COASTAL BROWNFIELDS AND ADAPTATION TO CLIMATE CHANGE: DISCUSSIONS ON POTENTIAL HAZARDS FROM CONTAMINATED GROUNDWATER DISPLACEMENT DUE TO SALTWATER INCURSION

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Abstract

Toxic-waste associated with coastal brownfield sites can pose serious risks to human and environmental health. In light of anticipated sea-level rise (SLR) due to global climate change, coastal brownfields require heightened attention. The primary intent of this study is to pose questions and encourage discussion of this problem among policy makers. Impacts from SLR on coastal zones are examined within a brownfield policy framework and, current coastal brownfield policy discussions with respect to SLR are also examined.

Introduction

Study of the impact of sea-level rise SLR due to global climate change, on coastal brownfields in the United States is new. Research in early 2009 revealed minor discussion of this issue. Now, in early 2010, research finds the issue being discussed at policy levels as a stand-alone topic or as part of a broader discussion on climate-change adaptation. The overarching theme of this paper is climate-change adaptation and coastal brownfields – focusing on the impacts of SLR and the displacement of toxic/hazardous waste. With SLR (1), some brownfield sites within the U.S. coastal zone will be at risk to saltwater inundation – possibly resulting in hazards to human and environmental health.

This paper has two goals: to introduce and pose questions about threats to human and environmental health from contaminated, coastal brownfield groundwater displaced by saltwater inundation as a consequence of climate change/SLR; and to present new developments and discussions – regarding coastal brownfields and SLR – at policy levels. To achieve these goals this paper begins (after a "Research Method" section) with background on, how brownfields (specifically, coastal brownfields) are defined, and policies.

Research Method

First, a literature review was conducted on the brownfield problem and possible impacts of SLR on contaminated/brownfield sites. And, second, an analysis of three recent, state discussions and a Canadian presentation to EPA in January, 2010.

Background

In common parlance, the term "brownfield" is used broadly to describe contaminated waste sites. In policy terms, the word brownfield specifically signifies (2), "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." Such sites are associated with former industrial and/or commercial facilities (often gas stations, factories, and dry cleaners) and usually located in commercial zones (3). A coastal brownfield is one that is situated in the coastal zone – within 200 feet of a mean, high-tide line (4). Furthermore, an "at risk" coastal brownfield would likely be located in a designated 100-year floodplain (5).

The EPA is the lead agency on all brownfield projects, which in turn are generally facilitated at the state level. Through EPA funding and oversight, some measurable success has been documented (6). Primary brownfield legislation is the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which places liability for clean up on "Potential Responsible Parties," who may be past or present owners or other stakeholders (7).

CERCLA's liability scheme has created a "catch-22" situation by requiring remediation as a condition of transfer of ownership, often leading owners to "mothball" properties. In response, Congress enacted the Small Business Liability Relief and Brownfields Revitalization Act of 2002 – an amendment to CERCLA designed to lessen the

burden on property owners and provide more funding to brownfield projects. While supporters consider it a step in the right direction, critics perceive it to favor short-term economic advantages over environmental and social-justice concerns (8). In addition, the American Recovery and Reinvestment Act of 2009, now contains environmental and social-justice guidance with regard to brownfield clean-up (9). It appears that brownfield policy has evolved to be more inclusive of a broader base of stakeholders and could possibly lead to more effective coastal brownfield remediation.

Discussion of Findings

The Intergovernmental Panel on Climate Change (IPCC) predicts average global temperatures to rise by over 4°C by 2100 – causing thermal expansion in Earth's oceans, leading to SLR and saltwater inundation (10). Impacts of seawater inundation ("permanent" or episodic") on coastal zones depend largely on geography. Permanent inundation applies to low-level areas such as estuaries or mudflats. Episodic inundation applies to storm surges and will occur with greater frequency as average air temperature increases and sea levels rise (11). As they address SLR-brownfield impacts, policy makers would do well to discuss both types of inundation with regard to effective remediation strategy.

Brownfields contain "hazardous waste" that, as defined by EPA as, "waste that is dangerous or potentially harmful to our health or the environment" and may be liquids, solids, gases, or sludge. They might contain discarded commercial products or by-products of manufacturing processes" (12). A common hazardous waste found in brownfields is Polychlorinated Biphenyl (PCB), which is known for negative health effects on humans and has been linked to cancer in laboratory test animals (13). In addition to PCBs, brownfields can contain petroleum products and/or thousands of other synthetic chemicals and chemical combinations. In a brownfield site, water most often displaces such chemicals. Moreover, because saltwater is heavier than fresh, it has a greater potential to displace contaminated groundwater plumes, pushing wastes upward to ground level. Furthermore, depending on the geological characteristics of a brownfield site, the direction of plume migration may be difficult to predict without comprehensive geophysical analysis. In their discussions, policy makers should focus heightened attention on sites at more immediate risk of saltwater incursion – sites with and without predictable plume migration.

Coastal brownfields are often located in or near areas of large human populations and in or near environmentally sensitive areas such as estuaries (14). Increased contamination from brownfields (due to SLR) in such locations poses obvious health risks to sensitive human populations (15) and ecosystems (16). While at greater risk of contamination, coastal communities with brownfields have additional remediation opportunities (17). In policy creation and implementation, how might access to such federal funding/tools be used to encourage communities to engage in more immediate remediation?

Current Policy-Level Discussions

During initial research in early 2009.the keywords "coastal brownfields, sea level rise, climate change, saltwater intrusion" were entered into an Internet search, nothing substantive was found at any policy level (18). In January 2010, a similar search found several references at state policy and national (Canada) levels.

In August 2009, the California Climate Change Center published, "The Impacts of Sea-Level Rise on the California Coast" (20). This 115-page document includes a page on the impacts of SLR on hazardous materials and brownfield sites in CA. The paper presents a matrix revealing a 250% increase in the number of facilities-at-risk situated within a 100-year flood plain with a 1.4m rise in sea level by 2100 (21). This paper also introduces the possibility of "flood-related facility malfunctions" in conjunction with contaminated groundwater flooding. The CA paper presents a useful quantitative application providing a model for forecasting SLR on other coastal brownfield sites.

The State of Rhode Island Coastal Resources Management Council drafted the "Natural Hazards: Hurricanes, Floods, and Sea Level Rise in the Metro Bay, Region Special Area Management Plan" in July 2009. This draft contains a section addressing the need for a study of previously capped brownfield sites that may be at risk to increased storm severity. This document specifically incorporates permitting and development language when referencing brownfield sites, and possible impacts from storm surges on capped contaminated sediment. Permitting language is important to brownfield discussion because remediation tools (financial) are available for remediation and revitalization projects.

In May 2009, the State of Delaware hosted a one-day workshop to develop a climate-change-adaptation plan titled, "Preparing for Sea Level Rise: Development of an Adaptation Strategy for the State of Delaware." The goal of the workshop was to identify and prioritize climate-change issues, specifically adaptation to SLR. Topics included, for example, "Landfill/Contaminated Lands: How will the migration of toxic sediments from brownfields, liner failures, dredge spoil sites, underground storage tanks, cemeteries, coal ash, and jet fuel . . . be affected as these areas are inundated or have elevated water tables." As with the previous two states' conversations/documents, Delaware's efforts also provide an excellent model for future scoping exercises and policies on state and national levels.

"Environment Canada Presentation to EPA Staff: Climate Change Adaptation and Contaminated Site Management," January 19, 2010. The discussion began by presenting two resulting foci and three general findings of a scoping exercise: 1. "are [coastal managers] considering climate change in their contaminated site management plans," and, 2. "To determine if climate change should be considered in selection of remedial/risk management strategies to minimize risk." General findings: 1. "Some types of climate change effects are more significant than others"; 2. "Determining risk zones may be problematic"; and 3. "Site-specific assessments may be required." US policy makers will do well to take these foci and cautionary findings into their discussions.

Conclusion

SLR-brownfield interaction poses both opportunities and challenges that will impact public and environmental health in U.S. coastal zones. Opportunities exist for coastal communities in need of revitalization in light of new urgencies regarding SLR. Coastal managers and stakeholders will need to not only ask the primary question, "What hazards can come from saltwater inundation to at-risk coastal brownfield sites?" but also, "How can those hazards be addressed creatively and effectively?"

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18. However, the EPA document, Synthesis of Adaptation Options for Coastal Areas, published in 2008 identifies contamination from sewage and toxic waste but only as an adaptation option in reference to future locations of facilities as opposed to existing sites. (Source: Office of Air and Radiation, Office of Water, EPA).[1]

19. The Impacts of Sea-Level Rise on the California Coast, California Climate Change Center, August 2009.
20. The Impacts of Sea-Level Rise on the California Coast, Table 14. Pp 67.

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