

Restoration Sustainable Re-use Reliable
Re-use Re-use Re-use Re-use
Land Reclamation & Urban Greening

Land reclamation

Woodland establishment

Urban greening

Recreation

Social inclusion

Amenity

Research



Forest Research

**Sustainable woodland remediation solutions
for multi-functional sites**

The benefits of woodland solutions

Woodland solutions can provide a wide range of socio-economic, health and environmental benefits.

- Social inclusion and cohesiveness
- Amenity and recreation
- Site phyto- and biochemical remediation
- Managing significant pollutant linkages
- Waste recovery, re-use and recycling
- Air quality improvement
- Public health improvements
- Resource optimisation
- Water quality improvement
- Ecological protection and enhancement
- Woodland sustainability
- Timber, biomass fuels and local trade products
- Conservation of our heritage and archaeology
- Economic regeneration of deprived areas

The challenges

Designing and implementing effective woodland solutions raises many challenges, including:

Site investigation

- Designing conceptual ground models
- Identifying contamination source-pathway-receptor linkages
- Risk assessment
- Evaluation of planting medium and available resources

Contamination

- Heavy metal / organic compounds
- Acid leachates
- Phytoremediation potential of woodland
- Selection of remedial methods and amendments

Soil and water resource management

- Soil and water quality requirements for sustainable woodland
- Resource planning and site management strategy
- Soil engineering
- Use of soil-forming materials
- Waste management and minimisation options
- Selection of organic and beneficial amendments

Woodland establishment and sustainability

- Meeting drainage, cultivation and amendment needs
- Appropriate species selection
- Planting, weeding and pest control
- Long-term management requirements

Achieving integrated remedial solutions

- Risk minimisation
- Hydrological, ecological and environmental impact assessment
- Site-specific remedial treatments
- Balancing site owner, user or public benefit requirements
- Multi-functional and cost-effective restoration



Restoration and remediation research

Good quality, professional research and development is essential for successful land reclamation. Forest Research has over 40 years of research experience in woodland restoration on greenfield, brownfield and contaminated land. The research programme is funded by the Forestry Commission, with support from many government, industry and academic sponsors and collaborators.

Our research projects are carefully selected to provide technical solutions for tree and woodland establishment, management and sustainability in restoration and remediation schemes. Research activities are undertaken within four broad themes:

1 Resource management optimisation for new woodland establishment

- Site investigations and conditions for sustainable woodland establishment
- Scoping studies for marginal land (for exSite Research Limited)
- Soil and planting medium resources, strategy and contamination status
- Deep (1 metre) cultivation trials and machinery development
- Drainage, soil amendment and soil-forming materials trials
- Waste minimisation, re-use and recycling of waste materials
- Woodland establishment and management
- Restored site recovery, evaluation procedures and sustainability indicators



2 Contamination, tree tolerance and phytoremediation studies

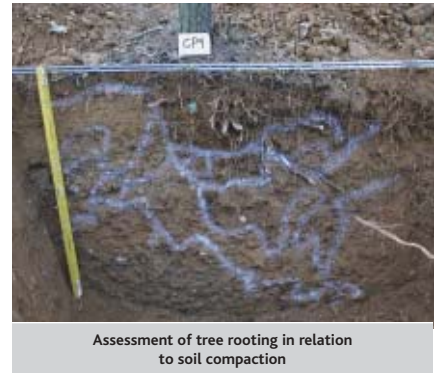
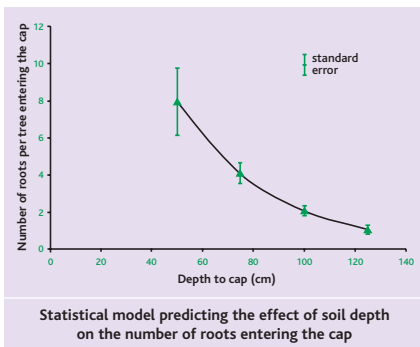
- Tolerance of trees to heavy metals
- Development of biological indicator methods to screen materials for potential contaminants (supported by CL:AIRE)
- Evaluating site remediation potential and methods

3 Impacts of woodland restoration on the wider environment

- Impacts of tree rooting on landfill caps (funded by ODPM)
- Sediment generation, contaminant transport and stabilisation potential (Tamar Valley AONB)
- Impacts on acid leachate generation from pyritic colliery spoils (funded by FC Land Regeneration Unit)

4 Integrated restoration and remediation solutions

- Processes and practices in multi-functional Community Woodland development
- Integrated urban remediation and greening (funded by EPSRC with the SUBR:IM Consortium)
- Novel composts (funded by EPSRC with SUBR:IM)
- Socio-economic and amenity value of woodland restoration



Research solutions and advice

Our research and advisory activities aim to disseminate best-practice methods and promote good standards of restoration. We have extensive experience of applying our research results to many active restoration sites, including china clays, sands and gravels, colliery shales, landfills, industrial wastes and many other substrates. This is the technical foundation for our credible and practical advice on woodland solutions for the reclamation industry.

We can advise you using site information or test data, or we can conduct selective research trials to identify woodland and remedial solutions tailored to your specific situation. Our services include:

Site investigation

- Reviews of site investigation programmes and data collection/remediation requirements for woodland end-uses
- Sampling strategies and geo-statistical analysis
- Soil and soil-forming material resource surveys
- Tree and soil health and contamination status surveys
- Laboratory services for a wide range of foliar, water and soil analyses

Land, soil and water resource management

- Producing site planning, resource management and restoration strategies
- Expert advice and equipment/operating practice specifications for soil movement, handling and placement, cultivations, drainage and amendments
- Use of soil-forming and waste or compost materials
- Preserving soil resources through drainage, erosion control and stabilisation

Contamination solutions

- Using novel methods to determine soil contaminant concentrations
- Guidance on the tolerance of tree species to a range of contaminants and their potential for phytoremediation
- The use of woodland for phytostabilisation and effects on contaminant mobility

Ecological and silvicultural solutions

- Selecting species which are tolerant of site physico-chemical conditions
- Guidance on silviculture and aftercare management (ground cover selection, weeding, fertilisers, pest and disease control and diagnostics)
- Selection and management of compatible ecological habitats

Achieving integrated remedial solutions

- Technical, product and machinery development and testing services
- Using byproducts, wastes and amendments to reduce contaminant bioavailability and mobility
- Long-term site monitoring and impact assessment programmes
- Multi-functional restoration with sustainable, cost-effective and minimal risk solutions for woodland, amenity, landscape, heritage, archaeological and ecological end-uses

Clients and collaborators

Brett Waste Management
Buckinghamshire County Council
Central Electricity Generating Board/PowerGen
CL:AIRE
Countryside Agency
Cranfield University
Department for Environment, Farming and Rural Affairs
Engineering and Physical Sciences Research Council
English Heritage
English Nature
English Partnerships
Environment Agency
Enviro Aspinwall
exSite Research
Farming and Wildlife Advisory Group
Forest Enterprise
Forestry Commission
Lafarge Aggregates
Mersey Forest
Office of the Deputy Prime Minister
Ove Arup
RMC Group
Shanks Group
Southern Water
St Regis Paper
The National Forest
Waste Recycling Group
Wessex Water
Yorkshire Forward
SUBR:IM Consortium (Sustainable Urban Brownfield Regeneration: Integrated Management) comprising Universities of Cambridge, Manchester, Reading, Sheffield, Surrey, the Building Research establishment and The College of Estate Management



Recent and ongoing reclamation programmes

Thames Chase, Red Rose and Mersey Community Woodland development

This 1100 ha of greenfield, brownfield and derelict land was restored to amenity and soft end-uses and was funded under a 3-year HM Treasury Capital Modernisation Grant to Forest Enterprise.

Newlands Community Woodland development

A total of 635 ha of contaminated and derelict land are currently undergoing staged site investigations for community woodland restoration by the Forestry Commission. This is a 5-year programme funded by the North West Development Agency.



Some recent publications

Foot, K.J. (2002). *Woodland establishment on landfill sites.* Fourth Forest Research Technical Progress Report to the Department for Transport, Local Government and the Regions, Landfill Contract ER541L, Feb 2002.

Foot, K.J. and Spoor, G. (2003). Breaking restored ground – ripping really works! *Mineral Planning* 94, 6–9. See www.defra.gov.uk/environ/landuse/landuse.htm.

Foot, K.J., Hislop, M. and McNeilly, S. (2003). The effect of composted green waste on tree establishment on landfill. In: *Land reclamation: extending the boundaries*, eds H.M. Moore, H.R. Fox and S. Elliott. Proceedings of the Seventh International Conference of the International Affiliation of Land Reclamationists, Runcorn, UK, 13–16 May 2003. Balkema, Lisse, 213–221.

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Hutchings, T.R., Moffat, A.J. and Kemp, R. (2001). Effects of rooting and tree growth of selected woodland species on cap integrity in a mineral capped landfill site. *Waste Management and Research* 19, 194–200.

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Spoor, G. and Foot, K.J. (1998). Soil compaction alleviation on restored sites. In: *Land reclamation: achieving sustainable benefits*, eds H.R. Fox., H.M. Moore and A.D. McIntosh. Proceedings of the Fourth International Conference of the International Affiliation of Land Reclamationists, Nottingham, UK, 7–11 September 1998. Balkema, Rotterdam, 277–286.



Land Reclamation & Urban Greening

Further information

The Land Reclamation and Urban Greening Team are currently co-ordinating a network between organisations to:

- develop strategic programmes to link research, industry and consultancy
- promote liaison, collaboration and partnership
- obtain research funding
- gain support in kind
- identify and source sites, products, resources and technology for research activities
- consolidate research findings and practical implementations
- disseminate good practice.

If you are interested in joining this network or wish to be updated on the latest developments in our research and advisory services please contact us at:

join.landrec@forestry.gsi.gov.uk

If you seek further discussion, information or advice, we would like to hear from you:

The Land Reclamation and Urban Greening Team

Andy Moffat, Kirsten Foot, Tony Hutchings and Danielle Sinnett

Forest Research
Alice Holt Lodge
Farnham
Surrey
GU10 4LH

Phone: +44 (0)1420 22255

Fax: +44 (0)1420 520180

e-mail: landrec@forestry.gsi.gov.uk

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Text: Kirsten Foot, Tony Hutchings, Andy Moffat

Photos: Forest Research Photo Library, authors and collaborators

Editing: Jenny Claridge

Design: Colourgraphic Arts, Jenny Claridge

Printed by Colourgraphic Arts, Bordon, Hampshire, UK May 2003



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