Regeneration of previously developed land

Introduction

Previously developed land (PDL), and derelict, underused and neglected (DUN) or brownfield land represents superb opportunities to deliver social, environmental and economic benefits via conversion to green infrastructure (GI). In 2007, there were an estimated 300 000 hectares of brownfield land in the UK, which pose severe human and environmental risks through contamination (Dixon *et al.*, 2007). Where this is a risk to human and environmental health, English planning law requires that the site must be remediated prior to reuse. Remediation must ensure the site is 'suitable for use' and reduce source-pathway-receptor linkages. Exposure pathways between receptors and sources of contaminants may include ingestion of soil, consumption of contaminated food and water, inhalation of dust and vapours, leaching of contaminants to controlled surface and ground waters, and skin contact with contaminated materials. The use of green space and woodlands to restore contaminated land has been proposed as a cost-effective remedial strategy for the redevelopment of contaminated land by limiting wind erosion of contaminated soils, reducing excess release of salts, physical/chemical or biological degradation of contaminants through the regeneration process, as well as reduced overland flow of water and improved infiltration (Hutchings, 2002).

Benefits

The benefits of converting PDL to GI include: reduced human and environmental health risks; improved soil, water and vegetation condition; improved biodiversity; and improved quality of place. In addition there are indirect health benefits as a result of the increased use of green space.

Economic evidence

- At Bold Moss, the former Bold Colliery site near St Helens in Merseyside, derelict industrial land has been transformed into community woodland and nearly 600 new homes have been built. A report by the District Valuer found property values in the area had risen by £15 million as a direct result, and new developments worth £75 million had been attracted (Forestry Commission, 2005).

- The annual healthcare costs that were avoided by the Cydcoed woodland programme between 2001 and 2008 were calculated to be £815,000 (Forest Research, 2008).

- The Capital Modernisation Fund (CMF) woodland programme developed 1500 ha of community woodland, approximately 40% of which was on brownfield land. Public benefits from woodland were worth an estimated £4,000 per ha annually, plus the programme led to £460,000 worth of further funding (Forestry Commission, 2003).

Evidence linking regeneration of PDL to benefits of GI

- The use of green space and woodlands to restore contaminated land has been proposed as a cost-effective remedial strategy for the redevelopment of contaminated land (Hutchings, 2002).

- The establishment of vegetation on contaminated sites can break the pollutant linkage pathways by providing a physical barrier to the soil surface and in the subsequent prevention of soil erosion which minimises dust production (de Munck *et al*., 2008).

- In the case of certain organic contaminants, soil conditions can be optimised to promote microbial breakdown of the contaminants in a process termed 'bioremediation' (Moffat and Lynch, 2005).

- At Markham Vale, a former mining site with areas of elevated heavy metal and dioxin contamination, GI was created through the planting of willow species in a technique known as phyto-stabilisation. This was in addition to bringing stability to eroding mining waste tips (Edwards *et al*., 2005).

- O'Riorden (2000) demonstrated that creating GI on a brownfield site can deliver significant environmental health benefits in both a preventative capacity and as a treatment to on-site pollution. The benefits can arise by limiting wind erosion of contaminated soils, reducing excess release of salts, physical/chemical or biological degradation of contaminants through the regeneration process, as well as reduced overland flow of water and improved infiltration. The benefits can include improving the condition of the soil, vegetation, surface waters (including culverts, surface waters, sustainable urban drainage systems and ditches) and groundwater.

- Ling (2000) called for reclamation projects to recognise the importance of maximising a site's potential for diversity.

- At Silksworth Colliery in Sunderland, pollution from acid drainage was brought to a halt following the regeneration of the site to create a town park (Cass, 2003).

- Reclamation involved planting 250 000 trees and shrubs, amongst other works, which helped improve the environment along 3 km of the Mersey River. The site regeneration replaced severe dereliction with an attractive landscape (Cass, 2003).

- At the Millennium Coastal Park, Llanelli in Wales, regeneration turned 520 ha of derelict industrial land into an environmental asset (Holmes, 2003).

Practical considerations

Funding regeneration can be an issue and land is more likely to be restored to GI if it is part of a larger programme (Dixon *et al*., 2007). In addition to the regeneration monies, funding is required for the ongoing maintenance to ensure the environmental benefits to air, land and water continue into the long-term once the GI is created.

Sites that contain insufficient volumes of contaminated soil to justify setting up and using on-site decontamination technologies often lead to decontamination by landfill disposal. Such sites may represent a majority for many local authorities throughout the UK. On their own, the sites pose problems for remediation, but can be clustered together to offer economical treatment of materials at a central, shared 'hub'.

Links to climate change

There is little evidence of the links between the regeneration of PDL to green space and mitigation or adaptation to climate change. However, the presence of a greater number of trees and shrubs as a result of regeneration to green space can provide an additional carbon sink for greenhouse gases. The presence of trees can also aid shading for amelioration of the heat island effect and can reduce flood risk. The effects of climate change on future remediation will become apparent, and the choice of species and vegetation for the adequate remediation of contamination will be site specific and should be factored in at the planning stage.

Tools

CLEA: contaminated land exposure assessment
CLEA is the Government supported methodology for estimating the risks to people from contaminants in soil on a given site. It determines acceptable levels for contamination in soil below which the risks are considered minimal, under Part IIA of the Environmental Protection Act 1990.

RAF; 'Prove it!'; Methuselah
Examples of monitoring strategies that can be used for or in support of the assessment of urban regeneration include the Redevelopment Assessment Framework (RAF; Pediaditi *et al*., 2006), 'Prove it!' (NEF, 2000) and 'Methuselah: a monitoring and evaluation strategy for greenspace' (Forest Research, 2009).

RBCA: risk-based corrective action toolkit
This toolkit is a generic term for corrective action strategies that categorise sites according to risk, and move all remedial sites toward completion using the appropriate levels of action (Environment Agency, 2003a).

RISC-HUMAN
This Windows-based computer tool can be used to estimate human exposure to contaminants in soil, groundwater and sediment, and is a method for deriving site-specific human health assessment criteria for contaminants in soil (Environment Agency, 2003b).

Case studies

London Olympic Park: improving environmental and human health benefits through brownfield land regeneration to green space.

Epstein, D. and Hellings, J. (2010). CL:AIRE Inaugural Lecture Delivering the Olympic Park Enabling Works. November 2009, London.

The Greenwich Peninsula: contamination remediation.

Barry, D.L. (1999). The Millennium Dome (Greenwich Millennium Experience site) Contamination Remediation. *Land Contamination & Reclamation* **7**, 177-190.

Knowledge gaps

- There is little evidence of the impact of national urban regeneration investment on socio-economic or health outcomes. Work to exploit and synthesise 'best available' data is required (Thomson *et al* 2006).
- There is the need for quantitative and qualitative toolkits to evaluate the impacts associated with regeneration projects. This knowledge gap is meritable for land regeneration to new hard-end uses as well as to soft-end uses, such as GI.
- There is limited research and few published case studies into long-term performance of stabilisation/solidification materials where the technique has been used on sites for GI (CL:AIRE, 2005). Research is needed to clarify long-term trends and potential impacts of climate change on performance.
- Evidence is needed on the effects of climate change on the remediation of contaminated land.

Citations of national policies/priorities

Government's Sustainable Communities plan of 2003
http://www.communities.gov.uk/publications/communities/sustainablecommunitiesbuilding

DETR Circular 02/2000 on Contaminated Land

Environmental Protection Act 1990: Part IIA, Contaminated Land. Circular 02/2000. (2000)

Planning policy statement (PPS23)
http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement23.pdf

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