Report

Report no. 13/24

Sustainable Remediation: Identification of sustainable management practices (SMPs) for remediation projects at fuel manufacturing sites

ISBN 978-2-87567-193-6

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Sustainable Remediation: Identification of sustainable management practices (SMPs) for remediation projects at fuel manufacturing sites

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Brussels
December 2024

ABSTRACT

This report presents the results of the initial phase of the project and is the culmination of a workshop held by Concawe in April 2024 and subsequent inputs from Concawe members and the CL:AIRE/ERM team. The primary objective of the project was to develop a shortlist of commonly applied and would-like-to apply sustainable management practices (SMPs) applicable for projects at fuel manufacturing sites, which reflect the specific requirements of that sector. Following the Concawe workshop, we have further developed the nature of the hypothetical site to be utilized as a case study for the purpose of the SMP assessment. The hypothetical site was adapted to be relevant to Concawe members and includes the different stages of the site lifecycle (site investigation, monitoring, remediation, etc.) and identifies three remedial technologies that will represent three agreed scenarios where the benefits of various SMPs can be realized. This study demonstrates the benefits of applying SMPs to soil and groundwater remediation projects to contribute to mitigating environmental, social and economic impacts relating to remediation processes. Through application of SMPs at a project-level the study demonstrates the scalable application to real remediation projects from a light-touch to more comprehensive approach to achieve positive 'sustainability gains'.

KEYWORDS

Sustainable management practices; SMP; sustainability; remediation; environmental impacts; social impacts; economic impacts; circularity; biodiversity; soil; groundwater, sustainable remediation

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This report is available as an Adobe pdf file on the Concawe website (www.concawe.eu).

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SUMMARY

Concawe commissioned CL:AIRE/ERM to explore and demonstrate the value of Sustainable Management Practices (SMPs) within the framework of fuel manufacturing site remediation projects. SMPs are a key component of sustainable remediation particularly in translating sustainability principles and indicators into practical actions that can be applied to any stage of a remediation project.

The primary objective of the project was to develop a shortlist of commonly applied and would-like-to apply SMPs applicable for projects at fuel manufacturing sites, which reflect the specific requirements of that sector.

This report presents the results of the initial phase of the project and is the culmination of a workshop held by Concawe in April 2024 and subsequent inputs from Concawe members and the CL:AIRE/ERM team.

The SuRF-UK indicator set was used to identify a selection of generic but industry relevant sustainability indicators. SMPs were collated from existing published guidance, most notably from SuRF-UK and the US EPA and were grouped into categories that reflect the number and significance of primary indicators associated with each phase. Seven overarching SMPs were identified with the greatest potential benefits for an individual project and also to serve as the catalyst for implementing site specific SMPs on a project-by-project basis:

1. Develop a sustainability plan for the project that includes relevant & measurable sustainability indicators
2. Include an assessment of sustainability in your Remedial Options Appraisal
3. Evaluate carbon footprint for major activities and implement a GHG emissions reduction plan
4. Implement a sustainable procurement plan for the project/site
5. Promote circular economy - Reduce, reuse and recycle where possible. Plan your activities to reduce waste.
6. Consider how climate change may affect the resiliency of your remediation strategy to meet long-term performance objectives
7. Consider ways to maximize positive benefits to local communities

Following the Concawe workshop, CL:AIRE/ERM and Concawe members further developed the nature of the hypothetical site to be utilized as a case study for the purpose of the SMP assessment. The hypothetical site was adapted to be relevant to Concawe members and includes the different stages of the site lifecycle (site investigation, monitoring, remediation, etc.) and identifies three remedial technologies that will represent three agreed scenarios where the benefits of various SMPs can be realized.

1. INTRODUCTION

1.1. BACKGROUND

Following the recent publication of sustainable remediation case studies demonstrating sustainable soil and groundwater remediation techniques and technologies (Concawe, 2023), Concawe commissioned CL:AIRE/ERM to further explore and demonstrate the value of Sustainable Management Practices (SMPs) within the framework of fuel manufacturing site remediation projects. SMPs are a key component of sustainable remediation particularly in translating sustainability principles and indicators into practical actions that can be applied to any stage of a remediation project.

SuRF-UK has published updated guidance on implementing the SMPs for projects (CL:AIRE, 2021).However, while there are a range of possible SMPs that could be applied, there are relatively few examples demonstrating the use of these SMPs to help practitioners identify which would be most suitable for their projects and promote SMP uptake in industry.

There are several European legislative drivers that provide a broader context for this project. The EU Soil Strategy for 2030 (European Commission, 2021) is key to achieving the objectives of the European Green Deal (European Commission, 2019), which wants to see sustainability central to all EU policies. More specifically, sustainable and risk-based remediation is one of the objectives of the proposed EU Soil Monitoring and Resilience Directive (European Commission, 2023) and SMPs are one way to rapidly identify sustainable practices that improve the overall sustainability performance of remediation projects.

1.2. OBJECTIVE

Concawe commissioned CL:AIRE/ERM to undertake a project to showcase the range of sustainability benefits that the introduction and application of SMPs can bring to a project (Concawe had previously identified a number of areas of potential benefit including circularity, biodiversity and greenhouse gas (GHG) emission reduction). The overall project scope consists of two parts:

i. Developing a shortlist of commonly applied and would-like-to apply SMPs applicable for soil and groundwater remediation projects in the fuel manufacturing industry.

ii. Use a subset of the identified SMPs and investigating them in detail by applying them to a hypothetical site.

This report presents the results of the initial phase of the project and is the culmination of a workshop held by Concawe in April 2024 and subsequent inputs from Concawe members and the CL:AIRE/ERM team.

1.3. REPORT STRUCTURE

This document is structured as follows:

Section 2:	Sustainable Management Practices - Provides an introduction to SMPs.
Section 3:	Discusses sustainability indicators that may be of relevance to remediation projects undertaken at fuel manufacturing sites.
Section 4:	Maps the SMPs to the identified indicators and highlights the key SMPs that are applicable to the fuel manufacturing sector.
Section 5:	Describes the development of the hypothetical site.
Section 6:	Summarizes the conclusions.
Appendix A:	Sustainability Indicator Alignment with Material Issues in the Oil and Gas Industry (IPIECA, 2020).
Appendix B:	Selected SMPs.
Appendix C:	Conceptual Site Model of Hypothetical Site (from April 2024 workshop).

2. SUSTAINABLE MANAGEMENT PRACTICES

2.1. CONTEXT

Sustainable management practices (SMPs) apply within the broader framework of sustainable remediation, as described in ISO 18504 (2017) and the SuRF-UK sustainable remediation framework (CL:AIRE, 2010). Sustainable and risk-based remediation is one of the objectives of the proposed EU Soil Monitoring and Resilience Directive (European Commission, 2023) and SMPs are one way to rapidly identify sustainable practices that improve the overall sustainability performance of remediation projects.

2.2. DEFINITION

SuRF-UK defines SMPs as *"relatively simple, common sense actions that can be implemented at any stage in a land contamination management project to improve its environmental, social and/or economic performance"*. SMPs were developed from Best Management Practices (BMPs) first promoted by US EPA (2009) and further defined by ITRC (2011).

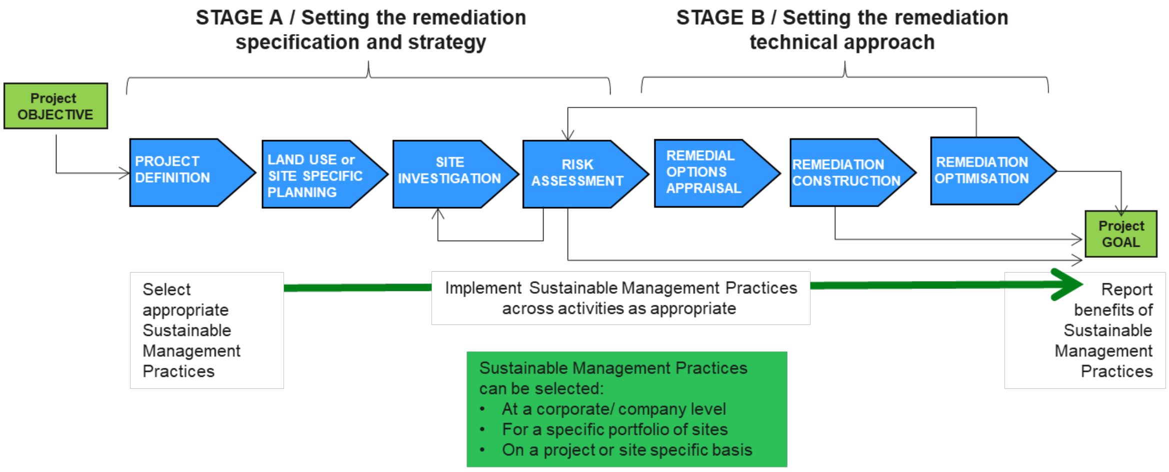
2.3. USE

SMPs may be considered and implemented at any stage of a project lifecycle (Figure 1). At a site-specific level, SMPs can be used to improve the benefits (e.g. increase resource efficiency, reduce costs) or reduce the negative impacts (e.g. spillages, complaints) of a project, leading to project 'sustainability gains'. This can be achieved without undertaking a formal sustainability assessment. SMPs may also be used where sustainability gains are sought at a programme of work level using generic criteria or standards that can apply to a range of project types. SMPs can be categorized as being related to:

- Establishing overarching principles that can set the boundaries for embedding sustainability in a project
- Being established good practice but having a potentially significant contribution to one or more project relevant sustainability indicators
- Being established good practice but having some contribution to one or more project relevant sustainability indicators
- Being a novel or technology specific contribution that can have a potentially significant contribution to one or more project relevant sustainability indicators.

These indicators can be further grouped or classified according to the stage in the lifecycle that they are most relevant to, or the sustainability indicators of primary relevance.

Figure 1 Sustainable Management Practices implemented within project lifecycle (Adapted from CL:AIRE, 2021*)*

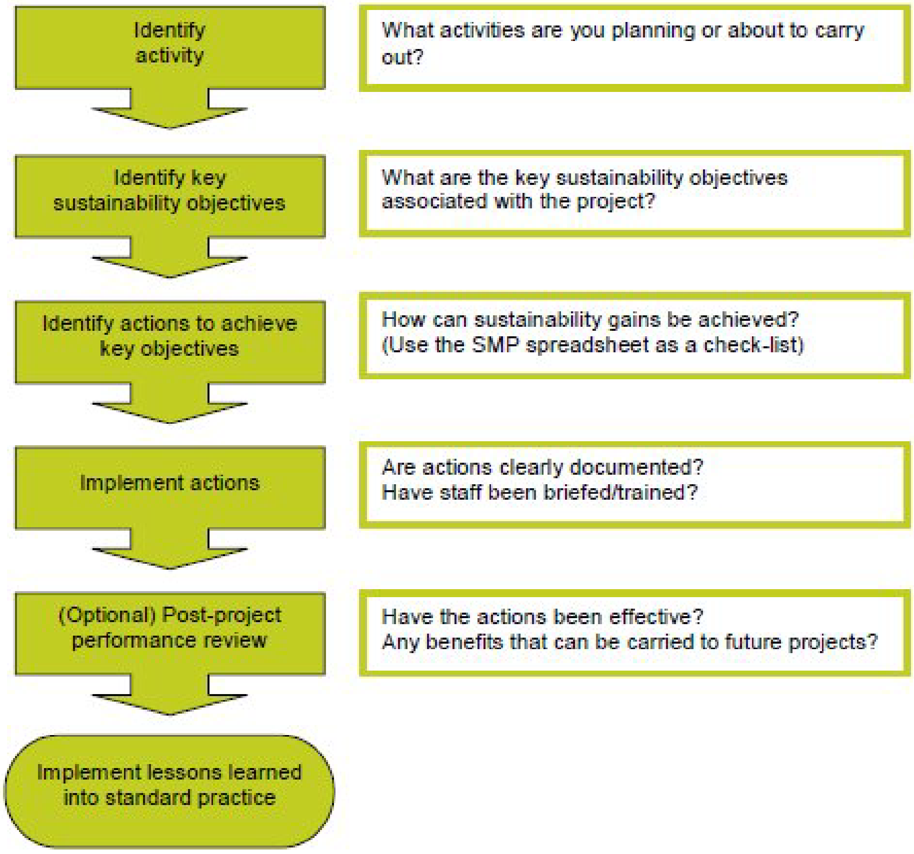


The SuRF-UK spreadsheet[1] is the first published list of SMPs that are mapped against a full indicator set, and this has been used as the starting point for this assessment. The SuRF-UK indicator set has also been supplemented by review of current US EPA BMPs for relevant technologies (US EPA, 2024).

As noted above SMPs can be applied at any stage of a land contamination project The process flow chart in Figure 2 summarizes the key stages associated with the implementation of SMPs.

[1] https://claire.co.uk/executing-sustainable-remediation/sustainable-management-practices

Figure 2 Sustainable Management Practices Process Flow Chart (CL:AIRE, 2021)



A key requirement at the outset is to identify the sustainability objectives and relevant sustainability indicators for a particular project. Potential indicators that may be applicable to remediation projects undertaken at fuel manufacturing sites are discussed in Section 3.

3. SUSTAINABILITY INDICATORS FOR REMEDIATION PROJECTS IN THE FUEL MANUFACTURING SECTOR

Sustainable remediation is defined in the International Standard for Sustainable Remediation (ISO, 2017) as the "*elimination and/or control of unacceptable risks in a safe and timely manner whilst optimising the environmental, social and economic value of the work*". Inherent in this definition is the identification of appropriate indicators across each of the three dimensions by which to measure sustainability and through which the application of SMPs may be able to contribute.

Sustainability indicators will typically vary on a site-specific basis reflecting the circumstances of the site and the views of relevant stakeholders. At a corporate or portfolio management level there may be groups of indicators that align closely with a company's own in-house sustainability policies and metrics which can be applied collectively. Typically reporting metrics at a corporate level may include the following broad categories (IPIECA, 2020) and a detailed breakdown of potential indicators is provided in Appendix A.

- Governance and business ethics
- Climate change and energy
- Environment
- Safety, health and security
- Social

For the purposes of this project and using the SuRF-UK indicator set as a benchmark (CL:AIRE, 2020) a selection of generic but industry relevant sustainability indicators were identified in discussions with Concawe members. The selected indicators are summarized in Table 1.

Table 1 Selected Project Sustainability Indicators

SuRF-UK		Sustainability Criteria	Quantification Possible?	Proposed Metric
Environment				
	Emissions to Air			
ENV 1	A	Climate change greenhouse gases (e.g. CO_2, CH_4, N_2O, O_3, VOCs, ozone depleting substances, etc.)	Yes	GHGeqv emissions
	C	Ground air quality - Particulates (especially PM5 and PM10), ground level ozone, volatile contaminants/reagents, ammonia (from biopiles) etc.	Yes (but not currently included in scope)	Output of lifecycle assessment model
	Soil and Ground Conditions			
ENV 2	A	Changes in soil functionality (particularly topsoil) for flora and fauna	No	Qualitative assessment
	C	Changes in soil erosion, particularly affecting surface water/ sediments	No	Qualitative assessment
	E	Structures in the subsurface (impact of wells, impact on buried services)	No	Qualitative assessment
	Ecology			
ENV 4	A	Effects on flora, fauna and food chains (esp. protected species, biodiversity, protected sites, consideration of alien species)	No	Qualitative assessment
	B	Significant changes in ecological community structure or function and consequent impacts on ecosystem services	No	Qualitative assessment
	Natural Resources and Waste			
ENV 5	A	Impacts/benefits for land reuse such as landscape changes, multifunctionality	No	Qualitative assessment
	B	Use of energy/fuels taking into account their type/origin and the possibility of generating renewable energy by the project	Yes	GHGeqv emissions
	C	Use of primary resources and substitution of primary material resources within the project or external to it, rates of recycling, rates of legacy waste generation, use of other recyclates.	Yes	Tonnes of waste saved, Tonnes of soil recycled
	D	Use / reuse of water, impacts/benefits for water abstraction, use and disposal	Yes	m^3 water saved, water reused
Economic				
	Direct Economic Costs & Benefits			
ECON 1	A	Direct financial costs and benefits of remediation / management for organization	Yes	High level scoping - high/medium/low
	Induced Economic Cost and Benefits			
ECON 4	A	Creating opportunities for inward investment into the area, for example, facilitating a follow-on remediation project	Yes	High level scoping - high/medium/low
	B	Benefits to the technology provider (e.g. in facilitating technology replication/demonstration)	Yes	High level scoping - high/medium/low
	C	Innovation and new skills (for organizations)	Yes	High level scoping - high/medium/low

		Project lifespan and Flexibility		
ECON 5	E	Robustness of solution to climate change effects	No	Qualitative assessment
Social				
		Human Health and Safety		
SOC 1	B	Risks to site workers, site neighbours and the public during restoration / management works (excavation, machinery and traffic, as well as smaller machinery, use of hazardous reagents or processes (e.g. heat) and potential transport of hazardous wastes	No	Qualitative assessment
		Neighbourhoods & Locality		
SOC 3	A	Effects from dust, light, noise, odour and vibrations during works and associated with traffic, including both working-day and night-time/weekend operations	No	Qualitative assessment
		Communities and Community Involvement		
SOC 4	A	Changes in the way the community functions and the services they can access (all sectors - commercial, residential, educational, leisure, amenity)	No	Qualitative assessment
	B	Quality of communications and community engagement (where this differs between options being considered)	No	Qualitative assessment
	C	Effect of the project on local culture and vitality	No	Qualitative assessment
	D	Compliance with local policies/spatial planning objectives, as well as national and international good practice	No	Qualitative assessment

4. SUSTAINABILITY INDICATOR MAPPING

4.1. INTRODUCTION

The primary objective of this project was to develop a shortlist of commonly applied and would-like-to apply SMPs applicable for projects at fuel manufacturing sites, which reflect the specific requirements of that sector.

Following feedback in the Concawe workshop held on 11th April 2024, the CL:AIRE/ERM team collated the SMPs from existing published guidance, most notably from SuRF-UK and the US EPA BMPs. The proposed shortlisted indicators were taken from the spreadsheet and SMPs have been grouped into the following categories that reflect the number and significance of primary indicators associated with each phase:

- Overarching Principal Indicators
- Carbon Footprint
- Circular Economy
- Biodiversity
- Site Investigation and Risk Assessment
- General Good Practice

4.2. SELECTED SMPS

Seven SMPs were identified with the greatest potential benefits for an individual project and also to serve as the catalyst for implementing site specific SMPs on a project-by-project basis. These are shown in Table 2.

Table 2 Selected Overarching SMPs

	Overarching SMPs
1	Develop a sustainability plan for the project that includes relevant & measurable sustainability indicators
2	Include an assessment of sustainability in your Remedial Options Appraisal
3	Evaluate carbon footprint for major activities and implement a GHG emissions reduction plan
4	Implement a sustainable procurement plan for the project/site
5	Promote circular economy - Reduce, reuse and recycle where possible. Plan your activities to reduce waste.
6	Consider how climate change may affect the resiliency of your remediation strategy to meet long-term performance objectives
7	Consider ways to maximize positive benefits to local communities

A summary of the proposed SMPs considered under each category above has been included in Appendix B. These SMPs were selected as they reflect the key areas of potential sustainability gains in fuel manufacturing remediation projects relevant to Concawe members.

5. DEVELOPMENT OF HYPOTHETICAL SITE

Following the workshop held in April 2024, CL:AIRE/ERM and Concawe members identified and agreed the nature of the hypothetical site to be utilized as a case study for the purpose of the SMP assessment.

The hypothetical site was adapted to be relevant to Concawe members and includes the scope of different stages of the site lifecycle (site investigation, monitoring, remediation, etc.) and identifies three remedial technologies that will represent three agreed scenarios where the benefits of various SMPs can be realized (e.g. sites with the opportunity for SMP gains in a number of areas) and where the scope of various activities including remediation can be readily defined such that quantification and analysis can be undertaken relatively simply and cost effectively.

The hypothetical site to be used in the assessment is based on a virtual site previously developed by CL:AIRE/ERM and adapted to a fuel manufacturing sector context. Using this virtual site, the boundaries and scope of remediation can be defined and alternative scenarios can be explored. The site can also be developed to reflect Concawe members experience of “typical” sites.

The Conceptual Site Model of the hypothetical site is shown in Appendix C.

6. CONCLUSIONS

The outcome of the workshop and subsequent feedback with Concawe members resulted in an agreed list of sustainability indicators and shortlisted SMPs that can be incorporated into a next phase (assessment phase) of this project utilising the hypothetical site developed.

These SMPs can be investigated in detail using quantitative and qualitative assessment methods to identify suitable applications to remediation projects.

Environmental, social and economic indicators were identified relevant to the fuel manufacturing sector with seven overarching SMPs selected that would be relevant to the majority of remediation projects. Other proposed SMPs can be applied to the hypothetical site to identify sustainability gains for carbon footprint, circular economy, biodiversity, site investigation and risk assessment and general good practice.

7. REFERENCES

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APPENDIX A - SUSTAINABILITY INDICATOR ALIGNMENT WITH MATERIAL ISSUES IN THE OIL AND GAS INDUSTRY

The SuRF-UK sustainability indicators selected for the assessment have been chosen to reflect the unique conditions of fuel manufacturing remediation sites for Concawe members.

Guidance on the wider application of sustainability indicators in the context of material issues faced by the oil and gas industry has been published by IPIECA to support corporate-level reporting for internal and external stakeholder audiences. These indicators are listed here for reference in Table A-1.

Table A-1 Sustainability Indicator Alignment with Material Issues in the Oil and Gas Industry (Adapted from (IPIECA, 2020))

MODULES	ISSUES	INDICATORS
Governance and business ethics	Governance and management systems	GOV-1: Governance approach
		GOV-2: Management systems
	Business ethics and transparency	GOV-3: Preventing corruption
		GOV-4: Transparency of payments to host governments
		GOV-5: Public advocacy and lobbying
Climate change and energy	Climate strategy and risk	CCE-1: Climate governance and strategy
		CCE-2: Climate risk and opportunities
	Technology	CCE-3: Lower-carbon technology
	Emissions	CCE-4: Greenhouse gas (GHG) emissions
		CCE-5: Methane emissions
	Energy use	CCE-6: Energy use
	Flaring	CCE-7: Flared gas
Environment	Water	ENV-1: Freshwater
		ENV-2: Discharges to water
	Biodiversity	ENV-3: Biodiversity policy and strategy
		ENV-4: Protected and priority areas for biodiversity conservation
	Air emissions	ENV-5: Emissions to air
	Spills	ENV-6: Spills to the environment
	Materials management	ENV-7: Materials management
	Decommissioning	ENV-8: Decommissioning
Safety, health and security	Workforce protection	SHS-1: Safety, health and security engagement
		SHS-2: Workforce health
		SHS-3: Occupational injury and illness incidents

MODULES	ISSUES	INDICATORS
		SHS-4: Transport safety
	Product health, safety and environmental risk	SHS-5: Product stewardship
	Process safety	SHS-6: Process safety
	Security	SHS-7: Security risk management
Social	Human rights management	SOC-1: Human rights due diligence
		SOC-2: Suppliers and human rights
		SOC-3: Security and human rights
	Labour practices	SOC-4: Site-based labour practices and worker accommodation
		SOC-5: Workforce diversity and inclusion
		SOC-6: Workforce engagement
		SOC-7: Workforce training and development
		SOC-8: Workforce non-retaliation and grievance mechanisms
	Community engagement	SOC-9: Local community impacts and engagement
		SOC-10: Indigenous peoples
		SOC-11: Land acquisition and involuntary resettlement
		SOC-12: Community grievance mechanisms
		SOC-13: Social investment
	Local content	SOC-14: Local procurement and supplier development
		SOC-15: Local hiring practices

APPENDIX B - SELECTED SMPS

Proposed SMPs - seven overarching SMPs selected

These SMPs were selected to represent the SMPs with the greatest potential benefits for an individual project and also to serve as the catalyst for implementing site specific SMPs on a project-by-project basis.

	SMPs
1	Develop a sustainability plan for the project that includes relevant & measurable sustainability indicators
2	Include an assessment of sustainability in your Remedial Options Appraisal
3	Evaluate carbon footprint for major activities and implement a GHG emissions reduction plan
4	Implement a sustainable procurement plan for the project/site
5	Promote circular economy - Reduce, reuse and recycle where possible. Plan your activities to reduce waste.
6	Consider how climate change may affect the resiliency of your remediation strategy to meet long-term performance objectives
7	Consider ways to maximise positive benefits to local communities

Proposed SMPs – Carbon Footprint

Below are the shortlisted SMPs considered most relevant to remediation projects undertaken at fuel manufacturing sites:

	SMPs	Primary Indicator	Secondary Indicator	ERM/CL:AIRE-Quantifiable in Case Study
1	Consider use of cleaner fuels & additives (e.g. ultra-low sulphur diesel) for non-road plant e.g. electric, hybrid.	ENV 1	ENV 5	✓
2	Don't allow plant and equipment to 'idle'	ENV 1	ENV 5	✓
3	Where appropriate, incorporate natural attenuation into a remediation strategy	ENV 5	ECON 1	✓
4	Conduct periodic review of treatment processes to identify redundant or inefficient equipment and maintain optimum efficiency	ENV 5	ECON 1	✓
5	Can you substitute electricity drawn from the utility grid with power generated by onsite renewable energy resources? (e.g. wind, photo-voltaic, ground heat pump)	ENV 1	ENV 5	✓
6	Can you modify or reconfigure the remediation system according to changes in a contaminant plume over time? Can you use equipment that can be easily removed and re-integrated into the treatment system as field conditions change?	ENV 1	ENV 5	
7	Size pumps, fans, and motors appropriately and using energy efficient motors to minimise energy consumption	ENV 5	ECON 1	

Carbon Footprint – Other SMPs Considered

Below are additional SMPs considered in the shortlist but not considered priority SMPs:

	SMPs	Primary Indicator	Secondary Indicator	ERM/CL:AIRE-Quantifiable in Case Study
1	Minimise vehicle miles	ENV 1	SOC 3	✓
2	Evaluate alternative waste transportation methods such as rail, barge or vehicles that operate using alternative fuels	ENV 1	ENV 5	✓
3	Identify opportunities for resource sharing with other sites (e.g. within portfolio, cluster)	ENV 5	ECON 1	
4	Identify potential incentives for improved site use (e.g. optimum land use options with contaminant distribution)	ECON 1	ENV 5	
5	Conduct bench-scale/pilot trials to estimate the material quantities required for remediation	ENV 5	ECON 1	
6	Optimise the efficiency of the remediation system to meet environmental, social and economic objectives	ECON 1	SOC 5	
7	Ensure the remediation remains protective through adaptive management before and post-closure	ECON 5	SOC 5	
8	Consider environmental offsetting (e.g. carbon, biodiversity)	ENV 1	ENV 4	✓
9	Can you supplement the remediation system with other remediation or auxiliary technologies to reduce clean-up progresses and new products or processes become available?	ENV 5	ECON 1	
10	Can you save energy costs by limiting the use of energy requiring operations (including operation of treatment systems) to only off-peak utility periods?	ENV 1	ENV 5	✓
11	Can you employ portable units or trailers equipped with photovoltaic panels to generate electricity or direct power for example, for equipment such as air blowers?	ENV 1	ECON 1	✓
12	Can you use energy recovery ventilators to capture energy from treatment system effluent?	ENV 1	ENV 5	
13	Are you generating waste heat? Can you use it? (solar thermal panels, combined heat and power, or water- source heat pumps can provide the needed heat, and heat exchangers enable reuse of heat rather than discharging it as part of the effluent.)	ENV 5	ECON 1	
14	Combine remediation works with other earthworks and development activities	ENV 5	ECON 4	
15	Promote the sequestration of carbon through reforestation or afforestation	ENV 1	ENV 4	
16	Can you record and evaluate energy consumption real time by installing amp meters?	ENV 5	ECON 1	
17	Do you require a heat source? Will all treatment system piping and equipment requiring heat be insulated?	ENV 1	ENV 5	
18	Can you encourage the use of natural lighting in buildings rather than relying on power sources? Think about the positioning of portacabins and use of skylights.	ENV 1	ECON 1	
19	Have you considered the trade-offs associated with energy use and air emissions when evaluating the potential for leaving waste in place at a portion of the site, if site-specific risk criteria can be met with minimal institutional controls this could be more sustainable?	ENV 5	ECON 1	

20	Have you considered environmental and economic trade-offs involved in onsite versus offsite treatment of excavated soil or sediment?	ENV 5	ECON 1	
21	Consider designing a network of extraction piping that initially provides a conservative hydraulic capacity for the planned treatment system (perhaps by increasing pipe size or laying additional pipe when a trench is open), which allows for future modular increases or decreases in the extraction rate and treatment modifications, if needed	ENV 1	ENV 2	
22	Consider whether pulsed rather than continuous rates of pumping can maintain the rate of groundwater transfer and treatment needed to ensure a protective remedy; additional gains in energy conservation may be possible by pumping during off-peak utility periods	ENV 2	ENV 1	

Proposed SMPs – Circular Economy

Below are the shortlisted SMPs considered most relevant to remediation projects undertaken at fuel manufacturing sites:

	SMPs	**Primary Indicator**	**Secondary Indicator**	**ERM/CL:AIRE-Quantifiable in Case Study**
1	Identify reuse or recycling options for materials, plant and equipment removed from site	ENV 5	ECON 1	✓
2	Minimise the consumptive use of water	ENV 5	ECON 1	✓
3	Minimise the volume of waste sent to landfill	ENV 5	ENV 1	✓
4	Consider capture and re-use of grey water	ENV 5	ECON 1	
5	Consider recovery of treated soil for re-use on-site where suitable for use as set out in the Materials Management Plan	ENV 1	ENV 5	
6	Consider export of contaminated soil to a local treatment facility and return of suitable treated soil for re-use (cluster approach)	ENV 1	ENV 5	
7	Minimise the volume of waste discharged to public sewer	ENV 1	ENV 5	✓

Circular Economy – Technology Specific SMPs

Below are technology specific SMPs related to the circular economy considered in the shortlisted SMPs:

	SMPs	**Primary Indicator**	**Secondary Indicator**	**ERM/CL:AIRE-Quantifiable in Case Study**
1	Can you employ evapotranspiration covers to promote microbial degradation, provide substrate for plant growth, and mitigate generation of leachate?	ENV 5	ENV 2	
2	Use liquid filters that can be backwashed to avoid frequent disposal of disposable filters	ENV 5	ECON 1	
3	Consider benefits of pre-treatment or pre-filtering prior to use of adsorption media such as GAC so that media are replaced based on chemical loading rather than fouling caused by solids loading	ENV 5	ECON 4	

4	Weigh the footprint advantages and disadvantages of preheating vapours prior to treatment with vapour-phase GAC	ENV 1	ECON 5	
5	Consider the source materials used to generate treatment media; for example, GAC media used in adsorption units can consist of virgin or reactivated coal-based GAC or virgin coconut-based GAC	ENV 5	ECON 1	
6	Take advantage of opportunities for chemical salvaging and material reuse, including regenerating rather than disposing of GAC, identifying uses for precipitated metals solids, and identifying uses of recovered product (such as creosote recycling or energy generation)	ENV 5	ECON 4	
7	Reduce the frequency and tonnage of hauling process-derived solid waste by improving solids dewatering with a filter press or other technologies,	ENV 5	ECON 4	
8	Use sequestering agents to keep a maximum amount of iron and manganese in solution, to prevent equipment fouling, rather than removing them and generating additional process waste.	ENV 5	ENV 4	
9	Consider discharge to a Publicly Owned Treatment Works (POTW) or other regional water treatment plant, which may allow more efficient offsite treatment of certain contaminants	ENV 5	ENV 4	
10	Consider beneficial onsite reuse of treated water (such as for irrigation, dust control, and constructed wetlands) to reduce the overall capacity needed by the local water supply network.	ENV 5	ECON 1	
11	Attempt to obtain needed chemicals and materials from local manufacturers in order to avoid long-distance transport	ECON 4	ENV 1	✓
12	Consider chemical and material disposal needs, including offsite disposal of hazardous waste	ENV 5	ENV 2	
13	Consider the resources consumed during manufacturing or processing of treatment chemicals	ENV 5	ECON 1	
14	Consider the potential for these chemicals or treatment byproducts to be present in treatment effluent and the potential effects of these chemicals on human health and the environment	ENV 5	ENV 2	
15	Conduct sufficient bench-scale tests to help optimize chemical dosage, which minimizes chemical use during treatment	ENV 5	ECON 1	
16	Consider reinjecting treated water downgradient of the extraction system to flatten the hydraulic gradient in the vicinity of the extraction wells, increase the capture zone width near the extraction wells, and potentially reduce the overall extraction rate	ENV 2	ENV 5	
17	Consider diverting upgradient, uncontaminated groundwater around the contaminant plume to reduce the amount of water to be extracted	ENV 2	ENV 5	
18	Establish an appropriate target capture zone and thoroughly evaluate the groundwater extraction needed to provide complete capture	ENV 5	ENV 2	
19	Base the capture zone analyses and design on parameters of actual aquifer test data and consider the use of modelling (with appropriate input information) to design the extraction system	ENV 2	ENV 5	

Biodiversity SMPs

Below are the shortlisted SMPs considered most relevant to remediation projects undertaken at fuel manufacturing sites:

	Proposed SMPs	**Primary Indicator**	**Secondary Indicator**	**ERM/CL:AIRE-Quantifiable in Case Study**
1	Consider measures to eradicate or control the spread of invasive, non-native species	ENV 4	SOC 3	
2	Identify any invasive, non-native species on-site	ENV 4	SOC 3	
3	Consider a survey of the site to identify and safeguard protected species and habitat	ENV 4	SOC 3	
4	Consider reusing local ecological resources (e.g. seeds, cuttings) in site restoration	ENV 4	SOC 3	
	Other SMPs Considered			
1	Take measures to prevent access and damage to protected areas	ENV 4	ECON 2	
2	Consider a survey of soil types before disturbing the site (Soil Resource Plan)	ENV 2	ENV 5	
3	Maintain vegetation corridors (riparian buffer strips) adjacent to water courses	ENV 2	ENV 3	
4	Have you planned to avoid tree removal when practicable including trees located within a staging area or intermittent uncontaminated zone that can be avoided during clean-up site activities?	ENV 4	SOC 3	
5	Have you considered the use of trees removed during remediation activities as habitat snags following restoration?	ENV 4	SOC 4	

Site Investigation and Risk Assessment SMPs

Below are the shortlisted SMPs considered most relevant to remediation projects undertaken at fuel manufacturing sites:

	Proposed SMPs	Primary Indicator	Secondary Indicator	ERM/CL:AIRE-Quantifiable in Case Study
1	Develop a conceptual model, with uncertainties identified, and review when additional information becomes available	SOC 5	ECON 5	
2	Have you designed the site investigation programme to reflect the conceptual site model and measure contaminant concentrations in media relevant to the exposure pathways of concern and data is 'fit for purpose'?	ECON 5	SOC 5	
3	Consider the use of a mobile laboratory/field testing techniques and/or non-intrusive surveys to reduce off-site shipment of samples and improve spatial data	ENV 1	ENV 5	✓
4	Consider use of direct-push technology rather than traditional techniques where appropriate	ENV 2	ENV 5	✓
5	Specify laboratory analytical methods that generate less waste and solvent use and meet data quality objectives (e.g. bias & precision)	ENV 5	SOC 5	
6	Where practicable avoid multiple mobilisations	ENV 5	SOC 1	✓
7	Are you able to use a site specific rather than generic risk assessment approach?	SOC 1	ECON 5	
8	Can you use long-term monitoring optimisation approaches to reduce the amount of sampling? Decision support tools such as monitoring and remediation optimisation system (MAROS) software can be used to perform statistical trend analysis for optimizing sample locations, sampling frequency, and analytical parameters?	ENV 5	SOC 5	
	Other SMPs Considered			
1	Plan to re-use boreholes through each phase of investigation, remediation and long-term monitoring	ENV 5	SOC 1	
2	Install and decommission monitoring wells in an appropriate way to prevent preferential pathways.	ENV 3	ENV 2	
3	Use bailers (no-purge) or low-flow samplers where suitable	ENV 5		
4	Where water has to be used to assist the drilling process, use only uncontaminated water and record the volume	ENV 3	ENV 5	
5	Have you maximised the collection of site specific physiochemical/soil/hydrogeological properties that may be used to refine the site-specific risk assessment?	ENV 2	ENV 3	
6	Where relevant have you considered the use of bioavailability testing to incorporate into the risk assessment?	ENV 4	SOC 1	
7	Have you considered derivation of toxicity values as a means of addressing over conservatism?	ENV 5	ECON 5	
8	Have you considered the derivation of site specific rather than generic degradation rates?	ENV 5	ECON 5	
9	Are you adopting a statistical approach to interpreting data?	SOC 5		

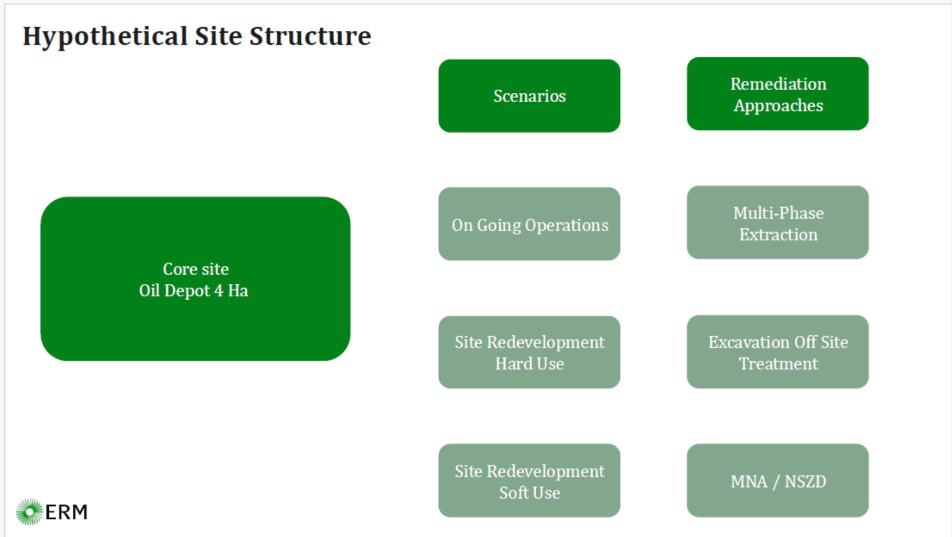
General Good Practice SMPs

Below are the shortlisted SMPs considered most relevant to remediation projects undertaken at fuel manufacturing sites:

	Proposed SMPs	Primary Indicator	Secondary Indicator	ERM/CL:AIRE-Quantifiable in Case Study
1	Ensure fuels, waste, and other chemicals are stored in secure, suitably bunded facilities away from watercourses, drains, flood risk areas and areas with high collision risk	ENV 2	ENV 3	
2	Have the presence of watercourses and surface water drains been considered so these can be protected/avoided during drilling and wash down activities?	ENV 3	SOC 3	
	Other SMPs Considered			
1	Identify all drainage systems on-site and design measures to mitigate any pollution risks	ENV 4	SOC 3	
2	Keep a spill kit close to the fuel or other fluids/chemicals storage area	ENV 2	ENV 3	
3	Consider covering excavated areas with biodegradable fabric or foam to suppress VOC emissions	ENV 1	SOC 1	
4	Install and maintain a leak detection system within a treatment system	ENV 2	ENV 3	
5	Consider piling risk assessment to reduce risks to groundwater / human health	ENV 1	ENV 3	
6	Can you limit the number of vehicles deployed on site so as to disturb as small an area as possible?	ENV 1	SOC 3	
7	Can you implement storm water pollution prevention techniques to prevent sediment travel off-site?	ENV 4	ENV 3	

APPENDIX C - CONCEPTUAL SITE MODEL OF HYPOTHETICAL SITE

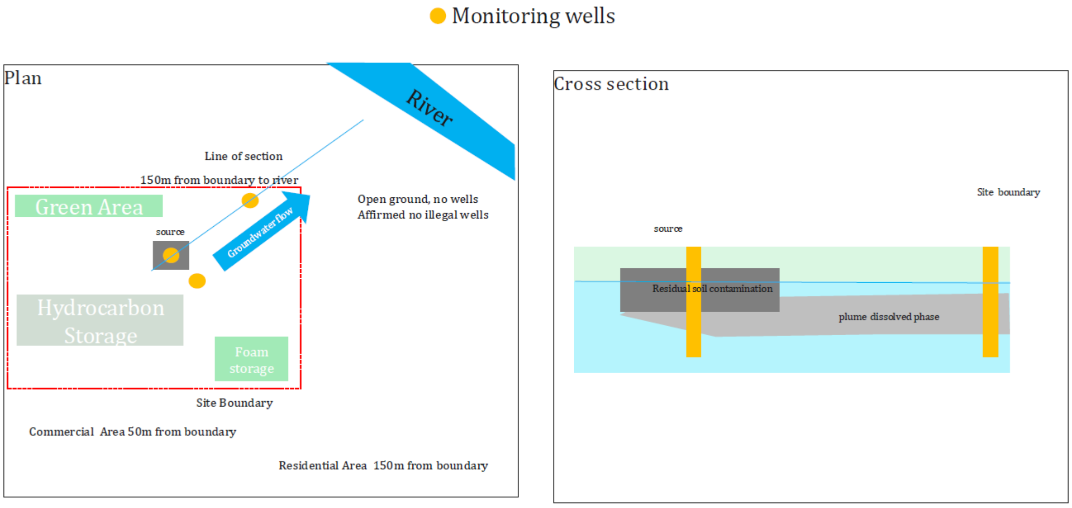
At a workshop held in April 2024, CL:AIRE/ERM and Concawe members agreed the nature of the hypothetical site to be utilized as a case study for the purpose of the SMP assessment. The following slide was presented which identifies three remedial technologies that will represent three agreed scenarios where the benefits of various SMPs can be realized.



Conceptual Site Model - Generic Depot Description

- Small Hydrocarbon Storage Depot in industrial area on edge of a town
- Currently & historically has stored and distributed a range of hydrocarbon fuels
- Fire fighting foam storage in small corner of site (not considered in this investigation)
- Site is operational
- Following an audit a site investigation was undertaken and the presence of residual soil contamination was detected near an old aboveground storage area (area about 40 m by 40 m)
- Source area is accessible
- A dissolved phase plume mostly (BTEX in 1000s of µg/l) appears to be migrating to site boundary and presumably off site
- Site is located on alluvial sediments mostly sands and gravels occasional clay lens
- Depth to groundwater between 2 and 3 m seasonally
- No groundwater abstraction but a high quality river located downgradient 150 m from site boundary

Conceptual Site Model - Example



Regulations & Risk Assessment

- Historic soil and groundwater contamination is managed using a risk based regulatory system
- Regulatory authorities provide guidance on risk based methodologies and publish generic assessment criteria for different land uses
- Soil and Groundwater contaminants are initially screened against the generic assessment criteria
- The residual soil contamination is shown to be stable and not migrating
- Generic risk assessment concludes no risks to human health under a commercial land use scenario but a potential risk to surface water

Remedial Objectives

On going Operations

- Site cannot be disturbed but in situ treatment possible
- No risk to onsite under current use
- Remedial objective to control groundwater concentration at boundary so it is protective of river
- Target in order of 10s of µg/l BTEX currently in 1000s µg/l

Site is closed and redeveloped for housing/retail use

- Risk to potential future occupants
- Short timescale
- Remedial objective to control groundwater concentration at boundary so it is protective of river
- Target in order of 10s of µg/l BTEX currently in 1000s µg/l and to reduce potential risk to human health

Site is closed and redeveloped for solar farm

- No risk to potential future occupants
- Long timescale
- Remedial objective to control groundwater concentration at boundary so it is protective of river
- Target in order of 10s of µg/l BTEX currently in 1000s µg/l

Technologies/scopes – to be used as basis for SMP analysis

Description	Excavation	DPVE	MNA
Site Investigation (Common to all options)	Installation of 15 soil bores (3m deep) and 5 monitoring wells (7m deep 50mm diameter) with percussive rig Collection of 40 soil samples for analysis Four rounds of measurement of soil gases and groundwater	Installation of 15 soil bores (3m deep) and 5 monitoring wells (7m deep 50mm diameter) with percussive rig Collection of 40 soil samples for analysis Four rounds of measurement of soil gases and groundwater	Installation of 15 soil bores (3m deep) and 5 monitoring wells (7m deep 50mm diameter) with percussive rig Collection of 40 soil samples for analysis Four rounds of measurement of soil gases and groundwater
Overall scope	Excavation of an area 40m by 40m by 4m deep. Is accessible but may disrupt some operations on site. Will require slope stabilisation and dewatering with mobile treatment unit that would be shipped in. Water to be treated before disposal to sewer Contaminated Soil would be transported on poor quality roads through a number of villages some 150km to disposal site. Clean materials would be brought from a quarry 45km distant.	Requires installation of an extraction well network (say 25 locations) and a manifold system that is connected to a vacuum extraction unit and associated water and air treatment. Power will be provided by site Discharged air and water will be treated via activated carbon. That will require disposal or recycling This option requires monitoring and modelling along boundary until completed.	Will require installation of five additional wells along plume to establish if natural attenuation is going to be protective of river. Will require additional investigation/modelling and discussions with regulators Programme of monitoring to demonstrate that natural attenuation is occurring, planned to occur over 30 years (with option for extension). Initial 4 times a year then twice a year - 10 wells.
Timescale	Six months	Up to 24 months	30 years
Cost	High	Medium to high	Low
Employment	Certified contractors brought in from outside areas with specialist equipment.	Certified contractors brought in from outside areas with specialist equipment.	Opportunity to train and use local labour for ongoing monitoring. Minimising mobilisation.

Concawe

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ISBN 978-2-87567-193-6

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