GENERALISED AND HYBRID SUSTAINABILITY ASSESSMENTS IN CONTAMINATED SITE REMEDIATION AND ASSOCIATED SUSTAINABLE BEHAVIOUR

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ABSTRACT

Contaminated sites are a huge liability in both developing and developed countries. Sustainable remediation of contaminated sites has drawn huge attention from governments, the industry, and academia in recent years. Many white papers and technical guidance have been published by various organisations and government agencies. A number of academic studies have been published on issues like sustainability assessment, life cycle also assessment (LCA) and sustainable technology development. However, there are research gaps in the sustainable remediation field which have impeded its adoption, due to an inability to quantify social and economic sustainability and tertiary impacts, and the lack of transferrable sustainability assessment results and the understanding of practitioners' actual behaviour. This study examined sustainability assessment and sustainable behaviour in the remediation of contaminated soil, groundwater, and sediment, in order to fill these research gaps and also to provide guidance to remediation practitioners and policy makers. Sustainability assessment aims to provide a basis for informed and balanced decision making, and it is a critical component of sustainable remediation. The present study expanded existing sustainability assessment tools, which are mostly based on process-based LCA of specific projects. The expansion occurred in two aspects. On a micro-level, this study developed an economic input-output based hybrid LCA method for project specific sustainability assessments which improves existing sustainability assessment methods by incorporating social and economic sustainability as well as providing more complete system boundaries. A case study at the London Olympic Park site demonstrated that the hybrid LCA method was more accurate, reducing up to 32% the truncation error in secondary impact estimates. It was also more flexible, offering a quicker sustainability assessment method based on project cost data, and more comprehensive, quantifying not only environmental impacts, but also social and

economic impacts. On a meso-level, this study developed a generalised LCA framework for evaluating the sustainability of a portfolio of projects which complements existing project specific sustainability assessment methods. A case study was conducted for evaluating the environmental sustainability in the remediation of chlorinated solvent sites using four technologies: pump and treat, enhanced in-situ bioremediation, permeable reactive barrier, and in-situ chemical reduction. On a macro-level, this study explored sustainability on a society level, namely sustainable behaviour. The study identified the main causes of sustainable remediation being increasing accepted. It provided a classification of sustainable behaviour based on statistical evidences. Moreover, the underlying drivers of sustainable behaviour were identified, including both internal characteristics such as organizational policy and personal belief, and external forces such as competitive pressures and stakeholder influence.