Appendix: Comparison of Environmental Remediation Methods (Khalid *et al*., 2016)

Techniques	Process	Applicability	Acceptance	Multi-metal sites	Time required	Advantages	Limitations
Physical remediation							
Soil replacement	Excavating contaminated soil and replacing with non-contaminated soil	Small scale but long term	Very low: limited to highly contaminated soils	Effective	Comparatively very less	Can effectively isolate risk metals from contaminated site. Effective for highly contaminated soils.	Large in working volume, costly, production of dangerous waste and negative effect on soil
Soil isolation	Isolating the contaminated soil from the uncontaminated soil using subsurface barriers	Small scale, and short to long term	Very low: limited to highly contaminated soils	Effective	Comparatively very less	Prevent off-site transport of heavy metals, Effective for highly contaminated soils	Costly, soil clean up still needs further engineering measures, effectiveness varies with the type of subsurface barrier
Vitrification	Using high-temperature to vitrify contaminated soil thereby reducing risk metal bioavailability	Small scale but long term	Very low	Effective	Comparatively very less	Easy application, applicable to variety of contaminants	High cost due to energy requirement
Electrokinetic Remediation	Applying DC voltage via electrophoresis, or electro-migration to reduce risk metals in soil	Small scale but long term	Very low	Effective	Comparatively very less	Easy application, economically effective, do not destroy the nature of soil	Requires soil with low permeability, pH needs to be controlled
Chemical remediation							
Immobilization	Reduction in metal mobility and bioavailability by applying immobilizing amendment, and forming stable and immobile complexes via adsorption	Small to medium scale and short-term	High public acceptability	Can be effective. Depends on the type of soil, metal and immobilizing amendment	Less to medium	Fast and easy applicability, relatively low costs, covers a broad spectrum of inorganic pollutants	Temporary solution and permanent monitoring is necessary

Soil washing	Applying extractants (organic or inorganic) and forming stable and mobile complexes	Small scale but can be long term	Medium to high public acceptability	Can be effective. Depends on the type of soil, metal and immobilizing amendment	Less to medium	Cost-effective, completely removes metals, meets specific criteria and reduces long-term liability	Washing extractants may cause environmental issue, effectiveness varies with soil, metal and extractant type
Biological remediation							
Phytovolatilization	Risk metal uptake by plants from soil and release in vapor form to atmosphere	Small to medium scale and long-term	Low-medium public acceptability	No	Very high	Economical and less disruptive	Restricted to volatile metals, may cause other environmental issues, no control after metal release to atmosphere
Phytostabilization	Use of plants to decrease metal bioavailability and mobility in soils via sequestration in plant roots	Small to medium scale and short-term	Medium public acceptability	Very low	Very high	Economical, less Disruptive	Temporary solution, effectiveness varies with soil, plant and metal type
Phytoextraction	Use of hyperaccumulator plants to uptake, translocate, and concentrate risk metals from soil to the aboveground harvestable plant parts	Large-scale and long-term	Highest public acceptability	Very low except for some plants	Very high	Highly economical, ecofriendly, less disruptive	Effectiveness depends on growing conditions, tolerance of the plant, bioavailability of metals in soil. Metal accumulator plants are generally very less in number
Chelate assisted Phytoextraction	Use of organic and inorganic ligands to enhance phytoextraction capacity of plants	Small to medium scale and long-term, low to moderate levels of metal	Very high public acceptability	Very low but more effective than phytoextraction alone	Very high but less than phytoextraction alone	Low time of remediation, enhance metal uptake and translocation	Costly, can be disruptive, effective for low-moderately contaminated soils, groundwater contamination risk
Microbial assisted phytoextraction	Use of microorganisms to enhance phytoextraction capacity of plants	Large-scale and long-term	Very high public acceptability	Very low but more effective than phytoextraction	Very high but less than phytoextraction alone	Economical, low time of remediation, enhance plant growth and metal uptake and translocation	Depends on microorganism, soil, plant and metal type