TURAS

TRANSITIONING TOWARDS URBAN RESILIENCE AND SUSTAINABILITY

Deliverable 2.3

Synergy and summary of WP2: Years 1 to 3

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1. Foreword and rationale

Work Package 2 (WP2) of the TURAS (Transitioning towards Urban Resilience and Sustainability) FP7 European Research and Knowledge Exchange Programme provides a unique and comprehensive reference for those interested in current understanding in relation to the benefits that green infrastructure can bring to cities in terms of increasing sustainability and resilience. To contextualise current understanding, it is necessary to understand the historical context of urban development. Architecture and planning theories since Le Corbusier' Ville Radieuse axiom, almost one century ago, theorised and advised that green space should be one of the basic components of human urban settlements. Nevertheless, due to numerous constraints and the prioritisation of economic and social drivers for urbanisation, the key foci leading the development of European cities have been those for which green space was not always an intrinsic consideration or, if it was considered, was restricted in scope and functionality.

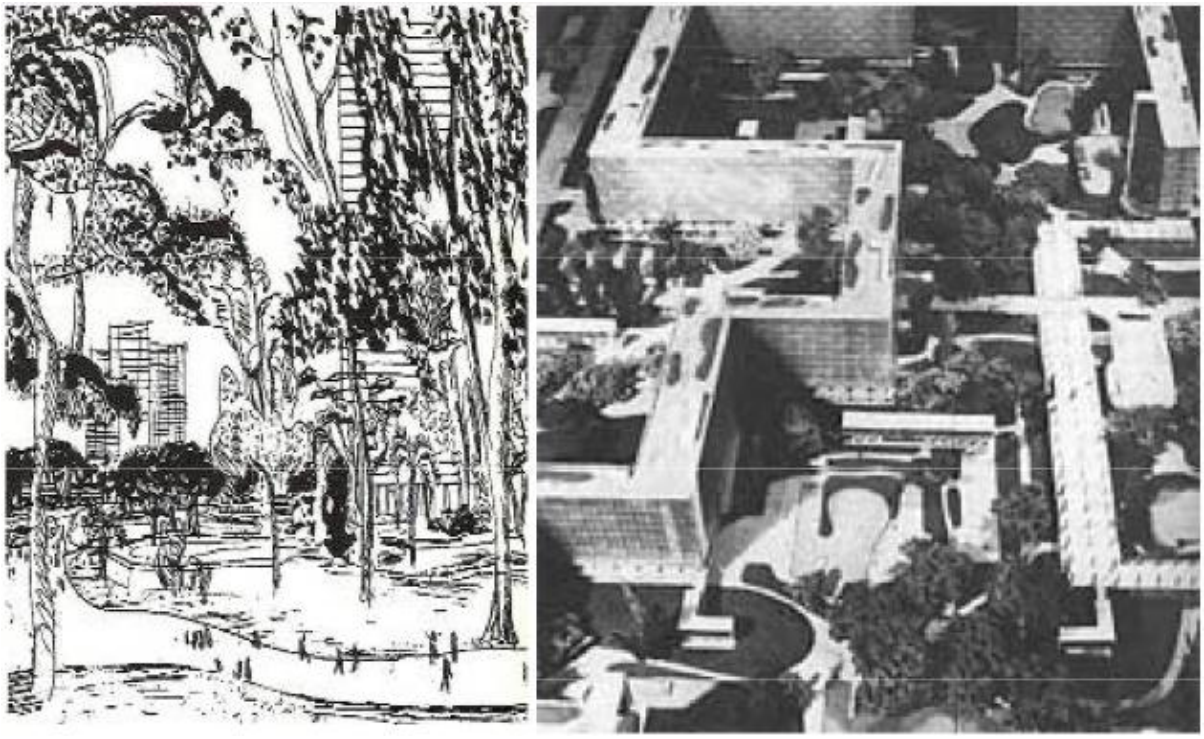


Figure 1. Artist's impression and model of the historic urban green infrastructure initiative, Ville Radieuse. © LC drawings and models

Whilst the green component concept and praxis have been treated as constituent components of cities, it is rare to find an infrastructural approach to designing and managing green space with specific reference to an overview spanning from metropolitan parks and naturalistic corridors to the micro-green areas. In contemporary society, however, human settlements and activities are completely based on infrastructures to a much greater extent than historically. Work Package 2 of the TURAS programme aims to demonstrate how relevant an infrastructure approach can be in relation to managing green infrastructure in urban areas and how best practice from such an approach can be transferred between cities to build resilient and sustainable communities. Some decades ago it was unfeasible to plan the enlargement of urban areas without considering the urban living standards (mainly the percentage of green space per inhabitant and, more recently, access to green space). Currently it is unsustainable to plan a city without considering the biodesign of green infrastructure and how the green infrastructure contributes to the functioning of the city.

Figure 2 (below) represents a skeletal framework of the functional role that green infrastructure can play in an urban context. It also presents these benefits juxtaposed against perceived barriers to implementation. As such, the framework presents an overview of the basis for establishment of the Work Package 2 research programme and a focus for the aims of transition and dissemination targets in terms of affecting change.

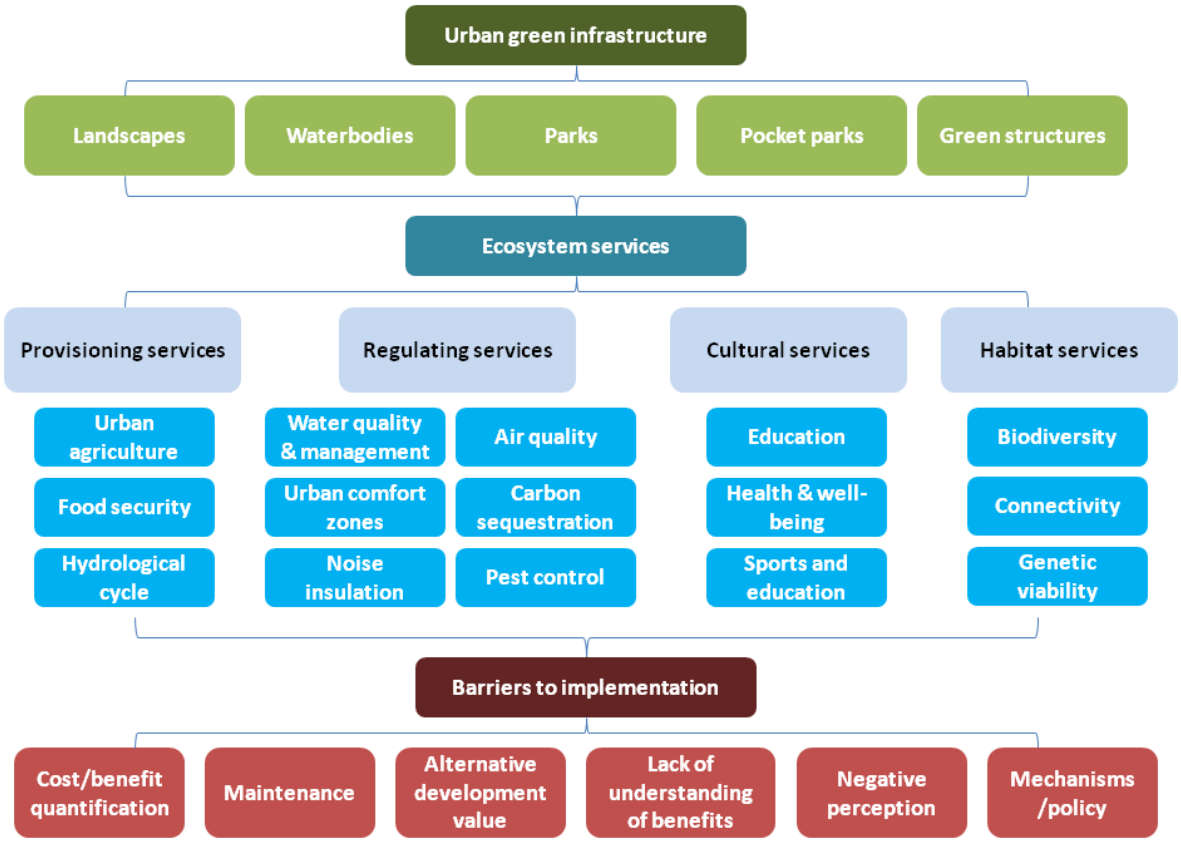


Figure 2. Framework for contextualising current understanding of urban green infrastructure

Critical to the development of urban green infrastructure (UGI) strategy is, of course, the importance of understanding the economic value of UGI not only as cost/benefit analysis but also as possible division between cities, and different regions within the same cities, in terms of social depravation indices and availability of public and/or private funding for green infrastructure schemes for the benefit of communities. For green infrastructure strategies to be taken forward in such scenarios, it is vital that the cost/benefits be quantified and also opportunities and mechanisms with regards to the engineering and construction components of UGI being recognised as relevant drivers. Construction and engineering of UGI solutions represent opportunities for SMEs and start-ups to be involved in the realisation process through linking enhanced resilience and sustainability with social economic development.

It has already been demonstrated that in positive social environments UGI may represent an aggregative tool and create social cohesion. In contrast however, where societal problems occur, it can be difficult to prioritise UGI, which may easily be considered as a superfluous and expensive. Part of the aim of WP2 experimentation was to demonstrate how UGI best practice can represent cost-effective solutions in terms of providing multifunctional benefits in urban areas including areas of social depravation and poor environmental quality. The next phase is to elaborate a strategy for raising awareness and capacity building for encouraging urban stakeholders to recognise and utilise UGI solutions. The design of the research and dissemination within WP2 is such that this should be achievable both from a bottom-up community-led approach and from a top down legislation and policy approach relating back to Directives, Strategies and Programmes already put in place by the EC. Due to the strong focus within WP2 on biodiversity-led truly multifunctional green infrastructure design in order to maximise ecosystem service provision in urban areas, this would include:

- The Water Framework Directive;
- The INSPIRE Directive (related to spatial data infrastructure with specific reference to environmental and planning data);
- The EULF (European Union Location Framework) - an initiative that is aiming to focus how public authorities may profit from geo-location providing services to citizens. A key focus in the on-going programme is the issue of energy;

- The Floods Directive;
- Waste legislation and policy - The Thematic Strategy on the Prevention and Recycling of Waste, the Waste Management Directive, and potentially the Management of Waste from Extractive Industries Directive (through the use of secondary recycled waste products in the design of green infrastructure elements);
- Environmental Noise Directive;
- Directive on Ambient Air Quality and Cleaner Air for Europe;
- 2030 Climate and Energy Policy Framework;
- EU Adaptation Strategy on climate change; and
- International, EU and local biodiversity policy and legislation including supporting the Habitats Directive and the International Convention of Biodiversity, EU Biodiversity Strategy to 2020 and national policy and legislation which supports the delivery of these targets.

In spite of these initiatives, and others that member states are undertaking nationally, it can be difficult to create awareness among politicians and stakeholders who are not keen on planning and environmental experiments that do not produce concrete and immediate results. With reference to this issue, WP2 has attempted to demonstrate experimental results in real-world settings with outputs representing quantifiable benefits in showcase settings that are relatable to all Public Authorities and stakeholders within target cities. Moreover, WP2 has demonstrated how UGI design can represent a multifunctional solution to interrelated issues associated with urbanisation that are relevant to all public authorities, including, flooding, urban heat island, air quality, recycling, biodiversity and health & well-being of communities.

Urban green infrastructure functions as design components spanning from regional and urban planning through architectural design to very detailed scale such as green roofs and walls. In order to generate results that could be transferred directly into practice, much of the experimental research conducted within WP2 activities related to the construction of green infrastructure at a 1:1 scale. This enabled subsequent collection and analysis of data from the UGI experiments and case studies to be more reflective of real world performance and to include guidance on replication of UGI design in addition to best practice performance. In parallel with links between urban biodiversity and urban resilience reported in Cities and Biodiversity Outlook research, integral to all of the WP2 research was the ideology that biodiversity should be embedded at the heart of all urban green infrastructure design. Additional multifunctional ecosystem service benefits are supported by this process of biomimicry of biodiverse and regionally typical green infrastructure in urban areas, rather than the more typically encountered process of biodiversity being an assumed benefit of urban green infrastructure designed for singular or narrow ecosystem service provision. Related to this has been the investigation of the feasibility of “pocket parks” to provide biodiversity benefits and associated ecosystem service benefits through small-scale greenspace provision for communities. This approach to the micro- or nano-park demonstrates the great opportunity offered by UGI practice when applied to high-density urban areas.

In spite of clear and positive technical achievements in WP2 the issues of how to create awareness and increase understanding in relation to UGI are far for being solved, the TURAS ethos has aimed to address this by moving away from a purely academic scientific and technical paper focus to knowledge exchange and collaboration with key stakeholders. Within the first three years of WP2 we have demonstrated how these partnerships can work and provided blueprints for such collaboration. Now there is a need to transfer this best practice in UGI planning, development and management to additional cities and Public Authorities within the TURAS partner network and beyond. To achieve this requires a process comprising both awareness raising and capacity building.

WP2 has thus far provided showcases for technical theoretical solutions and adaptive governance support. The next phase of WP2 is to develop these into practicable UGI support tools that demonstrate how biomimicry may be used as an approach that can be directly incorporated into planning, at different scales, for a more resilient environmental approach to urban planning. Physical planning techniques for shaping the greenspace within cities and meeting targeted living standards for inhabitants are traditional tools already in use by planners for city and neighbourhood planning. UGI introduces a new paradigm in relation to this urban greenspace planning. The innovative approach recognises the contribution that UGI may make directly to greenspace provision, but goes further than this in recognising its value as a new city component capable of supporting multifunctional benefits for the environment, biodiversity and communities and requiring

multidisciplinary collaboration between environmental and social planning departments (such as energy, air quality, biodiversity, health & well-being) to ensure that multifunctional benefits are maximised.

In recognition of the fact that multifunctional UGI is an emerging and innovative area of urban planning, TURAS WP2 has developed and is making available a repository database formed from ad hoc questionnaires of TURAS Case Study city partners. The questionnaire records examples of best practices and outstanding innovation in UGI in the EU. The questionnaires are designed to capture the entire process of UGI implementation from idea inception, through design, planning, construction and management. As such they provide a catalogue of the experience of UGI adaptive governance and represent a format that others can replicate in terms of collaboration and delivery.

The most relevant challenge now is how to make outcomes from WP2 transferable to Public Authorities and other final users in the UGI development process. It has been assumed by the project in the DoW that final users should have appropriate visions and match feasible strategies for achieving the aims. This Deliverable is the first step along that process, a summary of work published in WP2 and easily transferrable visions and guidance on how the principles developed in WP2 can be transferred to other cities and regions. This document aims to provide guidance on a way forward for Public Authorities to approach UGI and raises awareness on how they may benefit from best practice within WP2 and integration with other TURAS Work Packages.

The key steps required to achieve this transfer that this document was designed to support are:

- informing and motivating Public Authorities about UGI potential and best practice by the use of accessible and easily interpretable **VSCs (Vision + Strategy Cards)** that showcase examples of good practice from WP2;

- encouraging PAs to further evaluate ad hoc solutions for UGI rooted in their own regional context through best practice showcases, support tools and databases developed in WP2;

- integrating WP2 into the overall TURAS aim of transitioning urban areas through the use of standardised Activity Units to link and integrate WP targets and outputs.

2. UGI visions and strategies in the context of public authorities

Whilst numerous stakeholders are involved in the development of successful UGI initiatives, Public Authorities are generally the critical stakeholder within the process as their role encompasses providing urban planning guidance, making planning decisions and managing greenspace. As such, visions and strategies are primarily targeted towards this audience. Nevertheless, additional stakeholders such as Public Private Initiatives (PPI), private companies, non-government organisations and community groups may be involved in planning, building and maintaining UGI. As such, visions and strategies have been designed to be as broadly applicable as possible.

The successful transfer of visions created in this Deliverable is, however, ultimately dependent upon Public Authority engagement. It is critical that Public Authorities have flexibility for change, a long term view of their activities, and a willingness to review, analyse and synthesise their current policy on UGI in order to create opportunities for embedding best practice into policy and translating potential into reality. If such opportunity and willingness exists within Public Authorities, following the visions, strategies, and guidance tools and best practice UGI examples developed within WP2 will facilitate transition for urban communities to healthier, more sustainable and more resilient futures.

Public authorities continuously face challenges that need to be met in order to transition to a desired future state. Meeting these challenges relates to adopting appropriate strategies. In the case of UGI adopting these strategies may enable cities to develop physical solutions that build resilience in the face of climate-driven environmental change, mitigate against some of the environmental impacts of urbanization, and improve the quality of life of their communities including managing anti-social behaviour and creating social cohesion.

The next phase of TURAS will involve raising awareness within Public Authorities in relation to the visions, strategies, tools and practical examples of transitioning change detailed within this Deliverable. The entire of WP2 aims to provide effective strategic and decision-making tools of various forms in order to help the process. The initial phase of this comprises awareness raising within PAs and potential users with the ultimate aim of building the capacity to put UGI interventions in place. The remainder of this document provides examples, guidelines and tools to support this aim based on the diversity of methods researched and tested within the activities of WP2. The VSCs introduced in the following section are designed to provide an accessible platform showcasing snapshots of case studies, experiments and specific tools developed within WP2 to facilitate the awareness raising and knowledge transfer process.

3. WP2 Dissemination - Vision + Strategy Cards

The Vision + Strategy reference cards (VSC) presented in the subsequent section are designed to provide Public Authorities with an accessible overview of the lessons learned in relation to UGI planning within the key development aspects of the first three years of TURAS WP2. In so doing, they will increase understanding and raise awareness of the role that UGI can play in urban resilience and sustainability and support the decision-making process involved in strategic UGI planning.

In terms of strategy sharing, there is a well-known definition that strategy, is the determination of the basic long-term goals of a public authority, the adoption of courses of action, and the allocation of resources necessary for carrying out these goals. The VSCs support this strategic process by providing Public Authorities with the potential to identify the most suitable goals and courses of action that can be implemented to progress targeted UGI towards realisation and the potential for cost/benefit analysis to assess resource allocation in relation to environmental targets. This is possible due to the diverse nature of WP2 outputs, in relation to UGI assessment, planning, design, construction and monitoring, enabling selection of the most appropriate UGI principles that can then be used separately or jointly to realise the vision of truly multifunctional UGI.

Some of the tools developed represent ready-made solutions or guidance, but the majority of outputs from this Deliverable represent templates on which regional context must be applied if maximum value is to be achieved from UGI. Indeed, one of the most significant lessons learnt within the WP2 process is the need to avoid universality and focus on regional context in relation to UGI design, resilience and ecosystem service provision. The VSCs presented below provide an overview of WP2 actions and an introduction to the Activity Units presented later in this document. The Activity Units contain more detailed information about test scenarios, automated tools, best practice examples, and repositories of adaptive governance processes for real-world case studies. They also represent the next step towards integrating research carried out within different TURAS Work Packages. The Activity Units themselves represent a summary of the lessons learned from the key research project and Case Study outputs from WP2 (Figure 3). These outputs are listed and summarised in Section 7 of this report.

The process of raising awareness and supporting decision-making for implementation of UGI for Public Authorities involves:

- Public Authority (PA) being motivated to understand and consider the role of UGI in urban resilience, sustainability, biodiversity conservation and quality of life;
- PA understanding and/or analysing their situation in terms of planning for urban resilience and embedding sustainability in their communities, including in relation to identifying opportunities for urban green infrastructure;
- Promoting WP2 activities in the form of VSCs to PAs through the TURAS website, TURAS workshops and word-of-mouth to assess how targets may be correlated with different visions of WP2 and identifying new targets from WP2 that were not previously considered;
- PA selects WP2 activities appropriate to their targets and refers to specific Activity Unit or WP2 outputs to fully understand the specific tools, examples, practices, involved in the transition process;
- PA initiates the process of embedding UGI best practice into planning policy by assembling appropriate consortiums with the multidisciplinary range of expertise necessary to maximise the multifunctionality of UGI design and implementation.
- Linking to the WP2 role-play and best practice databases, in partnership with the PA, the consortium develops planning guidance to encourage multifunctional UGI best practice including the incorporation of regional context into UGI design.
- The PA develops and promotes flagship examples of best practice to demonstrate how achievable new aims and visions are in the specific urban context.

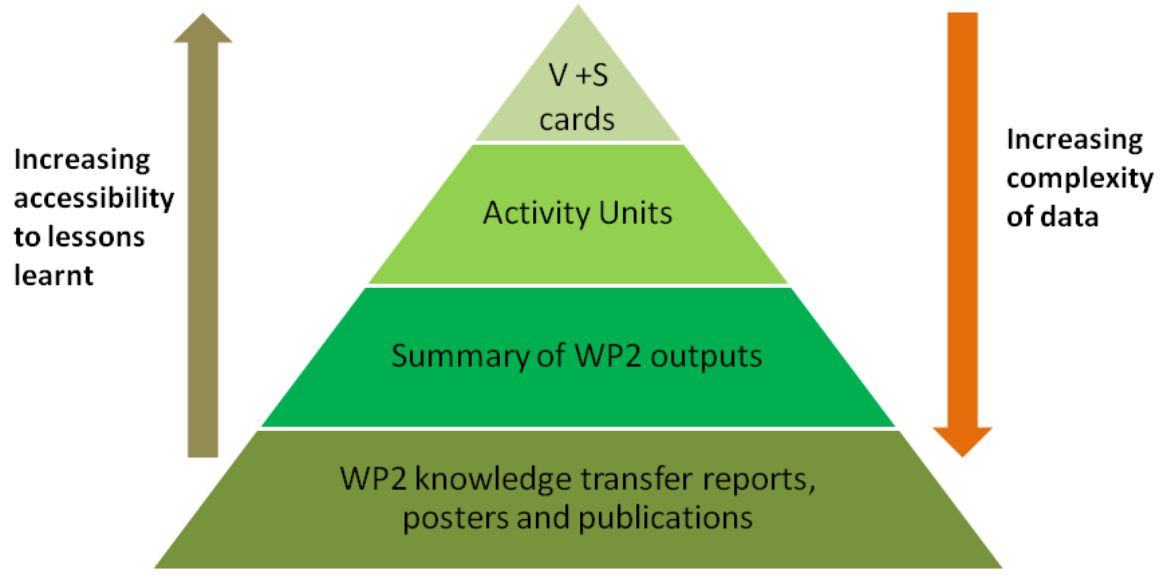


Figure 3. Hierarchy of accessibility to lessons learnt for transfer to Public Authorities

The following VSCs have been developed to support this process:

1. **Planning urban green infrastructure (UGI) retrofit for socially deprived areas**
2. **Urban green infrastructure (UGI) cost-benefit assessment model**
3. **Achieving biodiversity-led multifunctional urban green infrastructure (UGI)**
4. **Green Living Room, Ludwigsburg**
5. **Embedding urban green infrastructure (UGI) into a new community at Barking Riverside**
6. **Urban Green Infrastructure (UGI) best practice database**
7. **Urban Green Infrastructure (UGI) decision support tool**

4. Vision + Strategy Cards (VSCs)

The following section contains the VSCs (Visions + Strategies Cards) for WP2. They have been established to provide an accessible platform for Public Authorities, and a gateway to additional dissemination material and reports developed within WP2 of TURAS. Their aim is to initiate and motivate deeper understanding of the potential of UGI in order to support the decision-making process associated with restoration of green infrastructure in urban areas.

The cards relate to the main findings and developments established during the first three years of the TURAS projects. This includes literature review, cost/benefit analysis, green infrastructure audit, experimental studies, case studies and best practice. They are all designed to include 3 pages/slides, each based on the experience of the partners involved and documenting on overview of information in order to generate deeper interest in the subject and a basic framework from which others can replicate or utilise the best practice. The three pages comprise:

- **Page 1 -** a brief summary of the topic of the VSC followed by a summary of the Visions and Strategies associated with the topic, and a summary of the Activity Units the VSC relates to;
- **Page 2 -** a pictorial representation of the key stages within the process that were followed in the first three years of TURAS for the specific VSC;
- **Page 3** - a toolkit, best practice, guide or lessons learned summary to support Public Authorities and other stakeholders to replicate the UGI principles developed within the VSC topic.

It is intended that, initially, VSCs will be printed as dissemination materials for generating interest in TURAS design principles. The next phase of development will include converting the VSCs into a standalone multimedia presentation including audio clips that can be downloaded from the TURAS website to advertise WP2 activities.

Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC01 - Planning urban green infrastructure (UGI) retrofit for socially deprived areas

What is it about?

Case Study example of a multidisciplinary collaborative approach to define and design UGI solutions for retrofitting within a socially deprived high density urban neighbourhood around the A12 in London, UK

Visions

- Environmental impact mitigation
- Increasing resilience to the effects of climate change and road infrastructure
- Improved health and well-being and quality of life
- Enabling greater social cohesion through participatory design and maintenance
- Connecting people and nature through access to wildlife and grow-your-own opportunities
- Site promotion

Strategies

- Coordinated grass-roots approach to planning
- Community engagement
- Biomimicry for regionally targeted species and habitats
- Innovative approaches to design for biodiversity
- Multi–stakeholder collaborative working
- Multi-functional approach to mitigation of environmental impacts (community connectivity, grow-your-own, air pollution, noise pollution)

Link to Activity Units (AU)

AU 2.5 - Green roof experimental research
AU 2.7 – Landscaping for biodiversity
AU 2.8 - Landscaping for biodiversity - Case Study
AU 2.10 – A12: Green Mile, Poplar HARCA

VSC01 - Planning urban green infrastructure (UGI) retrofit for socially deprived areas

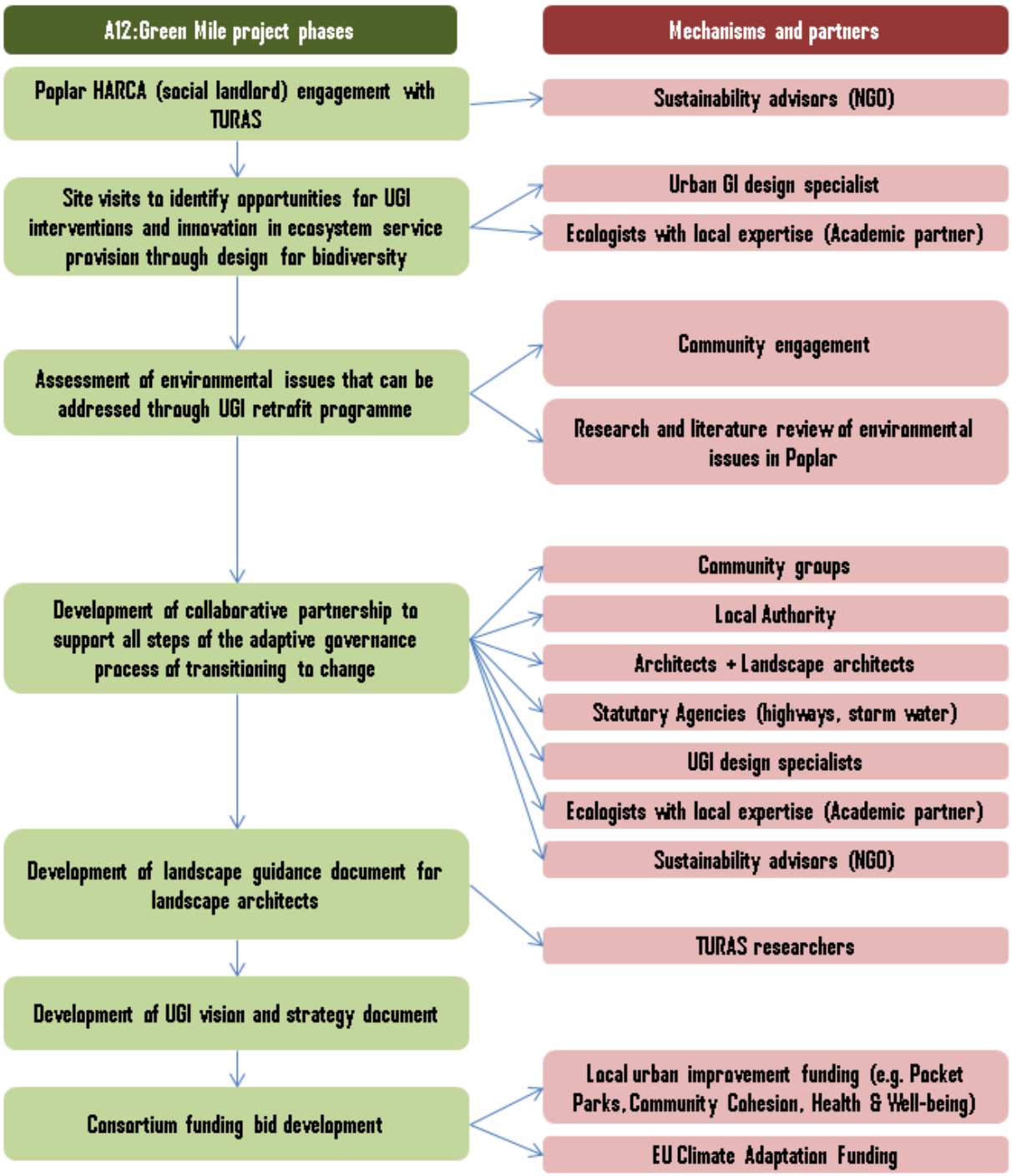
Community engagement and collaborative partner development

Generation of landscape guidance based on regional context

Identification of key environmental impacts

Development of opportunities for change through a vision statement and strategic plan to support collaborative funding bids

VSC01 - Planning urban green infrastructure (UGI) retrofit for socially deprived areas



Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC02 - Urban green infrastructure (UGI) cost-benefit assessment model

What is it about?

Creation of a cost benefit assessment model to assist in developing the business case for funding and implementing urban green infrastructure solutions.

Vision

- Innovative and novel assessment model development
- Raising awareness of multifunctional UGI benefits
- Model developed for broad audience including no technical users
- Suitable for a wide range of UGI typologies and contexts
- User-driven approach and complexity by design principals
- Base case can be enhanced through further use and research

Strategies

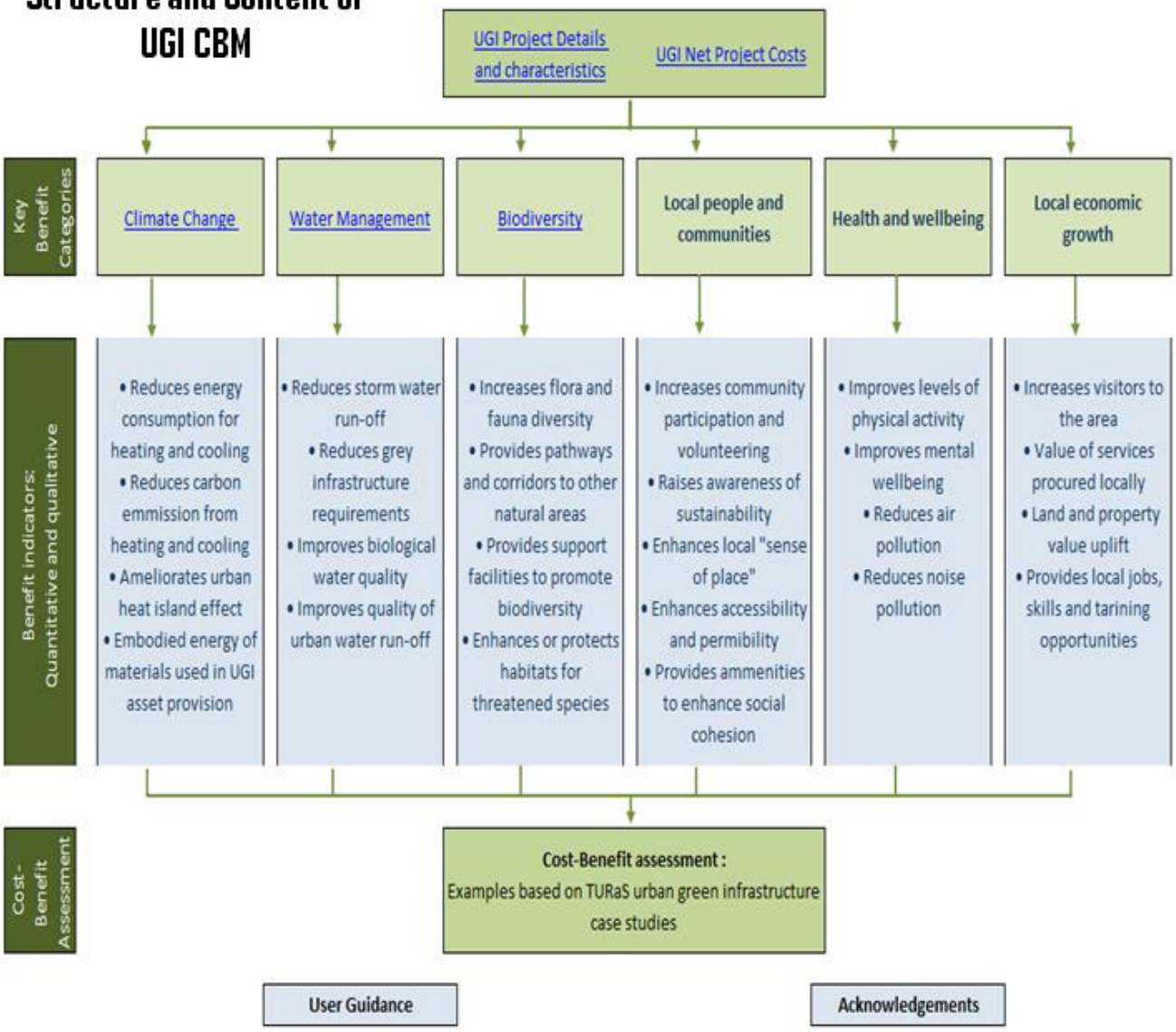
- Design of open source UGI assessment model
- Building on best practise assessment tools and research
- Cost-benefit focus on urban scale level interventions
- Identification of qualitative and quantitative benefit indicators
- Compliment and integrates with other TURAS tools (VSC07)
- User tested through TURAS UGI case studies

Link to Activity Units (AU)

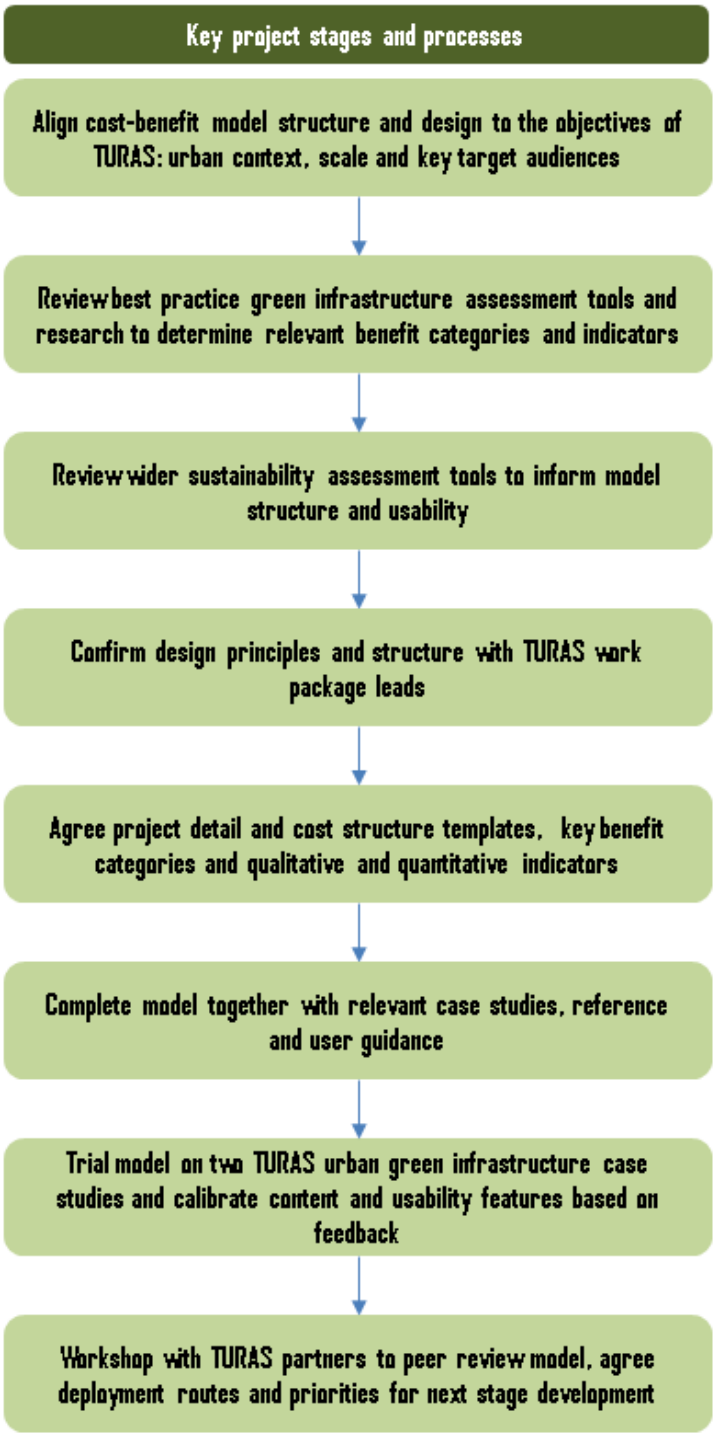
AU 2.3 – Urban Green Infrastructure cost/benefit assessment tool
AU 2.10 – A12: Green Mile, Poplar HARCA

VSC02- Urban green infrastructure (UGI) cost-benefit assessment model

Structure and Content of UGI CBM



VSC02- Urban green infrastructure (UGI) cost-benefit assessment model



Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC03 - Achieving biodiversity-led multifunctional urban green infrastructure (UGI)

What is it about?

UGI has the potential to provide multifunctional ecosystem service benefits in urban areas. Central to this is biodiversity conservation. It is being increasingly realised that biodiversity can support urban resilience. To support regionally distinct biodiversity there is a need to design for target species/habitats rather than rely on assumed benefits.

Visions

- Provide a refuge for biodiversity in urban areas
- Increase urban resilience through carefully designed UGI
- Enhance quality of life for urban communities through connections with wildlife and ecosystem service provision
- Protect and enhance biodiversity in line with EU Directives
- Create cost savings in design and maintenance
- Enhance sustainability through reuse of locally sourced products

Strategies

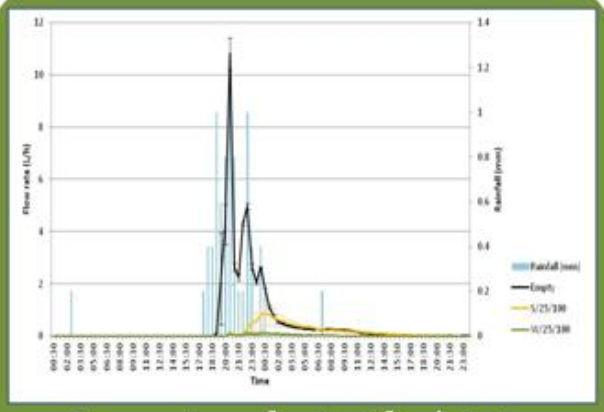
- Consideration of regional context through biomimicry
- Cost/benefit analysis of construction and maintenance
- Establishment of best practice case studies
- Embed best practice in planning guidance
- Design for multifunctional ecosystem service provision (energy saving, noise reduction, air quality, storm water management, etc.)

Link to Activity Units (AU)

AU 2.5 - Green roof experimental research
AU 2.6 – Green roof - Case Study
AU 2.7 – Landscaping for biodiversity
AU 2.8 - Landscaping For Biodiversity - Case Study
AU 2.9 - Practical application of WP2 research into planning guidance

VSC03 - Achieving biodiversity-led multifunctional urban green infrastructure (UGI)

Establishment of experiments to demonstrate how biomimicry of regionally important habitat can be fed into UGI design



Generation of scientific data to show that UGI designed for biodiversity does not necessarily have a cost in terms of other ecosystem services

Demonstration of benefits through Case Study examples on retrofit and new developments

Embedding best practice in local planning guidance documents using drivers such as SuDs Approval Bodies

VSC03 - Achieving biodiversity-led multifunctional urban green infrastructure (UGI)

Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC04 - Green Living Room, Ludwigsburg

What is it about?

The Green Living Room is a local intervention mitigation measure against the Urban Heat Island effect in Ludwigsburg. The Green Living Room was inspired by existing green wall concepts and projects with living plant construction (Baubotanik). The combination of the unique tree with modular green wall elements generates multifunctional and innovative green infrastructure

Visions

- Create a novel and multifunctional Green Infrastructure Module with high amenity value
- Mitigate the effects of the urban heat island
- Increase acceptance for mitigation projects
- Increase community resilience to the effects of climate change
- Showcase a sustainable irrigation system reusing rainwater
- Provide a stepping stone biotope
- Connect people and nature

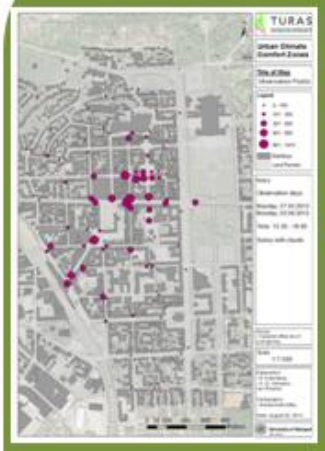
Strategies

- Develop and adapt the Urban Climate Comfort Zone concept
- Identify suitable locations for local interventions based on the UCCZ concept
- Design high quality open space with multifunctional ecosystem service benefits including supporting biodiversity
- Monitor and disseminate best practice including through future planning processes for the city of Ludwigsburg

Link to Activity Units (AU)

AU 2.1 - Green Living Room
AU 2.2 – Urban Green Infrastructure Evidence Database
AU 3.13 – Green Living Room

VSC04 - Green Living Room, Ludwigsburg



Assessment of movement patterns and tree density in Ludwigsburg

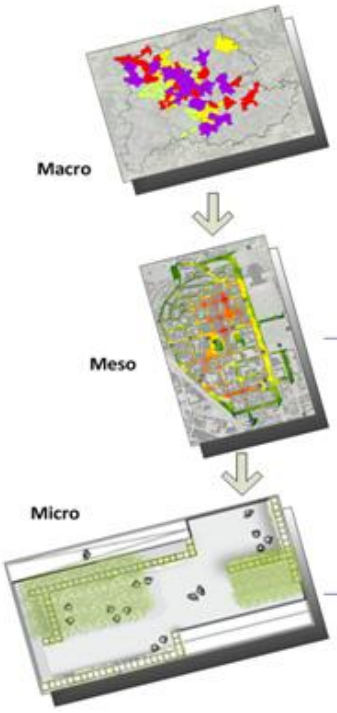
Identification of areas of concern in relation to the need for Urban Climate Comfort Zone

Construction of innovative multifunctional modular UGI

Launch and subsequent quantitative and qualitative monitoring of the Green Living Room high quality amenity space

VSC04 - Green Living Room Ludwigsburg

Developing the Urban Climate Comfort Zone Concept



Analysis of the region
=> spatial prioritisation

Analysis of prioritised municipalities
=> Identification of Core Areas

Analysis of local conditions
=> local adaptation and mitigation measures

Dimensions of analyses

Potential risk of thermal load

Potential of public movement

Sensitivity of potentially moving people

Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC05 - Embedding urban green infrastructure (UGI) into a new community at Barking Riverside

What is it about?

TURAS Case Study showcasing how multifunctional UGI can be embedded at the heart of the design of new communities. Barking Riverside is a new development of approximately 11,000 new homes. Working within TURAS Barking Riverside is trialling new UGI designs and showcasing innovation.

Visions

- Creating more sustainable communities
- Increasing community resilience to the effects of climate change and building on floodplains
- Developing more effective environmental impact mitigation when building on brownfield /greenfield sites
- Improving health and well-being and quality of life for communities
- Enabling greater social cohesion
- Connecting people, nature and greenspace management

Strategies

- Embed sustainability at the heart of masterplanning
- Multidisciplinary and multifunctional approach to UGI design using biomimicry to conserve wildlife
- Interweave SuDs management within community greenspace
- Provide community engagement workshops to promote understanding of the visions
- Establish a Community Interest Company (CIC) to provide ongoing management of the greenspace

Link to Activity Units (AU)

AU 2.5 - Green roof experimental research
AU 2.6 – Green roof - Case Study
AU 2.7 – Landscaping for biodiversity
AU 2.8 - Landscaping For Biodiversity - Case Study

VSC05 - Embedding urban green infrastructure (UGI) into a new community at Barking Riverside

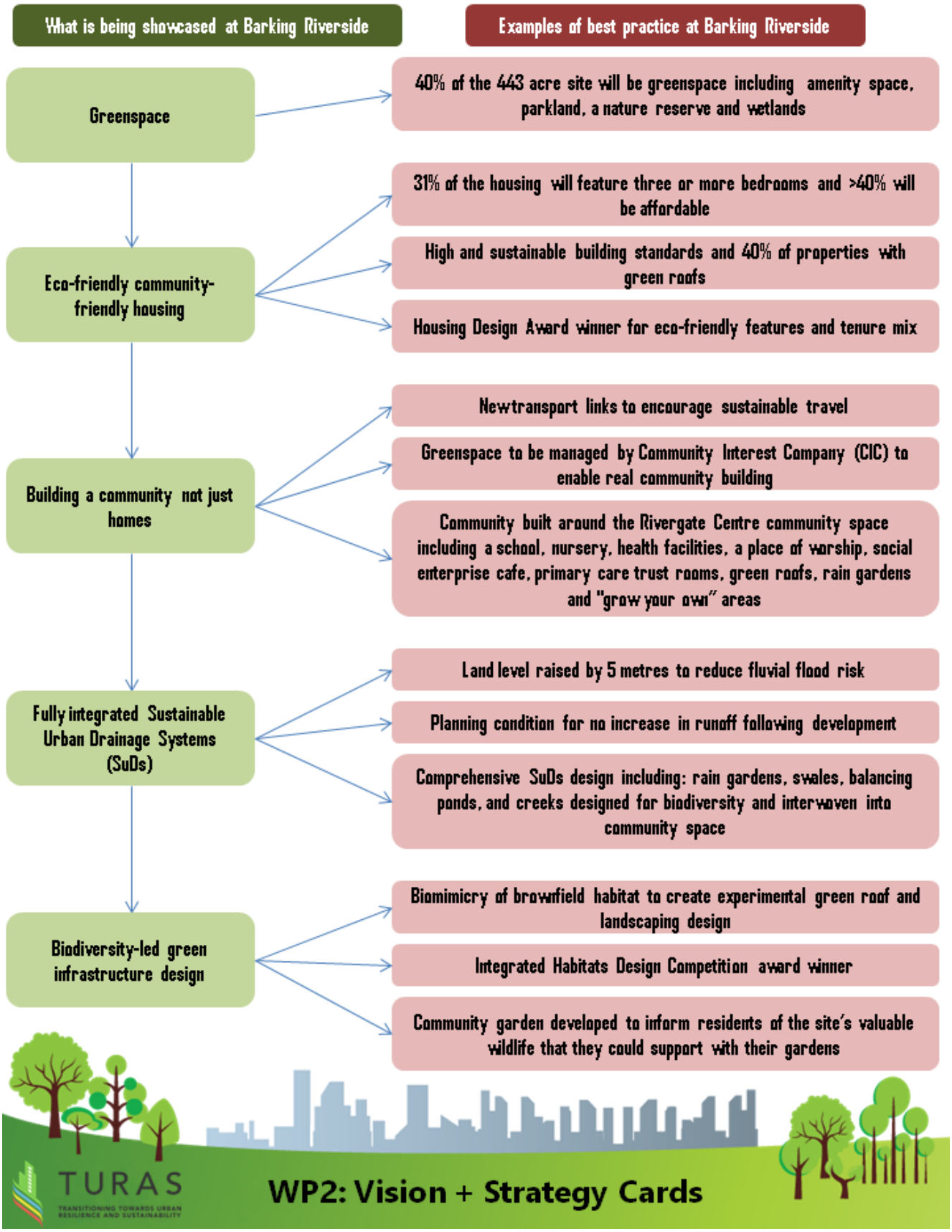
Barking Riverside masterplanning informed by site assessment to identify protected species , habitats and ecosystem services

Incorporation of multifunctional and biodiverse UGI throughout the development intertwined with community and living space

Community engagement to understand the needs and wishes of residents in the design of their green space

40% of site to be greenspace including innovative design of unusable land due to pylons. Green infrastructure to be managed by Community Interest Company

VSC05 - Embedding urban green infrastructure (UGI) into a new community at Barking Riverside



Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC06 – Urban Green Infrastructure (UGI) best practice database

What is it about?

Sharing of best practice is critical if TURAS research is to be disseminated and guidelines adopted. The UGI best practice database documents excellence in multifunctional UGI design from TURAS Case Studies, partner cities and beyond. By presenting examples of adaptive governance from design to management in UGI implementation it is possible to raise awareness , provide inspiration and support to future UGI initiatives.

Visions

- Support understanding of how UGI fits into the urban resilience and sustainability paradigm
- Document the decision making and planning processes involved in UGI implementation
- Transfer best practice for real-world examples
- Support future UGI initiatives on a global platform
- Provide a one-stop-shop for UGI adaptive governance and best practice

Strategies

- Browsing and utilising existing databases of best practices in EU
- Contacting developers and managers for meta-information and best practice through questionnaire
- Securing whole-process data from idea inception through to construction and management
- Embedding best practice database into TURAS UGI toolkits
- Supporting training and professional development

Link to Activity Units (AU)

AU 2.1 - Green living room
AU 2.2 – Urban Green Infrastructure Evidence Database
AU 2.4 – Urban Green Infrastructure best practice sharing
AU 2.6 – Green Roof - Case Study
AU 2.8 – Landscaping for biodiversity - Case Study
AU 2.9 - Practical application of WP2 research into planning guidance

TURAS TRANSITIONING TOWARDS URBAN RESILIENCE AND SUSTAINABILITY

WP2: Vision + Strategy Cards

VSC06 – Urban Green Infrastructure (UGI) best practice database

Generation of a catalogue of best practice to be used as metadata repository

Data gathered using a questionnaire including best practice at a building level

Also larger scale examples of UGI best practice including at a strategic landscape level

Data to encapsulate an adaptive governance approach including design, planning, construction and management

VSC06 – Urban Green Infrastructure (UGI) best practice database

Green Infrastructure

TURAS - URBAN RESILIENCE AND SUSTAINABILITY

VSC07 - Urban Green Infrastructure (UGI) decision support tool

What is it about?

Development of a role play tool for planners, citizens and practitioners that is a fun and easy-to-use framework for learning more about UGI best practice. The tool incorporates drivers and barriers to UGI in the decision-making process taking the user along a guided path and answering questions along the way.

Visions

- Provide a centralised accessible database of information on current understanding in urban green infrastructure implementation
- Present an overview of drivers and barriers of relevance to all stakeholders from practitioners to citizens
- Catalogue UGI implementation driver and barrier assessment decisions on an informed platform
- Support the UGI decision-making process

Strategies

- Create a user-friendly role play interface
- Provide an evidence base of UGI drivers and barriers to inform decision-making
- Make the information within the role play appropriate to all UGI stakeholders
- Focus the model on the UGI components most typical of high density urban areas (green roofs, courtyards and walls)
- Incorporate the flexibility to extend to other UGI components

Link to Activity Units (AU)

AU 2.2 – Urban Green Infrastructure Evidence Database
AU 2.3 – Urban Green Infrastructure cost/benefit assessment tool
AU 2.11 – Deliverable: Visions and Feasibility Strategies

VSC07 - Urban Green Infrastructure (UGI) decision support tool

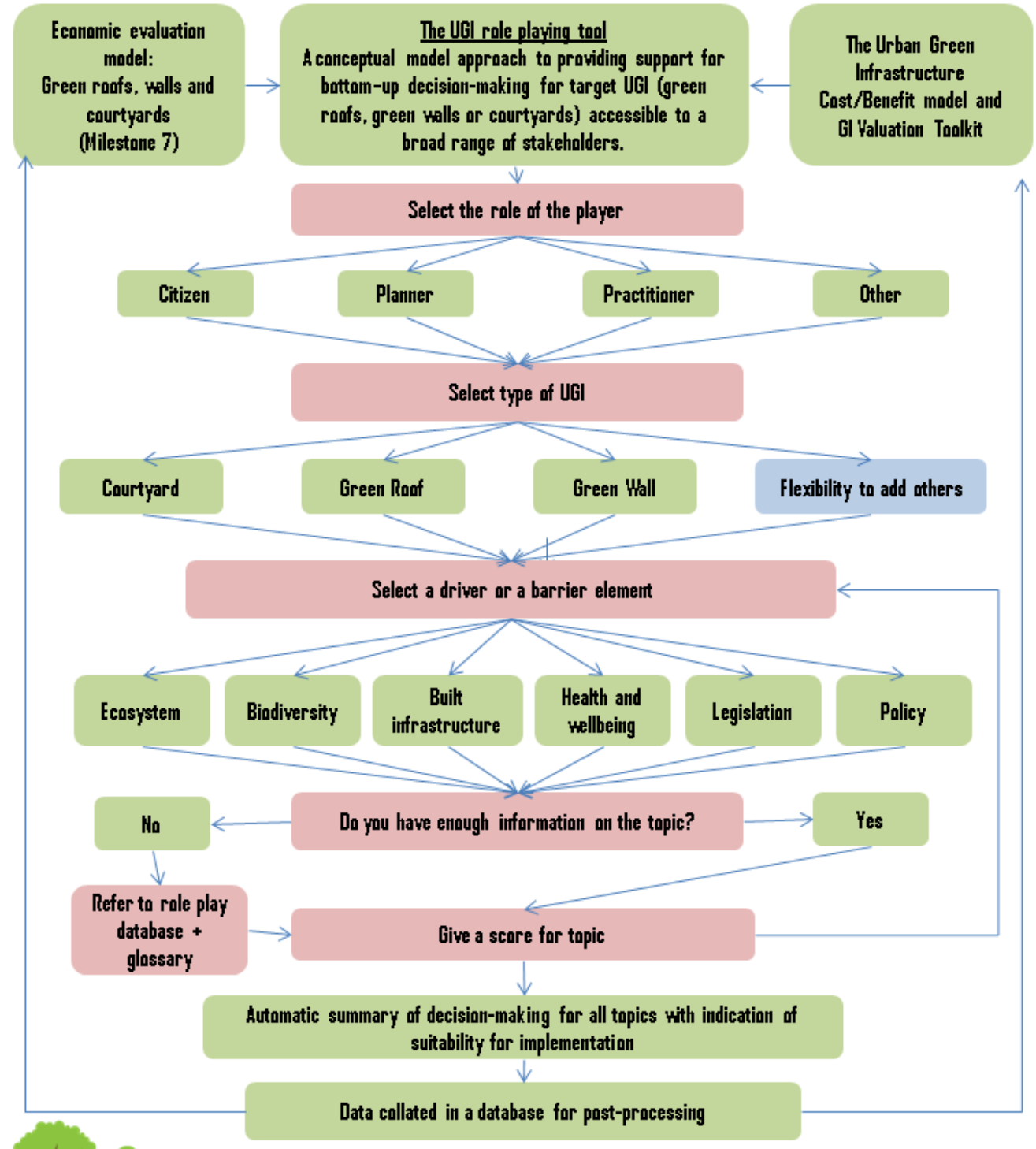
Evaluation of UGI barriers and drivers carried out

Development of a tool to involve all stakeholders in the decision-making process

Include a database of current understanding to support the decision-making process

Automated evaluation of decision-making to provide a summary output and catalogue importance in different stakeholder groups

VSC07 - Urban Green Infrastructure (UGI) decision support tool



5. How to use the VSCs: the mind map approach

The VSCs were constructed to be stand-alone tools/guidance notes for use by Public Authorities or to be presented and discussed with stakeholders by TURAS partners involved in WP2. To aid this, it useful to provide a road map to support the Public Authorities to reach their desired results and increase awareness about links between urban resilience, sustainability and the UGI concept. Figure 4 (below) depicts how VSCs may be orchestrated and linked, it also gives an à la carte menu to Public Authorities to decide from which point they want to start in relation to their own UGI policy development.

The road map represents the structure of the VSCs in relation to a natural policy development process from understanding and economic appraisal through to practical implementation of multifunctional UGI. It is also important to note, however, that there is a feedback loop back to planning and all activities under the more practical implementation VSCs also include examples of how the design principles could inform policy and support best practice understanding. The road map also includes representation of how each VCS can contribute to the removal of societal problems and barriers in relation to UGI implementation. In so doing, the road map provides the opportunity for Public Authorities to work backwards from specific problems that they are dealing with to find solutions from specific VSCs.

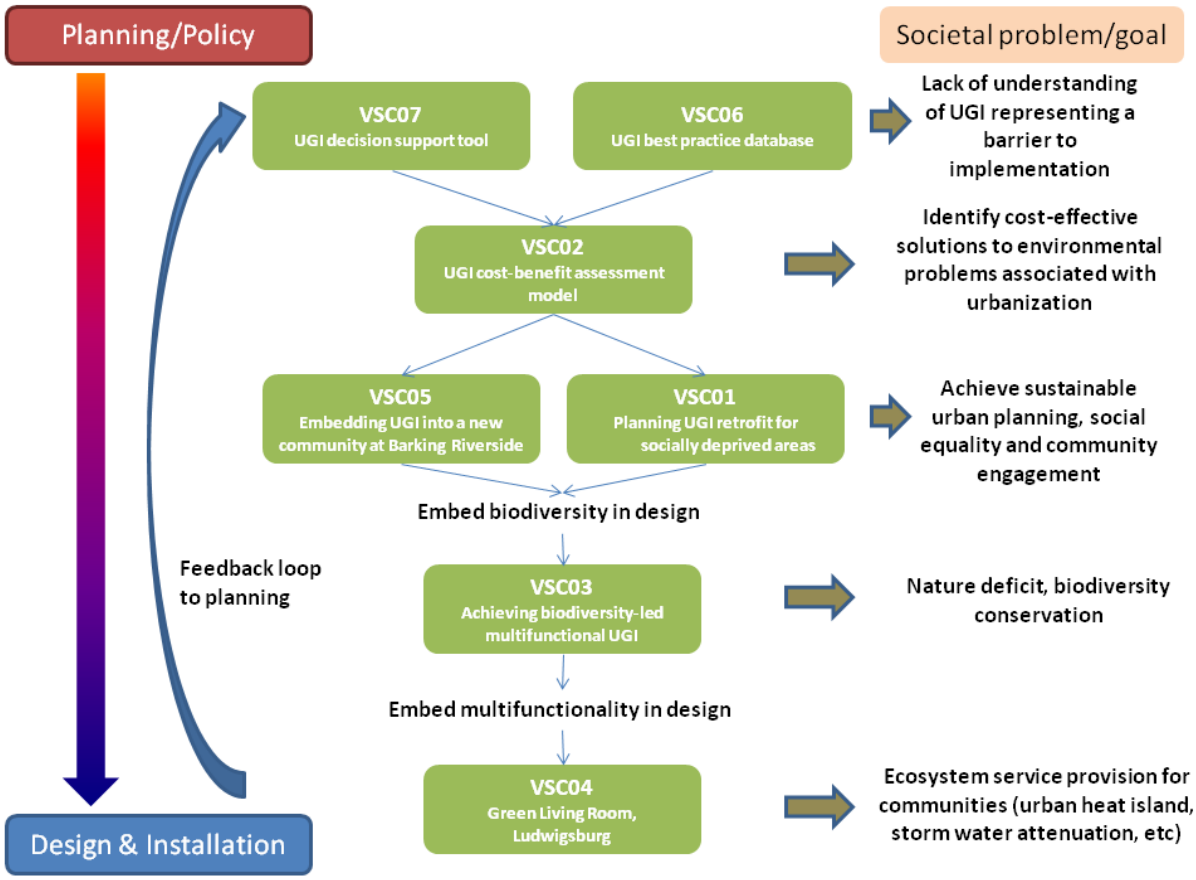


Figure 4. Mind map of Vision + Strategy Cards in relation to their value to Public Authorities

In a society driven by social networks and citizen participation, public pressure can often drive emerging issues and Public Authorities can be perceived as being unreactive due to limitations on rates of change in terms of planning policy review. By generating voluntary data (data directly produced by citizens and posted on open databases) citizens change their function from only being a user of data produced by Public Authorities to a data producer also. This emerging phenomenon is called 'prosumerism'. UGI can certainly be listed as one of these emerging issues, as a focus of the public's attention directly related to quality of life, and one for which citizens have a strong voice in terms of how they want their environment managed.

The VSCs cards and road map provide a framework for supporting community prosumerism by showcasing how Public Authorities can work with and support community groups and how community engagement can be embedded at the heart of UGI planning and development. Moreover, presentation of the multifunctional benefits that UGI can provide to communities (solution of social issues, the rehabilitation of the urban landscape, the improving of commercial activities, connecting with nature) may facilitate a more reactive response by Public Authorities to the needs of the community in terms of initiating the UGI praxis.

6. Overview of aims and delivery from Work Package 2

The remainder of this document details an overview of the original aims of WP2, the work done up to the 36 month reporting period, visions for how this work will be transferred to Local Authorities (Activity Units), and plans for how to continue the development of WP2 into the key transitioning and dissemination phase of TURAS.

6.1 WP2 Objectives

• To develop state-of-the-art techniques for evaluating and enhancing the ecological 'quality' of green infrastructure within urban environments.

• Generate a universal evaluation model for assessing the drivers and barriers to urban green infrastructure restoration. This model will incorporate the economic value of greenspace as carbon sinks and structural support for ecosystem services, the social drivers and barriers to installation, and the spatial scope for retrofitting and development.

• Design and establish field experiments investigating state-of-the-art technology and processes to maximise the biodiversity and economic value of roof-level green infrastructure leading to an overall reduction in a city's urban ecological footprint. This includes incorporating biomimicry into the design of green elements for retrofitting existing public and private urban infrastructure and design, planning and construction of new developments.

• Develop and evaluate a design protocol for incorporating art, creativity and regional habitat characteristics into landscape design for maximising the biodiversity value of urban green infrastructure.

• Pilot test design tools disseminating from field experiments at the case study area of the Barking Riverside Development in East London.

• Implement monitoring and analytical strategies in order to assess efficacy and structure recommendations for other case study areas.

• Develop visions, feasible strategies, spatial scenarios and guidance tools that would enable adaptive governance, collaborative decision-making, and behavioural change in green infrastructure design across selected areas in Greater London, Rome, throughout the TURAS project network and in non participating cities.

6.2 WP2 Tasks

TURAS WP2 objectives are being delivered through a series of Tasks:

Task 2.1 - Work Package kick-off meeting.

Task 2.2 - Generate a universal evaluation model for assessing the drivers and barriers to urban green infrastructure restoration.

Task 2.3 - Design and establish field experiments investigating state-of-the-art technology and processes to maximise the biodiversity and economic value of green walls and roof-level green infrastructure.

Task 2.4 - Develop and evaluate a design protocol for incorporating art, creativity and regional habitat characteristics into landscape design for maximising the biodiversity value of green infrastructure.

Task 2.5 - Pilot test design tools disseminating from field experiments at the case study area of the Barking Riverside Development in East London.

Task 2.6 - Develop visions, feasible strategies, spatial scenarios and guidance tools that would enable adaptive governance, collaborative decision-making, and behavioural change in green infrastructure design across selected areas in Greater London, Rome and throughout the TURAS project network.

The remainder of the present document represents a synergistic analysis of WP2 written dissemination outputs up to the 36 month reporting period at the summary and Activity Units level. As such it provides a foundation for the delivery of Task 2.6.

The following section presents an abstract describing each publication or toolkit developed within WP2. Outputs are listed by Task under which each piece of work was delivered. Documents are at different stage of development (complete, submitted, draft) and have different levels of accessibility due to issues with confidentiality and future publication. All of this information is presented for each piece of work.

7. Bibliography of WP2 publications

Task 2.1 - Work Package kick-off meeting

No outputs under this Task other than an initial meeting to introduce partners and develop a plan for the delivery of WP2

Task 2.2 - Generate a universal evaluation model for assessing the drivers and barriers to urban green infrastructure restoration

Output 2.2.1

Monastra G., Baffioni C., Mendozza M., Odorico M., Vallocchia S., Cresce A., Tudini F.M., Zubboli C. (2014) Milestone 7 - Economic evaluation model Green roofs, walls and courtyards: Working economic evaluation model for green infrastructure value and design: model completed and working on sample data. Roma Capitale, Roma, Italia

Summary - A document reviewing the experience of the City of Rome in the field of green infrastructure (roofs, walls and courtyards "green"). The document details the experience of, and references to, green infrastructure in Rome. It also represents a skeletal model for all cities to prepare a review on their green infrastructure. The review includes:

- an historical overview on green infrastructure from the ancient world until the recent past (Figure 5);
- a description of the key modern green infrastructure interventions recently implemented, both in the public and private sectors;
- an overview of educational initiatives associated with modern green infrastructure implementation put in place by Roma Capitale;
- a summary of the principal laws of reference to authorities national, regional, provincial and municipal;
- a collection of the main technical standards in the sector;
- a technical description of the types of green infrastructure achievable, taking into account the specific characteristics of the city;
- An assessment of the cost of installation of such facilities.

Also included in the appendices is a summary Table that catalogues the advantages/drivers for green infrastructure implementation and the obstacles and barriers that restrict green infrastructure restoration in urban areas. The Table also includes an overview of associated costs.

The document represents a strategic handbook containing a Roma case study of urban green infrastructure economic evaluation and responds to the requirements of Milestone 7 within Task 2.2 - "Economic evaluation model - Green roofs, walls and courtyards".

Link - Evaluators Area: WP2: Output 2.2.1.

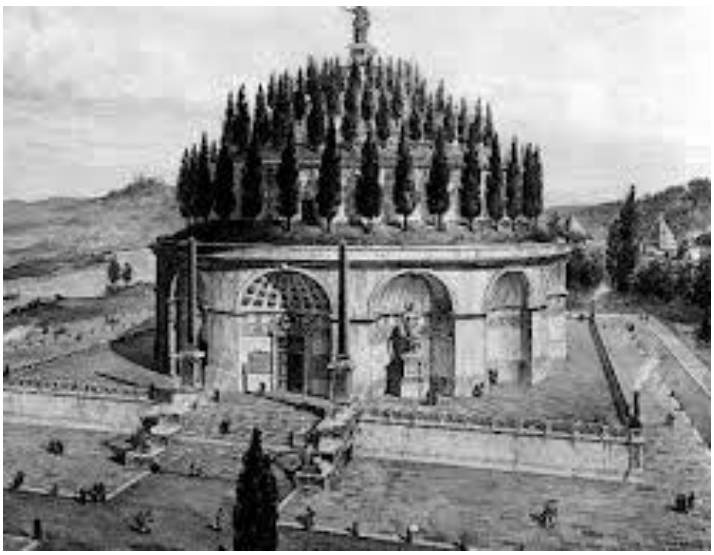


Figure 5. Historical green infrastructure in Roma, The Mausoleum of Augustus in Rome (29 BC) is still visible today.

Output 2.2.2

Salvemini, M. and Berardi, L. (2013) Annex to Milestone 7: Annotated Bibliography of best practice in urban green infrastructure. Sapienza – Università di Roma, Roma, Italia.

Summary - This document aims to support the transition of Roma Capitale's Milestone 7 report - Economic model green roofs, walls and courtyards " from a Public Authorities approach, utilising privileged access to base documents on their own experiences, into an international context. The report provides a bibliography of international level relevant initiatives taking places in relation to green infrastructures planning and analysis. The short and essential bibliography was intended to offer critical references and solid documentation for treating the issue in a wider perspective. The listed documents contain reports and manuals which are widely recognized as reference documents for the on-going research and best practice in urban green infrastructure. Another useful short list, although not exhaustive, contains already recognised best practices in other cities (Figure 6). This helps to provide a reference for the Rome document in relation to other contexts.

Link - Evaluators Area: WP2: Output 2.2.2

Figure 6. Example of present day urban green infrastructure best practice in Milan, Italy.

Output 2.2.3

Monastra G., Baffioni C., Mendozza M., Odorico M., Vallocchia S., Cresce A., Tudini F.M., Zubboli C. (2014) Online urban green infrastructure decision support toolkit Roma Capitale, Roma, Italia.

Summary - To support the urban green infrastructure economic and barrier/driver evaluation work carried out in document 2.2.1 Roma Capitale developed an online decision-making assessment toolkit (Figure 7). Utilising the barriers and drivers identified to urban green infrastructure implementation in Roma, a series of assessment criteria were combined with a scoring system to support a decision-making framework and also to assess how decisions are made and the value that green infrastructure stakeholders place on decisions.

The urban green infrastructure evaluation role play toolkit is being trialled with Roma stakeholders and WP2 partners to assess its potential for use as a universally applicable framework to evaluate green infrastructure implementation and to generate data on reasoning behind decisions related to urban green infrastructure implementation. It is intended that in the later stages of the TURAS programme, best practice from all of WP2 will be fed into the role play model to provide a database that supports and informs the urban green infrastructure decision making process.

Status - On-going development

Figure 7. Home screen of the TURAS urban green infrastructure decision-making support role-play toolkit.

Output 2.2.4

Kathrani, A. and Knapp, J. (2014) Interim Report for the 'Urban Green Infrastructure Assessment Tool (UGIAT)'. Institute for Sustainability, London, UK.

Summary - To support the urban green infrastructure evaluation work being carried out by Roma Capitale, the Institute for Sustainability (IfS) are developing an urban green infrastructure cost/benefit analysis toolkit - the Urban Green Infrastructure Assessment Tool (UGIAT). As part of this process the IfS have prepared an interim report that has:

- drawn and built on the CABE developed Green Infrastructure Valuation Toolkit (the preeminent general green infrastructure assessment tool in this arena) and identified gaps relevant for TURAS;
- reviewed other green infrastructure assessments to ascertain relevant assessment indicators;
- reviewed best practice from other relevant sustainability assessment tools.

The UGIAT is currently under development. The structure comprises four sections:

- a narrative: description of the GI project or areas. Users to articulate the aims and objectives for the project under evaluation;
- GI project characteristics: the scale, focus and key drivers for the GI project under evaluation, including the target audience, and the "type" of GI project being evaluated;
- Evaluation: assessment of the GI project using qualitative, quantitative and monetised indicators in each of 6 benefit groups (Figure 8);
- Detailed output: the evaluation of the GI project will bring together key elements from sections 1-3 and produce an output that can supplement a funding proposal or business case, identify the added value of the project and support the 'decision tree' that may be used by decision makers.

Once completed, the UGIAT will be trialled with WP2 local authority partner the London Borough of Barking and Dagenham and with other WP2 partners through a focus group meeting. The UGIAT will then be disseminated through TURAS workshops as a framework for urban green infrastructure cost/benefit assessment for all user groups involved in urban green infrastructure planning.

Link - Evaluators Area: WP2: Output 2.2.4

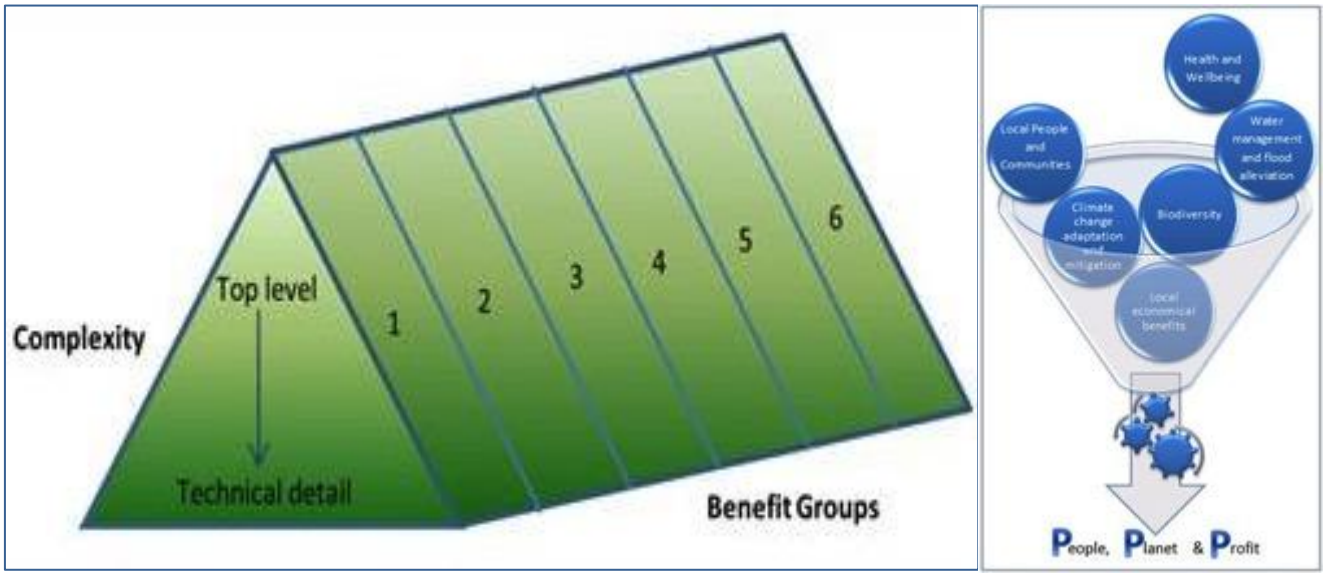


Figure 8. Benefit groups and complexity for the urban green infrastructure assessment tool (left) and the process of the Urban Green Infrastructure Assessment Tool (right).

Task 2.3 - Design and establish field experiments investigating state-of-the-art technology and processes to maximise the biodiversity and economic value of green walls and roof-level green infrastructure

Output 2.3.1

Eisenberg, B., Gölsdorf, K., Weidenbacher, S. and Schwarz-von Raumer, H-G (2014) Milestone 12 - Report on Urban Climate Comfort Zones and the Green Living Room, Ludwigsburg. University of Stuttgart, Stuttgart, Germany.

Summary - In April 2014 the Green Living Room (Figure 9) – a multifunctional green open space – was inaugurated by the deputy mayor of the city of Ludwigsburg, Germany and the Technical Director of the Verband Region Stuttgart. From the first day the Green Living Room attracted visitors and citizens of Ludwigsburg alike and instantly became a favourite place to sit and rest. This unique living wall structure is built implementing the Urban Climate Comfort Zone concept: an approach that tackles the challenges of increasing urban heat island effects in cities due to climate change.

The Green Living Room, as well as the Urban Climate Comfort Zone Concept, were elaborated at the University of Stuttgart, Institute of Landscape Planning and Ecology within TURAS. The project partners HELIX Pflanzen GmbH , Verband Region Stuttgart and the University of Stuttgart together with the collaboration partners City of Ludwigsburg and Ludwig Schoenle Architects contributed to the work presented in this report. It is a coherent document that covers the interlinked work done within the framework of Work package 2 and Work package 3 of TURAS. With respect to WP2, the report details the background, design, construction and monitoring of this novel technique for designing urban greenspace.

Link - Evaluators Area: WP2: Output 2.3.1

Figure 9. Visitors take possession of the Green Living Room, Ludwigsburg, Germany.

Output 2.3.2

Gölsdorf, K. (2014) Habitat quality of Green Wall elements: Progress Report. HELIX Pflanzen GmbH, Kornwestheim, Germany.

Summary - Progress report on the Stuttgart green wall development project (Figure 10) with particular focus on collaboration with Stuttgart University and the University of East London on how the green wall project can promote regionally important biodiversity. The report also includes details of dissemination from the project.

Figure 10. Prototype green wall construction, Stuttgart, Germany

Link – Evaluators Area: WP2: Output 2.3.2

Output 2.3.3

Gölsdorf, K. (2014) The Green Living Room Ludwigsburg - Construction: Progress Report. HELIX Pflanzen GmbH, Kornwestheim, Germany.

Summary - Report detailing a timeline for the Green Living Room development process. The timeline begins from the development of the open competition for local authorities and follows through to the installation (Figure 11) and monitoring. The timeline provides guidance for local authorities and green wall installers on the processes and barriers involved with such a project.

The report also presents a pictorial database of installation of the Green Living Room in Ludwigsburg.

Link – Evaluators Area: WP2: Output 2.3.3

Figure 11. TURAS Green Living Room installation in Ludwigsburg, Germany.

Output 2.3.4

Gölsdorf, K. (2014) The Green Living Room Ludwigsburg: Press report. HELIX Pflanzen GmbH, Kornwestheim, Germany.

Summary - Details of all of the media engagement work (Figure 12) publicising the TURAS Green Living Room development and installation in Ludwigsburg, Germany.

Link – Evaluators Area: WP2: Output 2.3.4

STADT LUDWIGSBURG 7

WWW.LKZ.DE

BAUBOTANIK

Auf diese Grüne Wand blickt halb Europa

Für die Verantwortlichen ist die Grüne Wand, die bis Ostern auf dem Rathausplatz errichtet wird, ein zukunftsträchtiges Prestigeprojekt. Einige Stadträte jedoch sehen in ihr absolut der Hauptverkehrsströme nur botanische Kosmetik.

VON JOHANNES KOCH

Noch ist der auffällige Prototyp am Rande des Kornwestheimer Firmengeländes deutlich mehr braun als grün. Nur erahnen lässt sich, wie die Grüne Wand der Gärtnerfirma Helix auf dem Ludwigsburger Rathausplatz einen Tagen aussehen könnte. Denn verläuft alles nach Plan, dürfte von den Metallstreben, die diese ungewöhnliche botanische Konstruktion tragen, schon im kommenden Sommer kaum noch etwas zu sehen sein.

„In acht Wochen ist das komplett grün", versichert Hans Müller, Geschäftsführer der Gärtnerfirma, und deutet auf die Prototyp-Wand. „Da ist Pflanzenmaterial drin." Das grüne Wohnzimmer, das auf dem Rathaushof aus drei 2,40 Meter hohen, verwinkelten Wänden entstehen wird, ist ein für den Laien reichlich kurioses Stück Baubotanik. Die Wände bestehen aus Baumodulen in drei verschiedenen Größen, die wie Legosteine in sechs horizontalen Reihen zusammengesetzt werden. Die Module werden derzeit im Helix-Werk in Leipzig mit 30 unterschiedlichen Gewächsarten bepflanzt. Mit Pfaffenhütchen und Efeu, die den Hauptschutz aus Kokos nach überdecken sollen, dazu Staudengewächs, Veilchen, Asters, Thymian und Lavendel.

128 Platanen verwachsen zu einem großen Organismus

Gewissermaßen das Herzstück bilden jedoch die 128 Platanen, die auf unterster, mittlerer und oberster Ebene gepflanzt und mittels Bambusrohren um die Wand geführt werden. Wo sie sich kreuzen, werden sie durch Schrauben verbunden – die verwachsen. Später werden die höheren Platanen über der Wurzel gekappt, so dass sie aus den Wurzeln im Boden versorgt werden. Innerhalb von zwei Jahren soll sich herum eine natürliche Dachkrone ausgebildet haben.

„Ziel ist es, die Konstruktion durch die Vegetation komplett zu verdecken", erklärt Müller. Wichtig sei, dass die Wand stets grün bleibe. Voraussetzung dafür ist nicht nur eine gute Pflanzenmischung, sondern auch eine gleichmäßige Bewässerung über einen Tropfschlauch, da der Niederschlag allein nicht reichen würde. „Sonst geht es kaputt", sagt Müller. Und das soll beim besten Willen nicht passieren – schließlich ist die Wand am Kulturzentrum ein EU-geförderten Pilotprojekt, aus dem neben der Firma Helix vor allem das Institut für Landschaftsplanung und Ökologie der Uni Stuttgart Erkenntnisse ziehen möchte, wie extremen klimatischen Verhältnissen in Innenstädten entgegengewirkt werden kann. Das Thema Feinstaub wird jedoch zwangsläufig ausgeklammert, nachdem aus den ursprünglichen Plänen, die Wand auf dem Arnulfplatz zu errichten, nichts wurde.

Die Hälfte der rund 100 000 Euro Baukosten trägt die Stadt – sie finanziert damit das Podest, auf dem die Wände stehen werden. Nicht nur deshalb stößt das grüne Wohnzimmer in der Lokalpolitik auf nicht allzu viel Gegenliebe. „Eigentlich ist eine Grüne Wand ja etwas sehr Schönes", sagt Stadträtin Elga Burkhardt von Lubu. „Aber nicht auf dem Rathausplatz, wo es weder Schadstoffe noch Lärm gibt." An der B 27 gäbe es bestimmt geeignete Flächen, die für eine Begrünung geeignet seien, meint sie. „Dass die Stadt diese Chance nicht wahrnimmt, kann ich nicht verstehen."

Ähnlich sieht es auch Ihr Kollege Roland Glauberner von den Freien Wählern. „Von einem großen ökologischen Nutzen kann man sicherlich nicht sprechen", sagt er. „Optisch ist die Grüne Wand sehr reizvoll – wenn man aber den finanziellen Aufwand sieht, steht das in keinem Verhältnis." Auch Markus Gerlich (Grüne) zeigt sich skeptisch. „Da es ein Pilotprojekt ist, müssen wir abwarten, ob das künftig im größeren Maßstab sinnvoll wäre", sagt er. „Es kann aber nur ein Baustein sein – denn um das Klima zu beeinflussen, ist umfangreiche Begrünung nötig." Alles andere ist Kosmetik.

Während in vielen europäischen Großstädten an Fassadenbegrünung geforscht wird, hat sich Ludwigsburg nun also ein EU-weites Prestigeprojekt gesichert, bei dem 16 europäische Städte zusammenarbeiten. Eine grüne Oase am Kulturzentrum, mit Nahrung für Bienen: Von dem Erfolg des Projekts ist Hans Müller überzeugt. „Auf der Welt gibt es nichts Vergleichbares", sagt er. „London, Dublin und Rom blicken auf Ludwigsburg."

Noch ist das Grün des Prototyps sehr dezent (im Bild links: Helix-Geschäftsführer Hans Müller und Projektkoordinatorin Katrin Gölsdorf), doch bald schon könnte die Wand auf dem Rathausplatz wie der Prototyp im vergangenen Mai (oben rechts) aussehen – auch dank 128 Platanen, die durch Schrauben zu höheren Streben verbunden werden und dadurch verwachsen (rechts unten).

Auf dem Rathausplatz hat der Bau des Fundaments begonnen

Ein Bagger schafft Platz für das Fundament des „grünen Wohnzimmers".

Mit Montag rollen auf dem Rathausplatz die Bagger, um nach Plänen der Planung den Bau des grünen Wohnzimmers vorzubereiten. Auf einer Fläche von etwa achtmal 17 Metern entsteht dort, wo bislang eine Handvoll Spielgeräte standen, das Fundament, das den begrünten Wänden Wurzelraum über der Tiefgarage bieten soll.

Das Podest besteht aus wasserdurchlässigen Bodenplatten und einer Betonumrandung. Der Zugang ins grüne Wohnzimmer erfolgt später auf der Seite in Richtung Rathausplatz über Treppenstufen, der obere Zugang in Richtung Kulturzentrum wird barrierefrei gestaltet. Die Planungen sehen vor, dass die drei Wandteile einen offenen Raum ergeben, der durch die Baumkronen der Platanen beschattet wird und Sitzgelegenheiten für ruhesuchende Passanten bietet.

Anfang April soll das Fundament fertig sein. Die Firma Helix will mit ihren Baumodulen am 8. April anrücken, um zehn Tage später, am Osterwochenende, mit dem grünen Zimmer fertig zu sein.

Mittels Umfragen wollen die Forscher von der Uni Stuttgart bis zum Jahr 2016 in Erfahrung bringen, wie ein solcher Raum bei den Bürgern ankommt und wie sich das Kleinklima in den Sommermonaten entwickelt. Helix-Geschäftsführer Hans Müller kann sich zudem vorstellen, dass sich der Effekt auf den Feinstaub ermitteln lasse, indem man die gesamte Blattoberfläche hochrechne. [pik]

Figure 12. Example of media article promoting the Ludwigsburg Green Living Room project and the TURAS SME partner Helix Pflanzen GmbH

Output 2.3.5

Gölsdorf, K. (2014) The Green Wall Prototype in Kornwestheim. HELIX Pflanzen GmbH, Kornwestheim, Germany.

Summary - In December 2012 the Helix Pflanzen GmbH installed a prototype green wall (Figure 13) at the company headquarters in Kornwestheim, Germany. The aim of this prototype was to collect experiences regarding the construction, irrigation, suitability of plants and maintenance of the novel green wall system (Helix Elementa) that was to be installed as a TURAS Case Study in Ludwigsburg. The report details the planning and installation process and documents an overview of the first observation results regarding irrigation and water consumption.

Link – Evaluators Area: WP2: Output 2.3.5

Figure 13. The Green Wall prototype experiment at the Helix Pflanzen GmbH headquarters, Kornwestheim, Germany

Output 2.3.6

Connop, S. and Nash, C. (2014) Milestone 8 - Barking Riverside Green Roof Experiment: Phase 2. London: University of East London, London, UK.

Summary - The TURAS project aims to bring together urban communities, researchers, local authorities and SMEs to research, develop, demonstrate and disseminate transition strategies and scenarios to enable European cities and their rural interfaces to build vitally-needed resilience in the face of significant sustainability challenges. To ensure maximum impact, the TURAS project developed an innovative twinning approach bringing together decision makers in local authorities with SMEs and academics to ensure meaningful results and real change are implemented over the duration of the project. Over the five year duration of the project, the feasibility of these new approaches are being tested in selected case study neighbourhoods.

This report represents a an example of one of these neighbourhood experiments. A green roof design research experiment (Figure 14) was established by the University of East London's Sustainability Research Institute as part of TURAS to investigate the effects of green roof hydrology, substrate variation and topography on the roof's value in terms of supporting regionally important biodiversity and associated ecosystem services. Incorporating biomimicry of the brownfield land on which the Barking Riverside community is being developed, the experiment provides a showcase to promote a shift away from industry standardised generic green infrastructure solutions to urban green infrastructure designed with regional context in mind to truly mitigate the impacts of development.

With monitoring on-going, the report details the rationale behind the experimental design, the design and construction process, and the monitoring programme currently being carried out on the roof.

Link – Evaluators Area: WP2: Output 2.3.6

Figure 14. Construction of the Phase 2 green roof experiment at Barking Riverside offices

Output 2.3.7

Connop, S., Nash, C., Gedge, D. Kadas, G, Owczarek, K and Newport, D. (2013) Milestone 9 - TURAS Green Roof Design Guidelines: Maximising ecosystem service provision through regional design for biodiversity. London: University of East London.

Summary - Transitioning Towards Urban Resilience and Sustainability (TURAS) aims to enable European cities and their rural interfaces to build vitally-needed resilience in the face of significant sustainability challenges through Knowledge Transfer Partnerships. The increasing proportion of people living in urban areas has led to a range of environmental issues and sustainability challenges. In order to ensure that urban living is sustainable and that cities have the resilience to cope with environmental change these challenges must be met. Restoration and re-creation of green infrastructure in urban areas is a potential solution to many of these challenges and, in high density urban areas with little usable space at ground level, roof level green infrastructure has perhaps the greatest potential to contribute to re-greening urban areas. Given the increasing recognition that the natural environment can provide goods and services of benefit to humans and the planet ('ecosystem services'), and that these services can provide resilience for urban areas, the European Commission is now advocating well-planned green infrastructure that provides opportunities to protect and enhance biodiversity.

In order to maximise biodiversity, and the associated ecosystem services, in urban areas it is necessary to incorporate local and regional environmental context into the design of urban green infrastructure. Unfortunately, the majority of green roof installations in London, across Europe and beyond are 'off-the-shelf' industry standard systems, predominantly designed for aesthetics and stormwater attenuation and an assumption is made that by installing something green a range of additional ecosystem services will be restored. The resulting lack of plant diversity and habitat structure means that these green roof systems offer restricted biodiversity and associated ecosystem service benefits and mean that opportunities are missed for supporting urban biodiversity and building the associated resilience that biodiversity can provide. In order to ensure that further opportunities are not missed, it is necessary to take a local view of key ecosystems and habitats and incorporate these into green roof design using biomimicry. This report details a Knowledge Transfer Partnership (KTP) (Figure 15) established in Barking Riverside (London, UK) between Barking Riverside Ltd, the London Borough of Barking and Dagenham, Livingroofs.org, the University of East London and the Institute for Sustainability to establish whether there is a 'cost' associated with shifting away from industrial standard green roofs designed for SuDs towards more biodiverse systems designed based on regional habitat characteristics.

Link – Evaluators Area: WP2: Output 2.3.7

Figure 15. Phase 1 green roof experiment at Barking Riverside offices

Output 2.3.8

Nash, C., Kadas, G., Newport, D., Ciupala, M.A. and Connop, S. (2014) Invertebrate community composition on Thames Gateway green roofs and brownfield sites. Draft journal for submission.

Summary - In urban areas brownfield land has been shown to support high biodiversity, in particular rare and scarce invertebrate communities. The conservation importance of brownfield land has been recognised in an international context. Brownfield sites are previously-developed land that have become derelict or underused. Brownfield sites which contain an open mosaic of successional habitats provide a dynamic and heterogeneous landscape, often of greater biodiversity value than intensively managed greenspaces such as parks and agricultural land. Whilst biodiverse brownfield land has been documented as a GI asset, brownfield sites remain a priority for new development in England. In a London context, a network of brownfield sites along the East Thames Corridor provide surrogate habitat for regionally distinctive and nationally important invertebrate populations formerly associated with the highly biodiverse Thames Terrace grasslands. Nonetheless, 4,000 hectares of brownfield land in this region are threatened by development for a massive urban regeneration project known as the Thames Gateway and its legacy, and wildlife-rich brownfield sites continue to be lost at an unsustainable rate.

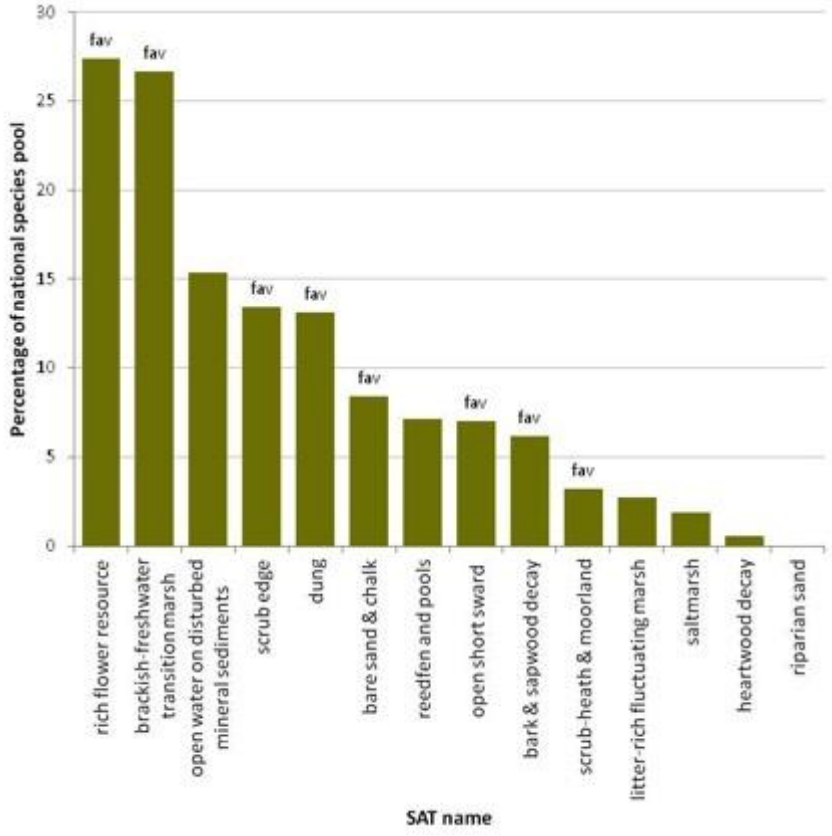
In the UK, green roofs are frequently adopted as a mitigation measure for the loss of species-rich urban brownfield sites to development. For reasons of cost, weight and maintenance, the majority of green roof installations in London, across Europe and beyond are 'off-the-shelf' industry standard designs, built with a uniform, shallow substrate layer and Sedum-dominated vegetation layer, they are designed predominantly for aesthetics and stormwater attenuation. 'Biodiverse' extensive green roofs specifically designed to benefit wildlife are beginning to gain a foothold in the green roof market.

Published research investigating the contribution of green roofs to biodiversity conservation remains limited. Their mitigation potential as surrogate habitat for important brownfield invertebrates has received scant attention, but researchers have recorded conservation priority invertebrate species on green roofs and studies investigating green roofs designed for biodiversity have shown that even modest modifications to the industry standard design can result in a broader diversity of invertebrate species utilising a roof.

Whilst the presence of rare species is a positive indicator in terms of nature conservation, further investigation is needed to determine the contribution of green roofs as a substitute for biodiverse brownfield land. This paper examines the invertebrate assemblage types found on green roofs and brownfield sites (Figure 16) in the Thames Gateway area to assess the effectiveness of green roofs as mitigation for diverse brownfield invertebrate assemblages of regional value. The study findings reveal that whilst current green roof design provides habitat for invertebrates associated with open flower-rich habitats, habitat requirements for other key assemblages associated with brownfield sites might not be provided for. The potential directions for green roof and urban green infrastructure design are also discussed in relation to providing mitigation for loss of these habitats.

Link – Evaluators Area: WP2: Output 2.3.8 (Confidential)

i)



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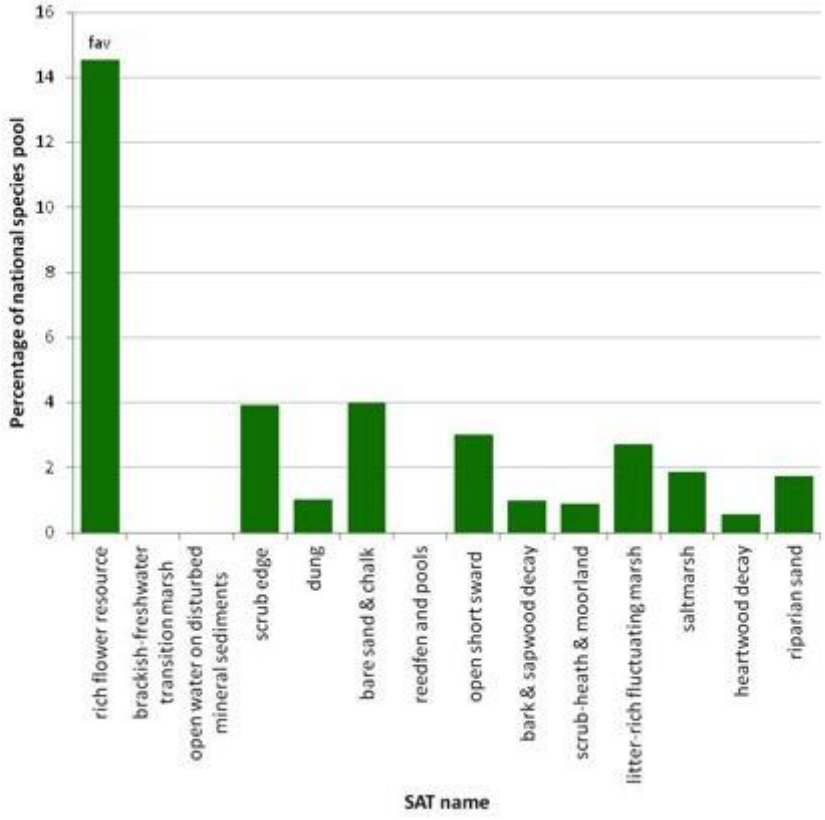

Figure 16. Comparison of invertebrate assemblages on Thames Corridor i) brownfield sites and ii) green roofs based on ISIS percentage of national species pool score for Specific Assemblage Types for samples of Coleoptera, Araneae and Hymenoptera. 'fav' indicates the SAT is in favourable condition according to Natural England's Common Standards Monitoring thresholds.

Output 2.3.9

Nash, C., (2014) Brownfield inspired green infrastructure: A new approach to urban biodiversity conservation. PhD transfer report for the University of East London.

Summary - Urban areas are known to suffer numerous negative environmental impacts associated with a loss of green space and preponderance of artificial, impervious surfaces. In response, governments and international agencies are advocating incorporation of multifunctional green infrastructure (GI) into cities to ameliorate these detrimental effects and provide ecosystem services, climate change mitigation and enhance urban resilience. In cities, brownfield sites have been shown to support high biodiversity and are considered a GI asset. However brownfield land is prioritised for new development, and biodiverse brownfield sites of high nature conservation value are being lost at an unsustainable rate. Using the ecologically valuable features of biodiverse brownfield sites (Figure 17) to inspire urban GI design could enhance biodiversity and promote sustainable development.

The report summarises the aim of the TURAS PhD research to develop and monitor novel, biodiversity-focused GI at roof, wall and ground-level designed to benefit brownfield biodiversity. The research comprises 4 elements: a heterogeneous, brownfield green roof in the Olympic Park, experimentally designed brownfield wetland green roofs, and brownfield-inspired office landscaping and green gabion walls. Comprehensive surveys of the flora and target fauna at these study sites are designed to enable quantification of the influence on biodiversity of using brownfield biomimicry in GI design. The novel design of the GI components and evidence of the influence of the design on the target groups studied makes an original contribution to knowledge.

The report includes updates on progress of the brownfield wetland experiment the brownfield office landscaping, the Olympic Park brownfield green roof, and the gabion experiment. Monitoring will be completed during 2014 and 2015 and the results will subsequently be published. The results of the research will be used to inform best practice for GI design for regional biodiversity.

Link – Evaluators Area: WP2: Output 2.3.9

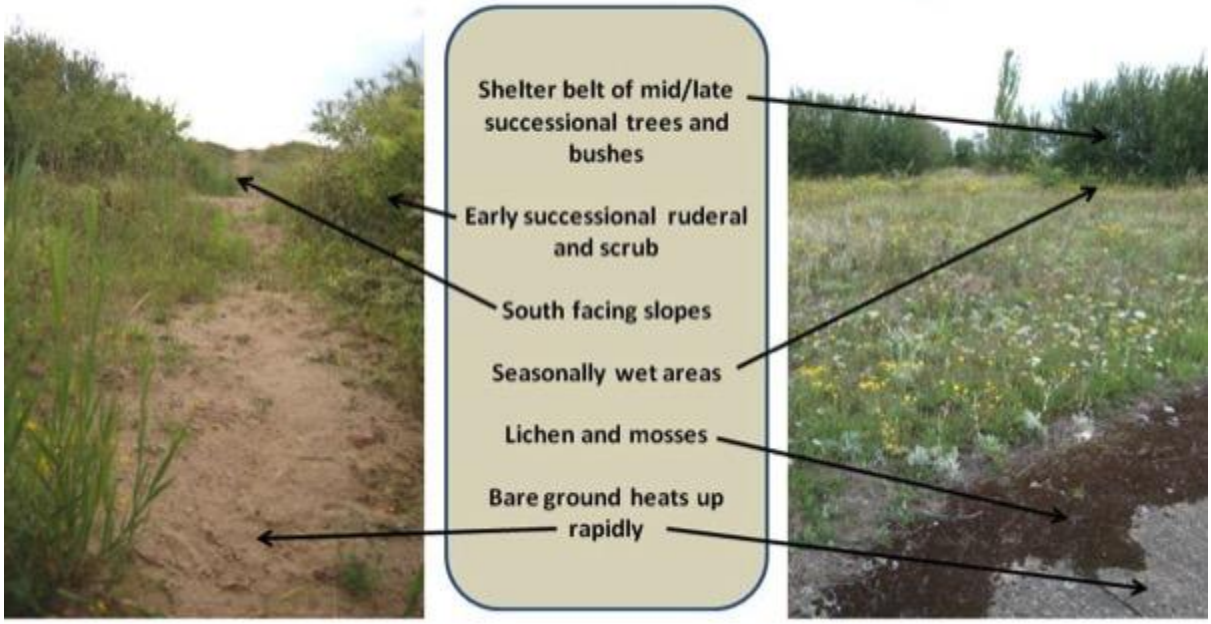

Figure 17. Example of the range of habitat types that can be present on urban brownfield sites that contribute to some sites supporting a diversity of wildlife including conservation priority species

Output 2.3.10

Molineux, C.J., Connop, S. and Gange, A.C. (2014) Manipulating soil microbial communities in extensive green roof substrates. Science of the Total Environment 493 (2014) 632–638.

Summary - There has been very little investigation into the soil microbial community on green roofs, yet this below ground habitat is vital for ecosystem functioning. Green roofs are often harsh environments that would greatly benefit from having a healthy microbial system, allowing efficient nutrient cycling and a degree of drought tolerance in dry summer months. To test if green roof microbial communities could be manipulated, we added mycorrhizal fungi and a microbial mixture ('compost tea') to green roof rootzones (Figure 18), composed mainly of crushed brick or crushed concrete. The study revealed that growing media type and depth play a vital role in the microbial ecology of green roofs. There are complex relationships between depth and type of substrate and the biomass of different microbial groups, with no clear pattern being observed. Following the addition of inoculants, bacterial groups tended to increase in biomass in shallower substrates, whereas fungal biomass change was dependent on depth and type of substrate. Increased fungal biomass was found in shallow plots containing more crushed concrete and deeper plots containing more crushed brick where compost tea (a live mixture of beneficial bacteria) was added, perhaps due to the presence of helper bacteria for arbuscular mycorrhizal fungi (AMF). Often there was not an additive affect of the microbial inoculations but instead an antagonistic interaction between the added AM fungi and the compost tea. This suggests that some species of microbes may not be compatible with others, as competition for limited resources occurs within the various substrates. The overall results suggest that microbial inoculations of green roof habitats are sustainable. They need only be done once for increased biomass to be found in subsequent years, indicating that this is a novel and viable method of enhancing roof community composition.

Link – Evaluators Area: WP2: Output 2.3.10

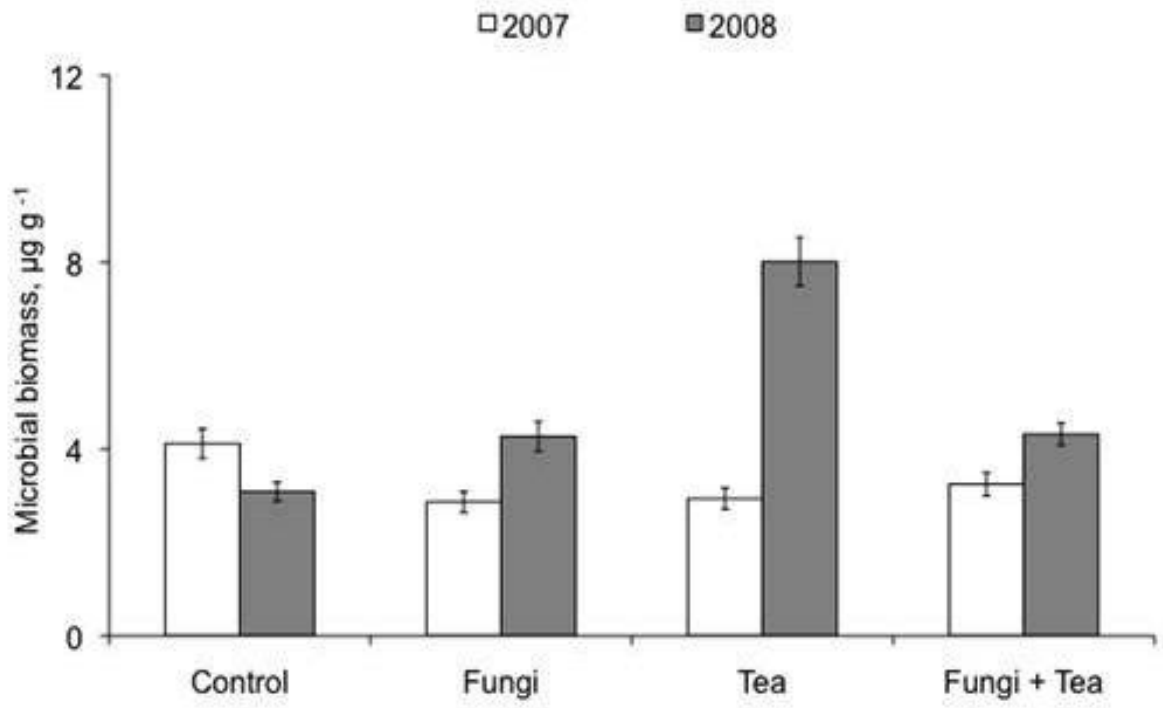

Figure 18. Total microbial biomass within green roof inocula experimental treatments. 2007 = after treatments and 2008 = one year after treatments applied. Bars represent ± standard error of the mean.

Output 2.3.11

Molineux, C.J., Connop, S. and Gange, A.C. (2014) Using recycled aggregates in green roof substrates for plant diversity. Submitted to Science of the Total Environment

Summary - Extensive green roofs are becoming a popular tool for restoring green infrastructure in urban areas, particularly as mitigation for loss of biodiverse habitats such as post-industrial/brownfield sites. This study investigated the use of six recycled lightweight aggregates and combinations of them in green roof growing media, to determine their effectiveness for enhancing plant abundance and species diversity (Figure 19). In two separate experiments, we examined the roles of substrate type and depth on the establishment of a perennial wildflower mix over a 15 month period. We found that some of the alternative substrates are comparable to the widely used crushed red brick aggregate (predominantly found in commercial green roof growing media) for supporting plant establishment. For some materials such as clay pellets, there was increased plant coverage and a higher number of plant species than in any other substrate. Substrates that were produced from a blend of two or three aggregate types also supported higher plant abundance and diversity. Generally, increasing substrate depth improved plant establishment, however this effect was not consistent across substrates. We conclude that recycled materials may be viable constituents of growing media for green roofs and they may improve green roof resilience, through increased plant cover and diversity. The results could provide evidence to support the construction of mosaic habitat types on single roofs using various substrate blends.

Link – Evaluators Area: WP2: Output 2.3.11 (Confidential)

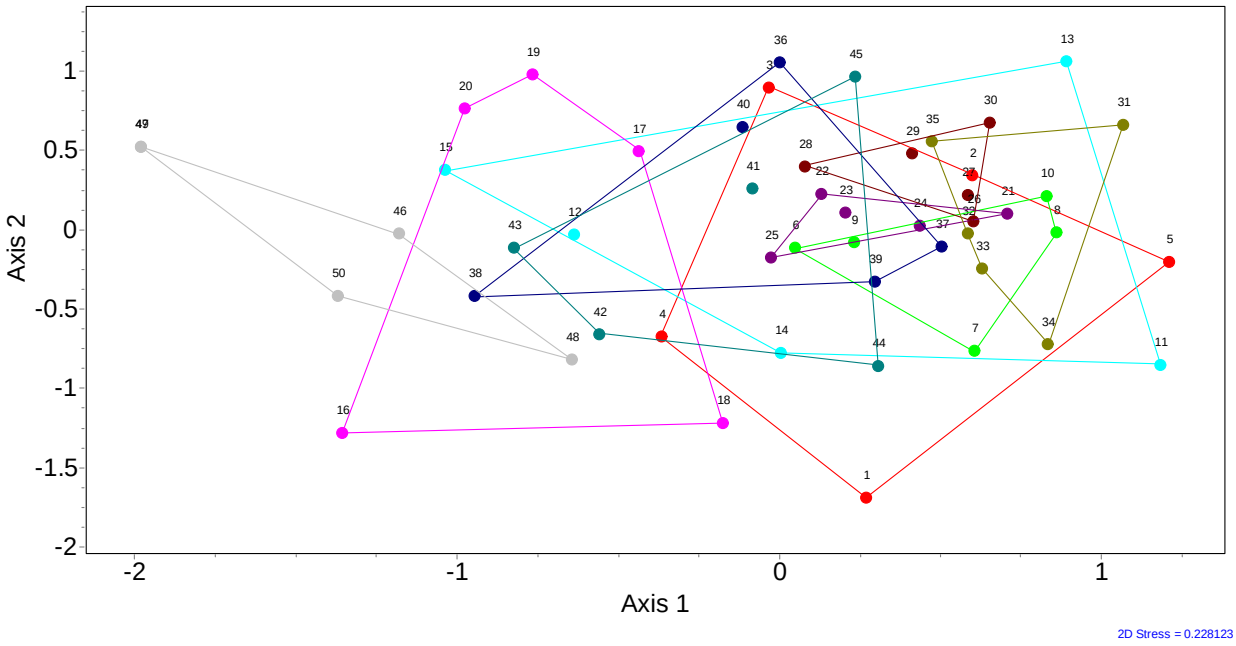

Figure 19. Results of non-metric multidimensional scaling analysis of plant communities in the different green roof substrates from a randomised experimental trial.

Key to points: 1-5: Carbon8 pellets; 6-10: clay; 11-15: clay + paper ash; 16-20: paper ash; 21-25: red brick; 26-30: red brick + clay; 31-35: red brick + clay + paper ash; 36-40: Superlite; 41-45: Superlite + paper ash; 46-50: yellow brick.

Output 2.3.12

Molineux, C.J., Gange, A.C., Connop, S. and Newport, D. (2014) Are microbial communities in green roof substrates comparable to those in post-industrial sites? Submitted to Urban Ecosystems

Summary - Green roofs have been implemented on new buildings as a tool to mitigate the loss of post-industrial or brownfield land. For this to be successful, the roofs must be designed appropriately; that is with the right growing media, suitable substrate depth, similar vegetation and with a comparable soil microbial community for a healthy rhizosphere. This study compared soil microbial communities (determined using phospholipid fatty acid or PLFA analysis) of two extensive green roofs and two post-industrial sites in Greater London (Figure 20). It was found that green roof rootzones constructed using engineered growing media are not depauperate, but can have an abundant soil microbial community that in some cases can be more diverse and numerous than communities found in natural wasteland areas. In particular, one green roof supported abundant soil microbial communities that were dominated by gram negative and aerobic bacteria, whilst fungal abundance was similar across all sites analysed. Furthermore, ratios of fungal: bacterial PLFA's were larger from post-industrial sites but overall were consistent with bacterial dominated soils typical of early successional habitats.

Link – Evaluators Area: WP2: Output 2.3.12 (Confidential)

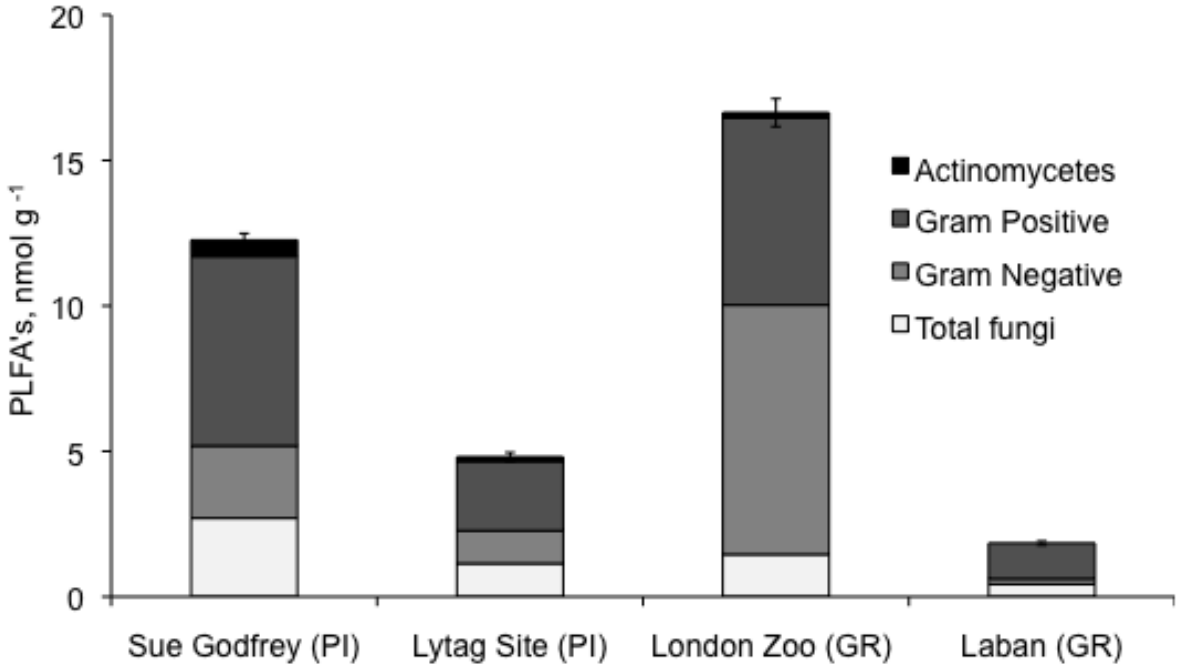

Figure 20. Total microbial biomass (nmol/g soil) from two post-industrial (PI) sites and two green roof (GR) sites. Specific microbial groups proportioned to the bars, showing composition of microbial communities. Bars represent ± the standard error of the mean.

Output 2.3.13

Blank, L., Vasl, A., Levy, S., Grant, G., Kadas, G., Dafni, A. and Blaustein, L. (2013) Directions in green roof research: A bibliometric study. Building and Environment 66, 23-28

Summary - Green roof research is a multidisciplinary and new research area. We conducted a bibliometric quantification to assess the rate of publications in specific areas of research for this novel research area based on the scientific literature as available from the Web of Science. Bibliometric research can provide valuable information about changes in the trends within a particular area of research. For example, we found that the number of publications in this field increased in the last two decades at very similar pace to other pre-established academic disciplines. We also found that papers on green roofs were classified into 32 research areas. There was very little change in the frequency of most research areas through time. The percentages of plant sciences, forestry, marine and freshwater biology and biodiversity conservation of the total research areas classifications used each year increased significantly with time, while architecture decreased significantly with time signifying an increased interest in environmental issues and less focus on architectural issues. The distribution of publications between countries has been skewed, with the USA and the EU conducting 66% of the research (Figure 21), and thus allocation of research effort is focused in those continents and predominantly in temperate ecosystems. However, there has been a sharp increase in the number of countries that conduct green roof research. Our work provides a suite of indicators that can be combined to give a useful picture of the development of green roof research and identifies the challenges which lie ahead for this novel research area.

Link – Evaluators Area: WP2: Output 2.3.13

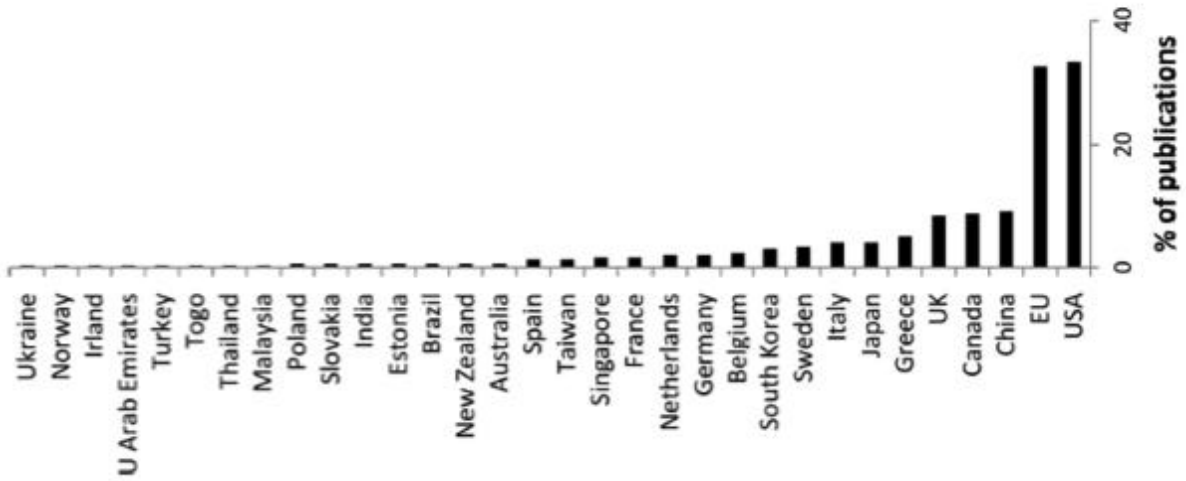

Figure 21. Distribution of green roof papers according to country between 2001 and 2012. The EU was included in its entirety as a classification.

Output 2.3.14

Kadas, G., Gedge, D., Grant, G. and Connop, S. (2014) Green Roofs: Invertebrate trapping techniques. Submitted to Israel Journal of Ecology and Evolution: Green Roof Ecology Special Edition

Summary - Green roofs are increasing in popularity and there is a need to undertake ecological studies of these habitats. Some commonly used methods to trap invertebrates at ground level cannot be used on roof habitats for reasons of safety and security. Pitfall trapping and suction sampling can be effectively used to sample invertebrate fauna on green roofs.

In this study, the trapping efficiency of pitfall trapping and suction sampling was compared on a series of green roofs (Figure 22), focusing on epigeal invertebrates, such as spiders and beetles. Suction sampling gave a significantly higher individual invertebrate count on green roof surveys, while the trapping efficiency of epigeal invertebrates such as spiders and beetles was much higher in pitfall trapping. Suction sampling can be used to provide a 'snapshot' of invertebrate communities on green roofs, while pitfall trapping is the most effective method for long-term monitoring.

Link – Evaluators Area: WP2: Output 2.3.14 (Confidential)

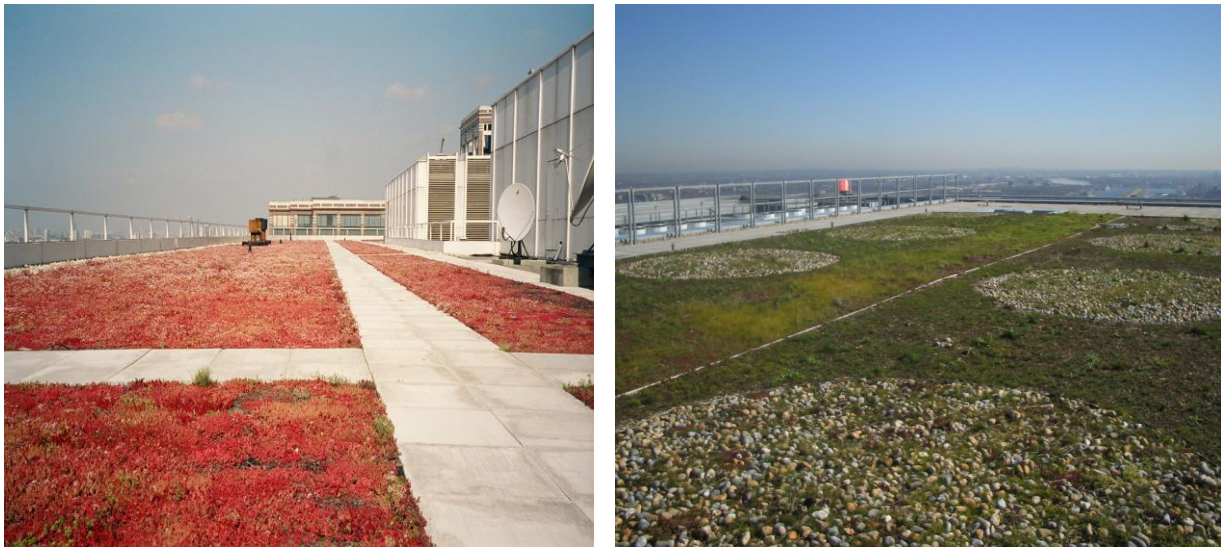

Figure 22. Two green roofs on the FC4 and Barclays HQ Buildings in Canary Wharf, London, in 2006 used for invertebrate sampling experiment.

Output 2.3.15

Schindler, B.Y., Levy, S., Kadas, G., Pearlmutter, D. and Blaustein, L. (2014) Integration of Photovoltaic Panels and Green Roofs: Review and Predictions of Effects on Electricity Production and Plant Communities. Submitted to Israel Journal of Ecology and Evolution: Green Roof Ecology Special Edition.

Summary - The integration of photovoltaic (PV) panels and green roofs has the potential to improve panel efficiency and enhance green roof diversity and productivity. In this review, we provide an overview of research on the effects of green roofs on PV panel electricity production, and predict the expected effects of PV panel on green roof plant communities. Previous studies suggest that PV panels are more efficient on a green roof than on a conventional roof due to the cooling effect of green roofs on the temperature- sensitive PV cells. Other ecological studies on shade suggest that shade imposed by panels may enhance green roof productivity. Shade is often shown to be important for seedling survival, particularly in arid environments - so the effect of shade on plants may depend on climate and presence of irrigation. Previous studies also suggest that shade variations over the roof area may enhance plant diversity, as such heterogeneity creates niches of light and water levels that are appropriate for a diversity of plants. These positive effects on plant diversity may lead to increased arthropod diversity as well. Future directions for research that could guide the design of green roof-PV integration include the effects of irrigation, plant diversity, and green area-to-panel ratio on the roof.

Link – Evaluators Area: WP2: Output 2.3.15 (Confidential)

Output 2.3.16

Owczarek, K. (2014) Assessment of the Use of Recycled Materials to Enhance Green Roof Performance. Poster presented at the Nurturing Tomorrow's Innovators Conference, UEL.

Summary - Poster presenting an overview of the green roof design research being carried out by Kinga Owczarek as part of her TURAS PhD studentship at the University of East London. The aim of the proposed research is to investigate the use of novel sustainable products (recycled or reused materials) as green roof construction elements (substrate/drainage layers) and to develop appropriate basic guidelines for multifunctional green roof design in the UK. This includes:

- identifying recycled/reused materials suitable for green roof design and to assessing their physical properties (Figure 23)
- assessing 'typical' commercial, extensive green roof performance
- assess the performance of extensive green roofs, constructed using alternative materials

Ultimately the aim is to propose guidelines for the design of extensive green roofs using locally sourced sustainable materials appropriate for the UK climatic conditions. It is intended that the research and guidelines will represent a framework for other countries to incorporate regional context into the development of sustainable materials for the green roof industry.

Link – Evaluators Area: WP2: Output 2.3.16

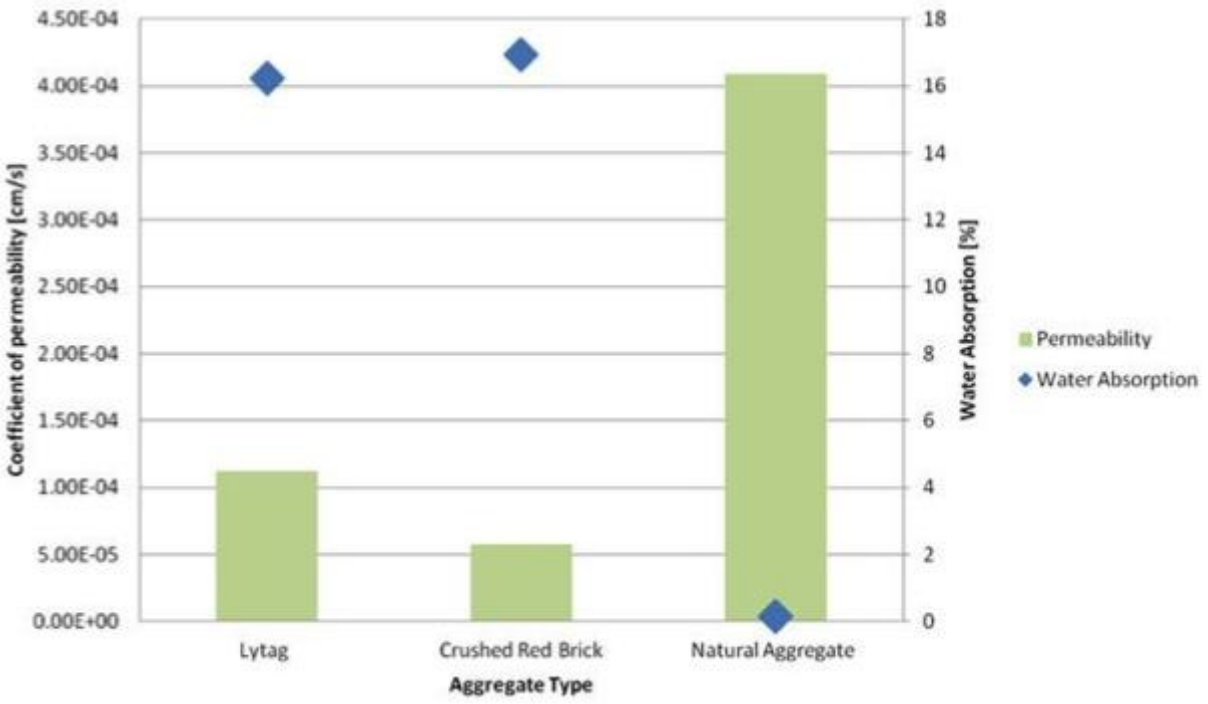

Figure 23. Permeability coefficients and water absorption of Lytag and Crushed Red Brick in comparison to natural aggregates used as green roof vegetation growth media.

Output 2.3.17

Owczarek, K. (2014) Assessment of the Use of Alternative Construction Materials to Enhance the Ecosystem Service Performance of Green Roof. PhD transfer report for the University of East London.

Summary - Green roofs are roofs on which vegetation is intentionally grown. The installation of a green roof has the potential to bring environmental, economical and aesthetical benefits such as reduction and delay of storm water runoff, improvement of the storm water runoff quality, mitigation of the heat island effect, air quality improvement, enhancement of biodiversity, energy savings, and provision of recreational and agricultural spaces, if carefully designed to specific climate conditions. Although green roofs are broadly investigated and installed in countries like Germany and Sweden, research on their construction and performance in the UK is limited. This research investigates the use of novel sustainable products as green roof construction elements and aims to develop appropriate basic guidelines for multifunctional green roof design in the UK. The investigation of green roof hydrological performance of roofs constructed using alternative materials is based on continuous monitoring program of nine different green roof configurations (on site experiment) and five different green roof designs (laboratory experiment (Figure 24)). Researched green roofs are constructed using varying parameters including substrate and drainage layer materials, depth of the substrate, water holding capacity of drainage layer, and vegetation type. This research will contribute significantly towards the dissemination of good sustainable practice in the construction industry promoting a positive environmental and social impact through increasing sustainability and resilience through green roof construction as well as green roof ecosystem service provision in urban areas.

Link – Evaluators Area: WP2: Output 2.3.17 (Confidential)

Figure 24. Rain simulator built as part of the TURAS project to test alternative materials for green roof construction under simulated storm event conditions

Output 2.3.18

Owczarek, K., Connop, S., Newport, D. and Ciupala, M.A. (2014) Green roof runoff monitoring systems: Review. Final Draft.

Summary - Recently, due to the wide range of benefits provided in urban areas, green roofs have been of increased interest to researchers across different disciplines. One area of key interest for urban resilience is the use of green roofs to help manage urban stormwater. Green roof water retention capacity is its ability to absorb (partially or completely) rainwater and it is generally presented as a percentage of precipitation. Absorbed water is thereafter evaporated and transpired into the atmosphere or used by the vegetation. Volume of stormwater not retained by a green roof is drained similarly to traditional roofs. Runoff attenuation includes the reduction in the magnitude of the peak discharge and the lag time associated with peak discharge from the green roof in comparison to control grey roofs. Due to the hydrological properties mentioned above, green roofs are often included as stormwater management tools as part of Sustainable Urban Drainage Systems (SuDs). Increasing development of impervious areas leads to a rise in surface water runoff causing overloading of existing sewage systems. SuDs components attenuate excess rainwater at source, by reducing and delaying runoff compared to traditional piped drainage systems, which are designed only to collect and transport rainfall runoff. In addition to providing stormwater storage, the retention capability of green roofs is also vital for plant survival. Water collected within the substrate and the drainage layers are designed to provide a reservoir of available water to vegetation long after rainfall ends.

Quantifying runoff retention and attenuation of green roofs has become crucial for engineers as well as for ecologists. Several studies have been conducted investigating retention efficiency of living roofs. However, there are disparities within the published data. Some studies have shown green roof retention at about 20% while others have recorded very high retention of about 80%. Green roof hydrological performance is influenced by green roof design (layers, materials, roof geometry, vegetation) and climatic conditions. Nevertheless, an additional factor that has been overlooked and could have an effect on quantification of green roof hydrological performance is choice of testing methods and equipment. Consolidated information on advantages and limitations of methods employed in green roof research is lacking. This review aimed to:

- compile the available knowledge on green roof runoff measurement methods (Figure 25);
- compare and evaluate available methods.

More accurate and efficient green roof monitoring will result in reliable data that would lead to better understanding of the hydrological performance of living roofs.

Link – Evaluators Area: WP2: Output 2.3.18 (Confidential)

Figure 25. Novel v-notch rainfall runoff gauge designed for retrofit green roof experiment at the West Ruislip London Underground Depot TURAS Case Study

Task 2.4 - Develop and evaluate a design protocol for incorporating art, creativity and regional habitat characteristics into landscape design for maximising the biodiversity value of green infrastructure

Output 2.4.1

Connop, S. Lindsay, R., Freeman, J, Clough, J., Kadas, G. and Nash, C. (2014) Milestone 11 - TURAS multidisciplinary urban landscape design guidance: Design, incorporation and monitoring of Barking Riverside brownfield landscaping. University of East London, London, UK.

Summary - Given the increasing recognition that the natural environment can provide goods and services of benefit to humans and the planet ('ecosystem services'), and that these services can provide resilience for urban areas, the European Commission is now advocating well-planned green infrastructure that provides opportunities to protect and enhance biodiversity. In order to maximise biodiversity, and the associated ecosystem services, in urban areas it is necessary to incorporate local and regional environmental context into the design of urban green infrastructure. Following the use of biomimicry to incorporate brownfield habitat characteristics into a landscape design project at Barking Riverside offices (Figure 26), a TURAS research project was established to assess and monitor the value of the landscaping in terms of biodiversity supported.

Monitoring comprised a mix of photographic, vegetation, invertebrate and brownfield habitat assessment surveys with the aim of quantifying the range of habitat niches (synusia), the effect of these synusia on overall site biodiversity, and the effect of management on maintaining the diversity of habitats and species. Comparisons were also made with more traditional soft urban landscaping within the Barking Riverside development and a neighbouring brownfield area of the site.

In total, 5 synusia were identified within the brownfield landscaping. Within these synusia, a maximum of 148 species of higher plant plus mosses, lichen and fungi were recorded in 2012. This represented substantial floral diversity within an area of approximately 0.5 ha of urban landscaping. In addition, many of the floral species recorded on the brownfield landscaping pockets were those considered to be representative of the high quality brownfield habitats within the region that the landscaping was designed to emulate. Comparison with soft landscaping pockets of approximately equivalent size revealed that most of the key brownfield flora was absent and floral diversity was significantly lower than in the brownfield landscaping pockets.

Invertebrate species recorded on the landscaping included several species of national conservation concern, most notably two UKBAP bumblebee species, and RDB1 (+ Extinct) and RDB2 species, several nationally rare and scarce species as well as numerous Essex Red Data book species. The brownfield landscaping consistently outperformed soft landscaping areas in terms of overall invertebrate diversity and for specific target indicator groups (Aranaea, Coleoptera and Hymenoptera) numbers, diversity and conservation importance. Similar patterns were also recorded during timed bumblebee and butterfly counts.

Overall results of the monitoring demonstrated that, if designed to mimic habitat of regional value, carefully planned green infrastructure within sustainable development could support biodiverse ecosystems containing species of regional and national conservation value. Such green infrastructure would also be expected to provide a broader array of additional ecosystem services benefits than generic urban soft landscaping.

Link – Evaluators Area: WP2: Output 2.4.1

Figure 26. Barking Riverside Brownfield Office Landscaping pocket featuring rubble substrate, concrete features for basking reptiles and thermophilic insects, metal features for shelter, trees and ornamental planting. Images represent landscaping (top) and synusial categorisation of habitat niches within landscaping pocket (bottom).

Output 2.4.2

Connop, S., Lindsay, R., Freeman, J. and Kadas, G (2011) Barking Riverside: Office landscaping for biodiversity. Essex Naturalist 28 (New Series), 49-67.

Summary - This manuscript represents a summary of the first year's survey on Barking Riverside's brownfield landscaping:

Following the incorporation of brownfield habitat characterised landscape design at Barking Riverside offices, a survey baseline was established to assess and monitor the value of the landscaping in terms of biodiversity supported. In total, 5 five different micro-structures of habitat were identified within which 112 species of plant plus lichen and fungi were recorded. Invertebrate species identified included several species of national conservation concern, most notably a UKBAP bumblebee species (Figure 27), RDB2 species, several nationally rare and scarce species as well as Essex Red Data book species. Timed observational surveys and pitfall trapping revealed variation across the landscaping relative to habitat heterogeneity. This indicated that the mosaic of habitats created within the landscaping may have been enhancing overall site biodiversity.

The baseline survey demonstrated that, if designed to mimic habitat of regional value, green infrastructure within sustainable development could support biodiverse ecosystems containing species of regional and national conservation value. Such biodiverse green infrastructure could play a vital role in urban conservation if incorporated on a landscape-scale. Further monitoring is vital to determine whether biodiversity is conserved following development and management of the office landscaping and whether these rare invertebrate species can persist within the landscape once the Barking Riverside region as a whole is developed.

Link – Evaluators Area: WP2: Output 2.4.2

Figure 27. UK Biodiversity Action Plan Conservation Priority Species *Bombus humilis* foraging on the brownfield office landscaping at Barking Riverside, London, UK.

Output 2.4.3

Connop, S. (2012) The Beetle Bump: innovative urban habitat creation for rare insects. Essex Naturalist 29 (New Series), 89-94.

Summary - On the day that a press release from the Rio+20 summit confirmed a 30% global decline in wildlife since 1970 (Black 2012), the University of East London (UEL) and Buglife completed an innovative urban habitat creation project in order to try to prevent the extinction of what might be Britain's rarest insect. After being considered extinct in the UK since a record at Beachy Head, East Sussex in 1928, a population of the streaked bombardier beetle *Brachinus sclopeta* was discovered in 2005 on a brownfield site adjacent to Thames Barrier Park, East London. The beetles were found on a mound consisting of a few square metres of sparsely vegetated brick and lime mortar left on site since the last time it was cleared. Roll on to 2012 and the mound was no longer found to be colonised, but a single population was recorded on a rubble mound a couple of hundred metres from where the original population was recorded. The bad news being that the rubble mound was on a brownfield site about to be redeveloped and was one of the last brownfield sites in the area. Despite representing perhaps the last population of these beetles in the UK, planning permission was granted. For development to be truly sustainable this must include conserving, on a landscape scale, the valuable ecosystem services that biodiversity provides. This means protecting and enhancing natural and semi-natural landscapes and also restoring green and blue infrastructure of high biodiversity value in urban areas. As such, rather than merely targeting conservation efforts towards high profile or 'cuddly' species, all biodiversity should be targeted in order to protect the natural cycles and services that nature provides on a global scale.

As part of the TURAS project, UEL's Sustainability Research Institute worked with Buglife to investigate how incorporating biomimicry of regional context into urban green space design can benefit not just ecosystem service provision for communities in term of environmental impacts such as flooding, but also in terms of conserving local biodiversity of national conservation importance. Just days before the bulldozers rolled into the streaked bombardier brownfield site, permission was granted for an attempted rescue. Buglife, London Wildlife Trust (LWT) and UEL staff, students and volunteers teamed up to create a 'Beetle Bump' (Figure 28) as part of the landscaping for UEL's new Sports Dock development. The Beetle Bump was constructed as a brownfield nature area designed specifically to support streaked bombardier habitat requirements. Beetles were then saved from the donor site and moved to UEL at the last hour before the bulldozers moved in. The site is being managed sympathetically for the conservation of the beetles. It will also be monitored to assess whether the translocation was successful and to see what other wildlife takes advantage of this pocket of wildflowers and brownfield habitat features. This report details the processes involved in the site creation.

Link – Evaluators Area: WP2: Output 2.4.3

Figure 28. Aerial photo of Beetle Bump at University of East London, UK

Output 2.4.4

Buglife (2012) Case study: Beetle Bump, London. Buglife - the Invertebrate Conservation Trust case study as part of their brownfield best practice hub. Buglife, Peterborough, UK.

Summary - Best practice case study on the TURAS Beetle Bump (Figure 29). The case study document is part of Buglife's brownfield hub, a one-stop centre for best practice associated with brownfield conservation, planning and mitigation. The case study summarises the work carried out on the Beetle Bump in a format that can be replicated on future projects.

Link – Evaluators Area: WP2: Output 2.4.4

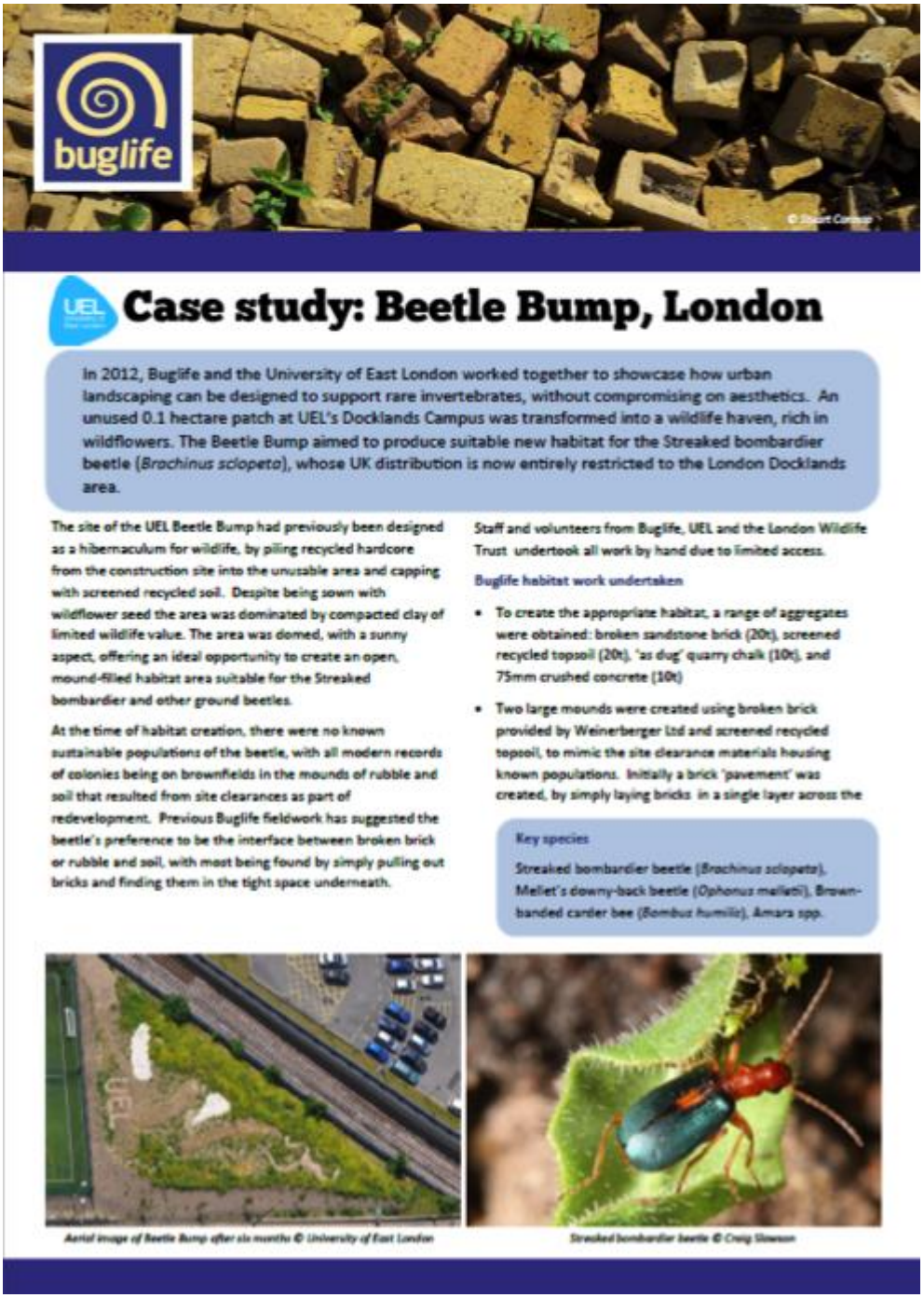

Figure 29. Buglife - The Invertebrate Conservation Trust's brownfield conservation best practice case study on the TURAS Beetle Bump case study at the University of East London, UK

Output 2.4.5

Nash, C. and Connop, S (2014) Mosaic Approach to Urban Green Infrastructure. Poster presented at AES Conservation Conference 2014: Mosaic Approach to Landscape Conservation.

Summary - Poster presentation showcasing the TURAS research investigating the comparison between green roofs and brownfield sites in terms of habitat provision with a view to identifying the efficacy of current green roof design for mitigating brownfield loss to urban development. Poster presents a comparison of the two systems in relation to invertebrate assemblage recorded on each. The poster presents a case for more informed design of urban green infrastructure then showcases four TURAS landscaping and green roof initiatives (Figure 30) to demonstrate how this can be achieved:

- Barking Riverside Phase 2 ephemeral wetland green roofs;
- Barking Riverside open mosaic habitat urban landscaping;
- Queen Elizabeth Olympic Park open mosaic habitat biosolar green roof;
- Beetle Bump open mosaic habitat brownfield landscaping.

Link – Evaluators Area: WP2: Output 2.4.5

Figure 30. Examples of experimental biodiverse urban green infrastructure based on open mosaic habitat biomimicry design principles. Clockwise from bottom left: MPC mosaic green roof (Olympic Park) with target species toadflax brocade moth (*Calophasia lunula*); Ephemeral wetland green roof; Brownfield office landscaping; Brownfield nature reserve with target species streaked bombardier beetle (*Brachinus sclopeta*). Target species photos taken on sites. All sites in London, UK.

Output 2.4.6

Connop, S., Clough, J. and Nash, C. (2013) Milestone 10 - TURAS Multidisciplinary urban landscape design guidelines. Poplar HARCA - Carradale House. London: University of East London.

Summary - Green infrastructure in the built environment has traditionally been designed with limited consideration for biodiversity or regional context. Instead, a blend of horticultural fascination with exotic species, ease of maintenance, accessibility and an innate desire to control nature have led to aesthetic appeal and amenity value being the key drivers for urban greenspace design. Even selection of species suited to local climates has been limited with artificial irrigation and heavy management of urban landscapes common place.

There is increasing recognition that the natural environment can provide goods and services of benefit to humans and the planet. In response to this, there is a need to develop and monitor 'novel', biodiversity-focused designs for green infrastructure at roof, wall and ground-level, and investigate its contribution to urban biodiversity. The key first step to maximising the resilience and sustainability in such a process is ensuring that design is multifunctional and is based on regional context both in terms of being current climate and climate adaptation resilient and relevant to regional biodiversity of national and international conservation value. The 'added value' of such a biodiversity-focused climate resilient approach, beyond biodiversity and ecosystem service benefits, is that the management requirements of the urban green infrastructure become more sustainable with reduced requirements for fossil fuel use, artificial irrigation, and fertilizer and pesticide input.

In order to maximise biodiversity, and the associated ecosystem services, in urban areas it is necessary to utilise biomimicry to incorporate local and regional environmental context into the design of urban green infrastructure. This includes the incorporation of plant diversity and habitat structure typical of regional habitat of national or international conservation value.

This reports (Figure 31) represents a best practice example of how biodiverse green infrastructure can be incorporated into high density urban design and how biomimicry of regionally important habitat can be used to inform this design and provide regional context. The document is a working document developed to support a major building and landscaping initiative being carried out by the social landlords Poplar HARCA in Poplar, East London, UK. It is also designed to represent a framework from which other TURAS cities can develop similar guidance.

Link – Evaluators Area: WP2: Output 2.4.6

Figure 31. Bug hotel as part of the allotments at Carrodale House, Poplar HARCA London, UK

Output 2.4.7

LBTH *(2014) London Borough of Tower Hamlets SuDs Guidance. Tower Hamlets, London, UK.*

Summary - A planning policy guidance note developed in partnership between the University of East London and the London Borough of Tower Hamlets. The collaborating organisations worked to embed TURAS WP2 urban green infrastructure design principles incorporating regional design for biodiversity into sustainable urban drainage component design.

The guidance note begins with the legislative and policy background information that serves to establish the legitimacy of Tower Hamlets requirement for the inclusion of sustainable urban drainage systems (SuDs) in developments across the borough. It continues with some practicable examples of SuDs (Figure 32) that are relevant to developments within the LB of Tower Hamlets. These examples are primarily designed to provide multifunctional benefits to the communities including: stormwater attenuation; biodiversity benefits; urban comfort zones; air pollution reduction; access to grow-your-own initiatives; access to nature and greenspace.

The report also includes an explanation of how to calculate water storage capacity of SuDs, together with worked examples. This provides access to understanding of SuDs calculations to all stakeholders involved in the urban planning process including small-scale private and community initiatives. The document concludes with information about how to apply for approval of SuDs, the approval and adoption process, and concluding with contact details for further information.

This guidance represents an exemplar of how local authority urban planning teams can work together to create multifunctional benefits from urban planning initiatives and how planning changes such as the legislative requirement for SuDs can be utilised as a lever to achieve real biodiversity benefits in urban areas.

Link – Evaluators Area: WP2: Output 2.4.7

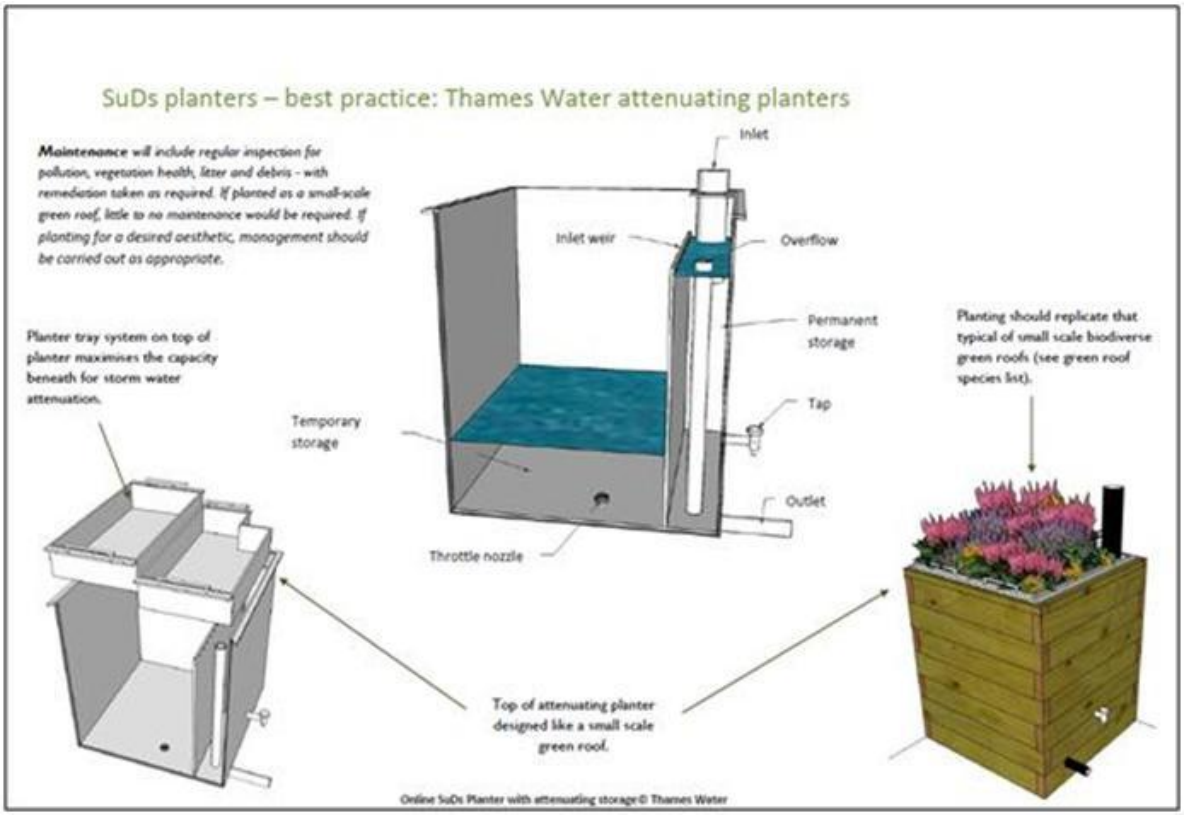

Figure 32. Example page from the London Borough of Tower Hamlets TURAS-informed Sustainable Urban Drainage System guidance document

Output 2.4.8

Connop, S. (2013) Ecosystem services come to Tower Hamlets: Derbyshire St Pocket Park editorial. TURAS website.

Summary - Following on from the collaborative development of Sustainable Urban Drainage System (SuDs) guidance based on TURAS WP2 urban green infrastructure design principles, the London Borough of Tower Hamlets applied for Pocket Park funding from the Greater London Authority to develop a flagship for their SuDs initiative. Having secured the funding Tower Hamlets have built and launched the pocket park (Figure 33) in an underused and area of Tower Hamlets that suffered from problems of fly-tipping and anti-social behaviour. The park now stands as a showcase of how the TURAS informed SuDs components recommended in the planning guidance note can be incorporated into high density urban areas within the borough to promote a more resilience and sustainable future.

This document represents an editorial describing this background and launch of the pocket park to celebrate this achievement.

Link – Evaluators Area: WP2: Output 2.4.8

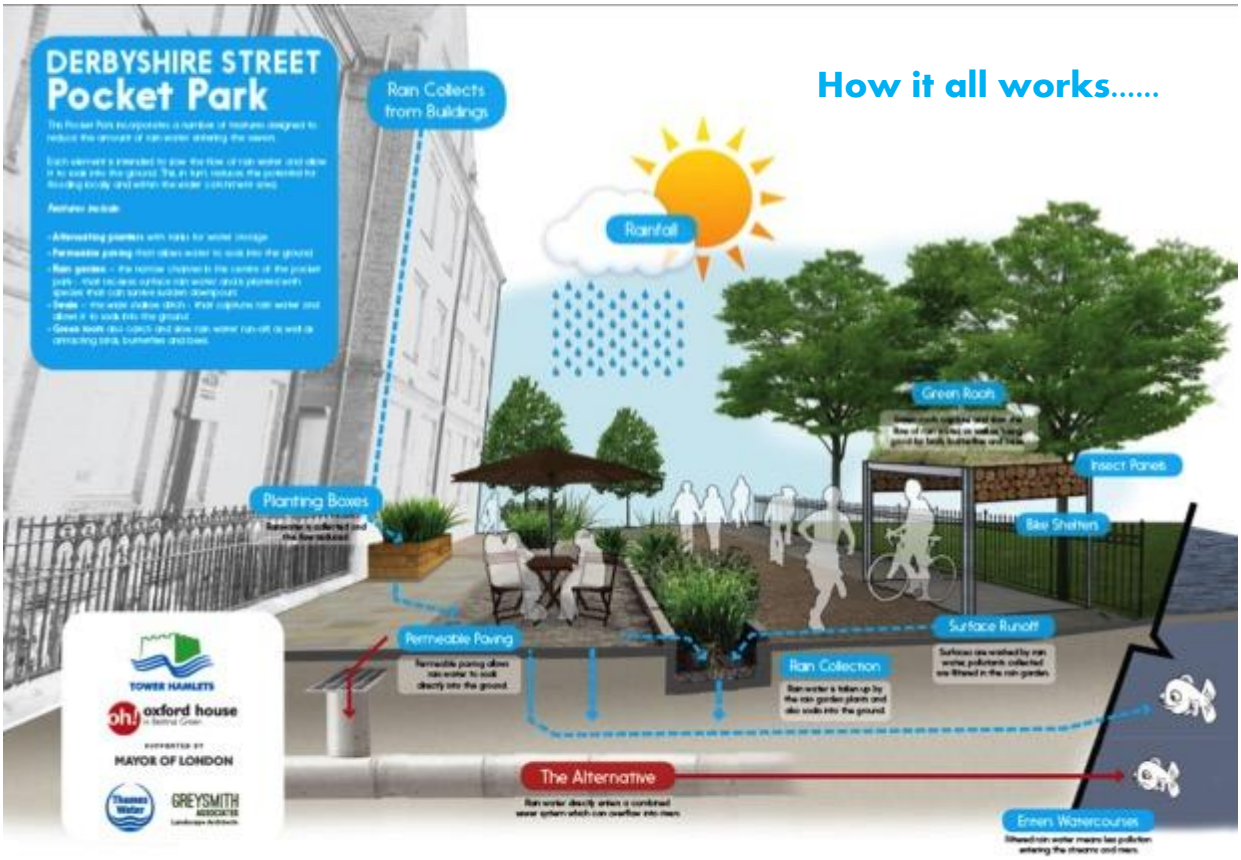

Figure 33. Information board for the Derbyshire Street Pocket Park, Bethnal Green, London Borough of Tower Hamlets, London UK

Task 2.5 - Pilot test design tools disseminating from field experiments at the case study area of the Barking Riverside Development in East London

Output 2.5.1

Connop, S. (2014) Milestone 13 - Barking Riverside: TURAS showcase of sustainable and resilient community design. University of East London.

Summary - Over the five year duration of the TURAS project, the feasibility of new approaches to sustainable and resilient urban design disseminating from research and investigation of best practice are being tested in selected case study neighbourhoods. The impact of these new approaches will be measured and results compared between participating cities before a final set of strategies and tools is developed for demonstration, dissemination and exploitation in other European cities. This report represents a dissemination tool from the TURAS Case Study site at Barking Riverside (Figure 34). The over-arching aim of WP2 is to develop new visions, feasibility strategies, spatial scenarios and guidance tools to enhance the biodiversity and ecosystem service benefits of urban green infrastructure. This report presents an overview of the sustainability innovation being implemented at the Barking Riverside case study in the London Borough of Barking and Dagenham, Greater London, UK, with a particular focus on experimental showcases and the role out of innovative green infrastructure design solutions throughout the development. The report documents the collaborative working between Barking Riverside Ltd, the London Borough of Barking and Dagenham and the University of East London's Sustainability Research Institute that aims to promote the development and the TURAS design principles at the heart of its construction.

Link – Evaluators Area: WP2: Output 2.5.1

Figure 34. Barking Riverside - a showcase for sustainable and resilient urban living incorporating multifunctional green infrastructure designed for nature

Output 2.5.2

Fairbrass, A. (2014) Biodiversity Monitoring: Barking Riverside. Report produced for Barking Riverside by University College London.

Summary - As part of the roll-out of biodiversity-led green infrastructure design green roof construction company ABG Ltd. designed and built a substantial green roof on Barking Riverside's Rivergate Centre, a school, place of worship and community centre at the heart of the Barking Riverside community. Designed based on the principles of multifunctional ecosystem service design studied in the Barking Riverside Phase 1 green roof experiment, the roof was designed with an innovative water attenuation and water storage drainage layer combined with wildflower vegetation designed to mimic the brownfield site on which it was built. This report represents a biodiversity survey of the roof utilising a novel acoustics monitoring methodology that was carried out as part of a PhD study currently being carried out at University College London. The survey recorded bat activity over the roof (Figure 35) and also species in flower on the roof at the time of the survey. Bat detection above the roof was frequent and several species were recorded indicating the biodiverse design of the roof is providing some benefits to bat communities on the site.

Link – Evaluators Area: WP2: Output 2.5.2

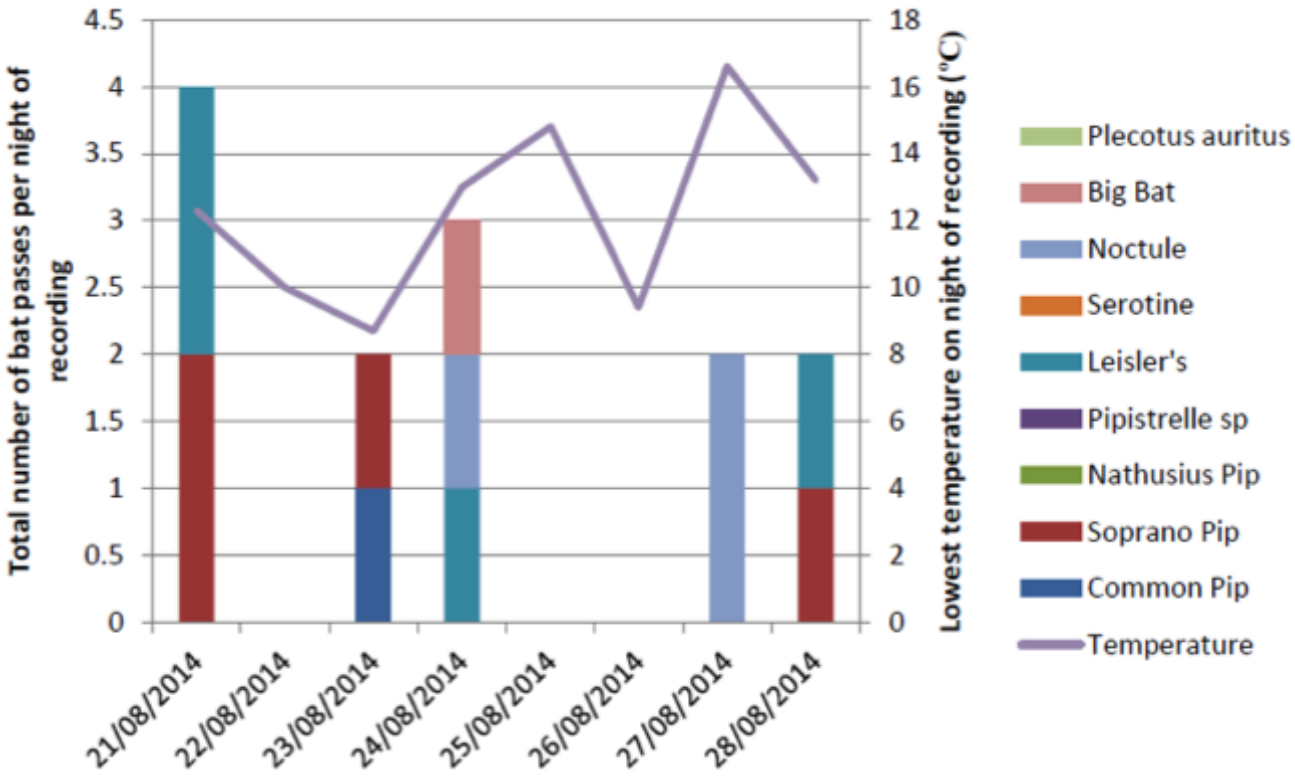

Figure 35. Total bat passes per species or genus and lowest temperature during a biodiverse green roof survey at Barking Riverside, London UK.

Output 2.5.3

Connop, S. and Nash, C. (2014) Queen Elizabeth Olympic Park: Green roof biodiversity baseline survey. London: University of East London.

Summary - The Queen Elizabeth Olympic Park (London, UK) is a major new asset providing a significant sporting, social, economic, cultural and environmental hub at the centre of East London regeneration. The new network of wildlife-rich greenspaces at the heart of the park will provide a range of ecosystem service benefits to the local community and environment and key to this is the biodiversity that this park will conserve and support. The Olympic Park Biodiversity Action Plan (BAP) established targets and guidance on how to create habitats, encourage species and generally enhance biodiversity through the Olympics to Legacy Transformation. This plan included the aim of conserving, enhancing and recreating the London and UK BAP priority habitats, the Built Environment (including living roofs) and high quality Brownfield Habitats (now known as Open Mosaic Habitat on Previously Developed Land) through a series of greenspace initiatives across the park.

As part of this aim, the Olympic Park's MPC building included a 2,500 m² biosolar roof (green roof and photovoltaic panels combined) (Figure 36). Designed by the TURAS advisor Dusty Gedge, the roof design included biomimicry of Open Mosaic Habitat to create a series of habitat niches through the use of blends of aggregates, aspect, shade and habitat piles. Designed to support biodiversity associated with the pre-development state of the site, the roof represents an excellent case study for TURAS design principles incorporating biomimicry of regional habitat context into urban green infrastructure design. This report comprises a detailed description of the work undertaken by the University of East London to establish a baseline monitoring protocol to assess the performance of the biodiversity-rich MPC green roof in relation to the Olympic Park Biodiversity Action Plan (BAP) aims. A combination of stereo fixed-point photographs, vegetation surveys, invertebrate surveys and bird and bat surveys were used to quantify the level of biodiversity on the roofs. Surveys were carried out three times during the summer survey period (June to October 2013). Results indicated that the habitat variation and floral diversity of the MPC green roof was providing a beneficial resource for a range of biodiversity including conservation priority species. As such, the green roof had achieved some of the Olympic Park BAP aims for its design and, with appropriate management, could be considered an exemplar of biodiverse green roof design.

Link – Evaluators Area: WP2: Output 2.5.3

Figure 36. Biosolar (biodiverse green roof combined with photovoltaic panels) roof on the MPC building, Queen Elizabeth Olympic Park, London UK

Output 2.5.4

Nash, C., Gedge, D., Newport, D., Ciupala, M.A. and Connop, S. (2014) Do photovoltaic panels and green roofs have a truly symbiotic relationship? A London Olympic Park case study revealing the role of PVs in green roof habitat niche enhancement. Submitted to Israel Journal of Ecology and Evolution: Green Roof Ecology Special Edition

Summary - Cities dominated by impervious artificial surfaces can experience myriad negative environmental impacts. Restoration of green infrastructure has been identified as a mechanism for increasing urban resilience, enabling cities to transition towards sustainable futures in the face of climate-driven change. Building rooftops represent a viable space for integrating new green infrastructure into high density urban areas. Urban rooftops also provide prime locations for photovoltaic (PV) systems. There is increasing recognition that these two technologies can be combined to deliver reciprocal benefits in terms of energy efficiency and biodiversity targets (Figure 37). Scarcity of scientific evaluation of the interaction between PVs and green roofs means that the potential benefits are currently poorly understood.

This study documents evidence from a biodiversity monitoring study of a substantial biosolar roof installed in the Queen Elizabeth Olympic Park. The design of the roof provided natural experimental replicates, enabling a monitoring programme to be established to assess the interaction between the PV panels and the habitat structure, floral and faunal composition of the green roof. Surveys identified variation in vegetation height and diversity associated with proximity to PV panels. Changing patterns of arthropod distributions were also identified, as was evidence that the PV panels could provide refugia for vegetation during dry spells. The study provided evidence that the PV panels contributed to the overall aim of the roof design - to create a mosaic of habitats to enhance biodiversity. Further detailed study is required to fully characterise the associated microclimatic zones and understand the effects of PV panel density.

Link – Evaluators Area: WP2: Output 2.5.4 (Confidential)

Figure 37. Olympic Park Biodiversity Action Plan Target Species, toadflax brocade moth (*Calophasia lunula*) on purple toadflax (*Linaria purpurea*) next to photovoltaic panels on the MPC green roof, Queen Elizabeth Olympic Park, London UK

Output 2.5.5

Carneiro, M A, Borland, T. and Connop, S. 2013. Report on water attenuation performance of green roof in the Ruislip Depot. London: University of East London

Summary - At over 1,500 km² and with an estimated 12.6 million residents, London is one of the world's megacities. Built on old models for high density living, London suffers from numerous environmental problems. Climate change is exacerbating many of these problems, the impact of which are predicted to become increasingly severe over the next 100 years. An example of the environmental problems linked to urbanisation and climate change in London is the storm water induced flooding being experienced at London Underground depots leading to hazardous working conditions and depot downtime. Due to the substantial size of depot roofs and the increased intensity of storm events, existing stormwater management drainage systems can become overloaded. This results in them backing up and overflowing into London Underground work areas making work impossible.

A potential solution to this problem is the incorporation of green roofs on depots to intercept storm events and reduce the occurrence of flooding. Green roofs are known to alleviate stormwater flooding issues by significantly reducing both peak flow rates and total runoff volume of rainwater from the roofs compared to a comparable conventional grey roof. They do this by storing rainwater in the substrate, drainage layer and vegetation components of the green roof and by releasing the stored rainwater back into the atmosphere through evapotranspiration. To assess the potential for green roofs to mitigate these problems, a knowledge exchange programme was established between the Greater London Authority (GLA) Drain London programme and London Underground at the London Underground Depot at Ruislip Gardens. The knowledge exchange programme comprised the installation and monitoring of green roofs at the depot (Figure 38) to assess their efficacy in comparison to the existing roof systems. Designed by TURAS advisor, Dusty Gedge, the roofs represent a Case Study for assessing the potential for using alternative more sustainable construction materials to improve vegetation resilience and stormwater attenuation performance. Due to the unusual nature of the monitoring required the Sustainability Research Institute (SRI) of the University of East London was commissioned to create novel rainfall runoff monitoring equipment and to analyse the data generated in order to compare the green roofs with the conventional roofs.

The report details the findings of the initial study period (July 2013) comparing an experimental green roof case study with a conventional green roof system and a grey roof system. Results indicated that the experimental system performed as well as or better than the industry standard green roof for water attenuation and far outperformed the industry standard green roof in terms of vegetation development and resilience. Monitoring of this Case Study will continue and results will be compared with laboratory tests of both green roof systems under simulated storm conditions to provide further evidence of the potential for alternative more sustainable construction methods for green roofs.

Link – Evaluators Area: WP2: Output 2.5.5

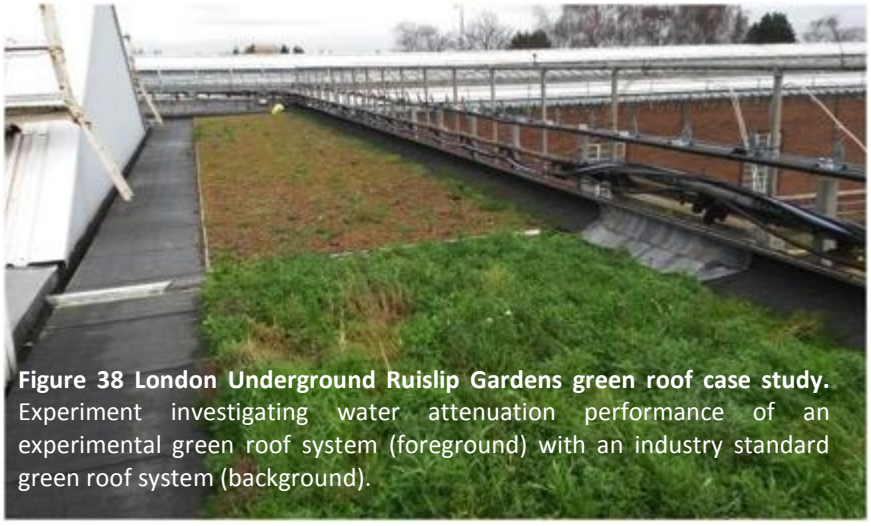

Figure 38 London Underground Ruislip Gardens green roof case study. Experiment investigating water attenuation performance of an experimental green roof system (foreground) with an industry standard green roof system (background).

Output 2.5.6

ANON (2014) Green Mile: greening the A12, Poplar, East London, UK. Report produced by Poplar HARCA/TURAS Consortium.

Summary - Ensuring that London's roads function smoothly is central to maintaining its role as a leading world city. However, London is not only in competition with New York, Tokyo and Paris in terms of efficiency but also in the quality of life that it delivers for residents and businesses. Too often the place function of streets has been sacrificed or ignored in subservience to their movement function. This has led to many areas of London becoming no-go areas for pedestrians, cutting off communities from their neighbours and condemning residents to high levels of air and noise pollution. The A12 from the Bow Roundabout to the Blackwall Tunnel (Polplar, London) is a strategically important arterial road that runs through an area that has both significant concentrations of deprivation and opportunities for new development. The A12 runs straight through the centre of the TURAS Poplar HARCA Case Study area and TURAS WP2 partners have been working with Poplar HARCA to design a series of multifunctional biodiversity-led green infrastructure initiatives to:

- improve the connections between communities;
- deliver short, medium and long term health benefits to those living and working in the local area;
- improve the context of, and prospects for, new development;
- reduce localised flooding;
- create biodiversity corridors; and
- alleviate the impact of the noise and air pollution that blights the lives of residents.

This report represents the evolution of these ideas into a strategic document (Figure 39) that is forming the foundation of consortium funding bids to move from ideas to a comprehensive TURAS Case Study green infrastructure implementation programme in Poplar. It also represents an excellent example of multidisciplinary collaborative strategic planning for multifunctional urban green infrastructure.

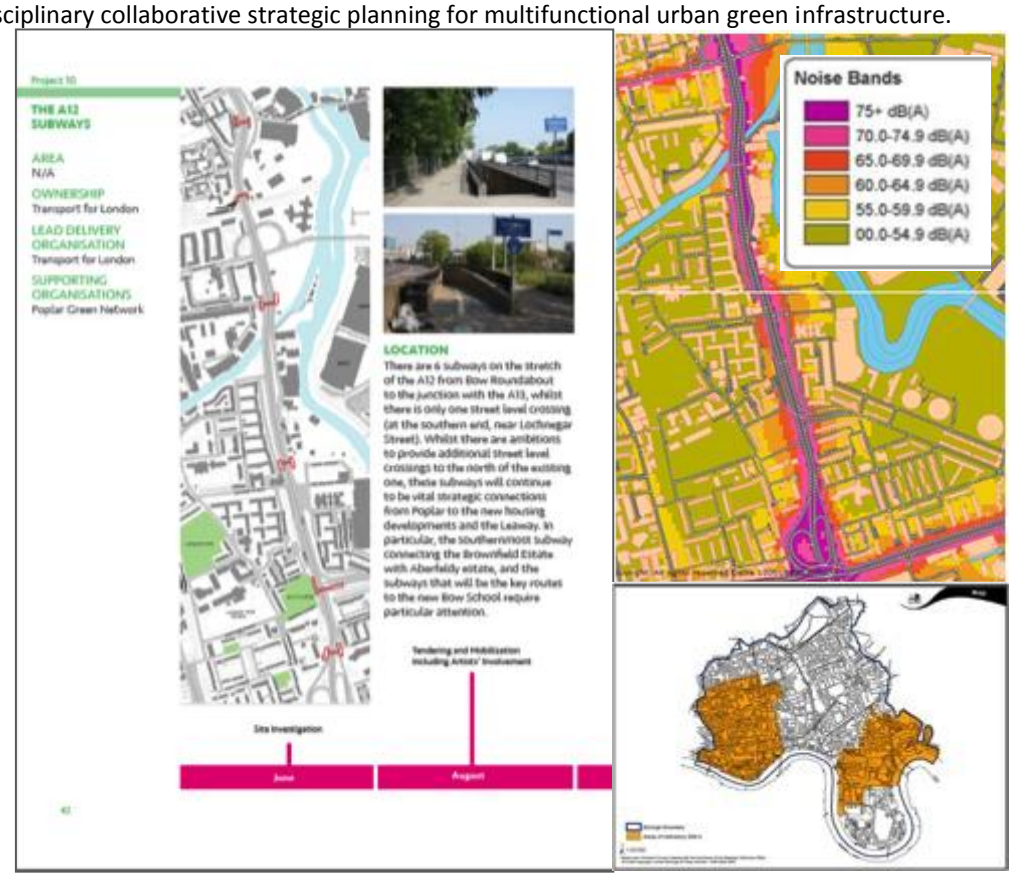

Figure 39. Concept pages from the Poplar HARCA and TURAS developed A12: Green Mile brochure. Greening A12 subways (top left) with data on noise pollution (top right) and nature deficiency in Poplar, East London (bottom).

Task 2.6 - Develop visions, feasible strategies, spatial scenarios and guidance tools that would enable adaptive governance, collaborative decision-making, and behavioural change in green infrastructure design across selected areas in Greater London, Rome and throughout the TURAS project network

This document represents a synergistic evaluation of the research and knowledge exchange undertaken and disseminated within the first three years of TURAS WP2. It presents an overview of all of the work undertaken, templates for collaborative working, visions for truly multifunctional urban green infrastructure design and guidance tools to ensure that informed decisions can be made when planning urban green infrastructure projects for building urban resilience and sustainability.

In addition to this report, two other initiatives have been instigated within Task 2.6 to disseminate best practice from WP2:

Output 2.6.1

Salvemini, M. and Berardi, L. (2014) Urban Green Infrastructure Questionnaire. University of Roma - Sapienza, Italia.

Summary - A questionnaire (Figure 40) for coding and filing urban green infrastructure best practices based on actual established examples. The questionnaire is designed to collect identification data for categorising and documenting best practice in multifunctional urban green infrastructure in order to provide a repository of excellence for the entire green infrastructure implementation process from idea, to design, planning, construction, implementation and management/legacy. Such an adaptive governance resource for urban green infrastructure implementation does not currently exist. The proforma questionnaires were also designed in such a way as to have synergy with the EU INSPIRE programme's building Case Use proformas.

The questionnaire has been distributed among the TURAS partners and their members or parent organizations to be completed. Best practices information and data is being assembled within a database to support the realization of an e-guide to urban green infrastructure implementation. Access to the best practice data will also be made available on the TURAS geo-portal through the geo-wiki function.

Link – Evaluators Area: WP2: Output 2.6.1


TURAS

2. **Questionnaire**

Urban Green Infrastucture: Best Practice questionnaire

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT	
id1	Best Practice identifier		letter country code+"A"+3-digit number (e.g. ITA001) In the case of a complex best practices it should be considered one questionnaire for the entire realisation and as many as needed questionnaires for all representative components which concretise one UGI best practice or excellent example, e.g. in the presence of a building which has green-walls, solar panels, energy saving special equipments and specific solutions for biodiversity increasing	
id2	Expert /organization/author surname		Who is filling the questionnaire	
id3	Expert /organization/author name		Who is filling the questionnaire	
id4	place		Where the questionnaire is prepared (city, country)	
id5	Date of compiling		AAAA-MM-DD date of questionnaire preparing	

Figure 40. Example page from the Urban Green Infrastructure best practice questionnaire that will be fed into an adaptive governance database to support urban green infrastructure planning

Output 2.6.2

Berardi, L. (2013) La GI per la GI! ....l'esempio del progetto TURAS. University of Roma - Sapienza, Italia.

Summary - Presentation (Figure 41) showcasing issues related to the TURAS project arising from studies and surveys carried out for TURAS WP2 about Green Infrastructure in relation to Geographic Information. It presents a comparison of the two disciplines (Green Infrastructure and Geographic Information) in relation to the similarity not only of their acronyms but also to their approaches and issues in terms of management and planning. The presentation has been published in the Conference Proceedings available on the Conference website.

Link – Evaluators Area: WP2: Output 2.6.2

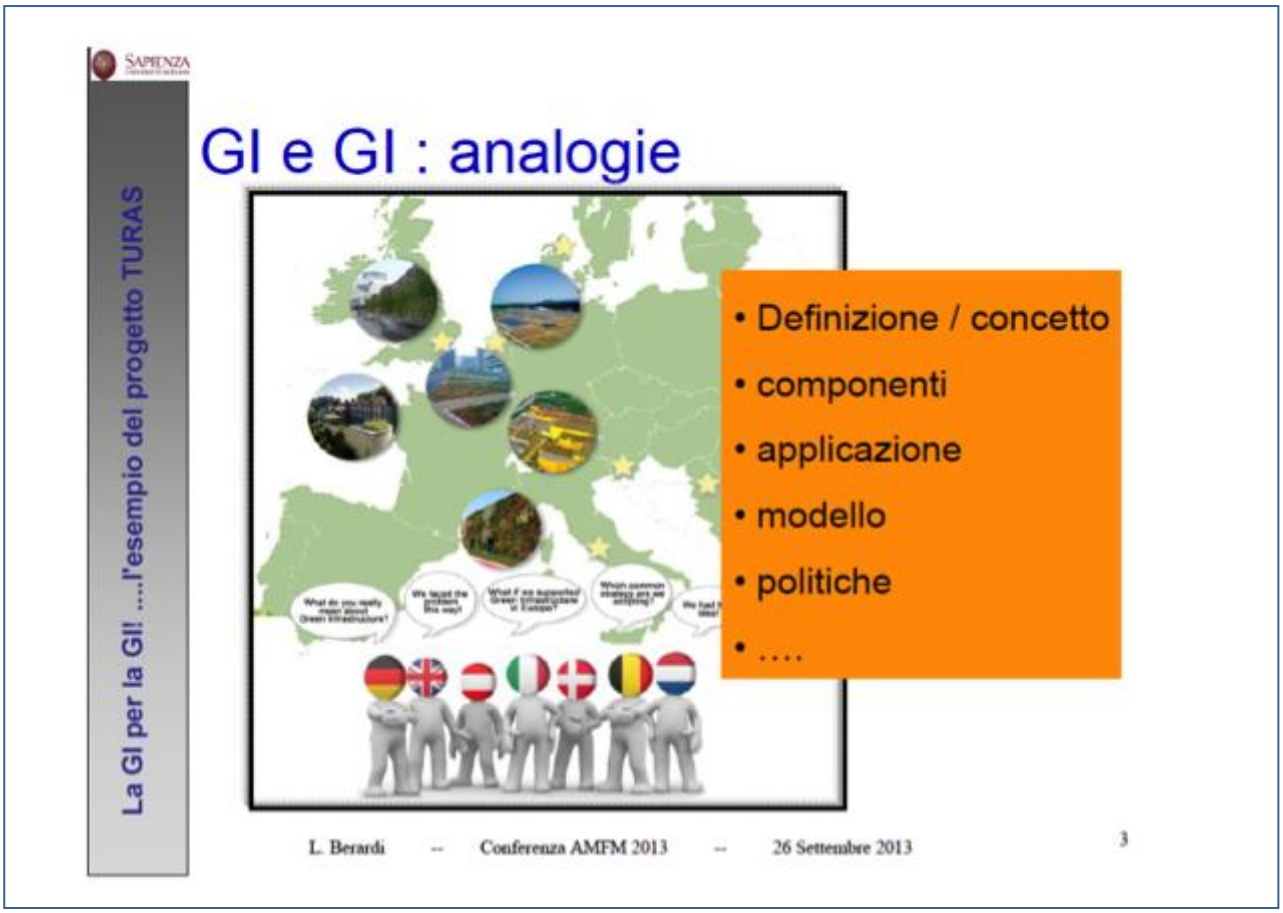

Figure 41. Slide from Conference presentation discussing the relationship between Geographic Information (GI) and Green Infrastructure (GI).

Output 2.6.3

WP2 Activity Units

WP2 activity units are showcases of work carried out under WP2 that will be carried forward into the dissemination phase of TURAS through a series of workshops to help Public Authorities transition towards more sustainable and resilient communities. Workshops will be designed to benefit all stakeholders in the urban planning process. Activity Units from WP2 will showcase:

- how urban green infrastructure can be embedded at the heart of sustainable urban design;
- best practice for cost/benefit analysis of green infrastructure projects;
- how decision-making tools can support the design and planning process for urban green infrastructure;
- how biodiversity can benefit from design incorporating biomimicry of regional context;
- how green infrastructure can be embedded into planning guidance;
- how to design urban green infrastructure to create multifunctional ecosystem service benefits;
- good practice for the entire process of urban green infrastructure implementation from idea through to installation and management.

The proposed Activity Units are listed on the following pages:

Activity Unit WP2.1 - Green Living Room

Current status: Green living room installed and operational, monitoring initiated, some results available but long term data gathering planned.

Name/title	Green Living Room
Description of…	
(Societal) Problem to be tackled	Urbanisation has led to numerous negative environmental consequences for communities. This includes the urban heat island effect, a scarcity of open space, issues related to noise pollution and air pollution, and nature deficit for communities in high density urban areas. Carefully planned multifunctional urban green infrastructure design can help mitigate these impacts.
Task force (main people involved)	Hans Mueller, Katrin Gölsdorf (HELIX Pflanzen GmbH); Silvia Weidenbacher (Verband Region Stuttgart); Bernd Eisenberg, Hans-Georg Schwarz v. Raumer (University of Stuttgart, Institute of Landscape Planning and Ecology); together with the collaboration partners the City of Ludwigsburg and Ludwig Schoenle architects.
(Research) Activities that are pursued	• Location competition to determine which region of Stuttgart would host the green living room (assess demand and feasibility for different locations). • Negotiation phase to discuss the logistics of installation and management • Design phase once a location has been determined to maximise the aesthetics and ecosystem service provision of the green living room. • Installation phase led by HELIX Pflanzen to bring the green living room to reality. • Detailed monitoring programme post-installation including community use and opinion surveys, irrigation requirements, cooling benefits, noise pollution reduction and biodiversity.

Purpose /goal	• Identification of a novel and innovative way of combining green wall design with urban open space provision.
	• Identification and demonstration of the potential for multifunctional benefits from carefully planned urban green infrastructure, including:
	  ○ Creation of a new social space in a high density urban area for the benefit of the community;
	  ○ Creation of urban comfort zones;
	  ○ Reduction of noise pollution;
	  ○ Provision for biodiversity.

Expected applicable output (measures)	• Showcase Green Living Room (a multifunctional green open space), including quantitative information on the cost versus the urban cooling benefits, noise pollution reduction, irrigation requirements, public perception and public use, and biodiversity benefits of such an intervention. • Field report for better understanding of adaptive governance processes involved in realising such a project.
Tags (no matter if in key term list or not)	City, climate change adaptation, innovation, biodiversity, health and well-being, green infrastructure, urban comfort zones, resilience

Activity Unit WP2.2 - Urban green infrastructure evidence database

Current status: Comprehensive assessment of green infrastructure implementation in Rome completed and available on website. Comprises a series of documents including Italian version, English version and additional reading bibliography. Role play e-tool developed and being tested with Rome stakeholders.

Name/title	Urban green infrastructure evidence database
Description of…	
(Societal) Problem to be tackled	Carefully planned multifunctional urban green infrastructure design can help mitigate the environmental impacts associated with urbanisation (e.g. urban heat island effect, a scarcity of open space, issues related to noise pollution and air pollution, and nature deficit). Lack of understanding of the processes involved in urban green infrastructure implementation (design, planning, construction), management (long-term funding, maintenance), and the basis of decision-making by stakeholders means that opportunities to develop and fund green infrastructure initiatives are being missed.
Task force (main people involved)	Claudio Baffioni, Monica Mendozza (Comune di Roma); Laura Berardi, Mauro Salvemini (University of Roma - Sapienza)
(Research) Activities that are pursued	• Develop an inventory of urban green infrastructure interventions in Rome with particular focus on green roofs and green walls. • Assess current barriers to, and drivers behind, green infrastructure implementation in Rome for ecosystem service provision. • Carry out a comprehensive review and assessment including the historical context of green infrastructure in Rome. • Develop a role play tool with embedded best practice and current understanding database for supporting and documenting the decision making process for green infrastructure implementation.
Purpose /goal	• Create an accessible e-tool for stakeholders in the urban green infrastructure process, from community groups to planners and practitioners, that supports the decision-making process by informing of the drivers and barriers involved in implementation. • To generate increased understanding of the decision-making process involved in urban green infrastructure development. • To provide a universal framework on which other local authorities can base an assessment of their own status in relation to urban green infrastructure implementation and management. • To support the development of greater opportunities for urban green infrastructure initiatives to improve the quality of life for urban communities.
Expected applicable output (measures)	• Development of a role play e-tool database developed to support the green infrastructure decision making process. • Guidance on how the role play e-tool can be adapted for other urban areas and cities. • Urban Green Infrastructure assessment reports acting as best practice demonstration for other local authorities.
Tags (no matter if in key term list or not)	City, urban planning, urban green infrastructure, community involvement, climate change adaptation, city planning.

Activity Unit WP2.3 - Urban Green Infrastructure Cost/Benefit Assessment Tool

Current status: Comprehensive review of available green infrastructure assessment tools carried out. Identification of best practice in current understanding. Set of green infrastructure indicators developed that area appropriate for the urban environment and benefit groups defined. Tool development underway and test scenario planned.

Name/title	Urban Green Infrastructure cost/benefit assessment tool
Description of…	
(Societal) Problem to be tackled	Carefully planned multifunctional urban green infrastructure design can help mitigate the environmental impacts associated with urbanisation (e.g. urban heat island effect, a scarcity of open space, issues related to noise pollution and air pollution, and nature deficit). Lack of centralised and quantified data on the cost/benefits of urban green infrastructure has been recognised as a key barrier to implementation. With these barriers in place, opportunities to enhance the resilience of urban areas and the quality of life for the communities are being missed.
Task force (main people involved)	Stefan Webb, Ajay Kathrani, Jutta Knapp (Institute for Sustainability); Stuart Connop, Jack Clough, Darryl Newport (University of East London)
(Research) Activities that are pursued	Develop a green infrastructure assessment toolkit specifically for urban areas. Research activity can be sub-divided into: • Draw and build on the CABE and Natural Economy Northwest Green Infrastructure Valuation Toolkit (agreed as a preeminent assessment tool in this arena) and identify gaps relevant for TURAS; • Review other green infrastructure assessments to ascertain relevant assessment indicators; • Review best practice from other relevant sustainability assessment tools; • Identify gaps in current understanding and thus gaps in the toolkit; • Define a set of green infrastructure indicators appropriate for urban context; • Assess the applicability of the toolkit as a universal assessment method for all TURAS case study areas.
Purpose /goal	• Develop a user-friendly toolkit to equip local authority planners with the cost/benefit understanding necessary to make sound and informed decisions on the use of urban green infrastructure to provide cost-effective solutions to urban sustainability, resilience and ecosystem service provision. • Provide a resource for all stakeholders in urban green infrastructure, from community groups to developers and architects, to be able to understand and analyse the cost/benefits of green infrastructure interventions to enable them to plan, seek funding for, and deliver green infrastructure initiatives. • Identify current knowledge gaps in quantifying the cost/benefit of green infrastructure interventions in relation to addressing environmental issues related to urbanisation and climate change (e.g. stormwater attenuation, air pollution, noise pollution, lack of access to nature). • Recommendations on how knowledge gaps can be addressed to support further development of urban green infrastructure cost/benefit analysis.
Expected applicable output (measures)	A novel cost/benefit evaluation toolkit for assessing the cost-effectiveness of urban green infrastructure solutions for solving environmental problems associated with urbanization.
Tags (no matter if in key term list or not)	City, urban planning, urban green infrastructure, community involvement, climate change adaptation, city planning, toolkit, resilience, land use

Activity Unit WP2.4 - Urban Green Infrastructure Best Practice Sharing

Current status: Proforma developed and sent out to TURAS partners. Database of green infrastructure good practice being developed. Mechanisms for data availability on the geo-wiki in discussion.

Name/title	Urban green infrastructure best practice sharing
Description of…	
(Societal) Problem to be tackled	There is a lack of information on the adaptive governance processes of developing urban green infrastructure projects from the idea phase through, design, planning, implementation, management and securing a legacy. There is also currently no standardised format to log and share information on best practice for green infrastructure development and management for building urban resilience and sustainability. Both of these represent barriers to the use and implementation of green infrastructure in urban areas to mitigate the environmental impacts associated with urbanisation (e.g. urban heat island effect, a scarcity of open space, issues related to noise pollution and air pollution, and nature deficit).
Task force (main people involved)	Laura Berardi, Mauro Salvemini (University of Roma - Sapienza); Stuart Connop, Paula Vandergert (University of East London)
(Research) Activities that are pursued	Development of a questionnaire for cataloguing and sharing best practice for urban green infrastructure design, implementation and management by: • Investigating the potential for using the EU INSPIRE programme's Building Case Use framework as the basis for developing a standardised pro-forma for recording and disseminating best practice on urban green infrastructure design; • Once a framework is decided upon, open discussion between partners to design and populate a questionnaire suitable for the collection of identification data for stage of the urban green infrastructure implementation process; • Distribution of the questionnaire among TURAS WP2 partners for trial and feedback; • Following the collation of feedback a finalised version will be sent to all TURAS partners their members or parent organizations to be completed; • Organisation of the data deriving from the questionnaires into a searchable best practice database; • Best practices information and data to be made available on TURAS geo-portal through the geo-wiki function.
Purpose /goal	• Develop a framework for reporting and filing urban green infrastructure best practice already realized within TURAS partner cities. • Create an open access searchable repository for sharing best practice in the adaptive governance processes associated with urban green infrastructure to support implementation for the benefit of urban communities. • Support the development of an e-guide to urban green infrastructure implementation to facilitate best practice sharing.
Expected applicable output (measures)	Searchable online database of adaptive governance best practice for urban green infrastructure projects
Tags (no matter if in key term list or not)	Best practice, city, urban planning, urban green infrastructure, resilience, land use, dissemination, methodology, implementation

Activity Unit WP2.5 - Green Roof Experimental Research

Current status: Overview of green roof experiment phase 1 results written up and presented as a knowledge transfer report milestone. Peer-review publication preparation on-going. Phase 2 green roof experiment constructed and operational, long-term monitoring on-going. Milestone report on the experiment available on TURAS website. Green roof rain simulator constructed and experiments with alternative materials on-going. Several peer-review papers on green roof design published, submitted or in draft form.

Name/title	Green roof experimental research
Description of…	
(Societal) Problem to be tackled	Industry standard green roofs represent missed opportunities for maximising the ecosystem service provision of urban green infrastructure. It is increasingly being recognised that consideration needs to be put into the design of green roof systems if they are to provide truly multifunctional benefits to urban communities including supporting biodiversity of national/international conservation value, developing urban resilience and adaptation through storm water attenuation and mitigating the urban heat island effect, and making the green roof construction industry itself more sustainable.
Task force (main people involved)	Stuart Connop, Darryl Newport, Chloe Molineux, Gyongyver Kadas, Caroline Nash, Kinga Owczarek (University of East London); Jonathan Speed, Clive Bell, Matt Carpen (Barking Riverside); Jo Sinclair, David Harley (London Borough of Barking Dagenham), Dusty Gedge (Green Roof Consultancy)
(Research) Activities that are pursued	Delivering a range of research and knowledge exchange projects investigating best practice for green roof design and disseminating results from the projects. This includes: • Monitoring a green roof experiment investigating whether there is an ecosystem service cost associated with moving away from industry standard green roof systems to green roofs designed for regionally important biodiversity; • Establishing a green roof experiment investigating whether using alternative secondary waste product substrates, microtopography and manipulating hydrology can create a mosaic of habitats enhancing overall biodiversity and habitat complexity; • Conducting a rain simulator experiment investigating the storm water attenuation behaviour of standard green roof construction materials and a series of alternative systems from more sustainable sources; • Comparing invertebrate assemblages on green roofs and brownfield sites to assess whether current green roof design is appropriate mitigation for brownfield loss; • Assessing how manipulating soil microbial communities can increase resilience in green roof vegetation and comparing green roof microbial communities with brownfield sites; • Assessing how the selection of recycled aggregate substrate effects plant diversity and the role this can play in creating habitat mosaics in urban green infrastructure; • Investigating the most appropriate trapping methodology for green roof invertebrate sampling; • Investigating the interaction between green roofs and photovoltaic panels in terms of the benefits to biodiversity.
Purpose /goal	• To advance understanding of how green roof design effects ecosystem service performance and therefore promote increased urban resilience and sustainability through better green roof design for stormwater

	attenuation, thermal insulation of buildings and supporting biodiversity. • To provide evidence to underpin the development of policy and planning guidance in relation to multifunctional green roof design to maximise ecosystem service provision in urban areas. • To provide a showcase to demonstrate the possibilities in terms of green roof design for biodiversity to increase urban biodiversity, a factor that has been linked to increased urban resilience.
Expected applicable output (measures)	• A series of knowledge transfer reports and/or peer-review publications increasing current understanding on best practice for green roof design with a particular focus on green roofs for biodiversity and detailing design principles. • Experimental demonstration sites for best practice. • Examples of embedding green roof design best practice into planning guidance, design guidance and real-world best practice case studies. • Guidelines on how to embed biodiversity.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, methodology, implementation, urban environment, innovation, biodiversity

Activity Unit WP2.6 - Green Roof - Case Study

Current status: Green roof case studies operational and long-term monitoring protocols initiated. Knowledge transfer reports from case study sites, completed or in draft form. Additional opportunities being developed.

Name/title	Green roof - Case Study
Description of…	
(Societal) Problem to be tackled	Industry standard green roofs represent missed opportunities for maximising the ecosystem service provision of urban green infrastructure and thus providing multifunctional benefits to urban communities suffering from impacts related to urbanisation (e.g. storm water flooding, poor air quality, urban heat island, nature deficit disorder). It is increasingly being recognised that consideration needs to be put into the design of green roof systems if they are to provide truly multifunctional benefits including supporting biodiversity of national/international conservation value, developing urban resilience and adaptation in the face of climate change, and making the green roof construction industry itself more sustainable. Whilst experimental data has demonstrated this, best practice real-world case studies must be developed to showcase how research can be embedded into best practice.
Task force (main people involved)	Stuart Connop, Darryl Newport, Caroline Nash, Jack Clough, Richard Lindsay, Ertion Axha, Toby Borland (University of East London); Melina Kakouratou, Rhys Lidstone (London Underground); Dusty Gedge, Gary Grant (Green Roof Consultancy); Steve Humberstone (ABG Ltd)
(Research) Activities that are pursued	Monitoring full-scale examples of best practice disseminated from green roof research including: • Monitoring of habitat heterogeneity and biodiversity of the Olympic Park MPC building green roof, a roof designed by TURAS advisor Dusty Gedge following best practice design for biodiversity; • Monitoring stormwater runoff from a standard and an experimental green roof at Ruislip London Underground Depot; • Monitoring biodiversity of the Rivergate Centre green roof, Barking Riverside; • Monitoring the biodiversity of a wetland roof on the Victoria and Albert Museum, London; • Monitoring the biodiversity and thermal insulation benefits of a native planted green wall on the Rubens Hotel, Victoria, London; • Publication and dissemination of results from Case Study monitoring.
Purpose /goal	• To quantify the multifunctional ecosystem service benefits that can be provided in urban areas with careful consideration of green infrastructure design to ensure that biodiversity and associated ecosystem service provision is maximised for the quality of life of communities • To demonstrate how best practice from TURAS experimental research can be translated into real-world benefits • To showcase how other areas and cities can replicate the design principles
Expected applicable output (measures)	• Establishment of best practice showcase sites • Best practice guidance in the form of knowledge transfer reports and/or peer-review publications from monitoring results
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, methodology, implementation, urban environment, innovation, biodiversity

Activity Unit WP2.7 - Landscaping for Biodiversity

Current status: Biomimicry landscaping experiment established and long-term monitoring initiated. Control areas in traditional landscaping established and long-term monitoring initiated. Site being used as a showcase for landscape design for biodiversity. Knowledge transfer report published as Milestone document, peer-review publication also published and a second is being prepared.

Name/title	Landscaping for biodiversity
Description of…	
(Societal) Problem to be tackled	Nature deficit is a common problem in high density urban areas where urban communities have limited opportunities to experience nature and greenspace. Current urban landscaping design, led by aesthetics and preconceptions of ease of management rather than biomimicry of regionally important habitat, represents a missed opportunity for enhancing the biodiversity value of urban greenspace. With increasing recognition of the potential for urban green infrastructure to provide ecosystem services for communities, including providing habitat for biodiversity of national and international conservation importance, there is a need for more concerted efforts to design urban landscaping capable of connecting people, wildlife and ecosystem service provision.
Task force (main people involved)	Stuart Connop, Caroline Nash (University of East London); Clive Bell, Jonathan Speed, Matt Carpen (Barking Riverside); Samantha Davenport (Natural England); Laeti Kemp, Dave Clark (DF Clark Ltd)
(Research) Activities that are pursued	• Evaluation and description of the use of biomimicry to incorporate habitat features associated with regional habitat of national conservation value into a brownfield landscaping experiment at Barking Riverside. • Monitoring of the added value for biodiversity of the habitat features incorporated into the brownfield landscaping by comparison with more traditional ground level urban green infrastructure. • Dissemination of results through a knowledge transfer report, peer-review publications and conference presentations detailing design, installation and monitoring of experimental brownfield landscaping and traditional urban landscaping at Barking Riverside.
Purpose /goal	To quantify and demonstrate the added biodiversity value of using biomimicry of habitat features associated with regionally typical habitat of national conservation importance in the design of urban landscaping in order to mitigate development and promote the conservation of biodiversity in an urban context
Expected applicable output (measures)	• Development of brownfield landscaping experiment as a showcase for good practice. • Dissemination of a 'how to' guide including design, installation and monitoring results in the form of a knowledge transfer report. • Presentation of results at conferences.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, methodology, implementation, urban environment, innovation, biodiversity

Activity Unit WP2.8 - Landscaping For Biodiversity - Case Study

Current status: Beetle Bump landscaping showcase established and monitored. Peer-review article on construction published. Best practice guidance published through partner NGO. Award and short-listing for innovative design. Best practice now being fed into neighbouring developments. Discussions underway with DEFRA over the inclusion of the Beetle Bump target species, the streaked bombardier beetle (*Brachinus sclopeta*), in Schedule 5 of the Wildlife and Countryside Act (1981) with the Beetle Bump acting as a basis for mitigation planning. Consortium partnership development on-going for a larger funding bid to support greater understanding of brownfield ecosystem service provision and conservation.

Name/title	Landscaping for biodiversity - Case Study
Description of…	
(Societal) Problem to be tackled	Nature deficit is a common problem in high density urban areas where urban communities have limited opportunities to experience nature and greenspace. Biomimicry of regionally important habitat in urban green infrastructure design represents a mechanism for supporting a broader diversity of habitats and species in urban areas and thus providing opportunities for reconnecting urban communities with nature and improving quality of life. The mosaic of low nutrient habitats found on brownfield sites can have exceptionally high biodiversity value and represents a regionally important habitat under threat from urbanisation. Unless brownfield sites can be conserved or effectively mitigated during development biodiversity, habitat connectivity and ecosystem service provision will be lost impacting local communities.
Task force (main people involved)	Stuart Connop, Caroline Nash, James McGill, Jack Clough (University of East London); Jamie Robins, Sarah Henshall (Buglife)
(Research) Activities that are pursued	• Identify opportunities for brownfield nature reserve creation as part of urban green infrastructure design. • Design, construct and install case study brownfield biomimicry nature reserve. • Monitor added biodiversity value of brownfield biomimicry landscape project compared to more traditional urban landscape design. • Disseminate best practice from innovative urban landscaping design.
Purpose /goal	• Develop greater understanding of how urban green infrastructure can be designed to maximise biodiversity, mitigate for development, and reduce nature deficit for urban communities. • Showcase best practice from experimental research within TURAS and how they can be translated into real-world examples of using biomimicry to design for biodiversity.
Expected applicable output (measures)	• Installation of a showcase brownfield landscaping project at the University of East London. • Dissemination of best practice in the form of knowledge transfer reports. peer-review publications and presentations.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, methodology, implementation, urban environment, innovation, biodiversity

Activity Unit WP2.9 - Practical Application of WP2 Research into Planning Guidance

Current status: Sustainable Urban Drainage Systems (SuDs) planning guidance based on TURAS multidisciplinary urban green infrastructure design principles developed in partnership with the London Boroughs of Tower Hamlets and Newham. Flagship pocket park launched in Tower Hamlets to promote SuDs design principles. Additional collaborative opportunities for green infrastructure enhancement with Local Authorities being developed including wet woodlands for stormwater attenuation, the Poplar HARCA Green Mile project and the Nature Improvement Areas project with Essex County Council.

Name/title	Practical application of WP2 research into planning guidance
Description of…	
(Societal) Problem to be tackled	Urban areas suffer from numerous environmental problems related to high density grey infrastructure including stormwater problems during heavy rain fall events. Predicted effects of climate change include an increase in heavy storm events with implications for urban communities in terms of property damage, lost work time and insurance costs. Stormwater management methods focused on a single function represent missed opportunities for restoring ecosystem services to urban communities which can provide a range of additional services such as reducing air pollution and noise pollution, reducing the urban heat island effect, supporting biodiversity and providing food security through grow-your-own projects. Unless best practice is embedded into local authority expectations through planning guidance, opportunities for multifunctional urban green infrastructure solutions will be missed.
Task force (main people involved)	Jack Clough, Stuart Connop, Darryl Newport (University of East London); Jessica Bastock, Paul Whitfield, Ruth Segers (London Borough of Tower Hamlets); Gavin Day (London Borough of Newham)
(Research) Activities that are pursued	• Identify mechanisms to promote TURAS WP2 design for biodiversity green infrastructure solutions with a focus on multifunctional ecosystem service provision and connecting urban communities with nature. • Work with local authorities to develop opportunities for embedding best practice from TURAS WP2 into urban planning policy. • Investigate the potential for developing a Sustainable Urban Drainage Systems guidance document for high density urban areas with biodiversity-led design. • Develop a showcase SuDs pocket park based on green infrastructure design for biodiversity principles.
Purpose /goal	• Develop exemplar guidance for biodiversity-focused multifunctional green infrastructure in high density urban areas using Local Authority urban planning mechanisms. • Showcase real-world examples of planning guidance recommendations for promoting multifunctional biodiverse urban green infrastructure in high density urban areas.
Expected applicable output (measures)	• Example guidance document showcasing how TURAS WP2 green infrastructure design principles can be embedded into the local authority planning process. • Flagship pocket park launched.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, implementation, urban environment, innovation, biodiversity, communication, urban planning, climate change adaptation, water management.

Activity Unit WP2.10 - A12: Green Mile, Poplar HARCA

Current status: TURAS researchers collaborated with the social landlords Poplar HARCA, landscape architects and community residents to embed TURAS green infrastructure design principles at the heart of a community housing renovation project. Outputs completed include a TURAS landscaping design guidance document; A12:Green Mile - a brochure detailing potential green infrastructure interventions that could be incorporated along the major arterial road running through the centre of the site to increase connectivity for residents and improve the environment. Outputs in development include a case study on the work done in TURAS developing the Green Mile concept and a Life+ consortium funding bid to realise the concept.

Name/title	Green Mile, Poplar HARCA
Description of…	
(Societal) Problem to be tackled	The Poplar/Bromley-by-Bow area of the London Borough of Tower Hamlets is an area characterised by high levels of deprivation and environmental impacts associated with high-density urban design. One of the key environmental blights in the area is a major arterial road that bisects the community and reduces quality of life through a range of environmental impacts including air pollution, noise pollution, flooding issues, nature deficiency, and lack of access to greenspace. The area is also the focus of significant investment, retrofit, and redevelopment. At 3.7 km² in size and home to 40,000 people the area includes subsections that are in the lowest 1% of the index of multiple deprivation and 10% of the population have fuel poverty. Because of these challenges, local partners (including social landlords) are committed to trialling and demonstrating both physical interventions, and innovative approaches, to improve the well-being and resilience of local residents. This includes innovative green and blue infrastructure, “meanwhile” uses of vacant spaces, new approaches to urban planning and development, new models for community engagement and financing local improvements, and support for local SMEs, jobs, and skills. These objectives are closely aligned with the goals of TURAS.
Task force (main people involved)	Stefan Webb, Ajay Kathrani, Jutta Knap (Institute for Sustainability); Nick Martin (IfS/Poplar HARCA); Stuart Connop, Darryl Newport, Paula Vandergert (University of East London); Paul Augarde, David Black (Poplar HARCA); Dusty Gedge, Gary Grant (Green Roof Consultancy).
(Research) Activities that are pursued	• Develop a collaborative partnership between the Poplar HARCA renovation project and TURAS transitioning to resilience and sustainability research. • Visit site to meet community groups and discuss green infrastructure design principles. • Develop green infrastructure guidance documents based on designing for biodiversity using biomimcry of regionally typical habitat of national conservation importance for landscape architects involved in the regeneration project. • Develop a strategic green infrastructure design document with innovative urban green infrastructure solutions to mitigate the effects of the major arterial road within the community and create connectivity across the divide. • Development of a consortium of partners to collaborate towards a Life+ funding bid to realise the strategic green infrastructure design document.
Purpose /goal	• Development of a community-scale application of the TURAS green infrastructure transitioning strategy to improve quality of life for a socially deprived urban community suffering from numerous impacts related to high density urban living.

	• To demonstrate, document and provide a framework for the multi-stakeholder approach necessary for success of such an initiative (including community groups, social landlords, urban planners, local authorities, landscape architects). • To demonstrate how true multifunctionality of urban green infrastructure can mitigate a range of negative effects associated with major arterial roads in urban areas if carefully designed using regional context.
Expected applicable output (measures)	• Guidance on the incorporation of regional context into urban landscaping for a community transition initiative. The guidance also represents a framework that could be transferred to other projects and local authorities. • A12: Green Mile document demonstrating a collaborative community-engagement approach to designing multifunctional urban green infrastructure initiatives to improve the quality of life associated with high-density urban living. • Case study on the collaboration between TURAS researchers and Poplar HARCA in relation to the evolution of the A12: Green Mile concept document to provide an adaptive governance overview of how the collaborative framework could be replicated in other neighbourhoods.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, implementation, urban environment, innovation, biodiversity, communication, urban planning, climate change adaptation.

Activity Unit WP2.11 - Deliverable 2.3: Visions and Feasibility Strategies

Current status: Deliverable document completed. Output comprises an online guide, but ultimately it is envisaged that TURAS will develop a navigable e-tool summarising WP2 outputs and detailing current understanding and best practice to support the planning and decision-making process involved in green infrastructure planning.

Name/title	Deliverable 2.3: visions and feasibility strategies
Description of…	
(Societal) Problem to be tackled	Urbanisation has led to numerous negative environmental consequences for communities. This includes the urban heat island effect, a scarcity of open space, issues related to noise pollution and air pollution, and nature deficit for communities in high density urban areas. Focus on single disciplinary solutions to environmental problems associated with urban areas mean that opportunities for multifunctional solutions that holistically enhance the health and well-being of urban communities are currently being missed. Increasingly, green infrastructure restoration is seen as a solution to this but industry standard fixes predominate and understanding of the adaptive governance processes from idea inception, through planning to implementation and management are lacking. As such, unnecessary barriers stand in the way of high quality green infrastructure provision to improve the quality of life for urban communities.
Task force (main people involved)	Mauro Salvemini, Laura Berardi (University of Roma - Sapienza), Claudio Baffioni; Monica Mendozza (Comune di Roma), Stefan Webb, Ajay Kathrani, Jutta Knap (Institute for Sustainability); Stuart Connop, Darryl Newport, Paula Vandergert, Chloe Molineux, Gyongyver Kadas, Caroline Nash, Kinga Owczarek (University of East London), Bernd Eissenberg, Hans-Georg Schwarz v. Raumer (University of Stuttgart); Hans Mueller, Katrin Gölsdorf (HELIX Pflanzen GmbH), Silvia Weidenbacher (Verband Region Stuttgart).
(Research) Activities that are pursued	• Assemble all of the work carried out in the first 3 years of WP2 into a coherent and focused over-arching dissemination format. • Update understanding of green infrastructure best practice throughout the evolution of TURAS. • Develop a usable urban green infrastructure database for community groups, green infrastructure practitioners and planners. • Create a series of easily accessible Vision + Strategy Cards that introduce and summarise the work carried out under WP2 of TURAS through a series of simple visual guides/toolkits.
Purpose /goal	To provide an evidence base and guidance tools that support community groups, urban planners, local authorities and other stakeholders to transition towards the design, development, implementation and management of truly multifunctional urban green infrastructure capable of supporting a broad range of biodiversity and ecosystem services to urban communities to mitigate the impacts of urbanisation.
Expected applicable output (measures)	• Summary strategy document - WP2 Deliverable 2.3. • E-tool.
Tags (no matter if in key term list or not)	Best practice, urban green infrastructure, resilience, dissemination, implementation, urban environment, innovation, biodiversity, communication, urban planning, climate change adaptation.

8. Future plans

Work package 2 will:

- Continue monitoring of the WP2 green infrastructure experiments and case studies followed by peer-review publication and knowledge transfer of results
- Continued development of Case Study opportunities at Barking Riverside and across WP2 partner cities and beyond
- Dissemination through workshops and partnership working with local authorities already embedded within TURAS and other global cities
- Development of WP2 outputs into an electronic database/web-based dissemination platform to ensure the message from WP2 reaches a broader audience
- Development of WP2 research outputs into toolkits and adaptive governance guidelines to support transition to truly multifunctional urban green infrastructure implementation
- Consortium building for further opportunities and development including the next phase of TURAS and spin-off projects.

9. Appendix

The following pages comprise examples of the urban green infrastructure best practice questionnaire that have been completed and returned in order to establish a database of urban green infrastructure adaptive governance.

Urban Green Infrastucture: Best Practice questionnaire			
ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
Id1	Best Practice identifier	ITA001	letter country code+"A"+3-digit number (e.g. ITA001) In the case of a complex best practices it should be considered one questionnaire for the entire realisation and as many as needed questionnaires for all representative components which concretise one UGI best practice or excellent example. e.g. in the presence of a building which has green-walls, solar panels, energy saving special equipment and specific solutions for biodiversity increasing
Id2	Expert /organization/author surname	Cresce	Who is filling the questionnaire
Id3	Expert /organization/author name	Alessandro	Who is filling the questionnaire
Id4	place	Rome, Italy	Where the questionnaire is prepared (city, country)
Id5	Date of compiling	2014-01-13	AAAA-MM-DD date of questionnaire preparing

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
A1	Name of BP	District CASANOVA	A name given to the resource; typically, a Title will be a name by

			which the resource is formally known.
A2	Builder	CLE, (Cooperativa Lavoratori Edili)	Executor/builder of a BP
A3	Designer/Engineer/Architect/Landscape architect	Fritz van Dongen	Author of a BP design
A4	Date of Realization	Started In 2011	Specify if it's a BP that is still in progress
A5	Subject of best practices	IPES Bolzano	Typically, the subject will be represented using keywords, key phrases, or classification codes.
A6	Status	In progress	Which is the current status (example: finished, in progress)
A7	Owner	Bolzano public administration	The present owner of the realisation
A8	Description	Homes for public residential housing	The realisation should be described through his major constituents and some representative particulars.
A9	City	Bolzano	Specify in which city and/or country is the BP
A10	Surface plan dimension of BP in ha If the BP is contained within a building or has a dimension less than 100 sq. meters the attributes A10 -A13 have not to be compiled	About 2.65 ha	The area of the BP in ha
A11	Surface plan dimensions in meters	About 7.00 ha	The maximum length and width containing the BP (Upper Right corner , Left Down corner)

A12	Geographic Coordinates or Gravity Center	Gravity Center: N 46° 28.890', E 11° 18.918'	The coordinates in longitude and latitude of the gravity centre of rectangle of attribute A11
A13	Vertical/sub-vertical dimensions of BP in meters	25 Meters	The maximum vertical or sub-vertical dimension of the BP realisation
A14	Dimensions of BP if internally contained in main structure in meters	1.54 ha	The overall dimensions of the BP in the case that is contained in a structure. e.g. a green wall contained in a building or .....
A15	The altitude on sea level (in meters) of the zero point from which the A13 or A14 parameter is measured	About 250 meters	The A15 parameter is measured starting from the sea level of bottom edge
A16	Type of UGI	B.3: Green Roof	Choice one of this U.G.I. **A.** Natural or semi-natural systems: **A.1.** Protected areas **A.2.** Ecosystems and high nature value outside protected areas **A.3.** Eco-corridors or stepping stone for wildlife **A.4** Restored habitat patches that have been created with specific species in mind **B.** Artificial features: **B.1.** eco-ducts or eco-bridges **B.2.** green wall **B.3.** green roof **B.4.** Features for climate change adaptation

			B.5. Rain garden **B.6.** Swale **B.7.** Park **B.8.** Amenity Space **B.9.** Allotments **B.10.** Gardens **B.11.** Sports & Recreation area
A17	Reason of the intervention	Create new homes for social housing in CO2 emissions 0	For example: heat island reduction, improving the building's energy class, stormwater control.
A18	Typology of current ownership and maintenance	Co-ownership public-private	Choice between public or private
A18a	Typology of future ownership and maintenance?	questionnaire filled out previously	Choice between public or private
A18b	Economic plan for future maintenance?	questionnaire filled out previously	
A19	Typology of users	Private	Choice between public or private
A20	People who benefit directly	C	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more
A21	People who benefit indirectly	difficult to define, roughly C	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more

A22	Biodiversity		to be defined
A23	Energy	40 kWh/sq./year (not sure)	To be defined
A24	References	www.comune.bolzano.it/lavori_context02.jsp?area=170&ID_LINK=3706	
A25			
PIC1	image of BP		

PIC2	image of BP		
PIC3	image of BP		

Urban Green Infrastucture: Best Practice questionnaire			
ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
Id1	Best Practice identifier	ITA002	letter country code+"A"+3-digit number (e.g. ITA001) In the case of a complex best practices it should be considered one questionnaire for the entire realisation and as many as needed questionnaires for all representative components which concretise one UGI best practice or excellent example. e.g. in the presence of a building which has green-walls, solar panels, energy saving special equipment and specific solutions for biodiversity increasing
Id2	Expert /organization/author surname	Cuccaro architect, head of the school buildings office of the city of Rome	Who is filling the questionnaire
Id3	Expert /organization/author name	Chiara Cecilia	Who is filling the questionnaire
Id4	place	Rome, Italy	Where the questionnaire is prepared (city, country)
Id5	Date of compiling	2014-05-02	AAAA-MM-DD date of questionnaire preparing

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
A1	Name of BP	Extension of the elementary school in Via di Motta Camastra 155,rome	A name given to the resource; typically, a Title will be a name by which the resource is formally known.
A2	Builder	EDILIN srl Rome	Executor/builder of a BP
A3	Designer/Engineer/Architect/Landscape architect	Marcello De Rito, architect, Rome	Author of a BP design
A4	Date of Realization	Project 2007-Completed 2013	Specify if it's a BP that is still in progress
A5	Subject of best practices	ROMA CAPITALE Dip.to SIMU U.O. edilizia scolastica	Typically, the subject will be represented using keywords, key phrases, or classification codes.
A6	Status	completed	Which is the current status (example: finished, in progress)
A7	Owner	City of Rome	The present owner of the realisation
A8	Description	Extension of an existing elementary school, consisting of 5 classes more plus services	The realisation should be described through his major constituents and some representative particulars.
A9	City	Rome, east outskirts	Specify in which city and/or country is the BP
A10	Surface plan dimension of BP in ha If the BP is contained within a building or has a dimension less than 100 sq. meters the attributes A10 -A13 have not to be compiled	About ha1,3	The area of the BP in ha

A11	Surface plan dimensions in meters	Mq 600	The maximum length and width containing the BP (Upper Right corner , Left Down corner)
A12	Geographic Coordinates or Gravity Center	Gravity Center: N 41°51'57'' E 12°40'49''	The coordinates in longitude and latitude of the gravity centre of rectangle of attribute A11
A13	Vertical/sub-vertical dimensions of BP in meters	8 Meters	The maximum vertical or sub-vertical dimension of the BP realisation
A14	Dimensions of BP if internally contained in main structure in meters	Mq 600	The overall dimensions of the BP in the case that is contained in a structure. e.g. a green wall contained in a building or .....
A15	The altitude on sea level (in meters) of the zero point from which the A13 or A14 parameter is measured	About 92meters	The A15 parameter is measured starting from the sea level of bottom edge
A16	Type of UGI	B.3: Green Roof	Choice one of this U.G.I. **A.** Natural or semi-natural systems: **A.1.** Protected areas **A.2.** Ecosystems and high nature value outside protected areas **A.3.** Eco-corridors or stepping stone for wildlife **A.4** Restored habitat patches that have been created with specific species in mind **B.** Artificial features: **B.1.** eco-ducts or eco-bridges

A21	People who benefit indirectly	difficult to define, the intervention was meant to test the green roofs technique in public schools and to suggest similar virtuous practices	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more
A22	Biodiversity		to be defined
A23	Energy	77,13 Kj/m^3 gg	To be defined
A24	References		
A25			
PIC1	image of BP		

PIC2	image of BP		
PIC3	image of BP		

Urban Green Infrastucture: Best Practice questionnaire

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
Id1	Best Practice identifier	ITA003	letter country code+"A"+3-digit number (e.g. ITA001) In the case of a complex best practices it should be considered one questionnaire for the entire realisation and as many as needed questionnaires for all representative components which concretise one UGI best practice or excellent example. e.g. in the presence of a building which has green-walls, solar panels, energy saving special equipment and specific solutions for biodiversity increasing
Id2	Expert /organization/author surname	Cresce	Who is filling the questionnaire
Id3	Expert /organization/author name	Alessandro	Who is filling the questionnaire
Id4	place	Rome, Italy	Where the questionnaire is prepared (city, country)
Id5	Date of compiling	2014-05-29	AAAA-MM-DD date of questionnaire preparing

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
A1	Name of BP	Palestra Downtown	A name given to the resource; typically, a Title will be a name

A12	Geographic Coordinates or Gravity Center	Gravity Center: N 45°27'44.22", E 9°11'22.61"	The coordinates in longitude and latitude of the gravity centre of rectangle of attribute A11
A13	Vertical/sub-vertical dimensions of BP in meters	About 25 Meters	The maximum vertical or sub-vertical dimension of the BP realisation
A14	Dimensions of BP if internally contained in main structure in meters	50 Sq	The overall dimensions of the BP in the case that is contained in a structure. e.g. a green wall contained in a building or .....
A15	The altitude on sea level (in meters) of the zero point from which the A13 or A14 parameter is measured	About 125 meters	The A15 parameter is measured starting from the sea level of bottom edge
A16	Type of UGI	B.3 and B.11	Choice one of this U.G.I. **A.** Natural or semi-natural systems: **A.1.** Protected areas **A.2.** Ecosystems and high nature value outside protected areas **A.3.** Eco-corridors or stepping stone for wildlife **A.4** Restored habitat patches that have been created with specific species in mind **B.** Artificial features: **B.1.** eco-ducts or eco-bridges **B.2.** green wall **B.3.** green roof **B.4.** Features for climate change adaptation

			B.5. Rain garden **B.6.** Swale **B.7.** Park **B.8.** Amenity Space **B.9.** Allotments **B.10.** Gardens **B.11.** Sports & Recreation area
A17	Reason of the intervention	Create a relax area for a fitness center	For example: heat island reduction, improving the building's energy class, stormwater control.
A18	Typology of current ownership and maintenance	Private	Choice between public or private
A18a	Typology of future ownership and maintenance?	questionnaire filled out previously	Choice between public or private
A18b	Economic plan for future maintenance?	questionnaire filled out previously	
A19	Typology of users	Private	Choice between public or private
A20	People who benefit directly	B	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more
A21	People who benefit indirectly	Difficult to define, roughly B	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more

A22	Biodiversity		to be defined
A23	Energy	Unknown	To be defined
A24	References	http://www.perligarden.com/vedit/15/img_referenze/Giardino-pensile-intensivo-prato-downtown-milano.pdf	
A25			
PIC1	image of BP		
PIC2	image of BP		

PIC3	image of BP			

Urban Green Infrastucture: Best Practice questionnaire			
ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
Id1	Best Practice identifier	GER001	letter country code+"A"+3-digit number (e.g. ITA001) In the case of a complex best practices it should be considered one questionnaire for the entire realisation and as many as needed questionnaires for all representative components which concretise one UGI best practice or excellent example. e.g. in the presence of a building which has green-walls, solar panels, energy saving special equipment and specific solutions for biodiversity increasing
Id2	Expert /organization/author surname	Silvia	Who is filling the questionnaire
Id3	Expert /organization/author name	Weidenbacher	Who is filling the questionnaire
Id4	place	Stuttgart Region	Where the questionnaire is prepared (city, country)
Id5	Date of compiling	2104-3-26	AAAA-MM-DD date of questionnaire preparing

ATTRIBUTE	DESCRIPTION	VALUE	COMMENT
A1	Name of BP	Uferwiesen Hoheneck	A name given to the resource; typically, a Title will be a name by

			which the resource is formally known.
A2	Builder	City of Ludwigsburg, co-funded by VRS and Water and shipping authority	Executor/builder of a BP
A3	Designer/Engineer/Architect/Landscape architect	Geitz&Partner + Planning Department of Ludwigsburg	Author of a BP design
A4	Date of Realization	2009-2010	Specify if it's a BP that is still in progress
A5	Subject of best practices	Subject of best practice: Natural restoration of the banks of the river Neckar combined with the creation of open space for recreation and nature experience.	Typically, the subject will be represented using keywords, key phrases, or classification codes.
A6	Status	finished	Which is the current status (example: finished, in progress)
A7	Owner	municipality	The present owner of the realisation
A8	Description	*Preface* *The banks of the river Neckar are mostly reinforced with concrete, the riverbed is channelled and has lost its original characteristics The demands of shipping, the use of hydropower, and the methods of flood protection have all left their stamp on the Necker. However, in the last decades there has been a rediscovery of the special quality of life and leisure which the river provides. Therefore Verband Region Stuttgart elaborated together with the municipalities along the river the so called Masterplan "Landscape Park Neckar" as an overall strategy for the development of green infrastructure along the Neckar river in the Stuttgart Region.It aims at enhancing green infrastructure for recreation purposes and for biodiversity.* *The best practise project idea was defined in the Masterplan.* *The implementation was also co-funded by the Verband Region Stuttgart and the water and shipping authority*	The realisation should be described through his major constituents and some representative particulars.

		The expanded flood plains below the health spa in the Ludwigsburg's Hoheneck quarter are a highly attractive and popular recreational spot. Important hiking trails and bike paths such as the Neckar valley bike path run along here. A Kneipp pool, a playground, the Hoheneck boat dock, and a restaurant popular with cyclists and walkers complete the setting. However, dense vegetation along the bank inhibited the view of the Neckar in many areas, while there was no point along the steep concrete embankment where one could obtain direct access to the water. In order to remedy these problems, this section of the river has been transformed. Its steep embankments have been flattened out, new bays and shallow water zones have been created, and alternating sections of open spaces and vegetation were landscaped. New habitats for the aquatic fauna (fishes invertebrates,..) have been created which strengthen the connectivity of the system. So by this natural renovation of the banks, the river ecology was improved while, at the same time, the needs of water traffic can still be met. Additionally it became an attractive area which can be experienced and utilised, and where one can dangle one's feet in the water at leisure.	
A9	City	City of Ludwigsburg, Stuttgart Region, Germany	Specify in which city and/or country is the BP
A10	Surface plan dimension of BP in ha If the BP is contained within a building or has a dimension less than 100 sq. meters the attributes A10 -A13 have not to be compiled	7 ha No buildings	The area of the BP in ha
A11	Surface plan dimensions in meters		The maximum length and width containing the BP (Upper Right corner , Left Down corner)

A12	Geographic Coordinates or Gravity Center		The coordinates in longitude and latitude of the gravity centre of rectangle of attribute A11
A13	Vertical/sub-vertical dimensions of BP in meters		The maximum vertical or sub-vertical dimension of the BP realisation
A14	Dimensions of BP if internally contained in main structure in meters		The overall dimensions of the BP in the case that is contained in a structure. e.g. a green wall contained in a building or .....
A15	The altitude on sea level (in meters) of the zero point from which the A13 or A14 parameter is measured		The A15 parameter is measured starting from the sea level of bottom edge
A16	Type of UGI	A.3 and A.4	Choice one of this U.G.I. **A.** Natural or semi-natural systems: **A.1.** Protected areas **A.2.** Ecosystems and high nature value outside protected areas **A.3.** Eco-corridors or stepping stone for wildlife **A.4** Restored habitat patches that have been created with specific species in mind **B.** Artificial features: **B.1.** eco-ducts or eco-bridges **B.2.** green wall **B.3.** green roof **B.4.** Features for climate change adaptation

			B.5. Rain garden **B.6.** Swale **B.7.** Park **B.8.** Amenity Space **B.9.** Allotments **B.10.** Gardens **B.11.** Sports & Recreation area
A17	Reason of the intervention	River restoration, enhancing biodiversity and ecological cohesion, creation of community green space	For example: heat island reduction, improving the building's energy class, stormwater control.
A18	Typology of current ownership and maintenance	public	Choice between public or private
A18a	Typology of future ownership and maintenance?	public	Choice between public or private
A18b	Economic plan for future maintenance?	The city administration of Ludwigsburg is responsible for maintenance for the open spaces. The water and shipping authority is responsible for the maintenance of the river. Both are funded by public money.	
A19	Typology of users	public	Choice between public or private
A20	People who benefit directly	B	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more
A21	People who benefit indirectly	C/D	Choice between: **A.** 0-100 **B.** 100-1.000 **C.** 1.000-10.000 **D.** 10.000 and more

A22	Biodiversity	Enhancement of Biodiversity for the habitat of the river and its banks	to be defined
A23	Energy	Not concerned	To be defined
A24	References	http://ludwigsburg-neckar.de/,Lde/start/Projekte/Uferwiesen.html	
A25			
PIC1	image of BP		
PIC2	image of BP		

PIC3	image of BP		
PIC4	image of BP