

Rethinking remediation: Mine reclamation, environmental justice, and relations of care

Caitlynn Beckett (Memorial University)

Dr. Arn Keeling (Memorial University)

Abstract:

To date, research on mine remediation in North America has focused primarily on technical management; relatively less is known about the historical, political and social dimensions of remediation. Remediation, as a continuation of the mining process, alters local landscapes and economies and can be both dangerous and beneficial for surrounding communities. Because remediation projects tend to focus on the technical aspects of clean-up, such projects risk overlooking the environmental injustices associated with past development and obscuring blame or responsibility from industry and government for environmental degradation. Insofar as it is understood as cleaning up or repairing environmental damage, remediation is generally seen as ‘doing the good’ and is less amenable to political or ethical challenges based on community concerns or values. This paper argues that greater attention needs to be paid to public participation and justice concerns associated with cleaning up mine sites. Drawing from the literatures on ecological restoration, environmental justice, reconciliation, discard studies, and perpetual care, we highlight critical, yet overlooked issues in the remediation of post-mining landscapes. We argue that remediation projects present a unique opportunity for the negotiation and articulation of morals, values, histories, and physical experiences associated with mine sites and we seek to re-frame remediation as an ongoing, creative process of community healing.

Key Words: Mine remediation, restoration, environmental justice, reconciliation, matters of care

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Industrial scale mineral extraction engenders some of humanity’s most dramatic and enduring landscape transformations. Open-pit or strip mining methods completely remove topsoil as “overburden,” often leaving behind landscapes hostile to recolonizing vegetation. Similarly, the disposal at the surface of non-ore-bearing material (“waste rock”) or of the by-products of mineral extraction (tailings) provides dramatic, visible, and long-lasting evidence of mining’s environmental transformations. These are not simply rock piles; they may present chemical and physical environmental hazards, from the erosion or failure of tailings impoundments, to the slow leaching of heavy metals into local waterways, to acute environmental toxicity from acid rock

drainage (Hudson-Edwards *et al.*, 2011). Mining's modification of the surface and subsurface environments may persist for centuries, or even indefinitely, after the supposed 'end' of mining.

In recent decades, efforts to clean-up, restore or remediate mine impacts have gained momentum under the influence of growing environmental concern and regulation, and corporate embrace of more 'sustainable' mining practices (Hilson, 2000, Hilson and Murck, 2000, Whitmore, 2005). Technical strategies for mine remediation such as acid rock drainage management, the construction of tailings covers, revegetation, soil decontamination, and water treatment are the focus of extensive research efforts, including frequent expert conferences (Lottermoser, 2010; Pepper *et al.*, 2014; Hockley and Hockley, 2015). At the same time, many government regulators have begun developing mine closure guidelines (Worrall *et al.*, 2009; Dance, 2015; Bainton and Holcombe, 2018).

While there has been increasing attention to the technical, environmental, and engineering challenges of remediation, there has been less attention given to public participation and community values associated with cleaning up mine sites (Banfield and Jardine, 2013). This gap arises from a variety of factors. First, in spite of a growing literature on the socio-economic dimensions of closure as part of the 'mining cycle' (Laurence, 2006; Halvaksz, 2008; Pini *et al.*, 2010; Browne *et al.*, 2011; McDonald *et al.*, 2012; Keeling and Sandlos, 2015; Rixen and Blangy, 2016; Kivinen, 2017; Bainton and Holcombe 2018), remediation is often overlooked in public and scholarly debates over cumulative environmental impacts, social license, and community engagement (Smith, 2014; Langhorst and Bolton, 2017). Second, mine remediation is dominated by engineering and environmental expertise around geochemistry, hydrology, and risk management, and debated in highly technical forums like environmental assessment hearings. Even when technical descriptions of remediation are presented to the public, these options are outlined only after experts have already defined the problem and the possible solutions (Ottinger,

2013; Bergmans *et. al*, 2015). In this sense, remediation is “rendered technical” (Li, 2007) and tends to limit or circumscribe public participation or non-expert assertions surrounding risk and remediation goals (Krupar, 2013; Tsosie 2015; Sandlos and Keeling 2016). Finally, insofar as it is understood as cleaning up or repairing environmental damage from mining, remediation is seen as improving the environment and “doing the good,” and is therefore less amenable to political or ethical critique.

Yet the generally positive association of remediation with “cleaning up” post-mining sites ignores the fact that simply containing and managing a toxic site is usually insufficient to deal with the broader histories, impacts, and liabilities connected to contaminated sites, and the challenges of perpetual care for these landscapes (Kempton *et. al.*, 2010; Storm, 2014; Langhorst and Bolton, 2017). Around the world, large-scale mining has often left a legacy of environmental damage and social displacement for Indigenous communities and lands (Roche and Judd, 2016; Horowitz *et al.*, 2018). Referring to such sites as “zombie mines,” Keeling and Sandlos (2017) argue mine remediation and redevelopment may reawaken historical wounds associated with negative social, economic, or environmental legacies of past developments. Because mine remediation projects tend to focus on the technical, scientific or risk management aspects of clean-up, such projects risk perpetuating or re-inscribing these environmental injustices and obscuring industry and government blame or responsibility for environmental degradation (Dillon, 2014).

To address these concerns, this paper argues for an expanded definition of mine remediation that encompasses concepts of social justice, repair, mediation, reconciliation, and care. Drawing from literatures on ecological restoration, discard studies, environmental justice, repair, and ‘matters of care,’ this review highlights critical, yet overlooked issues in the remediation of post-mining landscapes, particularly as it affects local communities. Recent

ecological restoration theory emphasizes the importance of morals, ethics and values in the re-creation of damaged landscapes. Discard studies and environmental justice research provide a conceptual framework for identifying spatial and temporal injustices associated with mineral extraction, and its implication in processes of displacement and dispossession. Engaging theories of repair and ‘matters of care’ push remediation beyond the *act* of cleaning up toxic and degraded landscapes, towards a focus on the *ongoing processes* of trust building, reconciliation, and perpetual care for humans, animals and environments alike. By embracing these concepts, we argue, remediation projects present an opportunity for the negotiation and articulation of the layered histories, presents and futures associated with contaminated mine sites. By engaging local and Indigenous communities on these questions, remediation projects may also facilitate discussion about relationships to land, perpetual care and future land uses.

Remediation and Restoration: Definitions and Contexts

Although terminology varies between different jurisdictions and contexts, increasing attention has been devoted to mine closure and remediation in response to rising concerns in the late twentieth century over mining’s environmental impacts (Smith, 1987; Hockley and Hockley, 2015). In North America (where the authors are based), post-closure environmental clean-up activities are typically referred to as *remediation*, although other terms such as *rehabilitation* and *reclamation* are often used interchangeably, with some temporal and regional variation.¹

According to Lima *et al.* (2016, p. 227) *reclamation* “aims to recover key ecosystem services and biogeochemical functions,” while *rehabilitation* “implies a repurposing of the landscape”.

¹ For example, in Northern Canada, the terms remediation and reclamation are used most often; however these terms have changed throughout time, and other terms such as rehabilitation are more popular elsewhere in North America. American management plans often use reclamation, rehabilitation or restoration. See: Hockley and Hockley, 2015; Dance, 2015; Steenhof, 2015.

Reclamation or rehabilitation thus imply the return (or creation) of some kind of value or utility to the landscape, alongside concerns of remediating or mitigating contamination. Joly (2017, p. 166) argues that traditional remediation and reclamation approaches often “prioritize a single or narrow set of values, reducing both the spatial-material-temporal complexities and ‘thickness’ of post-mining landscapes and the diversity of past and contemporary values projected onto them.” In the majority of cases, remediation projects focus on removing contaminants or stabilizing them on site, and reclaiming (where possible) some elements of pre-mining ecologies, with little recognition of the ‘thickness’ of these landscapes as spaces of social interaction with contested histories and meanings.

To restore means to bring about a former state or to return to health, and the term restoration is often used in regard to the restoration of art, historical buildings, and ruins (Hall, 2005; Howe *et al.*, 2016; Rohwer and Marris, 2016). Ecological restorationists work to bring back idealized versions of nature, and therefore are “automatically testing assumptions about past landscapes and the human role in the past” (Hall, 2005, p. 3). When used in the context of mining, *restoration* typically refers to an attempt to “reinststate the original functions of the soil in full measure,” with the goal of restoring ecological health or integrity (Bradshaw, 1997, 256; Cooke and Johnson, 2002; Peachmann, 2009; Kivinen, 2017). Initially, in the late 20th century, government clean-up programs in North America focused on efforts to restore land to an optimum state by using supposed ‘past conditions’ as a reference point (Brooks, 2015; Langhorst and Bolton, 2017). Such approaches were largely based on Western scientific approaches to land use planning and focused on identifying and containing point sources of pollution while ‘replacing’ the former landscape (Hobbs, 2013). In reality, the majority of mine reclamation sites fall short of true restoration: the extensive transformations wrought by extractive activities (including overburden removal, excavation of shafts and pits, waste dumping, and contamination)

mean it is nearly impossible to actually restore a site to full ecological integrity. Nevertheless, recent debates in the literature on ecological restoration provide important insights into the politics and social dimensions of landscape repair.

In the 1990s, debates over ecological restoration emerged critical of the idea that landscapes could actually be returned to some former “pristine” state or function (Hobbs and Norton, 1996). Increasingly, scholars characterized restoration as a value-laden and anthropocentric practice, preoccupied with the ‘improvement’ of ecosystems simply for the use or aesthetic value of humans (Katz, 1997; Elliot, 1997). However, these authors weren’t necessarily arguing *against* cleaning up contamination. Katz instead recognizes that restoration is fundamentally a process of human valuation:

We are not restoring nature: we are not making it whole and healthy again. Nature restoration is a compromise... We are putting a piece of furniture over the stain in the carpet, for it provides a better appearance... it would be much more significant to prevent the causes of the stains (Katz, 1997, p. 102).

Other observers, acknowledging this critique, suggested that, even if 'restored nature' is understood as a culturally produced artefact, the restoration of (positive) human relationships with nature remains possible (Smith, 2014). For instance, Rohwer and Marris propose a redefinition of restoration to indicate a “restoration of moral value rather than a restoration of a historical state” (2016, p. 677). They emphasize that when talking about restoration, we need to get “comfortable talking about choices, intentions, values and justifications in a world where historical fidelity no longer reigns supreme” (Rohwer and Marris, 2016, p. 678). While memorializing the past, Smith suggests, restoration has the potential to foster a new ‘sense of place,’ and can restore “faith and confidence in an area” (Smith, 2014, p. 300). Whether conceived in terms of ‘moral restoration’ (Hobbs, 2013) or ‘ecological redemption’ (Smith 2014), restoration is increasingly understood in terms of how communities can create or recover

economic, cultural and social value through the processes of healing environmental (and, perhaps, its associated social and cultural) damage (Hourdequin and Havlick, 2015).

Mine remediation practices reveal similarly contested cultural values and assumptions about degradation and nature. For example, Robertson outlines several cases of mines in the United States where locals have fought to preserve some of the industrial features that defined the mining landscape, such as tailings piles, while still protecting community and environmental health (Robertson, 2006). In this sense, the landscape degradation and change caused by mining became a part of local identities (Francaviglia 1991; Goin and Raymond, 2004). However, it is also important to question whose cultural values and land uses are prioritized, as mining developments and remediation have repeatedly overlooked and undermined treaty agreements and Indigenous sovereignty across North America (LaDuke, 2005; McGregor, 2018). Different community members can have different understandings of the same place caused by a variety of experiences, such as discrimination, racism, sexism, and economic and political marginalization (Volyes, 2015; Leech, 2018). Beyond different ‘senses’ of one place, some groups may have entirely different ontological frameworks that structure environmental relationships (Bawaka Country *et. al.*, 2016).

These debates around restoration and landscape values illustrate that part of rethinking remediation entails addressing the need to repair social relationships as well as environmental conditions, as relationships developed through mining have often been exploitative for local people, especially Indigenous communities. In a broader, less technical sense, *remediation* is related to *remedy*: a “medicine or treatment that relieves pain,” or “a way of solving or correcting a problem” (Merriam-Webster Dictionary, 2016). The root word ‘mediate’ also points to interesting ways to rethink remediation. *Mediating* can be seen as the (re)forming of relationships. *Re-mediation* therefore, could potentially be seen as the re-ordering or repairing of

relationships (France, 2008). Additionally, framed as a form of mediation, remediation can be used as a process to address harmful relationships between humans, non-humans and land.

Academic and technical discussions regarding mine remediation and reclamation rarely acknowledge these recent debates surrounding ecological restoration and cultural values. In remediation projects, the politics of who defines the past, and how this past is negotiated, articulated and memorialized is typically overlooked (Baeten, 2017). Remediation projects rely on narratives of toxicity and containment, often forgoing discussions on heritage, remembering, and healing. By contrast, ecological restoration literature has increasingly critiqued the ideals of recreating some past ‘wilderness,’ and has illuminated power struggles implicit in what is ‘covered up’ and what is remembered. Identifying the goals of mine remediation, we argue, should similarly entail an articulation and justification of values: questions of morality, redemption, the restoration of cultural, social, and economic value, and recognition of conflicting experiences and ontologies of place, are all essential parts of the healing process. In the following sections, we draw out these implications by mobilizing insights from the literatures on critical discard studies, environmental justice, repair and ‘matters of care,’ and outline how they contribute to a framework for rethinking remediation.

Landscapes of Waste and Toxicity

Post-mining landscapes are fundamentally defined by wastes: soils and vegetation removed as ‘overburden,’ waste rock piles accumulated from mining, tailings from mineral processing, ‘wasted’ landscapes of open pits, derelict mine works, and even abandoned communities and infrastructures. Social scientific scholarship on waste and ‘critical discard studies’ (Liboiron, 2014) highlights the importance of what Dillon (2014) calls “waste formations,” revealing how wastes are systematically produced, managed and re-valued. How we

define and manage waste, pollution, and environmental degradation reflects the social relations and structures within which such harms are produced and distributed (Gabrys, 2009; Liboiron *et al.*, 2018). Discard studies also prompts analysis of how the waste was created and managed in the past, how this material will act in the future, and the cultural, environmental, and economic valuations of this waste (Reno, 2015). Often in the case of mine remediation, contaminants are either contained and a community must live with the waste far into the future, or the contaminants are moved elsewhere and become someone else's problem, exacerbating issues of discrimination and environmental injustice (Lerner, 2010). Inherent in such questions are the challenges of managing the material characteristics, temporalities, and geographies of waste.

Remediation objectives are intimately tied to the perceptions and values of 'wasted' land: is mined land considered a toxic wasteland, an unused barren landscape, a historically treasured site, a 'home' for survival and (re)production, or a degraded sacred space (Kuletz 1998; Krupar 2011; Voyles, 2015)? As mentioned, mine wastes can be considered industrial ruins, associated with contested versions of history (Robertson 2006; Mah, 2012; Cater and Keeling 2013). Sebastien Ureta suggests that mining ruins also encompass contaminants themselves and can be seen as "chemical rubble... for which we have to take responsibility just as much as we have for more conventional ruins" (2012, p.3). Identifying differing perceptions and experiences of waste amongst different actors and outlining shared objectives can help to define how a community values the mine site, which in turn helps to define and direct the parameters of remediation alongside scientific assessments (Quivik 2001; Leech, 2011).

Waste is often perceived as the opposite of economic value; indeed, "waste is a category formed always in relation to value" (Dillon, 2014, p. 1207). Some mine wastes may become 're-commodified' and transformed from waste into an economically valuable commodity (Hudson-Edwards *et al.*, 2011). Other wastes, such as overburden and waste rock, are not considered

'toxic' and are used in building dams, roads and other infrastructure (Lottermoser, 2010). Mining infrastructure such as mine headframes can be considered waste to be removed, or preserved and revalorized as historical monuments (Baeten 2017). Most recently, as high-grade ore bodies become increasingly rare and with changes in technology, what was once considered waste may again be mined. In these ways, "mining by-products and landscapes may shift between the categories of 'waste' and 'value'" (Keeling, 2012, p. 553), depending on economic, environmental and cultural considerations.

Addressing mining's waste landscapes brings into focus the spatial challenges entailed in pollution and remediation. Mine wastes leak and permeate barriers, transforming into different entities in the process (for instance, acid rock drainage from tailings piles [Baeten *et. al.*, 2016]). In addition, remediation might not entirely clean up a site and often does not extend beyond certain arbitrary boundaries such as mining leases or territorial boundaries, disregarding the ability of waste to flow and change (Gregson and Crang, 2010; Reno, 2015). Similar to early ecological restoration practices, remediation often focuses on fixing or containing point sources of pollution, but may not account for long-term effects 'downstream,' or outside the physical limits of the mine site. For example, sediments in rivers are a source of long-term contamination that is difficult to track, map, quantify and remediate (Bird, 2016). Such examples emphasize the spatial challenges of waste containment and stabilization, which requires continual monitoring, and re-evaluation as waste moves and changes.

The extended temporalities of mine waste can also further complicate remediation projects. The legacies of mines, in the form of degraded ecologies or persistent toxicity, can continue to haunt the surrounding environment and nearby communities for generations (Keeling and Sandlos, 2017). Over time, mining landscapes may shift from landscapes of ruination to landscapes of regeneration and reuse, to demolition and ruination once again. As Nixon argues,

pollution can be understood as a form of “slow violence,” as its cumulative effects influence communities for generations to come (2011). Rather than a sudden, disruptive event, toxic waste manifests as a “slow disaster,” resulting in “chronic dread” and a sense of helplessness among those exposed (Erikson 1994). Gray-Cosgrove *et al.*, argue that remediation itself is implicated in the slow disaster of mine contamination, “when efforts to remediate and depollute in the face of extremely long-lived pollutants are a type of disaster in and of themselves” (2015, p. 3). Without a community discussion on these questions, the potential for waste to become a slow disaster increases. In such cases, remediation becomes a reactionary (and incomplete) response to slow disasters rather than a long-term solution.

Despite the complex temporalities of degradation, contamination, and recovery within these wasted landscapes, mine remediation increasingly focuses on creating a site that requires minimal long-term monitoring and management of waste, the ideal being a ‘walk-away’ solution. However, this is rarely the case, and more discussion about perpetual care plans for permanently degraded sites is necessary (O’Reilly, 2015). Research on long-term radioactive waste management has begun to hypothesize possible ways to use physical barriers and passive institutional controls such as text and symbols to ensure that people in the future know how to avoid disturbing that site (Benford 1999). Increasingly, researchers, companies and governments working with nuclear waste are looking at the importance of involving citizens in planning processes (Ialenti 2014; Bergmans *et. al.*, 2015; Cram, 2015). However, beyond discussions on the containment of nuclear waste, mine remediation practices more broadly have largely failed to deal adequately with the prospects of perpetual care of mine sites on large temporal and geographic scales. While there are important differences between remediating mine sites and managing nuclear waste repositories, there are lessons to be learned from research on nuclear waste management, as many mine wastes (including sites like Montana’s Berkeley Pit or

Canada's Giant Mine) pose similarly long-term management challenges (Kuyek, 2011; Leech, 2018).

Justice and Remediation

A discard studies perspective emphasizes that mine waste and ruins must be understood as a fundamental part of the system that produces them. Thus, alongside the material, geographic and temporal characteristics of mine waste, understanding the colonial, racial, and gendered relations within which waste is generated, contained, and managed carries important implications for best practices of remediation. The potential for continuous pollution or contamination produces uneven geographies of exposure and toxicity (Gray-Cosgrave *et al.* 2015; Liboiron *et al.*, 2018). Placing remediation within an environmental justice (EJ) framework helps to address the multi-layered human and non-human relationships connected to degraded industrial environments. An EJ approach situates environmental degradation within local political contexts and power structures, identifies instances of inequality and disenfranchisement, and provides a basis for calls to action. Within the EJ literature, there has been a shift away from questions of the distribution of environmental hazards, towards a broader conceptualization of EJ that stresses the need to address the contexts and processes within which environmental inequalities are actually produced (Mohai *et al.*, 2009; Holifield, 2012). However, while identifying instances of inequality and power imbalances related to environmental degradation, EJ literature often overlooks the creation, geography and temporality of mine waste itself. Therefore, combining an EJ approach with discard studies, as outlined above, aids in identifying and addressing both the political and material contexts of mine waste and the remediation of such waste.

Mobilizing concepts from environmental justice, global scholarship on mining and Indigenous peoples emphasizes the role of mining in processes of colonial dispossession and

marginalization (Gedicks, 2001; Martinez-Alier, 2001; Ali, 2003; Ballard and Banks, 2003; Keeling and Sandlos, 2009; Bebbington *et al.*, 2008; Horowitz *et al.*, 2018). For example, in her recent analysis of the effects of historic uranium mining on Diné (Navajo) health and way of life, Voyles argues that through the settler colonial process of ‘wastelanding,’ abandoned mines and industrial sites—as well as the land itself—are produced and perceived as wasted, derelict or useless. The people who live in and rely on these landscapes are also ‘wasted’ in the sense that their bodies and their cultures become a waste product of extractive industries, enabling accumulation through dispossession and degradation (Hall 2012; Voyles, 2015; Women’s Earth Alliance, 2016; Simpson, 2017).

Acknowledgement of these historic and ongoing colonial relations is typically absent from environmental remediation policy and planning. Indeed, remediation’s focus on technical fixes potentially allows responsible parties to cleanse themselves of social responsibility and overlook past injustices. Dillon argues that narrow, technical approaches to remediation, reclamation and restoration allow governments and industry to “defer responsibility for the social effects of industry,” instead presenting remediation as an environmental benefit or improvement (2014, p. 1218). Yet technocratic approaches to re-greening and clean-up also mobilize and reinforce certain kinds of power through expert knowledge, monitoring, and control of the site (Krupar, 2013; Ottinger, 2013). Such technical and legalistic efforts to define and remediate landscapes of exposure may remain entangled within colonial jurisdictional “mitigation politics” (Hoover 2017) that limit liability and circumscribe community concerns and experiences of environmental displacement (Leddy 2013; Wiebe 2017; Joly, 2017). In this sense, remediation may perpetuate, rather than repair the social and environmental injustices associated with the original development.

Recognizing the colonial context of both mine degradation and remediation, Indigenous (Yaqui) legal scholar Rebecca Tsosie develops a comprehensive “ethics of remediation” rooted in both Indigenous and Western legal orders. In her analysis of Indigenous claims for restitution relating to the history and legacies of uranium mining in Diné (Navajo) Country, Tsosie argues that, beyond the mitigation of contamination and restoration (as far as possible) of pre-mining ecological conditions, remediation should encompass the objectives “to repair social or political connections, restore trust, and instill a sense of peace” (2015, p. 250). For Tsosie, the current practice of remediation by U.S. government authorities remains rooted in the persistent inequality and injustices that resulted in the dispossession of Diné people and the degradation of their territories through mining in the first place. These effects are perpetuated in the present through the “epistemic injustice” of science-based policy approaches that “omit the testimony of Indigenous community members as ‘experts’ in favour of scientific and economic accounts of harm” (Tsosie, 2015, p.271).

Tsosie proposes an ethics of remediation that requires holistic attention to inequities in environmental, health, and socioeconomic conditions (past and present); acknowledges Indigenous sovereignty and self-determination as intrinsic to repairing relationships between people and land; incorporates Indigenous land values and knowledges; and attends to reparative justice for past harms, including various strategies of compensation, restitution (of land) and apologies or memorialization. In a similar vein, Tamar Cohen notes that in an Australian context, “For Aboriginal peoples affected by mining... rehabilitation represents a vision of the future—a future premised on greater control over their land” (Cohen, 2017, p. 137). In this sense, while technical remediation processes risk depoliticizing mining and its impacts through processes of environmental mitigation and improvement, an Indigenous ethics of remediation re-centres questions of justice and self-determination.

Ultimately, if remediation is to contribute to environmental justice, it must be seen as a process of rebuilding or reconciling relationships *and* decolonizing land (Tuck and Yang, 2012). Following Tsosie, we argue that remediation processes can and should be used as a process for addressing colonial and environmental injustices and for decolonizing and healing land. In the context of settler colonial nations (including those with extensive mining histories like Canada, South Africa, the United States, and Australia), reconciliation with Indigenous peoples entails the confrontation of colonial histories (and their ongoing legacies) through processes of truth-telling, apology, and compensation or redress (Regan 2010; Truth and Reconciliation Commission of Canada, 2017). Indigenous scholarship critical of reconciliation emphasizes the decolonization of land in the redress of colonial relations (Tuck and Yang 2012; Coulthard 2014; Todd 2014; Simpson, 2017; McGregor, 2018). Thus, remediation discussions must include a restoration of Indigenous sovereignty in order for justice to be fully realized. While there are complex social, historical, and legal contexts to reconciliation and decolonization in different countries, remediation processes can begin to contribute to environmental justice through official apologies, recognition of injustices suffered due to mining, and compensation for past and ongoing harms. Including reconciliation within the EJ and remediation dialogue can also entail practical strategies for direct socio-economic involvement in management, monitoring and long-term care of remediated sites (Carroll, 2015).

Remediation as Repair, Maintenance and Matters of Care

Pulling together these wide-ranging concepts from ecological restoration, discard studies, environmental justice, and reconciliation we hope to emphasize the importance of an ethical approach to environmental remediation rooted in place and landscape. Such a process would confront both the social and material legacies of post-mining landscapes (and the systems and

structures within which these legacies are produced). However, such a framework remains premised on the idea of achieving some ‘end point’ where remediation is complete, waste is contained, the community engaged, justice issues addressed, and some combination of economic, environmental, and cultural value has been returned or added to the mine site. Yet this presumption fails to recognize the *ongoingness* and indeterminacy of both the material effects of landscape degradation and the social relations constituted through environmental damage and remediation (Langhorst and Bolton, 2017). As noted above, many, if not most mine sites will remain incompletely restored or require long-term, even perpetual care and maintenance long after the active remediation phase. Maintaining a remediated site while ensuring Indigenous self-determination and environmental justice is not a straightforward process; further degradation of land and relationships is always a possibility. Acknowledging the challenges of ongoing care and maintenance requires attention to the social relations of repair and care.

The terms ‘repair’ and ‘care and maintenance’ are often used in the context of mine reclamation (Kempton *et al.*, 2010; Kuyek, 2011); however their wider implications for remediation practices are rarely questioned. Though its etymology suggests notions of temporal return, acts of repair are akin to restoration – there may be an objective, an end goal, or an agreed upon (or contested) optimum state, but the thing being repaired or restored will never be exactly as it was. Repair is also related to the word *reparation*, echoing the issues of reconciliation and compensation noted above. Similar to debates around environmental restoration, recent literature on repair and maintenance highlights the social formations, politics, and power relations surrounding repair practices. This approach frames repair practices as intrinsically ethical activities that raise broad questions about “how we live with socio-technical systems,” (Houston and Jackson, 2016, p. 1). Drawing attention to the social and ethical contexts of repair practices, Elizabeth Spelman argues that through repair, “from apologies and other informal attempts at

patching things up, to law courts, conflict mediation, and truth and reconciliation commissions, we try to reweave what we revealingly call the social fabric” (Spelman, 2008, p. 127-128).

Understanding repair and maintenance through this lens offers ongoing opportunities for creativity and adaptation throughout (and beyond) mine remediation processes.

Like remediation and restoration, repair and maintenance are not always inherently good (Barnes, 2016; Jackson, 2014). As Ureta (2014) points out (echoing critiques of restoration ecology), repair can also be seen as a normalization process that may be implicated in the maintenance of relations of power and order. As such, “maintenance and repair are moments of learning and of politics, as values and orders are being negotiated and re-made in and through restoration and reproduction” (Houston and Jackson, 2016, p. 3). In many cases, repair practices may reinforce the power of ‘expert knowledge’ (Henke, 2000; Barnes, 2016). A critical approach to repair practices in mining seeks to challenge this “normalization” by recognizing how environmental damage and pollution is normalized in extractive industries, while promoting repair as a site of ethical, creative, and accountable engagement.

To address the complex layers of histories, technologies, and politics at remediation sites requires going *beyond repair*, to a consideration of remediation as a ‘matter of care’ (Ureta, 2014; Puig de Bellacasa, 2017). In the context of remediation processes, terms such as caretaker or perpetual care invoke ideas of concern, responsibility, and even love for the environment and the social relations that sustain healthy ecosystems. In this sense, acts of repair and care can be mobilized to “serve as a gathering purpose: to hold together a thing” (Puig de la Bellacasa, 2011, p. 90). Care is a process of continually negotiating relations. Framing waste management as an act of care reflects everyday practices and the expectation of failure; “it proposes temporary and experimental ways to involve all the concerned parties in the search for alternative ways to *live with* our waste, in material, ethical and political terms” (emphasis added, Ureta, 2016, p. 1).

In his study of a Chilean copper mine, Ureta (2016) outlines three important aspects of caring for and living with waste: care as *tinkering*, care as a form of ‘*affective entanglement*’ and care as *a particular kind of power*. Always experimental and tentative, care as tinkering shines light on the importance of the day-to-day maintenance of the infrastructure and relations through which waste is produced, managed, stored and maintained long-term (Mol *et al.*, 2010). This not only applies to material fixes, but also to what Henke calls “social repair,” (2000) or the tinkering with relationships that are shaped by waste. Care as an ‘affective entanglement’ acknowledges an “ethical command of taking into account all the entities involved in industrial solid waste, even the ones we dislike or are opposed to” (Ureta, 2016, p. 5; Puig de la Bellacasa, 2011, 2017; Hird, 2013). The management of waste must consider all participants, from disempowered communities, to more-than-human beings, to the material waste itself. Acts of care can also manifest as particular kinds of power, cherishing some things while excluding others (Martin *et al.*, 2015; Ureta, 2016). Care may be framed as apolitical when governments or industries assert ‘care for’ communities and landscapes, but communities lose the political ability to care for themselves (Martin *et al.*, 2015; Murphy, 2015).

Framing mine remediation and landscape repair as ongoing *processes of care* signifies a way to embrace both the uncertainty and responsibility of living with the legacies of mining, rather than perpetuating the illusion of our abilities to contain such waste forever. An ethics of repair and care can be usefully brought into conversation with the Indigenous ethics of remediation and justice noted above—as well as Indigenous conceptions of relation and reciprocity (LaDuke, 2005; Tsosie, 2015; Hoover, 2017; Simpson, 2017; McGregor, 2018). Both mining and remediation processes have restricted the abilities of Indigenous communities to care for their land, and for land to care for them. Following Bawaka Country *et. al.*, framing remediation as a restoration of *relations of care* acknowledges that remediation processes must

"not only Care for Country, but Care *as* Country" in an ongoing process of "co-becoming" with Land (2013, p. 195-196; see also Rose, 2007). An 'ethics of remediation' rooted in reciprocity and care for relations (animals, plants, humans, minerals, water, and waste) would re-establish Indigenous communities' ability to care *as* land within their own practices of healing (Watts, 2013).

Conclusions: Rethinking Remediation

When mines 'die' they do not simply disappear; they cannot be buried and forgotten about. Remediation or reclamation is an extension of the mining process; it alters the landscape, society, and economy, and can be both dangerous and beneficial for surrounding communities. A wide range of definitions and valuation processes are involved in remediation planning; there are many stakeholders with a variety of perspectives, realities, and practices. Remediation may engage multiple levels of government, consulting companies, mining and construction companies, Indigenous groups, local communities, heritage groups, and environmental organizations. Post-mining landscapes are shaped not only by the complex history of the mine, but also by the many different groups articulating their values, how these values are ranked hierarchically, and how waste transforms and moves over time and space. Yet with few exceptions, mine remediation planning processes remain largely industry and state-driven, governed by techno-scientific evaluations of risk and ecological conditions.

Pulling together such wide-ranging concepts as ecological restoration, discard studies, environmental justice, repair and maintenance and care, this paper provides theoretical openings for a more holistic, ethical approach to remediation planning. As this review has argued, rethinking remediation entails its redefinition to include not only technical environmental questions, but also the contested political, social, and cultural relations generated by extraction

and its legacies. Doing so requires critical attention to the material flows, connections, and effects generated by mining, as well as their complex temporalities. Mineral extraction and its wastes produce environmental injustices (harms) that are implicated in (settler) colonial dispossession and other processes of social marginalization that must be addressed in equitable perpetual care and remediation processes. Alongside Langhorst and Bolton, we envision remediation as a “platform for debate in order to avoid erasure of contested and conflicted histories” (2017, p. 167) and a mechanism to confront the material challenges of perpetually contaminated landscapes. Incorporating practices of social repair and care into remediation activities draws critical attention to the ongoing process of healing damaged landscapes and relations, and can “help us locate immediate forms of technical work within wider moral and political orderings” (Houston, and Jackson, 2016, p. 9). In addressing environmental justice, we suggest remediation activities may create opportunities for marginalized communities to confront past injustices, to remedy negative legacies of mining, and to determine future relationships with post-mining landscapes.

New metaphors can help guide this reconceptualization. Writing about northern Sweden, Anna Storm (2014) invokes the metaphor of the scar to consider how communities relate to degraded environments. According to Storm, the recovery of post-industrial landscapes can be conceptualized as a ‘scabbing’ process, an intermediate stage where hierarchies are negotiated, values are defined, and perceptions of waste and future land uses are addressed. Scabbing, like repair and remediation, is a creative opportunity for how the space will be remembered, valued, and cared for in the future. Storm writes that, “To heal a mental or physical wound into a scar that one can live with is to recognize key signs of difficult or ambiguous pasts and to point towards possible reconciliation” (2014, p. 3). Possibilities for care, she suggests, can emerge from the wounds and the wreckage.

Following Storm's scar and scabbing metaphors, this paper suggests that remediation can be seen as an opportunity for negotiating the contested history of a site, a call for justice, and a creative, ongoing discussion about environmental futures. Ethical remediation of landscapes extends far beyond technical questions of contaminant levels and ecological repair, or even monetary compensation for past harms: "the discussion about reparations... is a discussion of how the past, present, and future are co-joined and interdependent" (Tsosie 2015, p. 253). In the context of the remediation of mine waste, which is likely to persist into the distant future, this ethic extends to encompass duties towards future generations of humans and more-than-humans likely to occupy post-mining landscapes. Our re-evaluation of the term remediation points to an alternative conceptualization of remediation activity as an intervention in conflict and a promotion of reconciliation and relationality in search of better practices for living with and caring for damaged places and relationships.

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