Selection of Remediation Technologies and Risk Management on Typical Service Stations

Tool: Assists stakeholders understand various remediation and risk management options for typical service stations. Not meant as a substitute for expert opinion. **For property specific decisions, engage a Qualified Person.**

List abbreviations provided at end of the Tool. See Glossary for definitions of terms

Remediation Type	Examples	Relative Chance of Success[1]	Approx. Time (months)[1]	Approx. Cost ($,000)[1]	Ontario Regulatory Requirements[3]	Other Considerations
A. REMEDIATION TO GENERIC STANDARDS						
A1. SOIL						
Excavation and Off-site Disposal	• Dig and haul to landfill for garbage cover ("dig and dump") • Dig and treat for surface land spreading	High	2-4	100 - 300	Licensed hauler, licensed disposal facility (May require PTTW and/or CofA (Sewage) if dewatering required)	o Problem removed from site o Relatively simple to design and implement o Shipping costs may be high depending on location of off-site disposal. Landfill tipping fees vary - market driven o May not be feasible for deep or difficult to access contamination o Fugitive emissions may be a problem
Ex-Situ On-site Treatment	• Bioremediation • Allu Bucket • Composting • Thermal desorption	Medium to High	4-36	100 - 200	CofA (Waste), CofA (Air) (May require PTTW and/or CofA (Sewage) if dewatering required)	o Requires space to operate treatment facility o Generally most effective for organic compounds o May not be feasible for deep or difficult to access contamination o Effectiveness may be limited by concentrations o Time varies depending on technology; biopile may take up to 2-3 years. Allu bucket may take only 4 months o Fugitive emissions may be a problem
In-Situ On-site Treatment	• Vapour Extraction • Multiphase extraction • In-Situ enhanced bioremediation • Bioventing • Chemical oxidation	Medium	24-48	200 - 400	CofA (Air / Groundwater)	o Generally creates minimal site disturbance o Degree of success variable o Geological complexity and/or shallow water table may limit applicability o Fugitive emissions and vapour migration may be problems o Vapour collection system may be required o Significant site characterization and significant operational and post-confirmatory monitoring required o Cold temperatures may slow process

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A2. GROUNDWATER						
In-Situ On-site Treatment	• Oxygen injection • Oxygen releasing compounds • Air sparging • Vapour extraction	Medium	24-48	100 - 300	CofA (Air / Groundwater)	o Generally creates minimal site disturbance o Degree of success variable o Geological complexity and/or shallow water table may limit applicability o Fugitive emissions and vapour migration may be problems o Vapour collection system may be required o Cold temperatures may slow process Significant site characterization and operational and post-remediation (2 – 4 years) confirmatory monitoring required
Monitored Natural Attenuation (MNA)	• Monitoring low level contamination or small source that is not expected to have an off-site impact	Medium to High	36+	50 - 100		o Long term groundwater monitoring and management (likely 10+ years) o May not be well received by the public because it is perceived as “doing nothing” o Minimal site disturbance o Less effective where PHC concentrations in soil are high (i.e. continuing source). May require source removal with MNA o Not suitable if receptors are being impacted o Significant site characterization required to establish plume stability and document evidence to support MNA o Attenuation may not proceed as predicted – contingency planning required
Pump and Ex-Situ On-site Treatment	• Pumping with biological treatment • Pumping with carbon adsorption • Pumping with air stripping	Low	100+	300+	PTTW, CofA (Sewage), licensed haulage & disposal of solids	o Requires significant site characterization, long term operation, maintenance and monitoring o Residual saturation of the contaminants in the soil pores and sorbed to in the soil matrix is not easily removed by ground water pumping o Generally considered a containment technology rather than a treatment method

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B. REMEDIATION TO PROPERTY SPECIFIC STANDARDS						
Remediation to Property Specific Standards (PSS) derived from Risk Assessment (RA)	Same technologies as in Section A for both soil and groundwater	Chance of success may be greater using more appropriate PSS through a RA	Time required may be less, due to use of more appropriate PSS	Costs may be less, due to more appropriate PSS	As per Section A. Additionally, RSC would require supporting RA	o As per Section A o PSS, based on a RA, are mandatory for sensitive sites
Similar to the step for Remediation to Property Specific Standards (PSS), a Risk Assessment (RA) is required to develop a Risk Management Plan (RMP) and implement Risk Management Measures (RMM).						

Remediation Type	Examples	Relative Chance of Success[2]	Approx. Time (months)[2]	Approx. Cost ($,000)[2]	Ontario Regulatory Requirements[3]	Other Considerations
C. RISK MANAGEMENT						
Containment of Soil, Groundwater, or Vapour	• Impermeable barriers or liners • Caps • Permeable reactive barriers • Protective membrane to inhibit vapour intrusion • Passive/active sub slab vapour movement	High	6	100	May require CofA (Air) and or PTTW. RSC requires supporting RA and RMM. CPU may be registered on title	o Practical for large volumes or sites where other treatment is impractical o Applicable to the complete range of contaminant groups o Cost relatively low for large volumes of soil o Does not lessen toxicity, mobility or volume of impacted material o Most effective where the majority of the underlying impacted material is above the water table o Cannot prevent the horizontal flow of groundwater, only the vertical entry of water into the impacted material o May require long-term maintenance and monitoring or containment mechanisms such as capping
Pump and Ex-Situ On-site Treatment of Groundwater	• Pumping with biological treatment • Pumping with carbon adsorption • Pumping with air stripping	High	6	100	PTTW, CofA (Sewage), Licensed haulage & disposal of solids. RSC requires supporting RA and RMM, CPU may be registered on title	o Requires significant site characterization, long term operation, maintenance and monitoring o May require financial assurance as part of the CPU

LEGEND:

(1) Sections A and B pertain to meeting soil and groundwater condition standards. Time and costs exclude up-front demolition and assessment work, but include all remediation-related activities and verification. Time and costs are based on a typical service station having 2000 tonnes of soil requiring remediation.

(2) Section C pertains to installation activities only. Operational timeframe is very long and life cycle costs cannot be generalized

(3) PTTW and CofA (Sewage) may be required if dewatering is involved. CofA (Air) required for permeable reactive barrier

(4) Abbreviations:

CofA – Certificate of Approval
CPU – Certificate of Property Use
MNA – Monitored Natural Attenuation
PHC – Petroleum Hydrocarbon
PSS – Property Specific Standards
PTTW – Permit to take Water
RA – Risk Assessment
RMM – Risk Management Measures
RMP – Risk Management Plan
RSC – Record of Site Condition

References:

- Redevelopment Framework for Former Service Stations (Ontario) Development Task Group, 2007