Appendix 3: Mowing

This appendix is one of four environment topics covered as part of the NERC funded project report: Naylor, LA., Kippen, H, Coombes, MA., et al. (2017). Greening the Grey: a framework for integrated green grey infrastructure (IGGI). University of Glasgow report. URL: http://eprints.gla.ac.uk/150672/

Business Case for 'Mowing for Pollinators' as an Integrated Green Grey Infrastructure (IGGI) Measure

This business case assesses the existing evidence of integrated green grey infrastructure (IGGI) measures that can support wider implementation of 'mowing for biodiversity' activities. It forms part of the NERC funded IGGIframe project outputs (URL: http://eprints.gla.ac.uk/150672/). Costs, benefits and measures of the engineering and ecological performance (called critical success factors) of a range of IGGI alternatives to traditional 'grey' approaches are drawn from operational and research examples across the UK and beyond.

Measures considered involve changing embankment mowing regimes to improve habitat for bees (CS-M1); replacing grass on verges with wild flower meadow (AP-M1); and improving conditions for wildlife and people using urban grassland (AP-M2). The business case is aimed at reducing the uncertainties when considering GI innovations, including:

- What are they?
- Where have they been applied?
- What evidence is there to show they work well?
- Will it cost more?
- What are the benefits over business-as-usual?
- What IGGI measures and solutions are there?
- Where are they suitable?
- What are the risks?
- How can I get approval?

What is it? / Greening innovation

Change of maintenance regimes to reduce cost and improve ecosystem services without any engineering impacts. Key drivers have been to save money, to improve biodiversity and/or amenity value.

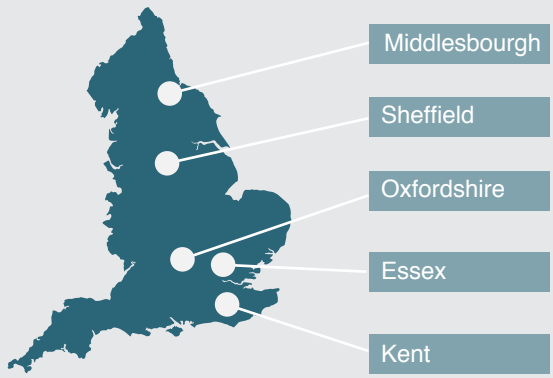
What types of infrastructure have been greened using this technique?

A range of linear and urban assets including: earth embankment flood defences, road verges, central reservations and industrial estates.

When in the design/life of an asset can this be applied?

As a strategic design goal (mowing for biodiversity) and as part of routine maintenance practice and/or as a cost saving measure. Mowing for pollinators is a cross-cutting measure that can be applied in a range of contexts. This includes any vegetated verge, bank or back/top of an existing asset that has an existing mowing regime. In this way, the measure may be used alongside other IGGI measures to achieve addition benefits in urban, coastal/estuarine and historic contexts.

Where has this innovation been tested or applied?



Evidence Summary

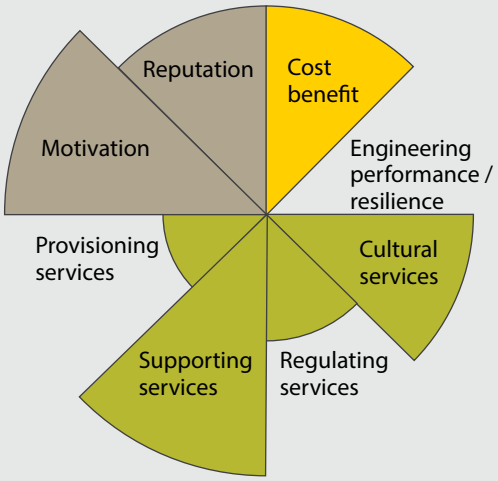
The evidence summary and benefits assessment are a summary of the critical success factors evaluated for all of the coastal case studies and 'Art of the Possible' examples. It is replicated across the four business cases to enable comparison between environmental contexts.

Costs	Ecosystem Services	Engineering	Policy
What do they cost compared to business-as-usual?	What evidence do we have that they deliver ecosystem service benefits?	Are there any risks to design life, inspection or effects on maintenance regimes?	How does it relate to policy and guidance?
Reduced frequency of mowing gives overall reduction in costs (e.g. staff time and fuel).	Biodiversity is enhanced by providing grassland and/or wildflower meadow. This has significant benefits for pollinator species.	No risk to design life. Possible small changes to asset inspection (i.e. timing).	Can help meet national pollinator strategic objectives and/or local Biodiversity Action Plan targets for bees.
LESS	POSITIVE	NEUTRAL	ACHIEVED

Data Quality	Social	Reputation	Asset Resilience
What is the quality of the data underpinning this bundle?	What are the potential additional social benefits - jobs, cohesion, education etc.?	How have the schemes helped improve public perceptions?	Is asset resilience affected, neutral or improved?
There are very good examples of this measure being implemented, including detail ecological survey data showing positive outcomes for wildlife.	Improved amenity value, improved community cohesion (some of the schemes have involved corporate-community partnerships) and new jobs have been created (Westhorpe scheme).	Led to improvements in corporate reputation, gained public support for changes in management and won awards (AP-M1). Local authority cuts and 'reduced' service provision has been offset by wildflower meadows that have high public approval.	Changes mowing practice has little adverse effect or benefit on structural integrity of earth embankments or verges.
MODERATE - HIGH	POSITIVE	POSITIVE	NEUTRAL

Benefits Assessment

The evidence summary presented above is derived from the examples contained in this bundle, each of which have been assessed using the Critical Success Factors guidance developed by this project. The benefits wheels show the benefits of each critical success factor relative to each other. They are a combination of ecosystem services and other important considerations necessary to evaluate IGGI measures compared to business as usual. More detailed breakdown of each element of each can be found below.



Cost
Reduced frequency of mowing reducing labour and fuel costs, although this is offset partly by possible increased costs of machinery maintenance due to cutting longer grass. Overall costs are considered neutral or slightly reduced compared to business-as-usual.

Engineering value
Mowing regimes have very little impact upon engineering performance. Whereas mowing frequency is reduced, grass is still cut during the year and so there is no concern with vegetation becoming unmanaged or possibly compromising engineering performance.

Cultural services
Reduced mowing supports semi-natural grassland habitats. These are rich habitats that often support wildlife of value to local communities. This includes opportunities for learning, aesthetic value, recreational and reflective experiences.

Regulating services
Grassland habitats provide some carbon sequestration.

Supporting services
Grassland habitats host valued pollinator species, important for supporting resilience ecosystems and agriculture. Examples show that reduced mowing can increases the number of native needs, including rare species.

Provisioning services
Little/no provisioning benefit is expected on-site, although may be opportunities for biomass and renewable energy production from cropped grass. Locally, the pollinators supported by longer grass and wildflowers important for commercial arable agriculture.

Motivation
IGGI measures can provide significant returns on investment and address the issues that motivated their implementation (e.g. statutory mitigation, threatened species etc.), by providing useful habitat, pubic engagement and amenity.

Policy
Reduced mowing can support protection of target pollinator species.

Reputation
Examples of reduced mowing show a mix of responses from the general public. Most appreciated the added value for wildlife, but some may perceive it as a lack of appropriate maintenance – education and engagement around the benefits can help appease these concerns.


Photo credit: Skanska

IGGI Measures

This bundle contains three IGGI measures:

Aim of the IGGI	Label	Title
Reduced maintenance /altered mowing regime to improve pollinator habitat and abundance	CS-M1	Embankment mowing for bees
Replacing grass verges on road estate land with flower meadows	AP-M1	Flower meadow verges
Improve the local environment for wildlife and people by improving biodiversity onsite and create a native tree	AP-M2	Urban grassland

IGGI solutions and relevance to other bundles

These IGGI measures can be applied more widely than the examples put forth here, as it can form part of managing of the wider more conventional green infrastructure estate including parks and open spaces.

In an urban context, these measures can be combined with enhancements to building or free-standing wall fabric (e.g. AP-U4, AP-U5) and street furniture (AP-U3) to optimise the value for people and pollinators. These measures can also complement greening techniques used on railway arches, embankments and sidings (e.g. CS-U4, AP-U1, AP-U2).

How can you get this type of greening approved for your scheme?

The case study, art of the possible examples and policy links provided here can be used to demonstrate the economic, environmental and social benefits that can be gained from this type of IGGI innovation. What is also required is a willingness to innovate where testing or application of these innovations often requires changes in behaviour or practice. For example, austerity was a key driver of innovation for AP-M1 where the need to make substantive savings to maintenance budgets for road networks and parks led to an innovative, low cost solution.

Known limitations or risks associated with these IGGI approaches

Risk Factor	Description and Risk Reduction Strategies
Ecosystem service provision	Different altered mowing and planting regimes can cater to specific species or overall biodiversity, but not necessarily both at the same time. Clear biodiversity goals need to be agreed at the outset and other forms of vegetation may also be more suitable than flower meadows.
Ecological connectivity	The potential wider benefits of improved habitat connectivity using these IGGI approaches is high; but it has not been measured by these examples so the precise benefits are currently unknown.
Geography	These can be widely applied across the rural to urban landscape. Where used in dense urban areas, it is recommended that additional habitat features are provided for key species such as solitary mason bees. Examples in the urban bundle can be used to provide these habitat alongside those in the mowing bundle to achieve this.
Machinery	Mowing late in the season may put additional pressure on equipment in terms of wear and tear (e.g. vegetation will be woodier but machines used less often) and also availability of machinery for cutting. Careful planning is needed to optimise ecological gains within operational constraints of limited numbers of mowers.
Maintenance	Although maintenance is typically less than for grass-mown features, there is still a clear need for a maintenance operational plan to be made and followed over time. Annual maintenance is critical for flood alleviation embankments to retain their engineering design performance criteria.
Scale	There is potential for widespread application of these IGGI approaches; limits are the availability of machinery for late season mowing.

Where to learn more

Case study: CS-M1 and references therein
Art of the Possibe: AP-M1 and AP-M2

HM Treasury (2016). The Green Book: Appraisal and Evaluation in Central Government. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf [Accessed August 2017].

DEFRA (2015). National pollinator strategy: for bees and other pollinators in England. https://www.gov.uk/government/publications/national-pollinator-strategy-for-bees-and-other-pollinators-in-england [Accessed August 2017].

Scottish Government (2016). Scottish Pollinator Strategy Consultation. http://www.snh.gov.uk/about-scotlands-nature/species/invertebrates/land-invertebrates/pollinator-strategy-consultation/ [Accessed August 2017].

Welsh Government (2015). Action Plan for Pollinators. http://gov.wales/topics/environmentcountryside/consmanagement/conservationbiodiversity/action-plan-for-pollinators/?lang=en [Accessed August 2017].

A related technique involves greening stalled brownfield sites using wildflowers to attract pollinators, e.g. Buglife's 'Managing brownfield sites for scarce bumblebees'. https://www.buglife.org.uk/sites/default/files/Managing%20brownfields%20for%20scarce%20bumblebees_0.pdf [Accessed August 2017].

Plantlife also has guidance on 'Good Verges' which may also be applicable: http://www.plantlife.org.uk/uk/our-work/publications/good-verge-guide-different-approach-managing-our-waysides-and-verges [Accessed August 2017].

How to cite: Naylor, LA., Kippen, H, Coombes, MA., et al. (2017). Greening the Grey: a framework for integrated green grey infrastructure (IGGI). University of Glasgow report. URL: http://eprints.gla.ac.uk/150672/

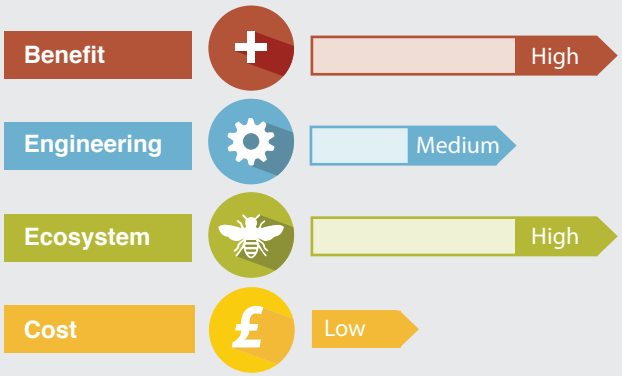
Mowing Case Studies

Case Study CS-M1:

Embankment mowing for bees

Summary

The Environment Agency took an innovative approach to an established mowing regime in an attempt to improve pollinator habitats and reduce costs. A reduced mowing reqime was tested compared to business-as-usual on an earth embankment flood defence on Canvey Island. The altered mowing regime has since been implemented across 120 km of earth embankments in Essex and Kent.



How does it work?

The embankments are engineered flood defences, where the landward side is terrestrial grassland habitat. If managed well these assets can provide important habitat for rich bumblebee assemblages, including UK Biodiversity Action Plan species, the Shrill Carder Bee (Bombus sylvarum) and Brown Banded Carder Bee (Bombus humilis). The business-as-usual model was to routinely cut the grassland (up to four times per year) but this trial showed that by leaving the grasses and flowers uncut until at least mid-September, significant biodiversity gains can be made.

Motivation

To improve habitat management to support declining bee populations (as is seen nationally), including UK BAP target species, and a drive to reduce maintenance costs.

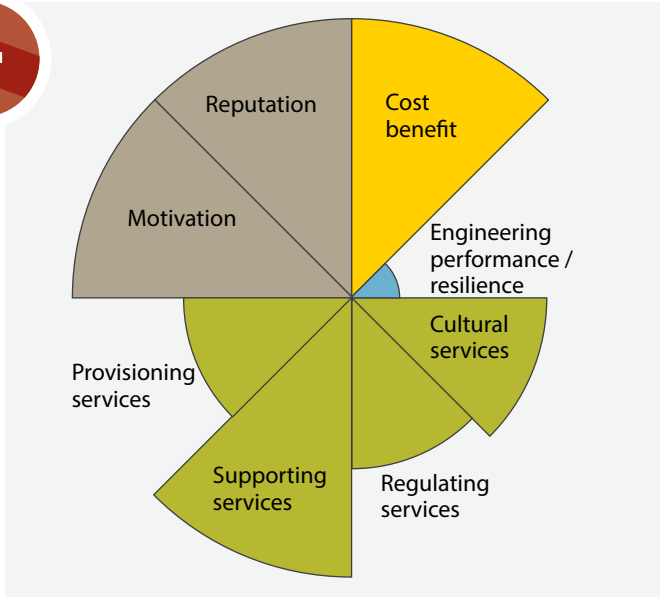
Design Innovation / Enhancement measure

Change in management regime – altered or reduced intervention

Benefits

Net cost benefit is expected to be positive, see below. For the Environment Agency the potential cost savings were important but, in addition, the measure was considered to have significant benefit for rare pollinator species. Alternative active habitat enhancement would likely prove more expensive. The ecosystem service value of bees and other pollinators is high.

The scheme has proved successful and it and has been extended further. Research is underway to determine the viability of using the mown material in anaerobic digestion to produce heat, gas and, potentially, electricity, which would further improve the benefits.



Net Cost

The overall cost of this measure is effectively zero or a net reduction compared with business-as-usual. Some additional expenses may occur from mowing thicker, dense grass swards (e.g. more frequent blade sharpening and increased likelihood of breakdowns) but with experience this may be reduced by mowing at lower speeds and mowing with more than one pass with increasingly lower blades. Mowing less often requires fewer people, less machinery and less fuel.

Direct cost of intervention

Currently mowing costs around £250 per kilometre. Average costs for 3 different regimes, therefore are:

- Change in mowing timing: little additional cost (due to increased maintenance of machinery)
- Reduction in mowing frequency from 2 to 1x per year = £250 p/km
- Reduction in mowing frequency from 4 to 1x per year (As per 2) = - £750 p/km

Cost compared to business-as-usual

Cost of mowing per hundred kilometres is reduced by between £25k and £75k year.

A slight increase in equipment maintenance and repair is expected. Mowing more mature grasses can be problematic if the operative is inexperienced. Initial trials in one area showed an increase in the frequency of breakdowns – minor repairs to bearings etc. This can be moderated by additional passes at increasingly lower mowing heights, but this does take more time.

Long-term cost

It is anticipated that there will be no increased cost in the long-term management of these earth embankments to offset the significant short, medium and longer-term savings. Change in mowing timing: little additional cost (due to increased maintenance of machinery).

Maintenance costs are unknown. Post-construction monitoring to measure enhancement effects on local ecology is expected to require 4 person days of monitoring per year (June, July, August and September) for 1-2 years.

Engineering performance, inspection and maintenance

This intervention represents a reduction (or change in timing) rather than a cessation of maintenance by mowing. The grass plays a vital role in the structural integrity of these older embankments and it is essential that it is not compromised. If the grass is too short, the soil may be eroded away by heavy rainwater or overtopping. Similarly, if it is too long then overtopping can rip out the grass and the soil, damaging the embankment. This does not inhibit inspection (which happens at 6 monthly intervals) and has no known effect on engineering performance or design life.

It may be that there is an increased time-pressure when completing one cut late in the season - mowing less often means the grass is longer, thicker and woodier so there is increased load on the mowers and blades may need sharpening, repairing or replacing.

Similarly, the frequency of breakdowns can increase if not properly managed. On average there may be one breakdown a year on Canvey under the traditional regime; however, with the increased load of a late mow (if the spring was wet and the operative is not experienced) this might increase, to double or more minor breakdowns, meaning that the machine is out of commission for one or more days. Most of these are minor repairs to bearings or bushes and can be avoided by doing additional initial cuts at higher blade heights. Inspection is routinely done 6-monthly, with an asset not visible to the inspector for more than 18 months (3 consecutive inspections) deemed to be failing and requiring remedial action. If the embankment is cut in alternate strips down the length at least twice a year, it is possible to inspect each element at least once within that 18-month period.

Ecosystem services

Ecological outcomes for target species have been met through minor changes in maintenance timing and frequency. Statistically robust trials showed overall number of bees increased (almost tenfold) including a significant increase in the variety of species of both bee and pollinator food plants (almost double, from 6 species on the trial site compared to 4 on the standard control sites where mowing was not altered).

The Environment Agency are required to consider biodiversity when developing asset maintenance plans and aim to encourage other landowners to follow. This requires baseline data to make informed choices and the EA have provided guidance documents to support others (e.g. 'Delivering more for pollinators on Environment Agency Land', 2016). Embankments are important resources for a range of species including birds, mammals, reptiles and amphibians, pollinating and non-pollinating insects and other invertebrates. The rarity and/or protected status of some species may mean that altering the mowing regime specifically for bees can be a thorny issue. For example, cutting waterside margins for water vole habitat or delaying cuts for breeding birds may reduce floristic diversity. It is important to establish clear goals and pathways to achieve them using up-to-date guidance and data, and by considering what is most appropriate for a particular location.

The nature and stewardship of much of this kind of habitat (most coastal earth embankments are EA managed) makes it a potentially quick 'win-win' management tool; to save money and provide a refuge for important pollinator species that provide supporting and provisioning services for food production/farming.

Fewer cuts reduces carbon emissions from diesel mowers and allowing the grass to grow longer provides some degree of carbon sequestration. In addition, the clippings could be used in anaerobic digestion for renewable energy production (income generated could be re-invested to further promote and maintain the environment).

As yet no data are available for amenity value. To some the increased biodiversity may provide enhanced aesthetic/visual amenity and in-turn may positively influence nature recreation and leisure values.

Social value

As yet no data are available for amenity value but local wildlife interest groups are very positive about the change. Increased biodiversity may provide some positive nature recreation and leisure values.

Who can apply this intervention / technique?

Any landowner, local authority or government agency with suitable grassland habitat.

Scaling up the benefits

Nearly 120 km of sea wall (118.5 km) in Essex (30% of the 391 km sea walls managed by the EA in the county) is now managed with wildlife in mind and should be beneficial to pollinators to some degree. The cumulative length of sea wall managed with reduced mowing has increased year on year since 2010. There is approximately 2,100 km of vegetated embankment in England and Wales (managed by Environment Agency and Natural Resources Wales). If 25% of the asset stock had a reduction of a single mow e.g. from four to three, or two to one per year, this could yield a net saving of approximately £134,000 per year. The EA also manages or oversees assets on third party land when necessary, so this could add to cost savings.

Data Quality

The table shows the relative strengths of the Economic, Technical and Environmental data available. They are classified as:

Scheme Specific
part of a PhD or similar detailed research

Expert Judgment
interpretation of the scheme by one or more experts

Wider Supporting Evidence
extrapolated from published work or reports by practitioners.

DATA TYPE	DATA QUALITY / QUANTITY						
	Scheme specific information			Expert judgement		Wider supporting evidence	
	No Data	Limited reported sources	Strong reported sources	Some expert opinion	Multiple experts	Some sources	Multiple sources
COST				●			
ENGINEERING				●			
ENVIRONMENTAL			●		●	●	

Further information

Gardiner T., Pilcher R. & Wade M. (2015). Sea Wall Biodiversity Handbook. RPS, Cambridge. http://www.essexfieldclub.org.uk/portal/p/Sea+Wall+Biodiversity+Handbook [Accessed August 2017]

Gardiner T. and Vetori C. (2015). "Incorporating pollinator friendly grassland management regimes into the Thames Estuary Asset Management (TEAM 2100) programme of works". ECSA Conference, September 2015, London.

Contacts

https://www.gov.uk/government/organisations/environment-agency#org-contacts

The Environment Agency
Fisheries & Biodiversity
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

This forms part of Naylor, LA., Kippen, H, Coombes, MA., et al. (2017). Greening the Grey: a framework for integrated green grey infrastructure (IGGI). University of Glasgow report. URL: http://eprints.gla.ac.uk/150672/

Mowing Art of the Possible

Flower meadow verges

What is the measure?

Switch from mowed to meadow flower verges and central reservations along the city's road network. Pictorial meadows was the company who did the ground preparation and sowed the annual meadow flower.

Primary driver

Budget cuts drove Hartlepool Borough Council to explore the possibility of a combined meadow flower seeding and reduced mowing.

Benefit

The key measured benefits of the altered mowing regime to create flower meadows are reduced costs and improved public amenity. It also helps the council support national policies and likely provides ecological benefits.

Cost

Direct reduction in weekly cutting and litter
Direct reduction in weekly cutting and litter picking maintenance costs from early summer to early/mid-autumn. Business as usual costs £5k per kilometre (mowing and litter picking).The flower meadow saves £1.5k in year 1 (installation), and £3.5k in year 2+ per kilometre. Savings per cut for 10 kilometres of verges is £35k.

Engineering

No impact on engineering function.

Ecosystem services

Cultural ecosystem services have improved from altering mowing practices and creating wildlife meadows on these verges. Similar altered mowing schemes have shown creating meadow flower habitats can significantly improve biodiversity (e.g. Urban Pollinators Project) or improve habitat for and numbers of key species including butterflies and pollinators such as bees (CS-M1). No data on supporting or provisioning ecosystem services were collected here, but other studies have compared meadow flower mixes compared to grass and have found significant ecological benefits from the flower meadows.

Social

Strong public support reported in the local press and social media, including "You so got this right Hartlepool Council. You have brought joy to the community. Everyone talked about it and the wildlife have had a great environment to help them thrive" and "These look beautiful around the town. Well done Hartlepool Borough Council."

Reputation

Since the initial trial in 2014 it has been extended each year and now covers 37 sites "The scheme has had a fantastic response from the public and visitors to the town."

Policy

National Pollinator Strategy, local Biodiversity Action Plans.

Further data

For underpinning research related to this topic see the Urban Pollinators Project: http://www.bristol.ac.uk/biology/research/ecological/community/pollinators/urbanmeadows/

Middlesborough County Council environment scrutiny panel: Maintenance of open spaces.
URL: democracy.middlesbrough.gov.uk/aksmiddlesbrough/images/att1004987.doc

Supplier: http://www.pictorialmeadows.co.uk/about-us/

Video: https://www.hartlepool.gov.uk/news/article/434/video_popular_wildflower_planting_programme_blooms_in_hartlepool

This forms part of Naylor, LA., Kippen, H, Coombes, MA., et al. (2017). Greening the Grey: a framework for integrated green grey infrastructure (IGGI). University of Glasgow report. URL: http://eprints.gla.ac.uk/150672/

Urban grassland: Greening a light industrial estate


Urban grassland


Tree nursery

What is the measure?

A novel social enterprise greening and growing scheme on an acre of previously underused land and paving around 11 industrial units on a trading estate between Sheffield and Worksop, Derbyshire. Greening involved a change in habitat from mown grass to urban grassland.

Primary driver

Light industrial areas are often some of the greyest areas of our cities and towns, with little ecological value. This project aimed to improve the local environment for wildlife and people by enhancing biodiversity onsite and creating a native tree nursery for community projects.

Benefit

Saving of £6.5K/annum estate maintenance
This initiative improved biodiversity in an urban area (light industrial estate) typically devoid of green infrastructure and through the plant nursery created jobs and yields an annual cost saving compared to business as usual. It also reduced waste to landfill (through re-use) and delivered a carbon sequestration gain.

Cost

Saving of £6.5K/annum/acre in estate maintenance costs to the industrial; net positive as space was re-purposed to create a successful plant nursery business.

Engineering

There are no engineering impacts from this change in use.

Ecosystem services

Supporting services were measured. The existing heavily manicured lawn and hedge provided little habitat value with no nesting birds, no amphibians, and limited invertebrates. Post-greening the area now hosts a diverse bird population and frogs, toads, newts, grass snakes, dragonflies and damsel-flies flies, water beetles, more than 10 different butterflies, an array of moths, shield bugs, centipedes, gaul wasps, burrowing solitary bees and other invertebrates are found across the microhabitats created. The flora includes over 40 species of native and naturalised trees and a profusion of meadow grasses and flowers. The scheme also provided regulatory services as the tree nursery and associated planting has improved local carbon sequestration. Change of habitat from mown grass to urban grassland may also improve rainfall attenuation. Cultural services were assessed (see social).

Social

The project has employed local people and volunteers in growing a range of plants and products cooperatively; the trees are used for social growing projects on similarly underused or derelict sites. Profits from the nursery reduce annual maintenance costs for the landowner and well-being is improved.

Reputation

The project has won a Gold Green Apple, a Silver Green World award and recognised as a Green World Ambassador. The local businesses have benefitted from an improved local environment and have a certificate showing environmental partnership.

Policy

UK BAP, Urban Forestry Initiatives

Further data

http://media.wix.com/ugd/18479d_2b324dca06b84c8f859c841f8c9f7d23.pdf

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