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Research article

Assessing sustainable remediation frameworks using sustainability principles

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A R T I C L E I N F O

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A B S T R A C T

The remediation industry has grown exponentially in recent decades. International organizations of practitioners and remediation experts have developed several frameworks for integrating sustainability into remediation projects; however, there has been limited attention to how sustainability is approached and operationalized in sustainable remediation frameworks and practices – or whether sustainability plays any meaningful role at all in sustainable remediation. This paper examines how sustainability is represented in remediation frameworks and the guidance provided for practical application. Seven broad sustainability principles and review criteria are proposed and applied to a sample of six international remediation frameworks. Not all review criteria were equally satisfied and none of the frameworks fully met all criteria; however, the best performing frameworks were those identified as sustainability remediation frameworks. Intra-generational equity was addressed by all frameworks. Integrating social, economic and biophysical components beyond triple-bottom-line indicators was explicitly addressed only by the sustainable remediation frameworks. No frameworks provided principle- or rule-based guidance for dealing with trade-offs in sustainability decisions.

1. Introduction

There are over 21,000 identified industrial contaminated sites in Canada (Government of Canada, 2014), an estimated 294,000 in the United States, and over 300,000 ha of known industrial contaminated land in the United Kingdom (Hou and Al-Tabbaa, 2014). The majority of attention in the life cycle of industrial development has been on predicting impacts at the pre-development stage, with relatively less attention to the effects that persist post-project operation (Morrison-Saunders and Arts, 2004; Tukker, 2000). Recently, however, as the legacy effects of industrial development become increasingly evident, there is a growing recognition of the importance of decommissioning and remediating industrial sites (Camenzuli et al., 2014; McHaina, 2001).

Remediation is the end cycle of industrial development. It may form part of a project's development plan and regulatory impact assessment process; or occur separate from impact assessment and, in some instances, be undertaking itself that is subject to impact assessment regulation. Remediation is broadly defined as reducing the contamination of a site to safe levels within the ecosystem, protecting human health, and restoring land uses and ecological and hydrological functions (Diamond et al., 1999). Historically, remediation literature and practice have focused on remediation technologies and physical environments (Favara et al., 2011; Fortuna et al., 2011; Ellis and Hadley, 2009), with considerably less attention to social factors (Bardos et al., 2011). In recent years, however, the notion of Sustainable Remediation (SR) has received increased attention both from scholars and the remediation industry. In 2006, for example, the Sustainable Remediation Forum (SURF) was created, an international non-profit forum of remediation practitioners, researchers and industries, with aim to promote the use of sustainable practices in remediation. SURF now has organizations in the USA, Canada, the UK, the Netherlands, Italy, China, New Zealand and Australia.

Sustainable remediation is variably defined, but there is general consensus about its broad purpose – to reduce impacts and maximize the long-term benefits of remediation projects, and ensure an overall net benefit among social, economic, and biophysical conditions (Cundy et al., 2013). Sustainable remediation is described as a holistic approach to remediation, aimed at balancing the impacts and influences of the triple bottom line of sustainability, while protecting human health and the environment

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(Holland et al., 2011). The potential benefits emerging from SR practice include more effective risk management; compliance with government and corporate sustainable development goals; and the identification of more sustainable actions (CL:AIRE, 2014). That said, there is no universal set of principles for incorporating sustainability in remediation (Hou and Al-Tabbaa, 2014; Fortuna et al., 2011). An ISO standard for the SR industry is currently being developed, but supporting approaches and methodologies remain diverse (Bardos et al., 2016). The lack of standard sustainability principles for remediation may pose barriers to realizing sustainability outcomes (Ellis and Hadley, 2009), if not generate skepticism that the sustainability label is being used simply to add importance to traditional remediation efforts (Darnall and Aragón-Correa, 2014). Part of the challenge is that notwithstanding the growth in scholarly literature on sustainability, translating sustainability to operational practice has been a persistent challenge. White and Noble (2013) report that assessment and evaluation frameworks often adopt the sustainability label, but provide little by way of substance in terms of how to operationalize sustainability in practice.

As the SR industry continues to grow, there is a need to critically examine and understand the adoption, integration, and use of sustainability in SR frameworks if such frameworks and practices are to help realize more sustainable outcomes. This paper introduces and applies a set of sustainability principles, appropriate to the remediation context, to examine how sustainability is represented in SR frameworks. We do so based on a review of six remediation frameworks from Canada, the UK and the US. Our overall objectives in applying the sustainability principles are to understand how remediation frameworks approach sustainability, including the guidance for practice, and to offer recommendations for research and development to improve the role of sustainability in remediation.

2. Sustainability principles

There is no universal definition of sustainability (Dimitrov, 2010), and there is no single-best process or criteria for assessing the effectiveness of sustainability integration (Bond and Morrison-Saunders, 2011; Hacking and Guthrie, 2008; Pope et al., 2004). Sustainability, and the extent to which particular tools or processes promote or achieve sustainability, including remediation, needs to be contextualized to the circumstances in which it is being used and the decisions being made (Bardos et al., 2016; Pope et al., 2015; Holland et al., 2011). In the remediation industry, this context is typically local, or site specific, and focused on a single remediation project concerning the identification and evaluation of alternative remedial solutions.

Sustainable remediation is often described as a remedy or combination of remedies whose net benefit is maximized through the judicious use of limited resources (CL:AIRE, 2014; Bardos, 2014; Ellis and Hadley, 2009). The implementation of SR is a process (vs. goal) based undertaking, focused on evaluating the components of a remediation project such that the best balance can be achieved to help realize the most sustainable remedial strategy (Holland et al., 2011). In this context, sustainability is often approached pragmatically by measuring social, economic and biophysical indicators and then attempting to integrate this knowledge to identify the more 'sustainable' remedial option – a triple bottom line (TBL) approach. Pope et al. (2015) explain that this is the discourse that often underpins government and industry-based policies, practices and tools.

Other conceptualizations of sustainability, in the context of remediation, focus on net positive gain. The Horinko Group (2014), for example, explain that SR is a move or a transition in the remediation industry to include net environmental and social benefits as criteria for remediation projects and site management. In this context, SR extends beyond a process-based framework (Holland et al., 2011) and TBL considerations in risk control (Bardos et al., 2011), and considers the overall net benefits of site remediation (Hou and Al-Tabbaa, 2014). This implies an approach to sustainability that is rooted in the "discourse of transition to a more sustainable future" (Pope et al., 2015: 32), rather than merely seeking to integrate environmental, social and economic factors in remediation actions and decisions. Our suggestion is that SR, as a site-specific tool with a specific goal (i.e., site remediation for reuse), necessarily implies a pragmatic approach – identifying TBL indicators and assessing the relative sustainability of remedial options. At the same time, if SR is indeed different than traditional remediation and represents a shift or transition in practice to help achieve overall net positive gains, then it must also reflect broader sustainability principles and the discourse of transition (Bardos et al., 2011; Beames et al., 2014; Fortuna et al., 2011).

There has been a considerable amount of scholarly literature focused on sustainability discourse and conceptualizing sustainability (Dryzek, 2013; McGregor, 2004; Owens and Cowell, 2002), particularly within the fields of sustainability assessment (Pope et al., 2015; Bond et al., 2013; Gibson et al., 2005) and sustainable remediation (Bardos et al., 2016; Hou and Al-Tabbaa, 2014 Moreno Pires and Fidélis, 2014), as well as the development of sustainability principles (Rinne et al., 2013; Pintér et al., 2012; Gibson et al., 2005). Numerous initiatives, including the IUCN's World Conservation Strategy and the IISD's Bellagio Principles, have illustrated how principles can assist more sustainable frameworks and action-taking. Flint (2013) explains that although sustainability principles are often diverse and sometimes political and context-specific, they typically address a number of common, underlying issues such ecological integrity, social equity, triple bottom line, immediate and long-term sufficiency, and democratic processes (Flint, 2013).

Below we present several foundational sustainability principles, as synthesized by Gibson et al. (2005), which capture the core principles often adopted by agencies (e.g. IGC et al., 2004; Government of Western Australia, 2003) and scholars to examine how sustainability is integrated and represented in development projects, assessment guidance, and strategic level frameworks and initiatives (Lamorgese and Geneletti, 2013; Morrison-Saunders and Hodgson, 2009; Hacking, 2005; Hodge, 2004). In presenting these principles, we approach SR as both a process-driven tool for TBL, and as a means to facilitate transition within the context of contaminated sites to achieve overall net benefits. We do not claim that these principles are the only principles against which SR frameworks can or should be reviewed, or necessarily the best. We do suggest, however, that these principles are broadly applicable to any process that directs decision making toward sustainability (see Morrison-Saunders and Hodgson, 2009; Hacking and Guthrie, 2008; Gibson, 2002).

2.1. Inclusive of social, economic and biophysical factors

At a most basic level, and a flagship of SR frameworks, the SR literature promotes the integration of social, economic and biophysical factors into the remediation process (The Horinko Group, 2014; Butler et al., 2011; Holland et al., 2011). This pragmatic integration of development and environmental goals most often occurs by way of TBL indicators or metrics – breaking down sustainability into its component parts (Pope et al., 2015), against which the impacts of SR options are then assessed. The TBL approach is the typical discourse underpinning most government- or industry-led policies and practices (Pope et al., 2004, 2015; Hou et al., 2014), and is a common direction for SR frameworks and