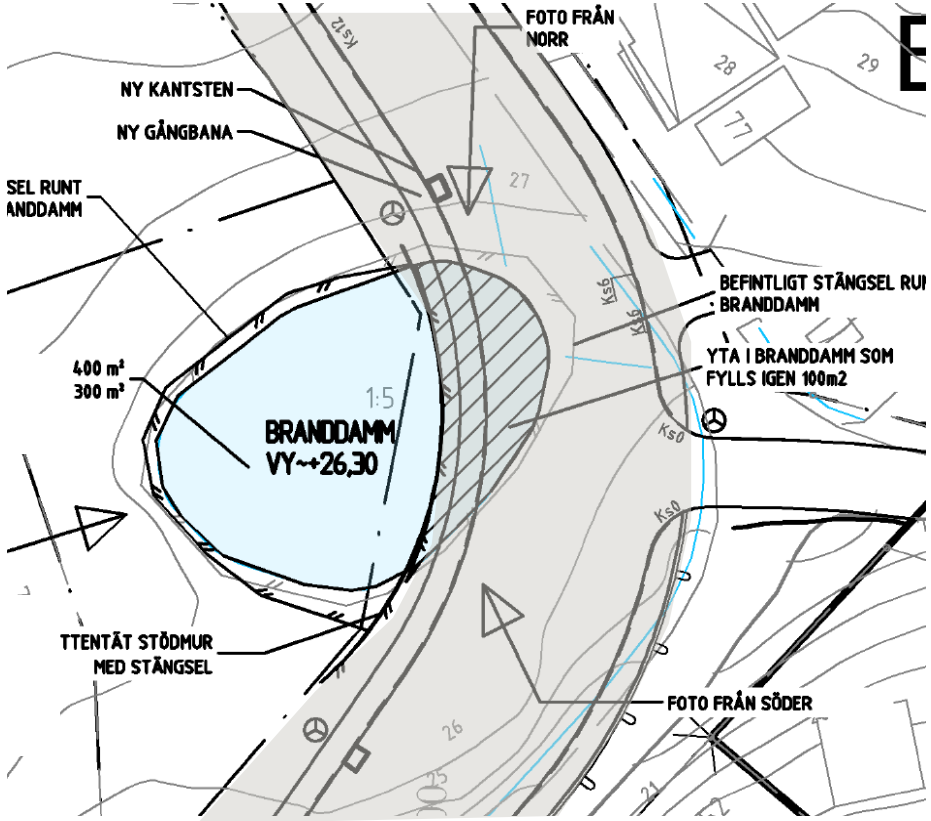
OPTIONS FOR SEDIMENT & ALTERNATIVE STRATEGIES

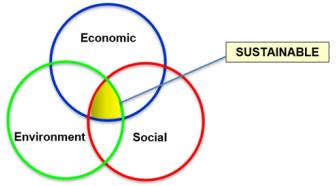
- Dredging and disposal was the only practicable option if sediment remediation was to be carried out.
- As such three strategies were evaluated using ROSET:

1. 'the zero alternative' - no remedial action, no road
2. no remedial action, with road
3. remedial action, with road

MOST SUSTAINABLE STRATEGY….

Actions	Remediation Options for Assessment		
	1	2	3
Road construction	No	Yes	Yes
Sediment remediation	No	No	Yes
% score - Environmental	71%	64%	70%
% score - Economic	47%	58%	66%
% score - Social	68%	81%	79%
Total sustainability score	62%	67%	72%





Option 3: Remedial action, with the road scored high overall.

Key drivers are the environmental benefit of clean sediment in the pond, the social benefit of the road and the increased property value when cleaned up

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ROSET – SUMMARY OF BENEFITS

- Directly developed from the Tier 1 spreadsheet available from SuRF
- Tool acts as a framing document so justification and rationale for all evaluations made can be recorded to provide transparency to stakeholders especially regulators
- Sensitivity analyses straightforward – what are the factors driving the decision-making process?
- Simplicity and conciseness of approach enables cost savings for client
- Avoidance of complex models makes process easy to understand by layperson

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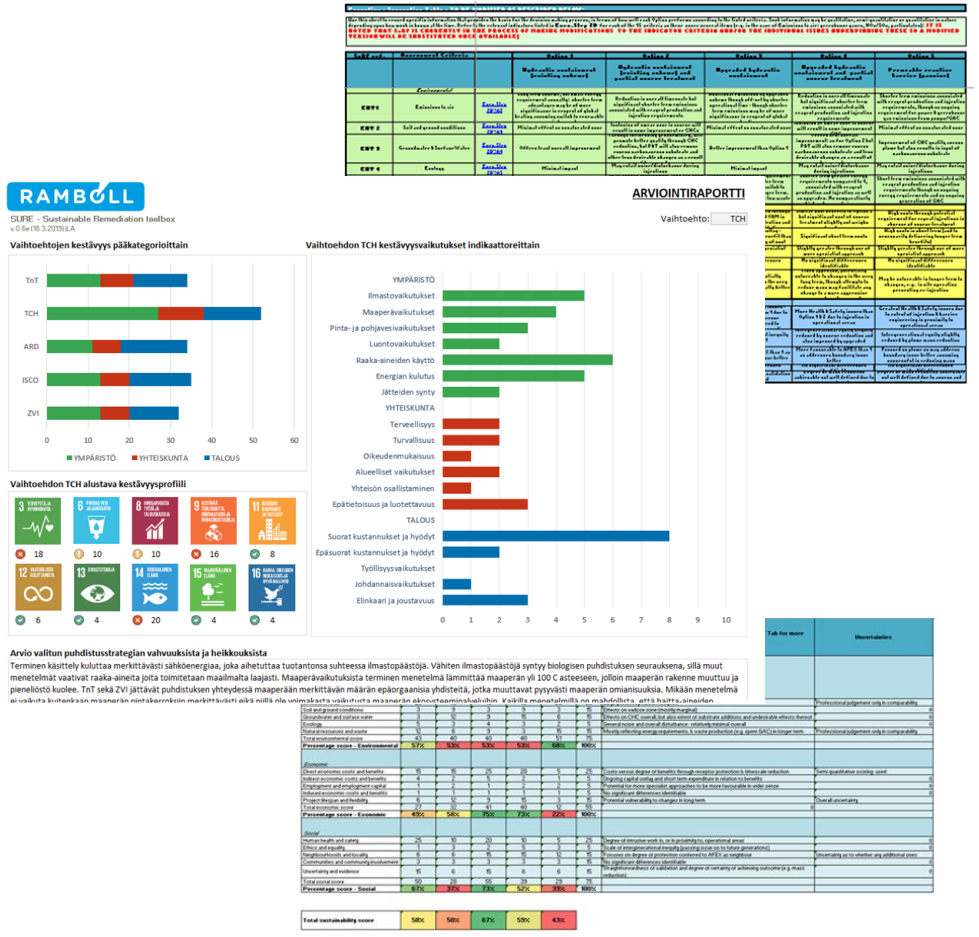
FUTURE DEVELOPMENTS

- Ramboll developed similar Tool ‘SURE’ , previously used in Scandinavia
- Combining both into single entity
- To incorporate the ‘framing aspects’ of ROSET within a more versatile SURE model applicable to any market / region
- Flexible, digital, decision-making tool
- Work in progress!



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