D3.3: Technical specifications of Liverpool demo

WP 3 , T 3.3, T.3.4, T3.5

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Technical References

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0 Executive summary

The Technical Specification sets out details for each of the technical interventions and non-technical interventions in the three Liverpool demonstration areas.

The Specification takes into account the reduced budget for delivery. Whilst all attempts have been made to deliver to agreed outputs related to full budget it is possible that outputs may be reduced accordingly in line with available budget and all outputs subject to tender outcomes.

The document forms the basis for the tendering process that will enable delivery of the interventions in late 2019 - early 2020.

The document also brings together;

- Location - the specific location for each intervention (though this may still be subject to change, all cities are dynamic and events can overtake plans)
- Budget for each intervention – taking into account the original unit cost estimate that was used to prepare the original bid and the actual total amount of funding allocated in the GFA to each intervention.
- KPIs - for each intervention the KPIs that will be assessed are listed.
- Anticipated Impacts – the impacts for each intervention, based on those identified in the original bid submission are listed.

The specification is considered correct at the time of writing. However, the procurement process, which will follow D3.4, will call for a design, build and establish pricing for the interventions.

This may lead to some revisions, both upward and downward in the costs of interventions. We believe that there is flexibility within the programme to allow these variations and deliver the overall intended programme.

1 Introduction

The Technical Specification for the Urban GreenUP Demonstration Area B, Liverpool BID, builds on the work undertaken in the baseline assessment for the demonstration areas, with input from other Work Packages.

The Specifications form the basis for procurement of technical and in some cases non-technical interventions planned in the city in each of the demonstration areas.

The Specification takes into account the reduced budget for delivery. Whilst all attempts have been made to deliver to agreed outputs related to full budget it is possible that outputs may be reduced accordingly in line with available budget and all outputs subject to tender outcomes re affordability.

The Specification also takes into account some deviations from original list of interventions which was inaccurate within bid document.

The specification is considered correct at the time of writing. However, the procurement process, which will follow D3.4, will call for a design, build and establish pricing for the interventions.

This may lead to some revisions, both upward and downward in the costs of interventions. We believe that there is flexibility within the programme to allow these variations and deliver the overall intended programme.

1.1 Purpose and Target Group

The Technical Specification sets out details for each of 7 technical interventions and 9 non-technical interventions in the Baltic Corridor.

The document forms the basis for the tendering process that will enable delivery of the interventions in late 2019 - early 2020.

The document also brings together;

- Location - the specific location for each intervention (though this may still be subject to change, all cities are dynamic and events can overtake plans)
- Budget for each intervention – taking into account the original unit cost estimate that was used to prepare the original bid and the actual total amount of funding allocated in the GFA to each intervention.
- KPIs - for each intervention the KPIs that will be assessed are listed.
- Anticipated Impacts – the impacts for each intervention, based on those identified in the original bid submission are listed.

1.2 Contribution of Partners

This document has been written with the full support of the Liverpool partners in the Urban GreenUP programme. In addition we have been grateful for the support of the partners leading on the Technical Specifications for interventions in Valladolid and Izmir.

1.3 Relation to Other Activities in Project

The nature based solutions to be implemented across the three areas in the Liverpool demonstration are developed from the baseline studies carried out previously in WP 3 (see WP3, D3.2).

The interventions have been informed by the work to develop both the NBS catalogue and the Urban GreenUP KPIs. For example, the NBS catalogue has helped to shape the specification for some of the interventions. The KPIs feature strongly in this document as they will guide the monitoring programme that will provide the baseline and post intervention data that will allow the effectiveness of the NBS implemented through Urban GreenUP.

Many of the impacts from the intervention are cumulative across the three demonstration areas and so the three documents should be considered together to assess the full impact of the Urban GreenUP interventions.

2 Definition of Interventions in Sub-Demo A - Baltic Corridor

2.1 Overview of Demo Area

The Baltic Corridor is south of Liverpool City Centre and connected to the Business Improvement District demonstration area by Bold Street. The area sits alongside and between several key investment zones, with over £3bn of investment on site or in the pipeline for delivery. The area is in the heart of the designated World Heritage Site.

Historically, this was an area of warehousing and primary industry for the docks of Liverpool. As the docks declined, so too did the businesses associated with them, leading to neglect and decline of the area over several decades. It is now emerging as an eclectic mix of independent shops and businesses, in particular creative industries. There is an increase in residential development and, more recently, of hotels in the area. As one of the fastest growing locations in the city there are potential conflicts between communities engaged in significant economic regeneration activity, new cultural businesses, new student accommodation and an established local residential population including a primary school and church. The area has a poor perception by residents and visitors of connectivity to surrounding areas.

As a former industrial area the Baltic Triangle has repurposed a significant amount of its built infrastructure but there remains a clear deficiency in the quality and quantity of its green and open spaces. The proposed corridor will link the quirky, independent retail area on Bold Street with Wapping Dock and pass through a number of distinct communities. The challenge in this corridor will be to engage the different stakeholders and link up the social spaces between the homes and businesses to promote greater fluidity of use and functionality in the Baltic area.

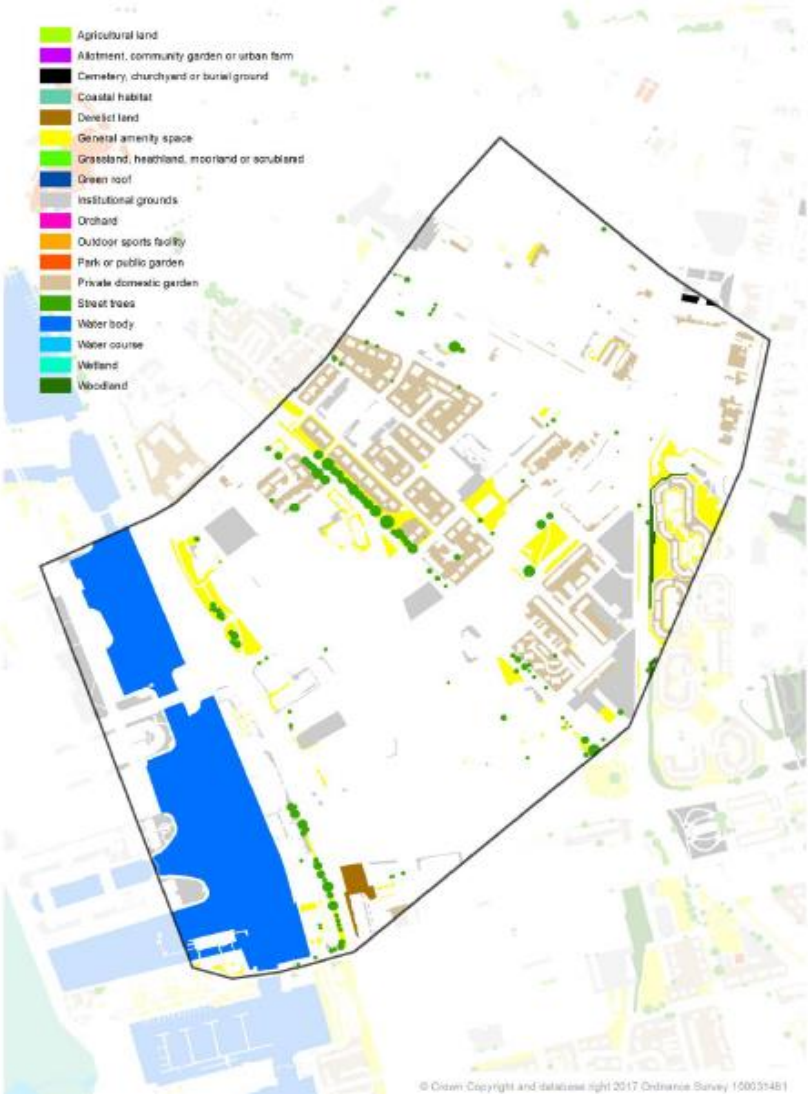


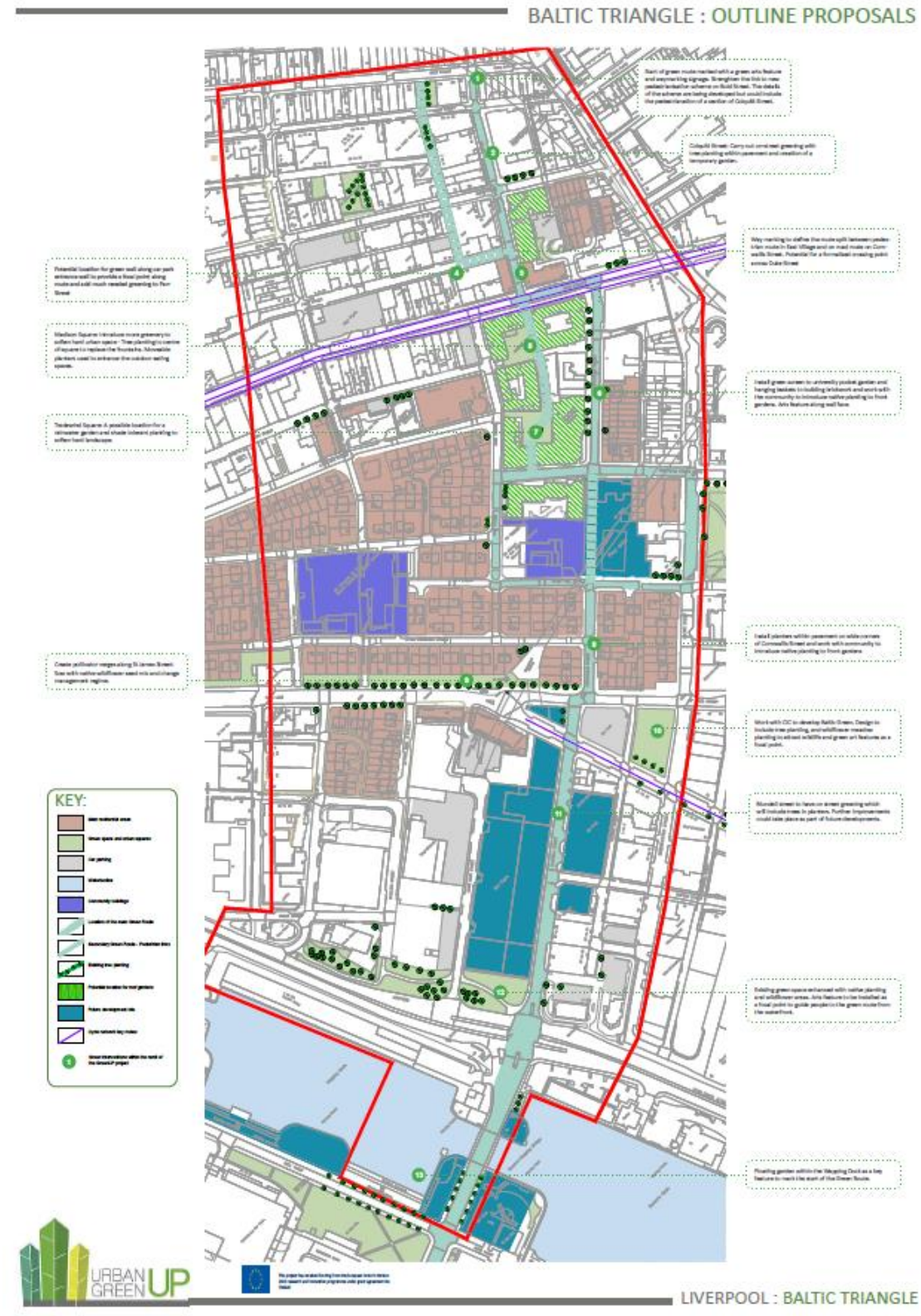
Figure 1 Baltic Corridor Green Infrastructure Typology

Table 1 List of interventions in Sub-Demo A

Re-naturing urbanization	Water interventions	Singular Green Infrastructures	Non-technical interventions
LAc1 – New pedestrian and cycleway green route	**LAc4- Urban catchment forestry**	**LAc12 – Pollinator verges**	**LAc22 – Green art/engagement**

LAc5 – Shade trees	**LAC8 – SUDS raingarden**	**LAc13 – Pollinator walls vertical**	**LAc23 – Forest Church**
LAc6 – Cooling trees	**LAc10 – Hard drainage pavements**	**LAc add2 – Green screens**	**LAc25 – GI for Physical Health**
LAc add1 – Green Resting Areas	**LAc16 – Floating gardens**		***Common non-technical interventions**

- Please, note that common non-technical interventions to the three sub-demos are included in a different section: 5 Non-Technical Interventions


BALTIC TRIANGLE : OUTLINE PROPOSALS
KEY:
URBAN GREEN UP
LIVERPOOL : BALTIC TRIANGLE

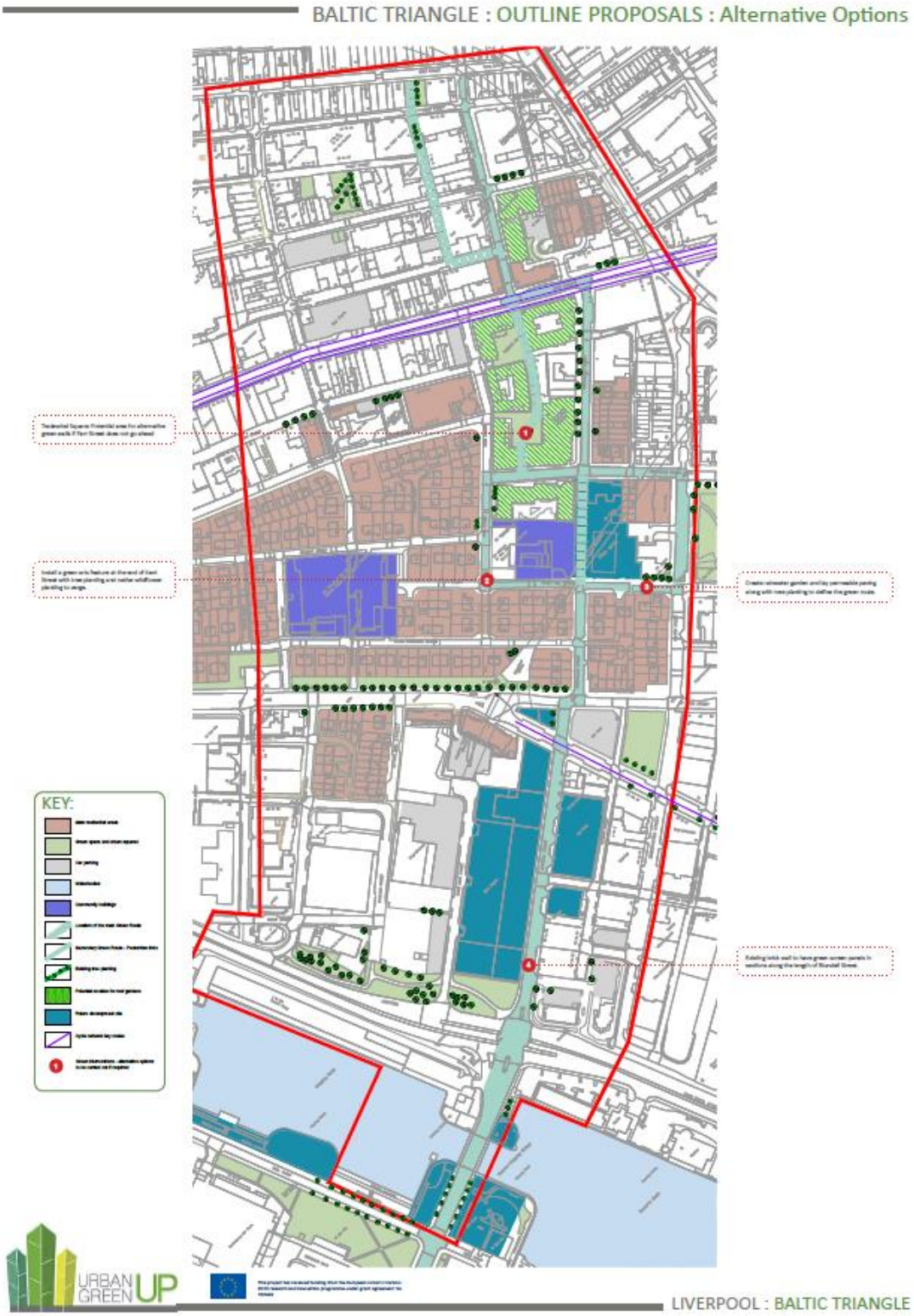


Figure 2: Location Maps of the Sub-Demo A Planned and Alternative Interventions

RENATURING URBANISATION

2.2 New pedestrian and cycleway green route (LAc1)

2.2.1 General Description

Walking and cycle routes provide recreational, public health and wellbeing opportunities as well as transportation linkages. Reducing the use of vehicles means fewer emissions of greenhouse gases mitigating climate change, as well as reduced air pollution. Providing green shady routes encourages walking and cycling.

The length of the informal pedestrian and cycle route being created is estimated to be 1.25 km long in each direction and will be used by local residents and students as a pleasant short cut or direct route from the Bold Street area to the city waterfront. This route will also connect with cycle access along the waterfront in both directions and with cycle access along Bold Street- thereby extending the cycle route access across the city through this informal linkage.

Expected impacts

The pedestrian and cycle route should provide a more liveable environment for local residents and provide a cleaner route with less pollution. The provision of safer crossing access and the promotion of the green cycle and pedestrian corridor is expected to attract local residents and visitors to use the Baltic corridor as a short and pleasant route to get from Bold Street to the waterfront and vice versa. More specifically this intervention will provide over 200m of cycle-pedestrian route through areas which are not cycle friendly or currently accessible. The expected impact is for more (20%) people to cycle and/or walk the green route, reducing local vehicle movements. 4.8tCO_2 equiv. will be saved through increased active travel. Along with LAc2 & 3, this intervention will engage 160,000 people and create 400m^2 of new green space.

Related KPIs

The pedestrian and cycle route through the Baltic corridor will contribute to a number of KPIs:

Table 2 New pedestrian and cycleway green route KPIs

Type of Indicator	KPI	Number
Social	Accessibility of urban green spaces for population	53
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS	1006
Social indicators (benefits)	Increased connectivity to existing GI	76

Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Social	Perceptions of health and quality of life	1007
Social	Increase in walking and cycling in and around areas of interventions	139

2.2.2 Location

The pedestrian and cycle route is informal and will follow the routes outlined in Figure 2 below. The route will run from Bold Street and Wapping Dock and follow a mixture of access roads with opportunities to divert through private areas with established public access. There are a few places where the route will cross larger roads, namely at Jamaica Street (A5040), St James Street (A561) and close to the Docks Wapping/Chaloner Street (A5036). The proposed route comprises of both main and secondary route options and will link a number of planned Nature Based Solutions along its length. To facilitate improved connectivity along the route a zebra crossing point will be established across Duke Street, giving priority crossing for pedestrians and cyclists and linking directly to an off road and safer element of the proposed green route. The Park Lane and Jamaica Street parts of the cycle and pedestrian route have also been designed to link to the recently installed and segregated cycle way on Jamaica Street so that cycling links are connected and can be encouraged in the new corridor.

The route will not be marked out as a formal cycle way as it will not meet the criteria for adoptable cycle ways but the green corridor being established will seek to provide a safer and greener route for pedestrians and cyclists.

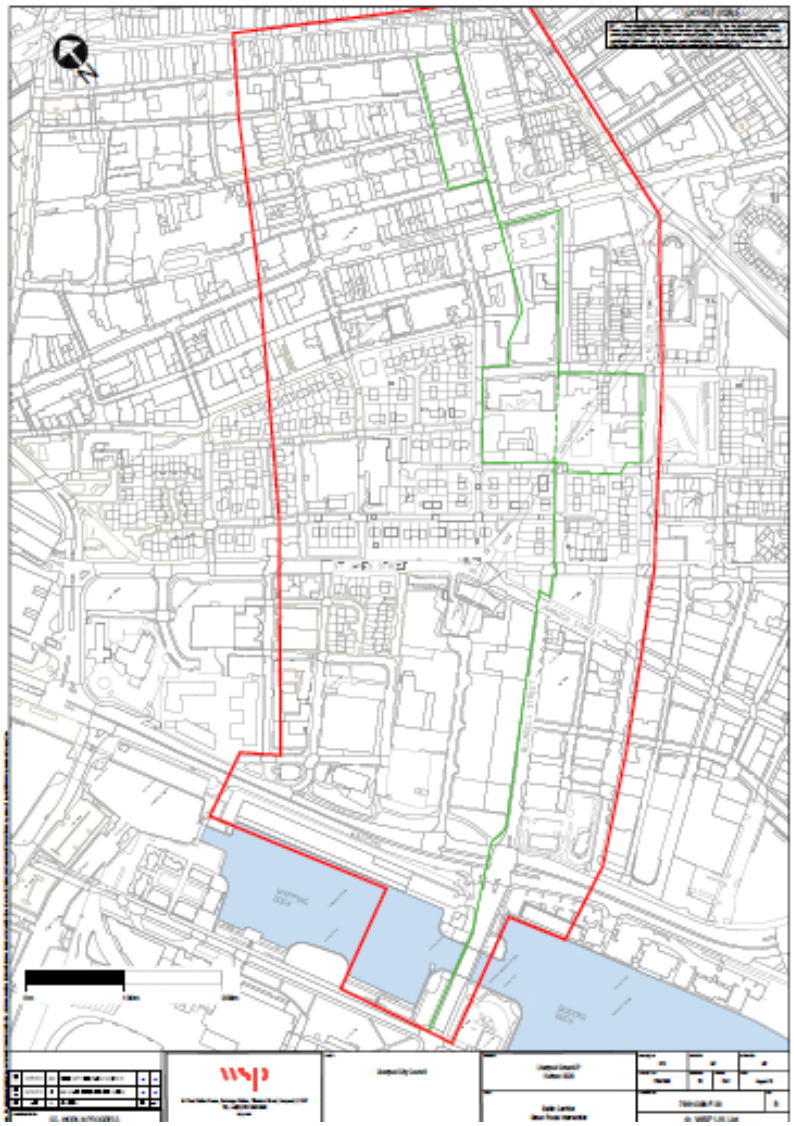


Figure 3 Proposed Pedestrian and cycleway green route

2.2.3 Technical Specifications

A key technical specification for the pedestrian and cycle way will involve the provision and installation of a zebra crossing facility at Duke Street, giving priority crossing to pedestrians and cyclists. This work is planned to be delivered by a partner stakeholder in spring 2019. There are also plans to provide dropped kerbs, corduroy tiles and/or tactile tiles at key locations along the proposed route to allow for easier pedestrian and cycle movement.

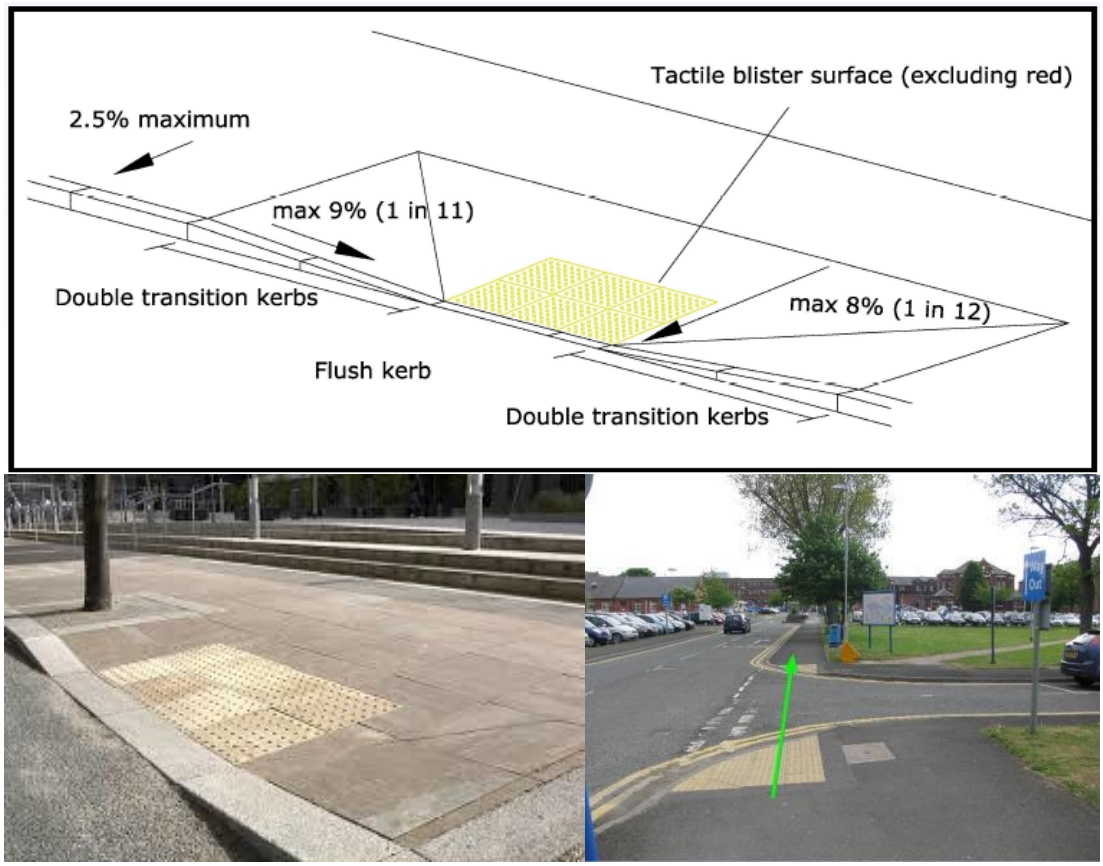


Figure 4 Example technical specifications and images of an accessible dropped kerb.

The route will additionally be way marked – but the details of the way marking are still under discussion and will be determined through the tender process, which will hopefully permit a creative approach to the delivery of this element of the work, using the skills of the wide range of creative sector businesses in this area.

2.2.4 Operational and Maintenance Considerations

The pedestrian and cycle way route will be maintained through both the city council highways department for the publically adopted roads/pavements and will be complemented by maintenance carried out in the more pedestrianised and private (but publically accessible) areas by the private landowners as and when appropriate.

2.2.5 Economic Specifications

Total for capital spend - €52,726

Table 3 New pedestrian and cycleway green route

Location	Item	Actual budget	Notes/Comments
Iliad Village (Tradewind and Madison Squares)	c.90m Pedestrian and cycle way additions potentially	Waymarking and accessibility works	
Cut through of new development Grenville Street South to Upper Pitt Street	c.135m Pedestrian and cycle way additions potentially	Waymarking and accessibility works	Date of completion for this section is estimated to be Autumn 2019
Accessibility and way marking for proposed route	Along the proposed corridor route there will also be 7 Dropped kerbs, corduroy tiles and tactile tiles along the route and one change in intervention level. There will also be way marking at identified locations that have yet to be determined.	Waymarking and accessibility works	Additional surface improvements on route to be pursued through Highways maintenance programme
Identified in bid	**c.200m pedestrian and cycleway**	**Available budget €52,726**	

2.3 Shade Trees (LAc5)

2.3.1 General Description

This NBS is based on the planting of trees individually or by groups in urban areas as part of a cities green infrastructure to provide shady places that can improve user's well-being, enhance local aesthetics, reduce surface runoff and provide an evapo-transpirative cooling effect. Shade trees will be selected to achieve larger areas of shadow. The impact will be localised cooling as the leaves intercept solar energy, leading to improved human comfort close to the intervention, providing data for wider implementation of this type of nature-based solution.

Expected impacts

Carefully positioned trees can provide shade to buildings, reduce heat loading on buildings and provide islands of respite from high temperatures in our urban areas. They provide spaces within the urban fabric for respite from direct sunlight and high temperatures during summer periods or heatwaves. There will also be an impact on nearby buildings, which may lead to reduced need for air conditioning, and so reduced energy consumption and costs and a reduction in the amount of heat that is "stored" by a building and released through radiation overnight. LAc5 and LAc6 will reduce urban heat island effects by decreasing the total amount of solar energy that is stored in the nearby building.

Street trees will aim to offer shadow places (3,200 m^2 with coverage rates of 40-70%) in summer time in areas with high population transit and new drainage surfaces. Trees offer pollutant capture and increase the habitat and biodiversity provision. The species selection will seek to reduce potential for allergy impacts and to reduce ambient temperatures by between 2-4^oC in the summer time. Collectively all the tree planting is expected to contribute equivalent to 5.55t/CO_2 sequestration per year. It is anticipated that the shade tree plantings planned under URBAN GreenUP will be visited by 30,000 citizens/year.

The shade trees have been located in soft landscaped areas where they can make a positive contribution to the immediate area. Some of the plantings will help to form shady tree lined boulevards to either side of the highway and serve to help define the green corridor route. Several of the trees are due to be planted in housing land owned and maintained by registered providers. This will help to offset the ongoing longer term-maintenance impacts for the city council whilst also providing additional green infrastructure to some of the more deprived areas of the city and directly benefit the local residents. The shade trees are expected to impact across a number of environmental and socio-economic indicators.

Related KPIs

Shade trees are expected to contribute to the following key performance indicators:

Table 4 Shade Trees KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Economic	Volume of water removed from water treatment system	38
Social	Accessibility of urban green spaces for population	53
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Increase in walking and cycling in and around areas of interventions	139

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.3.2 Location

Shade trees are identified to be planted in a number of locations on the Baltic Green Corridor. The shade trees will mainly be planted in 4 defined areas where they will contribute to forming a boulevard of street trees, help to define the green route, or improve an existing open space adjacent to a main carriageway. One shade tree will be planted at a turning point of the green route corridor to help define the way marking.

Six shade trees are due to be planted along Cornwallis Street, filling in the existing streetscene highway gaps to create a full and complete boulevard of shade trees that run past the college. These trees will be planted in the front gardens of the registered provider (Pine Court Housing Association) in this location.

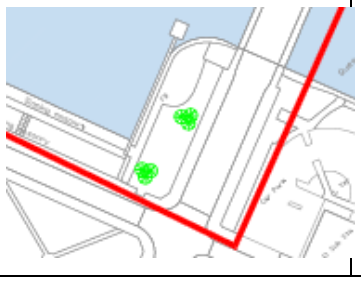
A further 5 shade trees will be planted in residential gardens further down on Cornwallis Street where it crosses Upper Frederick Street. These properties are also in the ownership of registered Social Providers (Pine Court Housing Association/Liverpool Mutual Homes Limited/Liverpool Housing Trust Limited). A single shade tree has been identified on land at the end of Parr Street on Highways designated land.

The 2 final sets of 6 shade trees are located on land adjacent to the Strand (non-water side), where they will be complemented by other planting and pollinator verges, and also close to the floating island site at Wapping Dock.

In total 24 shade trees are currently planned to be planted in 5 separate locations along the green corridor.

Table 5 Shade Trees location

Location/s	Number of trees	Proposed Location/s	Notes/Comment
Cornwallis St	6		Pine Court Housing Association owned
Cornwallis St Upper Frederick Street	5		Registered providers: Pine Court Housing Association Ltd, Liverpool Mutual Homes Limited, Liverpool Housing Trust Ltd.
Parr Street	1		Waymarker planting

Strand	6		Complement small park/resting area
Wapping Dock water side	6		Provide shade in an open area

2.3.3 Technical Specifications

The selected trees will be chosen for a range of attributes including factors such as:

- Spreading canopies and broad leaves to maximise shade
- Open winter canopy to allow for thermal gain in winter
- Species that are not likely to exacerbate allergies
- Tolerance to local conditions.

Trees will be planted in accordance with Liverpool City Council approved processes.

Urban trees face a range of conditions that can impact on their ability to thrive. These include the restricted rooting environment, higher levels of air pollution, increased levels of soil compaction and reduced levels of soil fertility and natural nutrient cycling processes. In addition, the selection of appropriate trees for urban planting has to take into account the location where they will be planted and the need to reduce any nuisance, such as "honeydew"[1].

Based on experience of urban tree planting in Liverpool, the following trees are deemed most suitable for planting for shade and cooling are;

Ginkgo Biloba – 30m^3

Metasequoia glytostroboides – 30m^3

Pinus nigra 'Austriaca' – 22m^3

Pyrus caleryana 'Chanticleer' – 12m^3

[1] Honeydew is a sugar-rich sticky liquid, secreted by aphids and some scale insects as they feed on plant sap

Quercus ilex – 30m^3

Ulmus lutece 'Nanguen' -17m^3

Tamarix gallica – 8m^3

The figure given beside each tree indicates the optimal volume of soil required for each species in an urban tree planting scheme. It is not always possible to reach these volumes for planting in urban areas as the existing urban infrastructure, buildings, roads, utilities, cables and other infrastructure has to be worked around.

In all cases the maximum volume possible for each location is specified.

- Tree Sizes

The trees will be 14cm-16cm girth. These trees are young enough to be forgiving and adapt to their new, harsher environment outside the nursery and they have the vigour to establish better than bigger trees and are reasonably snap proof.

- Tree Pit design

Tree pit design is perhaps the most important element of this intervention.

Tree pits will make use of structural elements (such as Sylva Cells or similar) to ensure that the tree pit is capable of taking the load from the highways and pavements safely. Tree pits for shade and cooling trees may take the form of single pits excavated for each tree, or where space allows, trench pits into which several trees are planted. The latter provides a greater soil volume and allows for more of the natural soil processes to take place.

The technical drawing for the type of tree pit to be used is shown in Figure 4 Sample of technical drawing for Urban GreenUP tree pit design.

- Positioning

The greatest impact will be gained where shade trees are placed south of the area or the structure that is to be shaded.

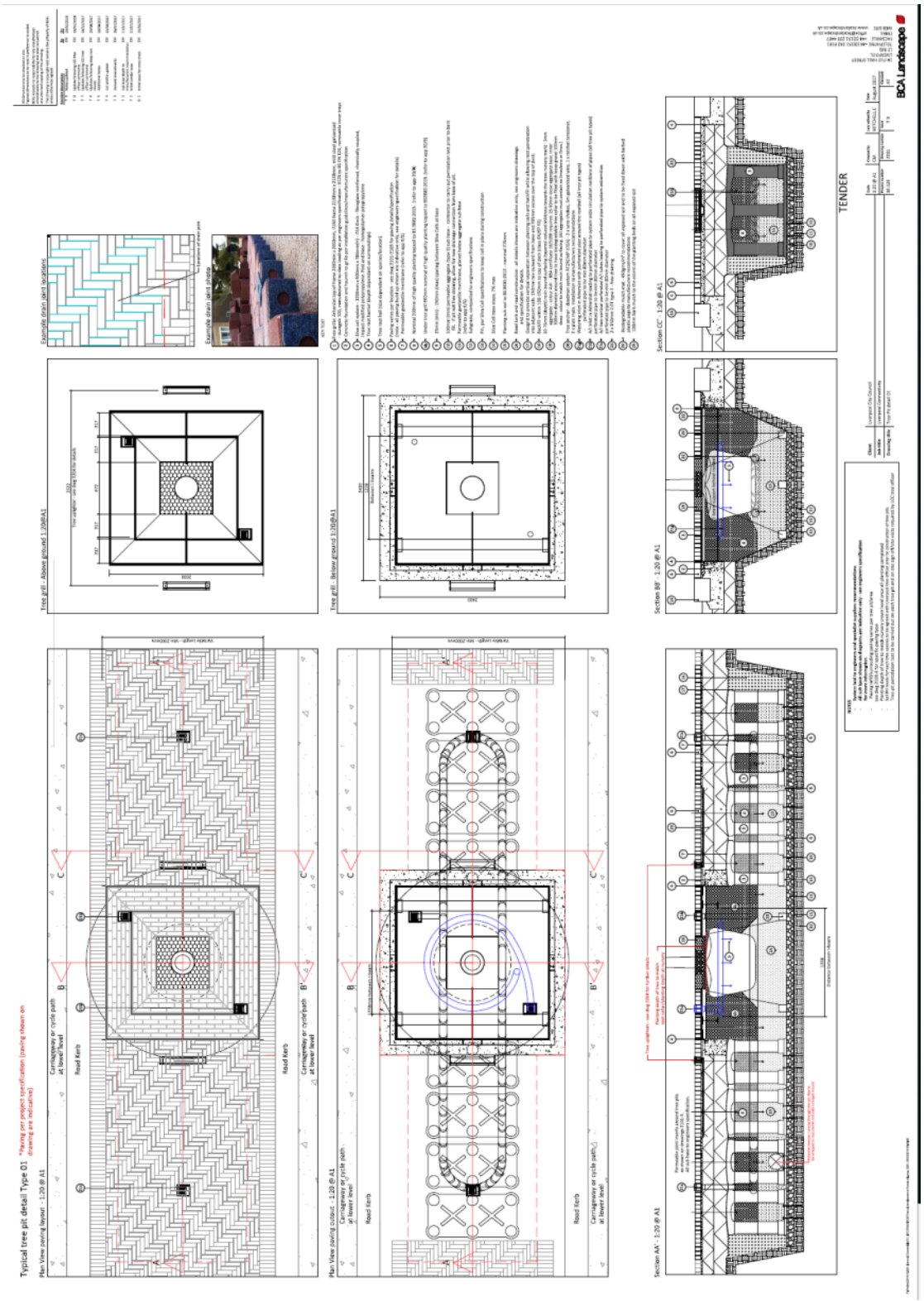


Figure 5 Sample of technical drawing for Urban GreenUP tree pit design

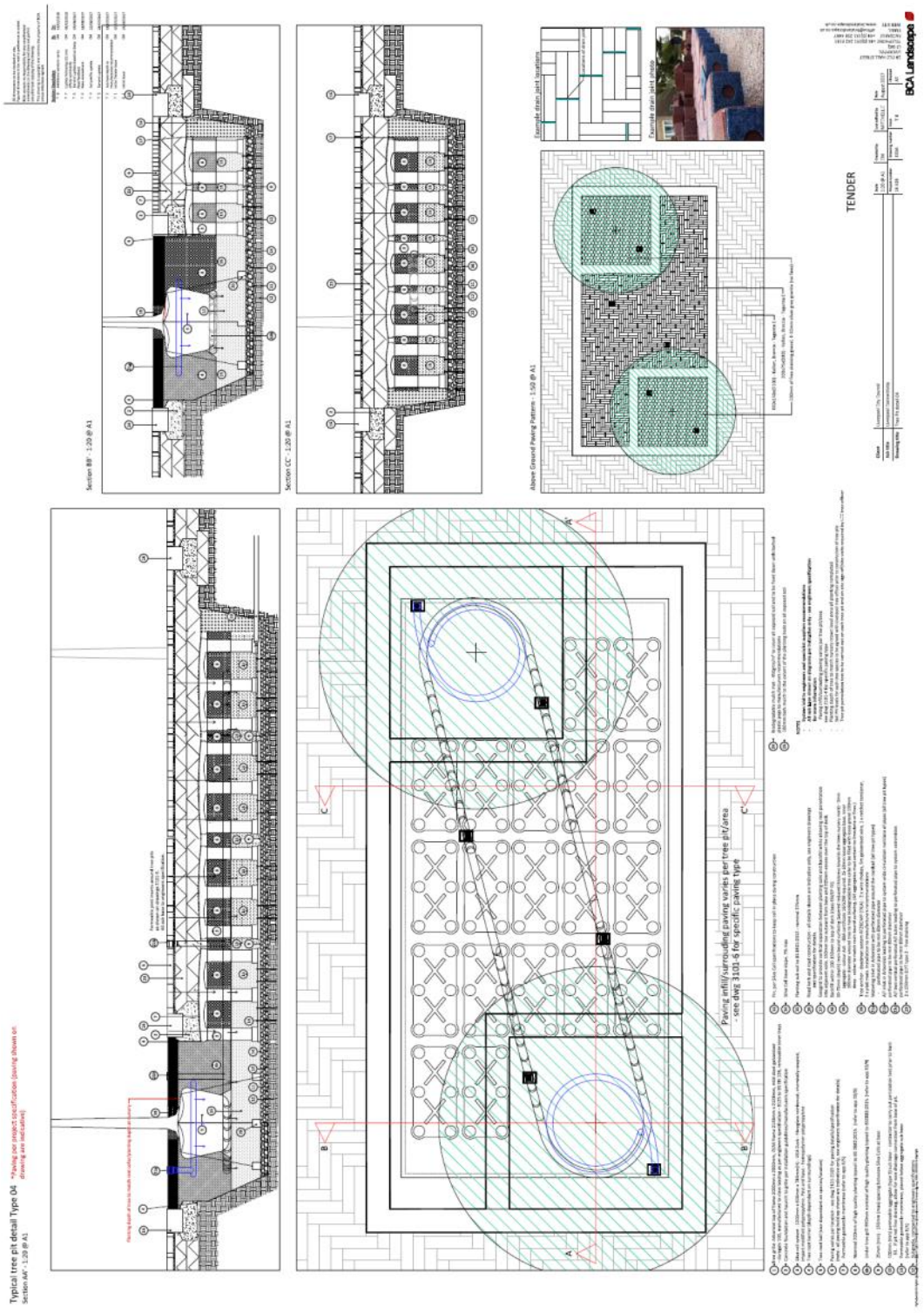


Figure 6 Sample of technical drawing for Urban GreenUP tree pit design with several trees in trench planting system

2.3.4 Operational and Maintenance Considerations

Once established the trees will be maintained by Liverpool City Council in line with their established tree management practices.

2.3.5 Economic Specifications

€94,875 for shade and cooling trees

Table 6 Shade Tree Economic Specifications

Location/s	Number of trees	Actual budget	Notes/Comment
Cornwallis St	6 trees	Trees plus associated works and establishment costs.	
Cornwallis St Upper Frederick Street	5 trees		
Parr Street	1 trees		
Strand	6 trees		
Wapping Dock water side	6 trees		
Identified in bid	**25 cooling trees**	**Available budget €94,875 for shade and cooling trees**	**N.B. Original intervention was just for 25 cooling trees. 24 shade trees are planned and 19 cooling tress are planned**

2.4 Cooling Trees (LAc6)

2.4.1 General Description

This NBS is based on planting of trees individually or by groups in urban areas as part of a cities green infrastructure to provide cool, shady places that can improve user's well-being, enhance local aesthetics, reduce surface runoff and provide an evapo-transpirative cooling effect.

The cooling trees have been located in hard urban landscapes where it is generally not possible to plant directly into the ground. Instead these cooling trees will be planted into large containers or pots to trial this temporary solution.

Cooling trees will be selected to achieve higher rates of transpiration during warm weather. The impact will be localised air cooling, leading to improved human comfort close to the intervention, providing data for wider implementation of this type of nature-based solution.

Expected impacts

Across the demonstration areas, Cooling Tree interventions will demonstrate reduction in urban heat island impacts.

Urban trees will aim to create shade (3,200 m^2 with coverage rates of 40-70%) in summer time in areas with high population transit. Trees also offer pollutant capture and increase the habitat and biodiversity provision. Careful selection of urban trees (selecting most suitable species) will reduce the impact of allergies caused by tree pollen. LAc5 and LAc6 suppose ambient temperature reductions in summer time in 2-4ºC. It is anticipated that cooling trees areas will be visited by 20,000 citizens/year. Reductions in air pollutants are also Expected impacts, with reductions in NOx (<1%) and vehicle emitted reactive organic gases such as ozone and volatile organic compounds (2%). CO_2 Sequestration is estimated at 5.5t/year across the entire Liverpool tree planting activity in Urban GreenUP.

Related KPIs:

Cooling trees are expected to contribute to the following key performance indicators:

Table 7 Cooling trees KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001

Economic	Volume of water removed from water treatment system	38
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.4.2 Location

Cooling trees are identified to be planted in a number of locations on the Baltic Corridor. Eight cooling trees are due to be planted along the upper stretch of Colquitt Street, adding green infrastructure to an area without any trees. Along this section of the green route it is not possible to plant cooling trees directly into the pavement due to underground utilities and obstructions and as such the cooling trees will be planted directly into large pots.

Within Tradewind and Madison Squares there is the opportunity to plant a further 11 cooling trees, split between 2 hard urban squares that currently lack more than a single tree. These squares have commercial and retail outlets at ground floor but higher floors are homes for local residents. The cooling trees will help to address the urban heat island effect within these confined and tightly packed urban squares, as well as offering cool places to stop and sit as residents use the green route.

It is possible in the squares that the cooling tree planting will be complemented by green screens, or seating features as well as by linking Nature Based Solutions such as rain gardens.

The cooling trees will be set into paved areas or where this is not possible due to planting constraints they will be planted into large containers which will provide an opportunity to test such temporary structures. There will be 19 cooling trees.

Table 8 Cooling trees locations

Location/s	Number of trees	Proposed Location/s	Notes/Comment

Colquitt street	8		
Madison and Tradewind Squares	11		

2.4.3 Technical Specifications

The Technical specification for this intervention is similar to that for shade trees. However, consideration will be given to the selection of trees that can best perform the function of cooling through transpiration at the times when it is most needed, i.e. hottest times of day, warmest days of the year.

The detailed pit design will consider whether there may be capacity for water storage following rain that might be used to ensure that moisture is available in the soil profile to allow transpiration when it is most needed.

In this location the option to use containerised trees will form part of the procurement process. Procurement will focus on two main elements.

1. Air pruned tree stock.

An air pruning container works by having slots or holes in its walls along with a system of ribs or other devices to force the root to grow out of the slot / hole. When the root grows out of the slot into relatively dry air its tip is desiccated or killed. Once this first root is air pruned it loses its dominance and many secondary roots develop to replace it, these are then in turn air pruned and again they are replaced by even more roots. Air pruning therefore trains a root system with a very large quantity of young vigorous roots.

This is good as it creates a lot of secondary roots right up the side of the root ball which means that after transplanting there are a much larger number of roots establishing and also more quickly in comparison to a traditional pot grown plant. Additionally, new roots emerge up the sides of the root ball and not just around the base.

The net result is that the plant will establish more quickly with a higher % survival rate and more uniform growth plant to plant. It is also expected that plants will develop a mature root

system earlier and also top growth has been reported to be 20% to 25% greater than for plants in a traditional pot. The reason for this is that if a better root system is developed with a large quantity of younger more vigorous roots which can feed / drink more and support more top growth. Raising the pot off the base of the container allows dryer air to circulate around the outside of the cell to "kill" the emerging root tips.

Trees will be 16-20cm girth, supplied in line with UK Biosecurity standards.

Figure 7 Contrasting root growth in traditional and air pruned pots

Figure 8 Nursey Grown air pruned trees

2. Mobile container

A secure, attractive and robust container for the air pruned pot with the tree. This will be a bespoke design to accommodate the 16-20cm trees and allow for ease of movement of the container.

Incorporation of Biochar into the tree soil will also form part of this intervention (LAc11), helping to improve the soil health, the lock up of carbon, reduce need for fertilizer and improve the growth of the trees. The soil mix within the container/air pruned pot should also include appropriate mycorrhizae through inoculation or addition prior to placement.

2.4.4 Operational and Maintenance Considerations

During the monitoring period the cooling trees will be maintained and irrigated by the city council and local businesses who will be encouraged to adopt and care for the tree nearest to them. However, following the completion of the monitoring period the trees in containers on city council land will either be incorporated into the city council tree management and maintenance programme or removed and planted into soft ground locations in existing green space, where they can be self-sustaining if resources and capacity to maintain them cannot be afforded.

Figure 9 Example 1 of potential container for trees

Figure 10 Example 2 of potential container

2.4.5 Economic Specifications

Location	Number of cooling trees	Actual budget	Notes/Comment
Colquitt street	8 trees	Trees plus associated works and establishment costs	
Madison and Tradewind Squares	11 trees		
Identified in bid	**19 cooling trees**	**Available budget €94,875 for shade and cooling trees**	**N.B. Original intervention was for 25 cooling trees. 24 shade trees are planned and 19 cooling trees are planned**

Table 9 Cooling trees economic specification

2.5 Green Resting Areas (LAc-add1)

2.5.1 General Description

Green resting areas are spaces that provide areas for social passive recreation (resting, relaxation, observing nature, social contact) and usually contain a seating element. Green resting areas, parks, and parklets are green spaces that play a central role in policies related to health, nature conservation and spatial planning. These areas are multifunctional, and can provide many benefits. Five resting areas or parklets are proposed for the Baltic corridor and these are currently proposed to be retrofitted into a range of existing streetscene landscapes.

Expected Impact

Green resting areas can form part of active recreation and transport corridors. They also provide a range of multifunctional benefits covering environmental (i.e. pollution control, local reduction in urban heat islands, increased biodiversity), economic (i.e. increased property values, reduced expenditure on health care) and psychological (i.e. wellbeing) aspects.

Parklets and green resting areas can also transform underutilised street space by providing seating, greenery and space to passers-by. As a result green resting areas can increase nearby property values and drive up revenues for nearby businesses as they provide somewhere for people to stop. Depending on their design some green resting areas may include air purifying plants that serve as green buffers for hosting biodiversity. Parklets and green resting areas also create small spaces that enhance the health and happiness of urban residents.

This intervention contributes to the impacts described in New pedestrian and cycleway green route (LAc1) above.

Related KPIs

Table 10 Green Resting Areas KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Heatwave risk	9
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Environmental (physical)	Run-off coefficient in relation to precipitation quantities (KPI 16)	16
Economic	Volume of water removed from water treatment system	38

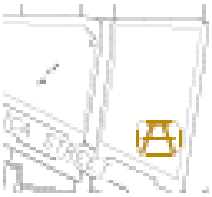
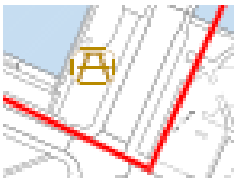
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Social	Perceptions of citizens on urban nature	115
Social	Engagement with NBS (sites/projects)	117
Social	Crime reduction*	123
Social	Perceptions of health and quality of life*	1007
Economic	Changes in mean house prices/rental markets*	142
Economic	Number of jobs created; gross value added*	141
Economic	Additional business rates*	143
Economic	Job creation, increased footfall and spend in the areas of interventions*	151

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.5.2 Location

Five green resting areas are proposed for the Baltic corridor, with each offering a different type of experience but providing the basics of shade, green or blue (water) interest and seating.

Table 11 Green Resting Areas locations

Location/s	Intervention	Proposed Location/s	Notes/Comment
Colquitt Street.	Seating		small on street parklet
Iliad Village	Seating		incorporated within NBS proposed
Baltic Hub	Seating		incorporated within NBS proposed
Non-water side of the Strand	Seating		small pocket park; requested during the community consultation
Wapping Dock	Reconfigurement of seating		

2.5.3 Technical Specifications

Green resting area 1 is comprised of cooling trees and a linking green screen.

Green resting area 2 in the Iliad village (Tradewind-Madison square) comprises of planned NBS cooling trees with the provision of seating.

Green resting area 3 comprises of seating onto the Baltic Hub in direct response to local community consultation feedback.

Green resting area 4 is located on existing soft ground on the non-water side of the Strand and was a specific request during the community consultation.

Green resting area 5 marks the start/end of the route and comprises of a green screen together with cooling tree planting and pollinator views across the dock.

Figure 2 Example green resting area.

Green resting areas are built with:

(1) Native soil
(2) Compacted soil mixture (20-30% sand, 20-30% compost, 30-40% topsoil)
(3) Draining gravel layer
(4) Vegetation – Tree (and possibly irrigation)
(5) Vegetation – Shrubs and planting (and possibly irrigation)
(6) Lighting (if desired)
(7) Bench or seating area
(8) Pavement or surface

2.5.4 Operational and Maintenance Considerations

Maintenance of these sites will be split between the city council and the landowner, depending on land ownership. Basic horticultural maintenance will be required, such as mowing, pruning etc. and it is likely that occasional maintenance may be required for seating and litter removal from bins.

2.5.5 Economic Specifications

No specific budget is currently allocated for this intervention but if it cannot be accommodated within the project budget at tender stage then additional funding will be sought.

Table 12 Green Resting Areas economic specification

Location	Item	Actual budget	Comment
Colquitt street	Parklet - 2 cooling trees, green screen, seating	Seating with associated installation and site works	Section 106 funding
Iliad Village (Tradewind/Madison square)	Green seating to planned NBS of cooling trees		Sympathetic seating to green interventions and square - Section 106
Baltic Hub	Green seating to multi user space with planned pollinator planting		Sympathetic seating to community sue of Baltic Hub - Section 106
Strand (non-water side) pocket park	Seating to be provided to the planned shade trees and pollinator planting		Small seating provision Section 106
Stand (water side)	Review of NBS provision and seating to create green resting area		Potential relocation of seating for resting area Section 106
Identified in bid	**0 resting areas**	**€ tbd**	**€0 Available budget** **Local funding to be sought**

WATER INTERVENTIONS

2.6 Urban Catchment Forestry LAc4

2.6.1 General Description

This NBS is based on planting of trees or vegetation, individually or by groups in urban areas as part of a cities green infrastructure to "slow the flow" of water through the catchment, thus reducing flood risk and the amount of polluted water entering the sewerage system. Urban catchment forestry will comprise of engineered solutions to retrofit sustainable tree cover in city landscapes. This will help to reduce flood risk and improve water quality. It is anticipated that opportunities for testing nutrient releasing soils, urban drainage techniques and tree pit designs can be included into these works.

In addition to the tree component of this work the urban catchment forestry will be complemented by the installation of a rain garden and associated planting in the Baltic corridor, which is detailed in section 2.7.

Expected impacts

The urban catchment forestry planting is anticipated to positively contribute to reducing flood risk and improving water quality through the rain garden.

The urban catchment forestry planting is anticipated to positively contribute to reducing flood risk and improving water quality. The tree-based planting will allow for the testing of nutrient releasing soils. LAc11 which will be incorporated into this intervention will provide healthy soils/substrate. These soils will improve natural growth of the trees and will improve the functionality of NBS installed (1,000 m^2 which will capture 385kg/year of NO_2 from urban air, and avoid need for fertilizer).

The integrated activity of LAC8 and LAc9 techniques could reduce the urban flood water flows in storm periods. Actions included in this intervention will be designed to absorb flow peaks that can occur in the City Centre. LAc4 will provide protection and hydrological tree pit structures for 45 new trees.

By developing a localised Urban Catchment Hydrograph, we will show the impact of the interventions on the peak water flow and the total volume of water that is released to the sewer system from the Urban Catchment Forestry intervention.

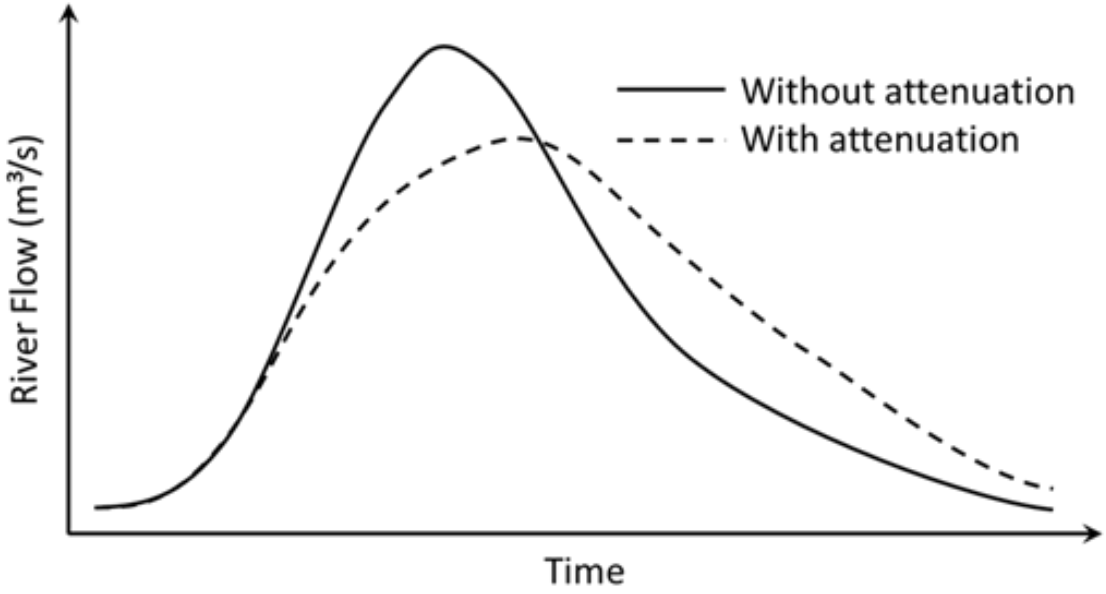


Figure 3 Example of urban catchment hydrograph

Related KPIs

Table 13 Urban Catchment Forestry KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Economic	Volume of water removed from water treatment system	38
Social	Assessment of typology, functionality and benefits provided	109
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Social	Diversity of NBS (land use and functionality)	95

2.6.2 Location

In the Baltic corridor there are plans to retrofit 32 trees under this element of the project. One group of 7 trees will be introduced along Colquitt Street and be retrofitted into the pavement. The second set of 13 trees will be introduced along Blundell Street and may need to be in containers as there are imminent and significant development works planned which would require removal of any trees retrofitted into the highway and footway. Additional tree planting for this element of the project (12 trees) is proposed in the streets between Nelson Street and James Street. Many of these trees will also be containerised for logistical issues.

The rain garden is due to be located within a hard urban linking corridor that runs between Tradewind and Madison Squares and is detailed in section 2.7. Similarly the hard drainage pavement may also have planting which could contribute to this measure.

Table 14 Urban Catchment Forestry locations

Location/s	Intervention	Proposed Location/s	Notes/Comment
Colquitt Street	7 trees		
Blundell Street	13 trees		Container trees

Nelson St to James Street	12 trees various locations		Container trees
Iliad Village	Rain garden vegetation		
Upper Pitt Street	Hard drainage pavement planting		

2.6.3 Technical Specifications

The Technical Specification for the trees in this intervention will mirror that for the cooling trees.

Where possible trees will be planted directly into the hard landscaping using the tree pit design illustrated in Figure 6. However, the most likely option is that these trees will be planted into large containers. The details of the containers are not yet known and their design will form part of the tender process but a planting capacity of not less than $3m^3$ soil will be specified.

The containers can be varied depending on location and opportunities exist in the tender process to seek innovative containers that fit with the surrounding locations. For example, parts of the Baltic are quite contemporary and creative and this can be reflected in the types of container utilised.

Figure 4 Examples of alternative containers for tree planting, including IBC containers with the opportunity to include lighting at night

Raingarden specifications are detailed in section 2.7.

2.6.4 Operational and Maintenance Considerations

During the project monitoring period the trees will be maintained by the city council and afterwards these will form part of the city's tree maintenance programme. Trees in containers may be removed and planted into existing greenspace sites elsewhere across the city if ongoing maintenance cannot be secured.

Rain garden maintenance is addressed in section 2.7 and hard drainage pavement maintenance is addressed in section 2.8.

2.6.5 Economic Specifications

€159,000 available

Table 15 Urban Catchment Forestry economic specification

Location	Item Urban catchment forestry Number/m2	Actual budget	Comment
Colquitt street	7 trees	Trees plus associated works and establishment costs	Groups of 5 and 2
Pitt St	12 trees		Small groupings/containerised
Blundell street	13 trees		Containerised
Tradewind-Madison link	Raingarden planting covering circa 50m^3 Hard drainage planting up to 350m^2	Costs to be included in other NBS costings for rain garden and hard drainage	Raingarden/hard drainage planting
Identified in bid	15 units	Available budget €159,000	

2.7 Rain garden SUDS LAc8

2.7.1 General Description

A rain garden is a type of SUD drainage system that is considered to be environmentally beneficial, causing minimal or no long-term detrimental damage. SUDs in general are designed to efficiently slow down and reduce the quantity of surface water runoff from a developed area to manage downstream or localised flood risk. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground drain.

SUDs such as rain gardens can create new ecosystems (providing habitat for beneficial pollinators, plants and birds) and can also increase both the quality and quantity of green areas and if planted strategically in green corridors, they can also improve connectivity. Rain garden Suds typically have a bioretention shallow basin designed to collect, store, filter and treat water runoff. To optimise its functions, it must include a porous soil mixture, native vegetation and some hyper accumulator plants, capable of phytoremediation.

The rain garden SUD is to be located between Tradewind and Madsion squares.

Expected impacts

The raingarden SUD will be designed to capture surface water run-off from the surrounding areas of hard landscaping. It will retain water during periods of heavy rainfall and the aquatic planting in the raingarden will contain pollinator species and contribute to local biodiversity. The aquatic vegetation will make a positive contribution to carbon capture and storage. Additionally, SuDS provide opportunities to create visually attractive green (vegetated and landscaped) and blue (water) corridors in developments connecting people to water. This in turn can improve the wellbeing of people that live or work in, or visit or pass through, the area. The SUD will provide a pleasant water and planted space that serves to link urban squares with little existing greenery and way mark the proposed cycle and pedestrian route. Seating close to the SUD and urban squares will encourage the local community to stop and rest in the squares; thereby creating a green resting area, with an opportunity for increased footfall and retail spend in the immediate area.

Related KPIs

Table 16 Rain garden SUDS KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9

Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of citizens on urban nature*	115
Social	Engagement with NBS (sites/projects)*	117

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.7.2 Location

The rain garden will be situated within the Iliad Village complex and run the length of the connecting urban corridor from Tradewind to Madison square, which is potentially up to 25m long. This is a privately owned but publically accessible part of the proposed green corridor. Consultation with the emergency services has established that there is no access issue associated with this installation.

Table 17 Rain garden SUDS locations

Location/s	Size	Proposed Location	Notes/Comment
Tradewind to Madison square	c 50m^3		Iliad Village complex

2.7.3 Technical Specifications

Planting within the rain garden will consist of aquatic and damp loving species, with an emphasis on planting a mix of species known for their beneficial attributes. This will include aquatic species for pollination, water purification, biodiversity and where possible carbon storage etc. Species selection will also consider maintenance requirements, plant tolerance to different environmental conditions, anti-allergy properties, species encroachment and conservation. This land is privately owned, but publically accessible and final design etc. will need to be in consultation with the land owner, who will also take on the longer term maintenance.

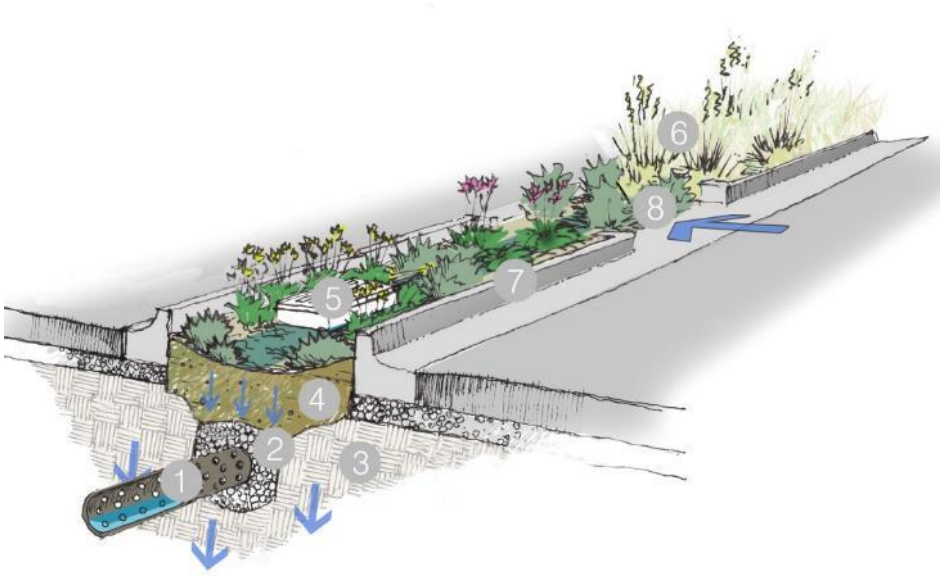


Figure 5 Example technical specification of the proposed rain garden.

Rain gardens are built with:

- A perforated pipe connecting to basin or stream outlet. **(1)**
- Gravel pipe bed. **(2)**
- Native soil. **(3)**
- Soil mixture of 50% sand, 20-30% compost and 20-30% topsoil. Sand creates a draining soil. **(4)**
- Overflow control structure. **(5)**
- Vegetation. Native plants with deep root systems that absorb runoff and pollutants. **(6)**
- Curb and gutter. **(7)**
- Curb cut to allow water to enter the rain garden. **(8)**

2.7.4 Operational and Maintenance Considerations

The rain garden site will be on private land and it is anticipated that the landowner in conjunction with the adjoining college and businesses will take on the future rain garden maintenance. Regular maintenance will include:

- Removal of litter and/or debris
- Cleaning of the inlet and outlet
- Management of the vegetation
- Sediment monitoring and removal when required.

2.7.5 Economic Specifications

Table 18 Rain garden SUDS economic specification

Available budget €607,200

Location	Item/Size	Actual budget	Comment
Rain garden Tradewind to Madison Square	c 50m^3		Additional area identified in section 2.8
Identified in bid	**400m^3 SUDS**	**Available budget €607,200** **(for raingarden and hard drainage pavement)**	**SUDS funding to cover both raingarden and hard drainage pavement (2.8).** **Any underspend to be used to fund other NBS in Demo A.**

2.8 Floating Gardens (LAc16)

2.8.1 General Description

Floating gardens are self-contained ecological units, which can provide habitats for various aquatic and terrestrial species. They can also act as connective features linking habitats across urban boundaries. They provide an additional set of green spaces that can utilise otherwise redundant spaces. They can provide recreational, sociocultural and ecological benefits in terms of environmental education, the provision of spaces for interaction, and additional water/terrestrial habitats in high-density urban areas.

Expected impacts

The main impact of the floating island will be to increase biodiversity and to attract attention and raise awareness of both the role of Nature Based Solutions and the Baltic Green Corridor. Opportunities exist for associated vegetation to help filter pollutants and provide habitats for water based biodiversity whilst additionally acting as a food source for aquatic and bird species. High quality floating gardens can be associated with property uplift in urban areas and can also promote increased tourism and spend when they are located in sites with high footfall and an attractive amenity offer.

Concepts for the floating garden are still being designed by students at a local technology college and their ideas will help to inform the final design for tender. The total surface area of the floating island(s) is not expected to exceed 60m^2 and there will be a focus on designing for biodiversity and habitat provision.

This intervention will form part of the programme that will engage and inform local people about NBS, with an expected 250,000 people expected to have an opportunity to see the intervention.

Related KPIs

Table 19 Floating Gardens KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Social	Assessment of typology, functionality and benefits provided	109

Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of citizens on urban nature	115
Social	Engagement with NBS (sites/projects)	117

2.7.2 Location

Between 1-3 floating island gardens are proposed for a corner of Wapping Dock. These floating islands will introduce greenspace on the blue space and provide additional habitat and diversity to the dock space. The islands will be offset by pollinator planting on the dock slip way and together these features will additionally help to signpost the start or finish of the Baltic green corridor route.

The preferred location for the floating island habitats is close to the slipway where the water is relatively shallow and the location is largely protected from prevailing winds. Locations close to the slipway also offer benefits of being able to securely anchor the island, provide easier practical opportunities for any irrigation/maintenance and make biodiversity monitoring easier to perform. Tucked into the corner the islands will also not impede water traffic through the central part of the dock and will not intrude on the open aspect of the water body.

Table 20 Floating Gardens' locations

Location/s	Size	Proposed Location	Notes/Comment
Wapping Dock	c 60m^3		1 - 3 islands subject to design

2.7.3 Technical Specifications

Construction can be of various forms but materials with natural buoyancy are often used for the sub layer. The strength and extent of the floating garden will depend upon the construction of the raft and the weight of material placed on it. Engineered designs will need to consider a number of factors:

- Ability for materials to withstand all weather conditions

- Cross braced structure for added strength
- UV resistant thermo fused tough floats
- Secure anchorage using weighted guide rail
- Plant species will need to be salt tolerant and low growing and unpalatable to local wildlife so that the island remains aesthetically pleasing.

The islands can be made up of several component shapes which are available to buy.

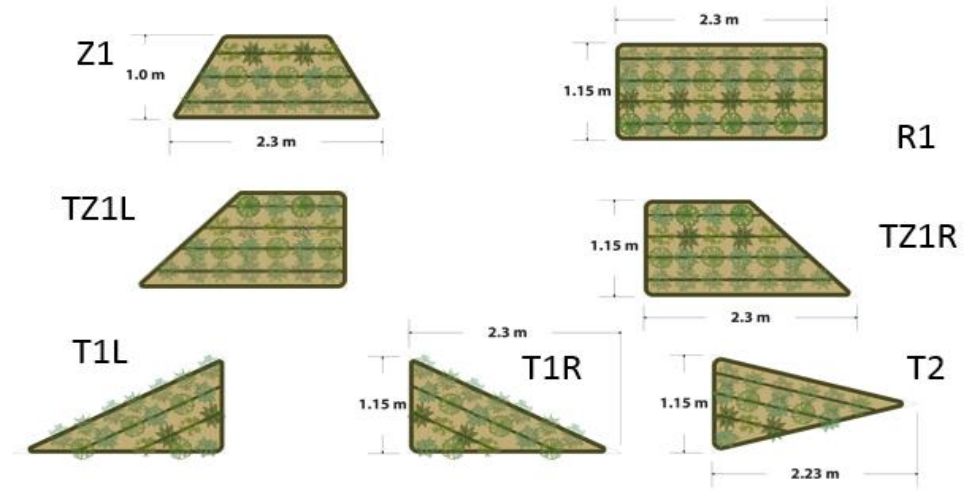


Figure 6 Example component shapes for floating islands with visualisation.

The islands could also incorporate hanging sub-surface biofilter columns to create an artificial reef-like habitat for microorganisms, fish and other aquatic life. The final construction details will be confirmed as part of a design and deliver tender that will be subsequently tendered but the strength and extent of the floating garden will be dependent on the construction of the raft and the weight of the material placed/grown on it.

The Liverpool Life Sciences College which is close to the Baltic corridor route are keen to use this real life opportunity with the students and to challenge them to design an island concept that meets the needs of the project. This work will start with the September 2018 intake of students and form a key part of their independent project work in the autumn term. Students will be encouraged to develop easy sensors that can detect issues such as when the floating island may require additional irrigation etc. Successful project ideas will be provided as part of the project brief for later tender.

2.7.4 Operational and Maintenance Considerations

Floating gardens should be relatively self-sustainable, but may require weeding, restoration after storm events, and water pollution may need to be addressed if nutrient runoff causes excessive eutrophication.

Many of the operational and maintenance details will not be known until the final design is confirmed. However, the design will need to take into consideration a number of practical details for issues like anchoring, irrigation, maintenance, aesthetics and monitoring.

2.7.5 Economic Specifications

€79,200 available

Table 21 Floating Garden's economic specifications

Location	Item	Actual budget	Notes/comment
Wapping Dock	1 -3 floating islands 60m^2	Islands plus associated works including design, delivery and maintenance	Salt water habitat Life Sciences College students involved
Identified in bid	**1 -3 floating islands Up to 60m^2**	**Available budget €79,200**	

2.8 Hard drainage pavements - LAc10

2.8.1 General Description

Hard drainage pavements, also known as porous pavements, are nature-based infrastructure which provides opportunities for increased percolation of rain and surface water through a paved surface. They are constructed of smaller areas of impermeable surface compared to more traditional paving, which is interspersed with greased or areas of sand to allow water to dissipate through the surface more quickly. Hard drainage pavements can also trap suspended solids and thus filter out pollutants associated with storm water. The central goal of hard drainage pavements is to control storm water, reduce runoff and surface water stagnation and improve water quality in substrate layers via additional filtration. They are suitable for pedestrian and cycling activity, as well as car parks and other areas of standing water. They differ from sustainable urban drainage (SuDS) or porous pavements, as they are not designed with a permeable membrane but a combination of hard (engineered) and an ecological (NBS) surface.

It is possible that up to 350m^2 of hard drainage pavement could be introduced at this location.

Expected impacts

Hard drainage pavements increase the level of infiltration and retention of rainfall thus helping to alleviate spikes in peak flow. They can also help remove suspended particulate matter from water systems thus lowering the impacts on water quality. Hard drainage pavements can be used to improve the permeability of urban areas and housing development thus alleviating the instance of surface water flooding. They can be developed as part of an integrated SUDS system to (a) decrease the likelihood of flooding and associated insurance/rehabilitation costs and (b) increased the economic value of a property due to the amenity and aesthetic quality they add to the location.

The new paving will also reduce the thermal capacity of the paved area, reducing ambient temperature by up to 2^o C in summer.

At this location there is evidence of localised surface water flood risk and a lack of green infrastructure. The hard drainage SUD and associated rain garden planting would seek to address both these aspects.

Related KPIs

Table 22 Hard Drainage Pavements' KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1

Environmental (physical)	Heatwave risk	9
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of citizens on urban nature*	115
Social	Engagement with NBS (sites/projects)*	117

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.8.2 Location

An option for a hard drainage pavement and rainwater garden exists at the junction of Upper Pitt Street and Nelson Street. The site is currently hard paved and lies adjacent to a small park, Great George Square. The area identified for potential improvement shown shaded in grey is estimated to be circa 350m^2.

Table 23 Hard Drainage Pavements' location

Location/s	Size	Proposed Location	Notes/Comment
Junction of Upper Pitt Street and Nelson Street	350m^2		

2.8.3 Technical Specifications

Hard drainage pavements can be constructed from a variety of materials whose main property is the additional filtration of rainfall/storm water from a surface area to a substrate.

The most common forms of hard drainage pavement consist of:
1. Porous concrete
2. Porous asphalt
3. Permeable interlocking concrete pavers
4. Polymer-based grass pavers, grids and geocells.

Their construction includes the creation of a series of layers that provide opportunities for rainfall/water to permeate through the surface to the substrate. This includes the porous top layer (porous concrete/asphalt or interlocking pavers) which are placed over a rock/stone reservoir or filter layer, which provides space for water to leach through the different layers. Depending on the location of intervention there may also be a fabric membrane installed as the bottom layer. The thickness of the reservoir/filter membrane varies depending on the climatic conditions, with areas of heavily rainfall requiring a deeper layer to mitigate the additional flow and time needed to dissipate. In addition, depending on the type of hard drainage system utilised the physical composition of the porous layer will vary. Porous concrete/asphalt and permeable interlocking concrete pavers will have a uniform look (depending on their design). However, polymer based grass pavers, grids and geocells have a more varied form (due to the design of different manufacturers), and this can include the use of hexagonal cells which are subsequently filled with natural material, i.e. soils.

The identified area is currently paved. The new rainwater garden would be incorporated into some semi permeable paving to make a pavement feature that lies alongside the green pedestrian and cycle route. The existing paving would need to be broken and removed and permeable blocks and a sub base would be required, as would a connection into the drainage system. An area of up to 350m^2 is available at this location.

Figure 7 Artist's impression of semi permeable pavement with rain garden feature.

2.8.4 Operational and Maintenance Considerations

Regular maintenance is recommended for permeable pavements. This may include re-sodding, laying gravel, and other small repairs. More typically, maintenance of a permeable structure refers to vacuum sweeping, pressure washing, or air blowing to remove debris, with vacuum sweeping being the preferred method in many cases. Depending on the site, this may need to happen 2-4 times a year.

Concerns for maintaining the permeable pavement are typically limited to aesthetics and the prevention/repair of clogging. Proper design may prevent clogging, such as designing for drainage away from the porous section of pavement. This will keep debris from sweeping onto the pavement while allowing rain to infiltrate the soil below.

Prevent Clogging of Pavement Surface with Sediment

- Vacuum pavement twice per year
- Maintain planted areas adjacent to pavement
- Immediately clean any soil deposited on pavement
- Do not allow construction staging, soil/mulch storage, etc. on unprotected pavement surface
- Clean inlets draining to the subsurface bed twice per year

Winter maintenance for permeable pavements is simpler than that for typical pavements. Avoid using any abrasives, such as sand, on or near the porous pavement. Heat retention in the stone bed beneath the pavement tends to provide good snow melt, leading to reduced snow and ice problems. Snow plowing may be used with caution, setting the blade about an inch higher than normal. Salt may be used; however, nontoxic organic deicers are preferred, as the contaminated water will go directly to the water table.

In terms of repair, surfaces should never be seal-coated and whilst mall damaged areas can be patched with porous or standard asphalt; larger areas should be patched with an approved porous asphalt.

2.8.5 Economic Specifications

Table 24 Hard Drainage Pavements' economic specification

€607,200 available

Location	Item	Actual budget	Notes/comment
Upper Pitt Street, Nelson Street	c 350 m^2 of hard drainage	Semi permeable surfacing plus adjoining raingarden plus associated works costs and planting.	Additional works include smaller rain garden under section 2.6
Identified in bid	**c 350m^2 of hard drainage surface**	**Available €607,200 (raingarden, hard drainage pavement with raingarden)**	

SINGULAR GI

2.9 Pollinator verges and spaces (LAc12)

2.9.1 General Description

Pollinator verges will play an important role in the biodiversity element to the URBAN GreenUP project. These new or existing linear features (verges) or patches (spaces) of green space, sown with a wildflower-rich grassland seed mix, will provide nectar and pollen to attract foraging insect pollinator species. In addition they can be usefully used to help define the green corridor and link neighbouring Nature Based Solutions as well as link areas of flower-rich green space, both new and existing, to create sustainable networks of pollinator habitat within the urban area. The choice of pollinator verges can also reduce the need and costs associated with traditional maintenance.

Expected impacts

Linking areas of flower-rich green space, both new and existing, will create sustainable networks of pollinator habitat within the urban area. The addition of pollinator planting (together with the introduction of pollinator homes where possible) will establish new sustainable systems of food sources for pollinator insects that will be on land close to highways and footways to help visually establish the green route. The introduction of these ecologically selected plantings will ensure that they can attract and sustain insect and pollinator populations and increase biodiversity and social cohesion throughout the corridor. Pollinator planting in preference to amenity space can also reduce in lower mowing frequencies and reduced maintenance costs. Pollinator verges can also have a small effect on mitigating local heat island effects by reducing ambient temperature in urban areas and can be particularly beneficial for enhancing air quality when in close proximity to traffic.

In conjunction with LA13 & 14, this intervention will provide

- 7200m^2 of green space, 840m^2 of which will be pollinator species
- 45% increase in pollinator activity
- 15,000 opportunities to see or visit the intervention.

Related KPIs

Table 25 Pollinator verges and spaces' KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9

Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Environmental (biological)	Pollinator species increase	77
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of citizens on urban nature*	115

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention

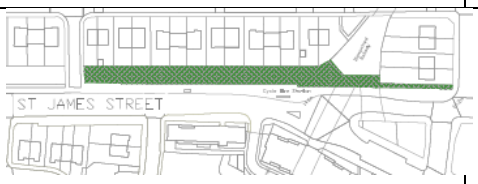
2.9.2 Location

In the Baltic corridor there are a number of pollinator verges and spaces planned. These are located on Upper Frederick Street, along Park Lane, around the central Baltic Hub, along the Strand and also on the slipway of Wapping Dock.

In total it is estimated that pollinator verges and spaces for this demo area will cover an area of approximately 5500m^2 (on existing amenity grass spaces), with an additional 320m^2 of planting on the slipway to the dock. In total there will be 5,820 m^2 of planting across 4 key sites within the demo area.

The areas for pollinator planting are shown on the map below. Each of these sites provides a suitably sized area of amenity space that can treated to create a pollinator verge.

Table 26 Pollinator verges and spaces' locations

Location	Size	Location	Comment
Pitt Street	2400m^2		
Park Lane	3100m^2		
Baltic Hub			
Strand non waterside			
Slip way Wapping Dock	320m^2		

2.9.3 Technical Specifications

Amenity grass sites identified for sowing will need to be treated and the existing grass will need to be removed. The soil will need to be prepared and suitable seeds sown. The seed mix used should contain a mixture of indigenous pollinator species that will be visually aesthetic.

For sowing on the slip way, the existing weed growth and vegetation will need to be cleared from the slipway and the embankment will need to be hydroseeded with pollinator species that are both low growing and attractive.

Where possible, insect pollinator homes will be incorporated into the schemes.

Figure 8 Pollinator homes

2.9.4 Operational and Maintenance Considerations

Maintenance of these areas will be carried out by the city council. The sites may require occasional watering in hot weather. A clear 1m wide strip should be mowed around the edge of the pollinator areas during their flowering and this should be maintained as they die back in autumn, until such time as the seed has set and the site can be fully mown for the winter. The clear strip indicates that the site, although wild in appearance, is still cared for and being maintained. This is especially important during the autumn, when die back before the seed has set can cause the areas to look unsightly and uncared for. Explanatory signage can help to alleviate concerns over maintenance.

2.9.5 Economic Specifications

€136,620

Table 27 Pollinator verges and spaces' economic specification

Location	Item	Actual budget	Comment
Pitt Street	2400m^2	Spray off amenity grass, prepare soil, sow seeds, establish	
Park Lane			
Baltic Hub			
Strand non waterside	3100m^2		
Slip way Wapping Dock	320m^2	Clear existing vegetation, hydroseed embankment and establish	

Identified in bid	**6,000 m^2**	**Available budget €136,620**	**Insufficient space prevents further sowings**

2.10 Pollinator walls vertical LAc13

2.10.1 General Description

Vegetated 'green' or 'living' walls, supporting flowering plants, can provide nectar and pollen to attract foraging insect pollinator species.

Expected impacts

The pollinator wall will form a key component of the green route in an unexpected location for the green route user. The wall will raise awareness and attract curiosity as it is expected that it will make a large visual improvement to the local streetscene.

Vegetation on the wall will store carbon and protect the building from direct sun; thereby contributing to lower ambient temperatures. The green façade will also provide connectivity between other Nature Based Solutions and act as a natural air filter; contributing to improvements in local air quality. In addition there are a number of socio and economic benefits that will be investigated to determine any changes in the perception of well-being for those nearby, any increase in footfall, dwell time, and wider issues such as property value increases and crime reduction.

The addition of pollinator planting (together with the introduction of pollinator homes where possible) will establish new sustainable systems of food sources for pollinator insects. The introduction of these ecologically selected plantings will ensure that they can attract and sustain insect and pollinator populations and increase biodiversity.

In conjunction with LA12 & 14, this intervention will provide

- 7200m^2 of green space, 840m^2 of which will be pollinator species
- 45% increase in pollinator activity
- 15,000 opportunities to see or visit the intervention.

Related KPIs

Table 28 Pollinator Walls' KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Type of Indicator	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001

Environmental (biological)	Increase in density and seasonal spread of floral resources for pollinators*	1004
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Environmental (biological)	Pollinator species increase	77
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention

2.10.2 Location

The pollinator wall in the Baltic demo area will be installed (retrofitted) along the façade of an ordinary brick building that is currently used as a car park on Parr Street. The pollinator wall will cover an area of approximately 100m^2 and form a big impact or 'splash' piece on the green corridor route.

The location here provides a number of important factors for site selection; namely a suitably sized and stable façade, a willing land owner who is happy to financially maintain the green wall as well as good 24/7 CCTV security.

Table 29 Pollinator Walls' locations

Location	Size	Location	Comment
Parr Street	Up to 100m^2		Iliad site

2.10.3 Technical Specifications

The green pollinator wall in the Baltic is most likely to take the form of a green panel wall consisting of a modular structure containing organic media in which plants are rooted. This

type of wall comes in many forms and is typically composed of plastic grid like components or large sheets of felt like material with pockets for soil. Plant species selection will be important to support local pollinator species and the wall will contain some small insect hotels that provide habitat for pollinator insects.

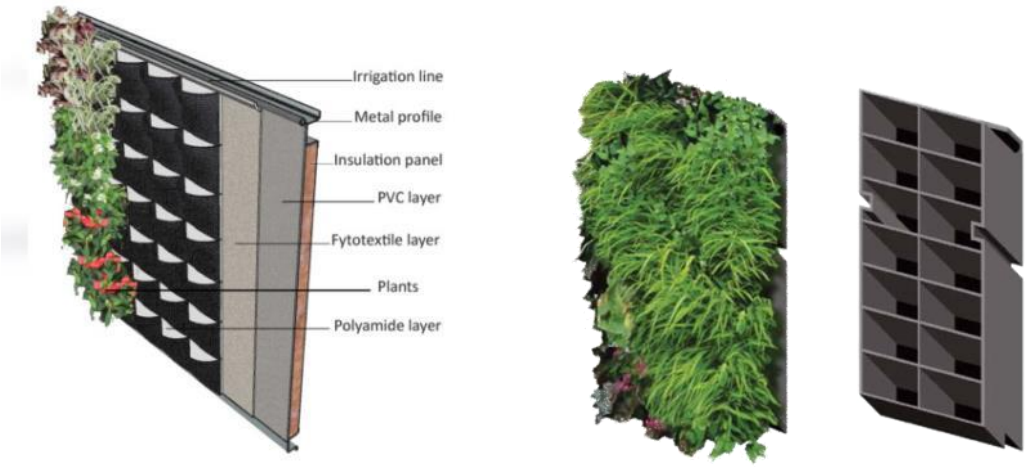


Figure 18: Examples of green modular walls.

An irrigation system is required to deliver water and nutrients to the pants. If possible a grey water irrigation system will be considered. Final designs of the modular walls and irrigation system will form part of a design and build tender specification.

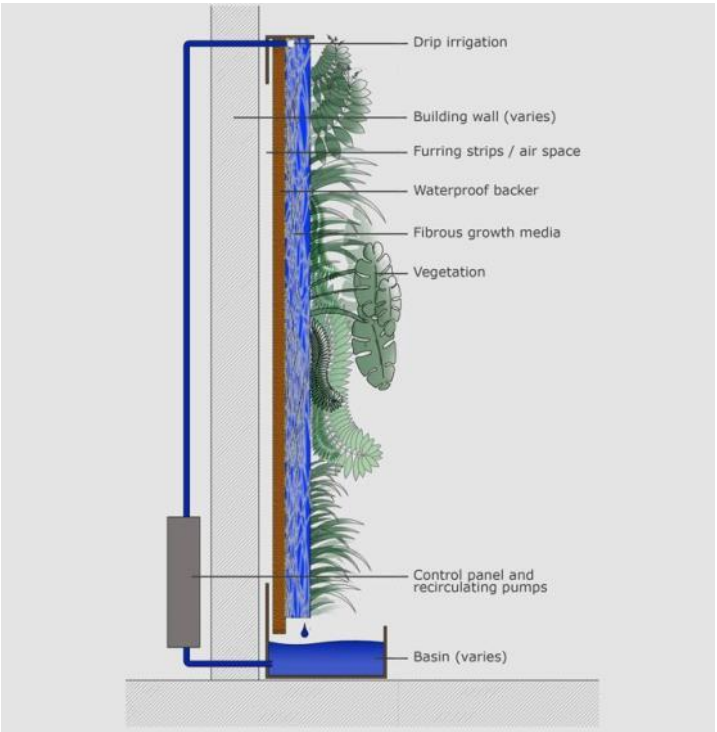


Figure 19: Green wall irrigation system

The technology for green roofs is now well established. The Green Wall installations in Liverpool as part of the Urban GreenUP programme have a primary purpose of providing increased habitat for pollinators.

The following provides information that will be provided to potential tendering organisations for the installation of green walls. However, we have not been prescriptive in this section recognising that green wall installation is normally carried out by system developers who will provide specific technical specifications for each green wall that is to be delivered.

This technical specification is also provided on the basis that the contractor will need to satisfy the building owner that the structure of the building has been assessed and the necessary calculations on building load, irrigation volumes and rates and any other relevant engineering and structural issues have been made and agreed with the building owner.

Our specification provides the basis for a manufacturer/installer to provide details on how our requirements will be met in a design, build and establish framework.

- Plant selection

The focus for the green wall intervention is to provide additional habitat for pollinator species. The plants need to be suitable to the system selected. The Royal Horticultural Society (RHS) suggests that selection should be kept simple, choosing plants with similar light and moisture requirements. In addition, the aesthetic of the green wall will be important as the wall is located on a high profile anchor store in the main Liverpool shopping area.

- Growing medium and nutrition

There are a range of types of wall that the contractor may consider.

In modular walls, planting is rooted in a growing medium which is irrigated. The planting medium is a mixture of compost and inert material which needs to be non-biodegradable to ensure its longevity. The medium supports the plant, permitting water, air and nutrient delivery, creating a buffer that reduces the constant management prevalent in hydroponic systems.

Irrigation is mandatory for living walls and moisture levels are to be digitally monitored. Use of rainwater and rainwater harvesting will increase the sustainability of the green wall.

With pocketed systems, large vertical panels are sub-divided into roughly 3 metre panels with separate drainage channels. The irrigation system supplies moisture and can also remove excess. As with the above, emitter spacing, water flow rate, application frequency and retention are linked to ensure moisture uniformity, to prevent desiccation.

Modular systems can use weep hose drip irrigation; emitter pipes with capillary mats are an alternative. Irrigation can be distributed on a multi-level basis at one metre intervals or split into module heights. Drainage at the base of each panel can be integral.

The design of system needs to ensure that plants and the growing medium are held firmly in their pockets or sleeves; to resist wind erosion and plant loss. With modular systems this can be achieved with a capillary mat, around which roots are wrapped, to ensure plants are secured and vandal proof.

- Weight

This information is based on manufacturer's estimate and should be verified.

As described above all structural calculations and requirements will have to be agreed with building owner to ensure long term building integrity, the safe installation and long term safeguarding of health and safety of those using the roadway beneath the structure(s).

- Ecological benefits

To promote biodiversity, broadening the variety of plants will attract a more diverse array of insects and birds.

An article by AECOM (The journal of the Landscape Institute – Summer 2013) suggests that there is a clash between keeping a striking green appearance throughout the year with the use of evergreen species and the ability to improve biodiversity; colonization and succession by native species and seasonality are desirable but this will result in brown patches and dead material.

Certain species, such as Ivy, will have a tendency to dominate slower growing competing species, therefore creating a mono-culture. Publication 'Designing for biodiversity' gives guidance on creating the right conditions for attracting wildlife onto buildings – an overview of the large array of planning and other legislation that affects wildlife is provided along with a programme of when, on a project, biodiversity needs to be considered.

The focus for the wall is to attract pollinator species, but given the location, aesthetics will also be important.

- Maintenance aspects

Green walls all require maintenance get the best out of the planted material. Maintenance is required to manage growth that is intruding into building services or fabric and to keep the planted material in good health and looking its best. With some plants regular pruning is advised and deadheading of flowers can encourage regrowth. Maintenance will include periodic checking of the layers of felt systems, replacement of dead plants and checking of the irrigation system.

Some manufacturers recommend two primary maintenance visits a year; these will include a calibration of the irrigation system.

- Fire load

The Department for Communities and Local Government (DCLG) carries guidance of fire performance of green roofs and walls in the UK on the gov.uk website. It is suggested that whilst growing medium, with the exception of organic material, is unlikely to contribute to flame spread, HDPE plastics used on modular living walls systems are capable of igniting.

The DCLG document 'Fire performance of green roofs and walls' states that there has been 'no significant fire testing of green wall systems'. It suggests for fire prevention that considerations are made for:

- Increasing the non-combustible content of the growing medium
- Decreasing the organic content of the growing medium
- Preventing the system from drying out

For fire prevention the document suggests that use of grasses and mosses is avoided and plants with high moisture/ low resin content be used. A recommendation for fire breaks, supporting standards and a summary of compliance requirements to the (English) Building Regulations is offered.

2.10.4 Operational and Maintenance Considerations

The green wall will require regular irrigation and maintenance. There will also need to be some pruning and care of the vegetation. A periodic review of the irrigation system will also be required. Pruning, clearing dead growth and leaf litter and cutting back all need to be undertaken on a seasonal basis to prevent self-strangulation and manage undesired plant growth. If neglected, this will interfere with the building structure, and services and clog cavities or gutters. Annual inspection of planting is required, together with checking of supports and fixings at not more than five yearly intervals.

2.10.5 Economic Specifications

Table 30 Pollinator Walls' economic specification

Available €91,080

Location	Item	Actual budget	Comment
Parr Street Garage	100m^2	Modular green wall, design, installation and establishment	Design to be in conjunction with business owner
Identified in bid	**100m2**	**Available budget €91,080**	**Budget to also include green screen options as far as possible.**

2.11 Green screens - LAcadd2

2.11.1 General Description

Green fences provide vertical green surface/s that can reduce the negative effect of vehicle pollution on adjacent roads. These self- supporting structures can be located anywhere in the city, as long as they can be irrigated. They can also be used to define areas and provide both physical and mental wellbeing benefits.

Expected impacts

The green screens are expected to deliver a number of impacts. A key benefit is thought to be the ability of green screens to act as natural air filters with the vegetation metabolizing harmful toxins while releasing oxygen and filtering out some particulate matter. The green screens will also house pollinator species which will help to add biodiversity to areas. Opportunities exist to explore the use of green screens to screen off less desirable land uses (e.g. temporary car parking plots) along the green route. It will help to define some small, temporary spaces on the route, forming a barrier between the vehicles using the road and pedestrians and cyclists using the pavement.

Related KPIs

Table 31 Green Screens' KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Heatwave risk	9
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Economic	Volume of water removed from water treatment system	38
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83

Environmental (chemical)	Trends in levels of NOx and SOx	84
Economic	Value of air quality improvements	88
Social	Perceptions of citizens on urban nature*	115
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.11.2 Location

A number of locations have been identified for green screens. These vegetated fences will be used both to create small parklets (or green resting areas see section 2.12) between tree planted areas, to provide additional free standing green facades at a low level in some of the urban squares and to help delineate parts of the route by screening off areas that are temporarily being used for car parking. The current proposals estimate that 151 m^2 of green fencing or green screens can be provided.

Green screen locations are identified along various sections of the route with the preference for location being for screens on Colquitt Street for a pocket park, within Tradewind and Madison squares, around the college land on Cornwallis Street, and from St James Street to Blundell Street to define the route and screen off car parking area with an opportunity for an additional green screen at the dock side to enclose the seating area.

Table 32 Green Screens' locations

Location	Size	Location	Comment
Colquitt Street	38m^2		Pocket Park
Tradewind and Madison squares			Lower storey commercial area

Cornwallis Street	113m^2 for 5 sites		College site
St James Street to Blundell Street			Car park
Blundell Street car park			Car park
Wapping Dock			

2.11.3 Technical Specifications

The green screens will be free standing and constructed from a weather proof self-supporting structure. The following criteria should be considered:

- A metallic, self-supporting structure with an irrigation system that soaks the substrate
- Vegetation plants with little nutrient and water needs. These should also be species resistant to local climate that are suitable for growing in an irrigated soil or inert substrate such as rock wool.
- A water collection/irrigation system during establishment and hot weather.


Figure 20 Example green screens

2.11.4 Operational and Maintenance Considerations

The green screens will need to be robustly fixed in place to avoid falling or being toppled. They will require irrigation and pruning as they grow. The planting containers and support framework should be of a durable material.

2.11.5 Economic Specifications

Table 33 Green Screens' economic specification

Budget €91,080 (Green walls)

Location	Item	Actual budget	Comment
Colquitt street	38m^2	Installation, irrigation and associated costs	
Tradewind/Madison/College at Cornwallis Street	113m^2		
James Street to Blundell Street			
Wapping dock side			
Identified in bid	**100m^2 green walls**	**Available budget €91,080**	**Budget to also include green wall and green screens**

2.10 Summary Demo Site A Baltic Corridor

Table 34 Summary of Baltic Corridor interventions

ACTION	Intervention	Total Cost (Including Co-Financing)	EU Contribution	Municipality Contribution	Output
RENATURING URBANISATION					
LAc2	LAc1- Green pedestrian and cycle route	52,726	52,726	0	200m
LAc5	LAc5- Shade trees. Species to spread canopies	Inc. in LAc6 budget	Inc. in LAc6 budget	0	24 trees
LAc6	LAc6- Cooling trees. Species to maximise cooling effect	94,875	94,875		19 trees
LAc add1	LAc add1 Green resting area	tbd	0	tbd	5 areas
WATER INTERVENTIONS					
LAc4	LAc4 Urban Catchment forestry	159,390	159,390	0	32 trees
LAc8	LAc8 SuDS	607,200	607,200	0	50m^3 raingarden
LAc10	LAc10 Hard drainage pavements	Inc. in LAc8	Inc. in LAc8	0	350m^2 hard drainage pavement
LAc 16	LAc16 Floating garden	79,200	79,200	0	60m^2
LAc11	Enhancing nutrient managing and releasing soil	Tbd	Tbd	Tbd	Tbd (as suitable)
SINGULAR GREEN INFRASTRUCTURE					
LAc12	LAC12 Pollinator verges	136,620	136,620	0	5820m^2 planting
LAc13	LAc13 Pollinator walls/vertical	91,080	91,080	0	100m^2
LAc add2	LAc add2 Green Screens			0	151 m^2
NON TECHNICAL INTERVENTIONS					
LAc24	LAc24 Bio app	22,400	22,400	0	I app
LAc22	LAc22Green art	30,360	30,360	0	tbd
			1,273,851		

3 Definition of the Interventions in Sub-Demo B City Centre, Liverpool BID

3.1 Overview

The City Centre demonstration area is focussed on the main business and commercial areas of the city and the city region. The demonstration area is focussed on the historic heart of the city, central to its development over 800 years since the city was granted a royal charter by King John in 1207. The original grid iron of seven streets, Castle Street, Chapel Street, Dale Street, High Street, Old Hall Street, Tithebarn Street and Water Street, that were the basis for the mediaeval development of the city are part of this demonstration area.

The business community in Liverpool City Centre is of significant importance to city's regeneration. The city is in the top five visitor destinations in the UK, generating £3.5bn for the local economy. The BID area is also part of the Liverpool World Heritage Site.

The Commercial BID currently has over 550 businesses, employing more than 60,000 people.

Liverpool Central BID covers the main shopping area of central Liverpool. It is one of the UK's leading retail areas, with footfall of over 60 million people per year.

Maintaining and enhancing the City Centre experience, attracting more visits and increasing spend is crucial for the long-term growth and development of retail centres. Making best use of all the available assets is essential. These provide the draw and the experience, influencing return trips and the amount of money spent.

The city centre of Liverpool is one of the least well-resourced neighbourhoods of the city for green space - Figure 9. City Centre Green Infrastructure Typology. The city centre is constrained by its density and the limited availability for green space development. However, there opportunities for targeted interventions that tackle specific issues, such as flood risk, using Nature Based Solutions.

Through the development of the Liverpool Diagnosis we also found that the district to the east of the city, known as the Fabric District due to its historical link to cloth sales and clothing manufacture, is undergoing significant redevelopment. Over 14,000 new housing units are anticipated to be built over the next few years. Creating a link from Fabric District to the city centre, to both promote active travel and also blend green infrastructure improvements for aesthetic and habitat connectivity reasons is seen as an excellent opportunity for Urban GreenUP.

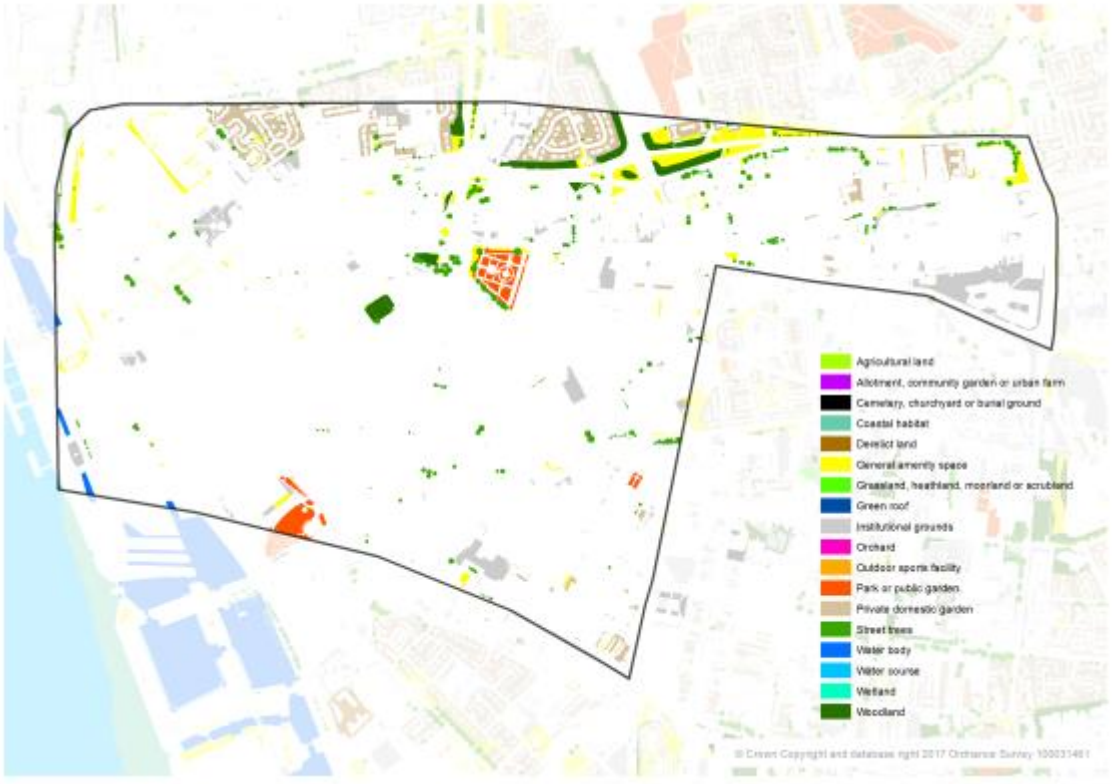


Figure 9. City Centre Green Infrastructure Typology

There are 7 technical interventions planned for the BID area and 9 non-technical interventions.

Table 5 List of interventions in Sub-Demo B

Re-naturing urbanization	Water interventions	Singular Green Infrastructures	Non-technical interventions
LAc2- Green travel route	LAc4- Urban Catchment forestry	LAc13- Pollinator walls/vertical	LAc19- GI For Education
LAc5- Shade trees. Species to spread canopies		LAc14- Pollinator roofs	Lac21` - Engagement Portal for citizens*
LAc6- Cooling trees. Species to maximise cooling effect		LAc15- Mobile gardens	Lac24 – Engagement app for citizens*
			Lac25 - GI for physical health*
			Lac26 - GI for mental health
			Lac27 - Promotion of ecological reasoning*
			Lac28 - Single window/desk for RUP deployment*
			Lac29 - Support to citizen project of NBS*
			Lac30 - City mentoring strategy*

Figure 10 Liverpool BID Interventions

3.2 LAc2- Green travel route

3.2.1 General Description

The Green Travel Route will link the areas of new development in an area known as Fabric District to the BID area, with its shopping and leisure facilities. The route will make use of both existing green infrastructure and the Urban GreenUP interventions to establish a route that is as green as possible in the city centre. In addition, the green travel route along the strand will form the western boundary of the BID and provide linkage to the Waterfront, Liverpool One and the new developments at Liverpool Waters. These two routes will come together along the main shopping area in the BID to create a 4.4km route.

Local promotion of the green route is planned to increase the amount of green travel, travel by foot or bike.

Where possible the route will link into the established network of city bikes that can be hired.

4.3km (against a planned 2km) of green travel routes will be identified along with re-naturing of 3 km in order to develop a green pedestrian and cycle route through the city to make them more attractive and encourage greater use, in particular linking key gateways such as commercial and retail areas with city waterfront conference and leisure/commercial areas and joining up train and bus stations to areas of employment or projected future employment to increase active travel and reduce carbon emissions.

The route will be promoted locally though mapping apps.

Expected impacts

The expected impact is for more (20%) people to cycle and/or walk the green route, reducing vehicle movements and so release of both pollutants and CO^2 from vehicles (79.5tCO_2 eq.). it is anticipated that 160,000 people will make use the new route provided by LAc1, 2 and 3. An additional 400m^3 of green surface will be created. These impacts are delivered cumulatively across the three demonstration areas in Liverpool.

The Related KPIs

Table 6 Green Route KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (biological)	Increase in density and seasonal spread of floral resources for pollinators*	1004
Environmental (biological)	Increase in plant species richness and functional diversity as a result of NBS*	1005

Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter (KPI 83)	83
Economic	Value of air quality improvements (KPI 88)	88
Economic	Savings in energy use due to improved GI (KPI 110)	110
Social	Increase in walking and cycling in and around areas of interventions	139

3.2.2 Location

The two key locations for the route are the Fabric District and the Strand. The existing green infrastructure network, discussed in the baseline assessment (D3.2) and the new Urban GreenUP interventions, along with the wider works to green the city, will be used to form an attractive route, or network of routes.

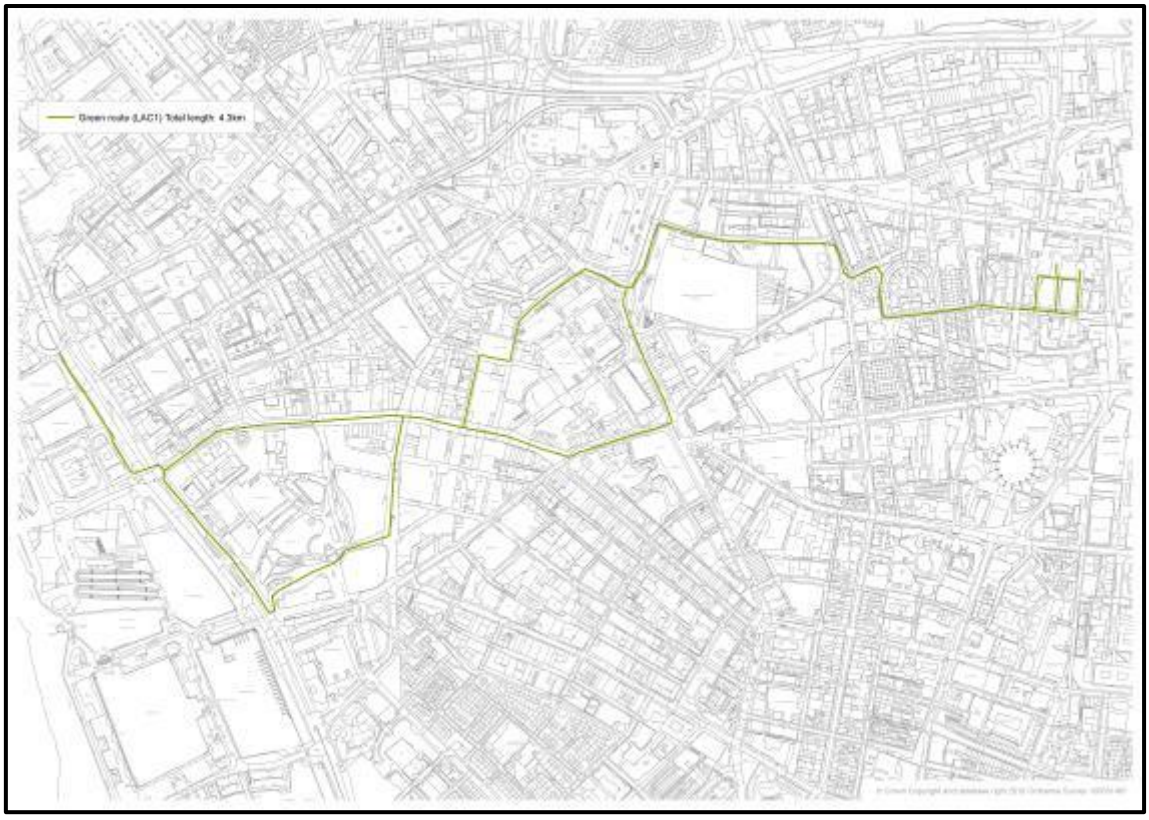


Figure 11 Green Routes

3.2.3 Technical Specifications

Having identified the route, this intervention will focus mainly on the promotion of use of the route by providing information to the target audiences such as those in the new homes in Fabric District, those using the Strand and also users of the main shopping and business areas in the BID.

This will involve social media and leaflets as well as promotion at community events and networking through the University accommodation teams.

3.2.4 Operational and Maintenance Considerations

Existing components of the proposed green travel route have operational and maintenance plans in place. The additional non-Urban GreenUP interventions planned for the areas around Lime Street Station and within Fabric District also have operational and maintenance plans in place.

The promotion of the route via mapping apps will be maintained beyond the programme by The Mersey Forest Team.

3.2.5 Economic Specifications

Table 7 Green Route economic specification

Location	Item	Actual budget	Comment
Fabric District to BID and down to Strand	Green route created to take in areas of Urban GreenUP interventions and also existing green infrastructure assets along the routes – 4.3 km potential.	€5,594	Key link for new homes being built in Fabric District to the commercial and business areas of the City.
Identified in bid	3km	€5,594	

3.3 LAc5- Shade trees. Species with canopies that provide good shade

3.3.1 General Description

Shade trees will be planted as part of the environmental improvements along the Strand in Liverpool on the western edge of the BID area. Where possible these will be located so that they provide shade in places where people might linger, or to shade adjacent structures.

See Figure 10 Liverpool BID Interventions

Expected impacts

Shade trees will be selected to achieve larger areas of shadow. The impact will be localised cooling as the leaves intercept solar energy, leading to improved human comfort close to the intervention, providing data for wider implementation of this type of nature-based solution.

There will also be an impact on nearby buildings, which may lead to reduced need for air conditioning, and so reduced energy consumption and costs and a reduction in the amount of heat that is "stored" by a building and released through radiation overnight. This impact will reduce urban heat island effects by decreasing the total amount of solar energy that is stored in the nearby building.

Street trees will provide shadow (3,200 m2 with coverage rates of 40-70%) in summer time in areas with high population transit. Together, LAc5 and LAc6 will reduce ambient temperature in summer time by 2-4ºC. It is foreseen that shade and cooling trees areas will be visited for 30,000 and 20,000 citizens/year respectively. Reductions in air pollutants are also Expected impacts, with reductions in NOx (<1%) and vehicle emitted reactive organic gases such as ozone and volatile organic compounds (2%). CO_2 Sequestration is estimated at 5.5t/year across the entire tree planting activity in Urban GreenUP.

Figure 12 Shade Trees trial - Williamson Sq.

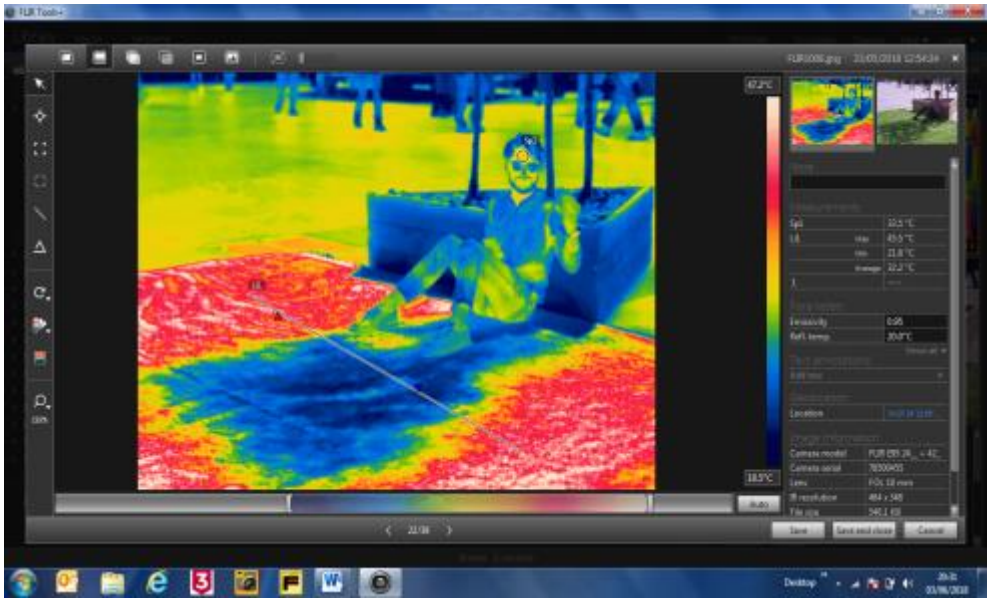


Figure 13 Thermal image of person sitting half under shade tree in cooling tree trial showing a 20° reduction in temperature under the shade tree.

Related KPIs

Table 8 Shade Tree KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Projected maximum surface temperature reduction	13
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS	1001
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38

Social	Accessibility of urban green spaces for population	53
Social	Assessment of typology, functionality and benefits provided	109
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS	1006
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Economic	Value of air quality improvements	88
Economic	Savings in energy use due to improved GI	110
Social	Social learning concerning NBS	113
Social	Perceptions of citizens on urban nature	115
Social	Perceptions of health and quality of life	1007
Social	Increase in walking and cycling in and around areas of interventions	139

3.3.2 Location

Shade trees will plant as part of the environmental improvements along the Strand in Liverpool on the western edge of the BID area. Where possible these will be located so that they provide shade in places where people might linger, or to shade adjacent structures.

3.3.3 Technical Specifications

Urban trees face a range of conditions that can impact on their ability to thrive. These include the restricted rooting environment, higher levels of air pollution, increased levels of soil compaction and reduced levels of soil fertility and natural nutrient cycling processes. In addition, the selection of appropriate trees for urban planting has to take into account the

location where they will be planted and the need to reduce any nuisance, such as "honeydew"[2].

Based on experience of urban tree planting in Liverpool, the following trees are deemed most suitable for planting for shade and cooling are;

Ginkgo Biloba – 30m^3

Metasequoia glytostroboides – 30m^3

Pinus nigra 'Austriaca' – 22m^3

Pyrus caleryana 'Chanticleer' – 12m^3

Quercus ilex – 30m^3

Ulmus lutece 'Nanguen' -17m^3

Tamarix gallica – 8m^3

The figure given beside each tree indicates the optimal volume of soil required for each species in an urban tree planting scheme. It is not always possible to reach these volumes for planting in urban areas as the existing urban infrastructure, buildings, roads, utilities, cables and other infrastructure has to be worked around.

In all cases the maximum volume possible for each location is specified.

- Tree Sizes

The trees will be 14cm-16cm girth. These trees are young enough to be forgiving and adapt to their new, harsher environment outside the nursery and they have the vigour to establish better than bigger trees and are reasonably snap proof.

- Tree Pit design

Tree pit design is perhaps the most important element of this intervention.

Tree pits will make use of structural elements (such as Sylva Cells or similar) to ensure that the tree pit is capable of taking the load from the highways and pavements safely. Tree pits for shade and cooling trees may take the form of single pits excavated for each tree, or where space allows, trench pits into which several trees are planted. The latter provides a greater soil volume and allows for more of the natural soil processes to take place.

The technical drawing for the type of tree pit to be used is shown in **Error! Reference source ot found.**.

- Positioning

The greatest impact will be gained where shade trees are placed south of the area or the structure that is to be shaded.

[2] Honeydew is a sugar-rich sticky liquid, secreted by aphids and some scale insects as they feed on plant sap

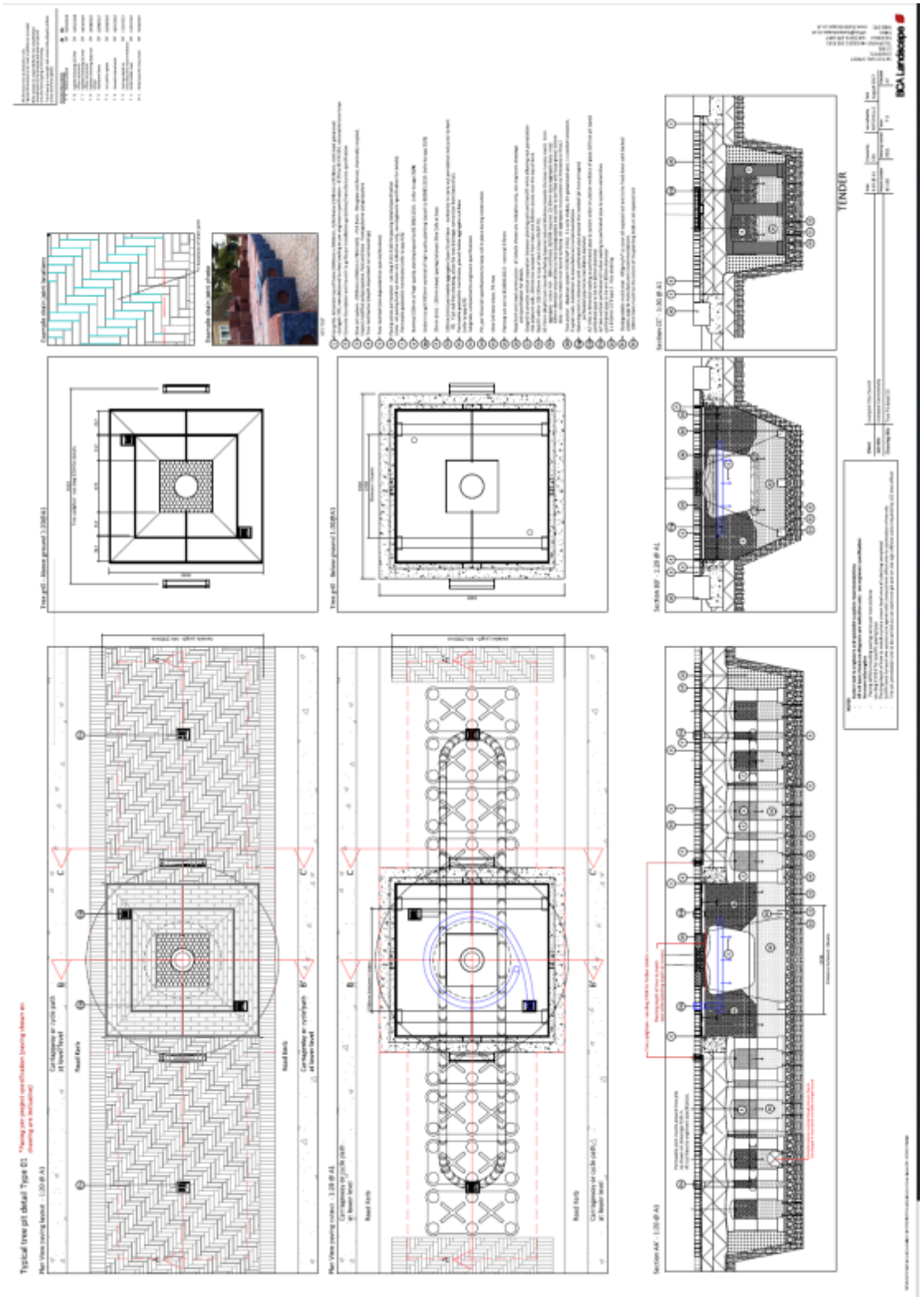


Figure 14 Sample of technical drawing for Urban GreenUP tree pit design

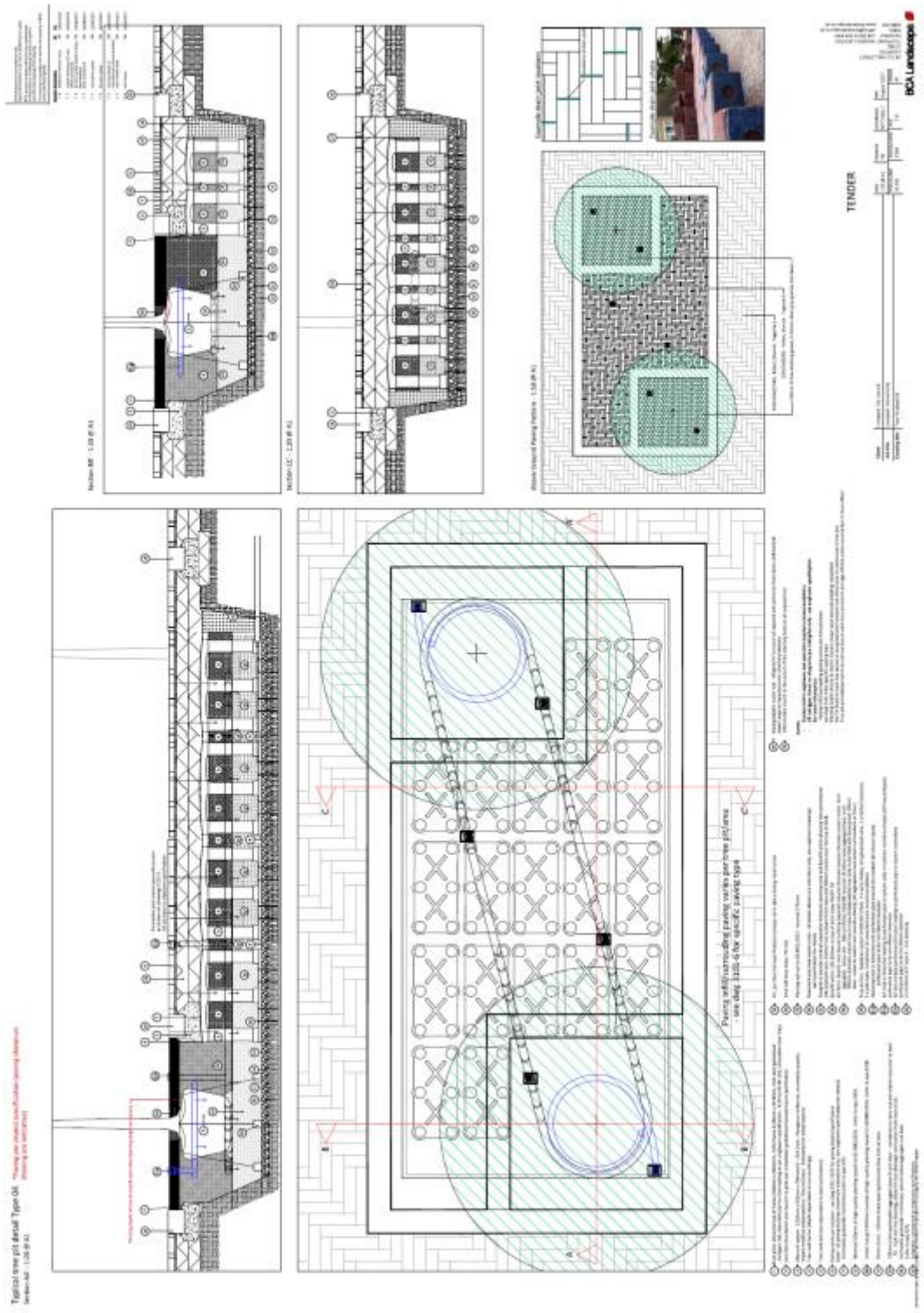


Figure 15 Sample of technical drawing for Urban GreenUP tree pit design with several trees in trench planting system

3.3.4 Operational and Maintenance Considerations

Following establishment, the trees will be maintained by Liverpool City Council in line with their tree management strategy and protocols.

3.3.5 Economic Specifications

Table 9 Shade Tree economic specification

Location	Item	Actual budget	Comment
Strand	Planting of 2 shade trees on the Strand as part of the wider tree planting programme.	€18,975	
Identified in bid	2 trees	€18,975	

3.4 LAc6- Cooling trees. Species to maximise cooling effect

3.4.1 General Description

Two Cooling trees will be selected to achieve higher rates of transpiration during warm weather. The impact will be localised air cooling, leading to improved human comfort close to the intervention, providing data for wider implementation of this type of nature-based solution.

Expected impacts

LAc5 and LAc6 together will demonstrate reduction in UHI impacts. Street trees will aim to offer shadow places (3,200 m2 with coverage rates of 40-70%) in summer time in areas with high population transit. Trees offer pollutant capture and increase the habitat and biodiversity provision. Careful selection of urban trees (selecting most suitable species) will reduce the impact of allergies caused by tree pollen. LAc5 and LAc6 suppose ambient temperature reductions in summer time in 2-4ºC. It is anticipated that shade and cooling trees areas will be visited by 30,000 and 20,000 citizens/year respectively. Reductions in air pollutants are also Expected impacts, with reductions in NOx (<1%) and vehicle emitted reactive organic gases such as ozone and volatile organic compounds (2%). CO_2 Sequestration is estimated at 5.5t/year across the entire tree planting activity in Urban GreenUP.

Related KPIs

Table 10 Cooling Trees' KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Projected maximum surface temperature reduction	13
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Economic	Value of air quality improvements	88

Social	Assessment of typology, functionality and benefits provided	109
Economic	Savings in energy use due to improved GI	110
Social	Social learning concerning NBS	113
Social	Perceptions of citizens on urban nature	115
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS	1001
Social	Perceptions of health and quality of life	1007

3.4.2 Location

Shade trees will be planted as part of the environmental improvements along the Strand in Liverpool on the western edge of the BID area. Where possible these will be located so that they provide shade in places where people might linger, or to shade adjacent structures.

3.4.3 Technical Specifications

The Technical specification for this intervention is similar to 3.3 above. However, consideration will be given to the selection of trees that can best perform the function of cooling through transpiration at the times when it is most needed, i.e. hottest times of day, warmest days of the year.

The detailed pit design will consider whether there may be capacity for water storage following rain that might be used to ensure that moisture is available in the soil profile to allow transpiration when it is most needed.

3.4.4 Operational and Maintenance Considerations

Following establishment, the trees will be maintained by Liverpool City Council in line with their tree management strategy and protocols. The trees are part of a wider programme of public realm and transport infrastructure improvements across the city.

3.4.5 Economic Specifications

Table 11 Cooling Tree economic specification

Location	Item	Actual budget	Comment
Strand	2 cooling trees planted as part of	€18,975	

	wider Strand planting programme.		
Identified in bid	2 trees	€18,975	

3.5 LAc4- Urban Catchment forestry

3.5.1 General Description

Urban catchment forestry will comprise of engineered solutions to retrofit sustainable tree cover in city landscapes. This will help to reduce flood risk and improve water quality. It is anticipated that opportunities for testing nutrient releasing soils, urban drainage techniques and tree pit designs can be included into these works. The tree pit designs can help to reduce flood risk locally and maximise water supply to the tree.

Expected impacts

The urban catchment forestry planting is anticipated to positively contribute to reducing flood risk and improving water quality. The tree-based planting will allow for the testing of nutrient releasing soils. LAc11 which will be incorporated into this intervention will provide healthy soils/substrate. These soils will improve natural growth of the trees and will improve the functionality of NBS installed (1,000 m^2 which will capture 385kg/year of NO^2 from urban air, and avoid need for fertilizer).

The integrated activity of LAC8 and LAc9 techniques could reduce the urban flood water flows in storm periods. Actions included in this intervention will be designed to absorb flow peaks that can occur in the City Centre. LAc4 will provide protection and hydrological tree pit structures for 45 new trees.

By developing a localised Urban Catchment Hydrograph, we will show the impact of the interventions on the peak water flow and the total volume of water that is released to the sewer system from the Urban Catchment Forestry intervention.

Related KPIs

Table 12 Urban Catchment Forestry KPIs

Type of indicator	**KPI**	**Urban GreenUP KPI Number**
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Economic	Volume of water removed from water treatment system	38
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83

Environmental (chemical)	Trends in levels of NOx and SOx	84
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Social	Perceptions of health and quality of life*	1007

3.5.2 Location

The Urban Catchment Forestry intervention will be installed along the Strand, one of the main routes through Liverpool, on the southern boundary of the BID area. Tree species will be selected from the following species which are known to be successful and tolerant to local conditions.

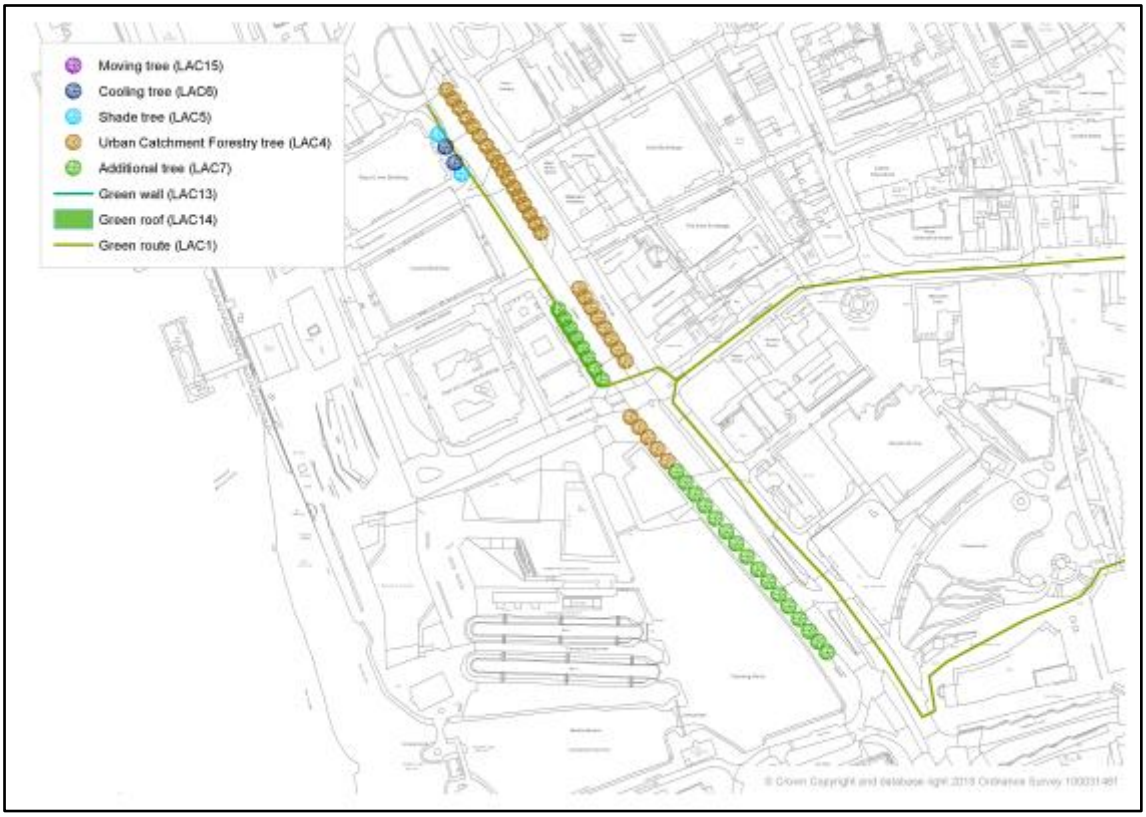


Figure 16 Strand tree planting

As can be seen from **Figure 17** the Strand has few trees at present and this intervention will help to increase canopy cover considerably. The design will help to reduce future flood risk.

The Urban Catchment Forestry intervention will develop the concepts of urban catchments, the man made catchments created by the sewer and drain infrastructure and the creation of urban catchment hydrographs.

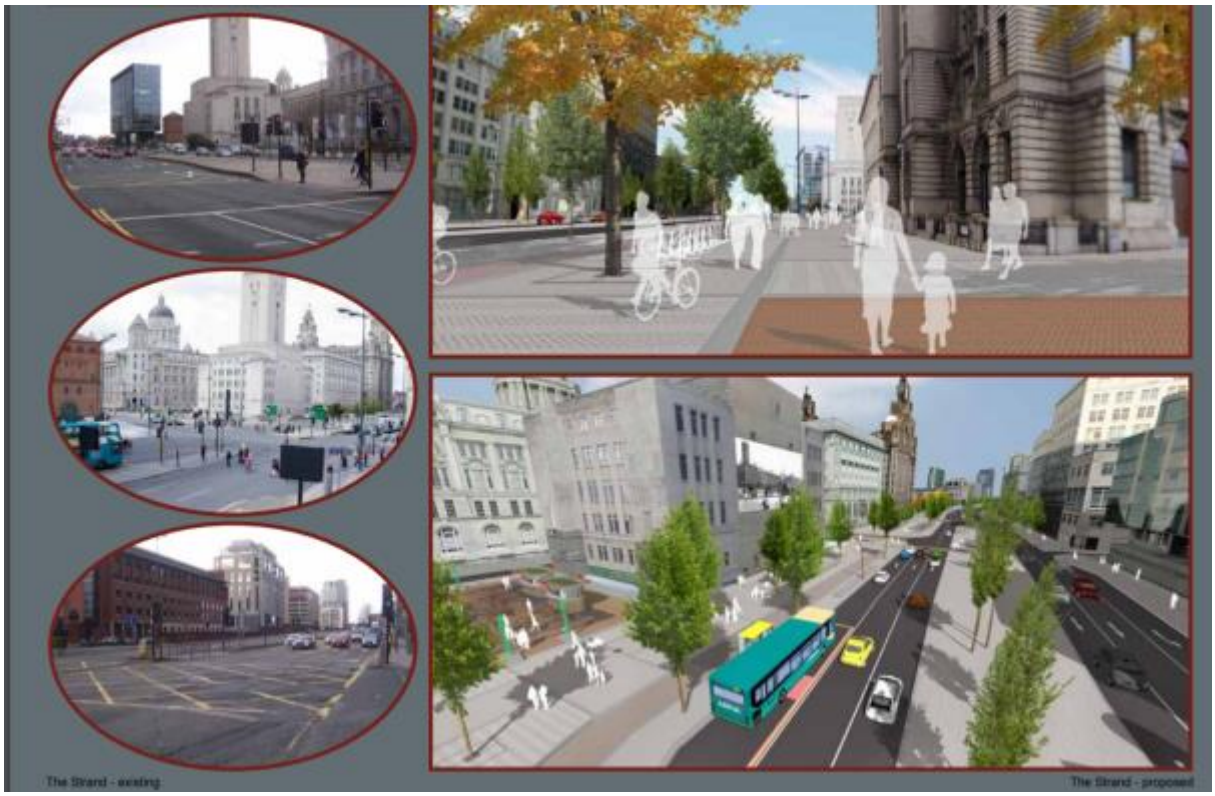


Figure 17 Design examples for the Strand trees

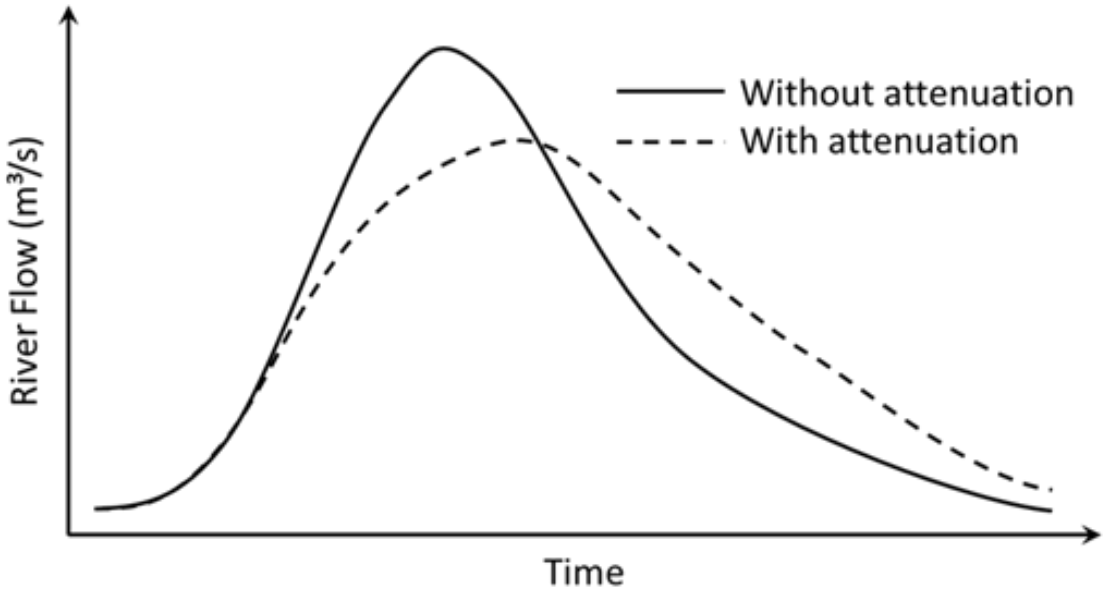


Figure 18 Example of urban catchment hydrograph

3.5.3 Technical Specifications

Construction details, characteristics of products/plant species, installation operating schemes, technical drawings and plans…

The objective in specifying for the Urban Catchment Forestry intervention is to;

1. Base the specification on what is known to work in Liverpool in terms of suitable tree species
2. Adapt and innovate in tree pit design so as to
    a. Maximise the opportunity to reduce flood risk, without adversely impacting on the tree health
    b. Maximise opportunities to improve water quality at the end of the SUDs chain of interventions, in this case the Urban Catchment Forestry trees.

The principles of Urban Catchment Forestry design are shown in Figure 19 Principles of Urban Catchment Forestry design

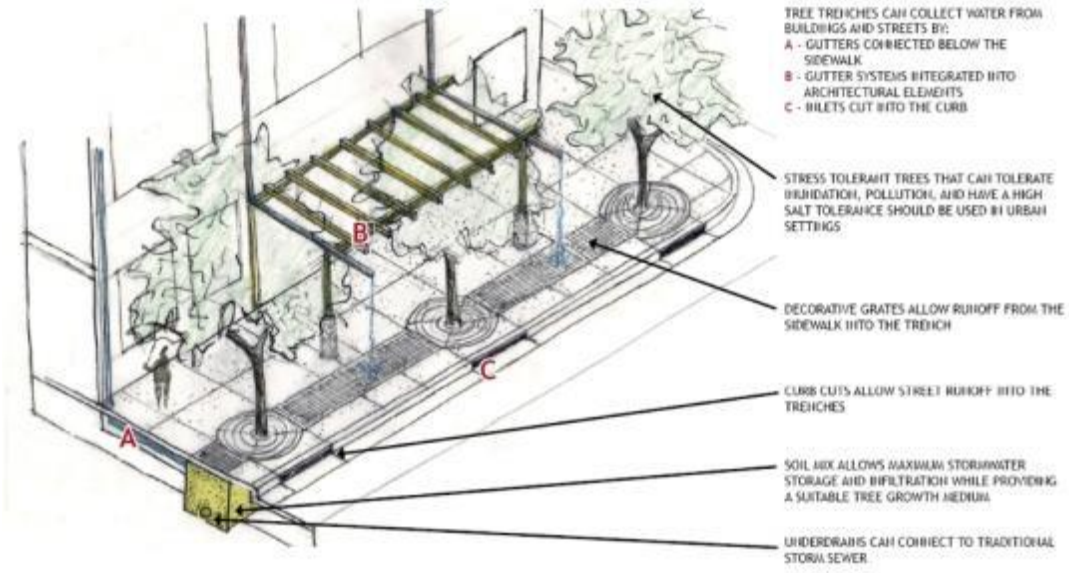


Figure 19 Principles of Urban Catchment Forestry design

Urban trees face a range of conditions that can impact on their ability to thrive. These include the restricted rooting environment, higher levels of air pollution, increased levels of soil compaction and reduced levels of soil fertility and natural nutrient cycling processes. In addition, the selection of appropriate trees for urban planting has to take into account the location where they will be planted and the need to reduce any nuisance, such as "honeydew"3.

The Specification is based on BS 8545 and related standards.

Based on experience of urban tree planting in Liverpool, the following trees are deemed most suitable for planting as part of Urban Catchment Forestry schemes are;

Ginkgo Biloba – 30m^3

Metasequoia glytostroboides – 30m^3

Pinus nigra 'Austriaca' – 22m^3

Tamarix gallica – 8m^3

The figure given beside each tree indicates the optimal volume of soil required for each species in an urban tree planting scheme. It is not always possible to reach these volumes for planting in urban areas as the existing urban infrastructure, buildings, roads, utilities, cables and other infrastructure has to be worked around.

In all cases the maximum volume possible for each location is specified.

[3] Honeydew is a sugar-rich sticky liquid, secreted by aphids and some scale insects as they feed on plant sap

- Tree Sizes

The trees will be 14cm-16cm girth. These trees are young enough to be forgiving and adapt to their new, harsher environment outside the nursery and they have the vigour to establish better than bigger trees and are reasonably snap proof.

Trees will be pre-selected at the nursery by Liverpool City Council.

- Biosecurity

The latest guidance on biosecurity and the sourcing of trees and plant material should be followed through the procurement process[4].

- Watering

Watering of the trees may be required during periods of dry weather and this will be incorporated into the procurement. The use of in soil water monitors that will indicate the need for watering is being investigated and will form part of the specification for all tree interventions.

- Replacement

Any trees that fail within a five year period will need to be replaced by the contractor as part of the intervention contract. The choice of species for replacement planting will be based on a discussion between Liverpool CC and the contractor and will aim to reduce the risk of future failures. The initial specification for planting and establishment is aimed at minimising risk of failure and reducing need for establishment and longer term maintenance interventions.

- Tree Pit design

Tree pit design is perhaps the most important element of this intervention.

Tree pits will make use of structural elements (such as Sylva Cells or similar) to ensure that the tree pit is capable of taking the load from the highways and pavements safely. Tree pits where space allows will be trench pits into which several trees are planted. The latter provides a greater soil volume for tree growth, allows for greater impact on the flow of water and more of the natural soil processes to take place.

The technical drawing for the type of tree pit to be used is shown in Figure 20 Sample of technical drawing for Urban GreenUP Urban Catchment Forestry tree pit design

The tree pit and trench design is similar to that for the cooling and shade trees. The design incorporates elements to increase water interception and storage and also, for this intervention, structures to enable water sampling and flow rate monitoring to take place.

- Soils

[4] https://www.trees.org.uk/Trees.org.uk/media/Trees-org.uk/Documents/AA-Biosecurity-Policy.pdf

Soil specification will be appropriate for the structural elements that are being used in the tree pit and will be provided by the contractor as part of the procurement process and conform to BS8601:2013. In addition, as part of LAc11, though not a specific intervention planned for Demonstration Area B, we will specify the need for a proportion of the trees to be planted in soils that have ameliorants, such as Biochar.

Small scale moisture monitors that can alert the contractor if soil moisture conditions change to the extent that watering is needed are to be included the costing of the intervention.

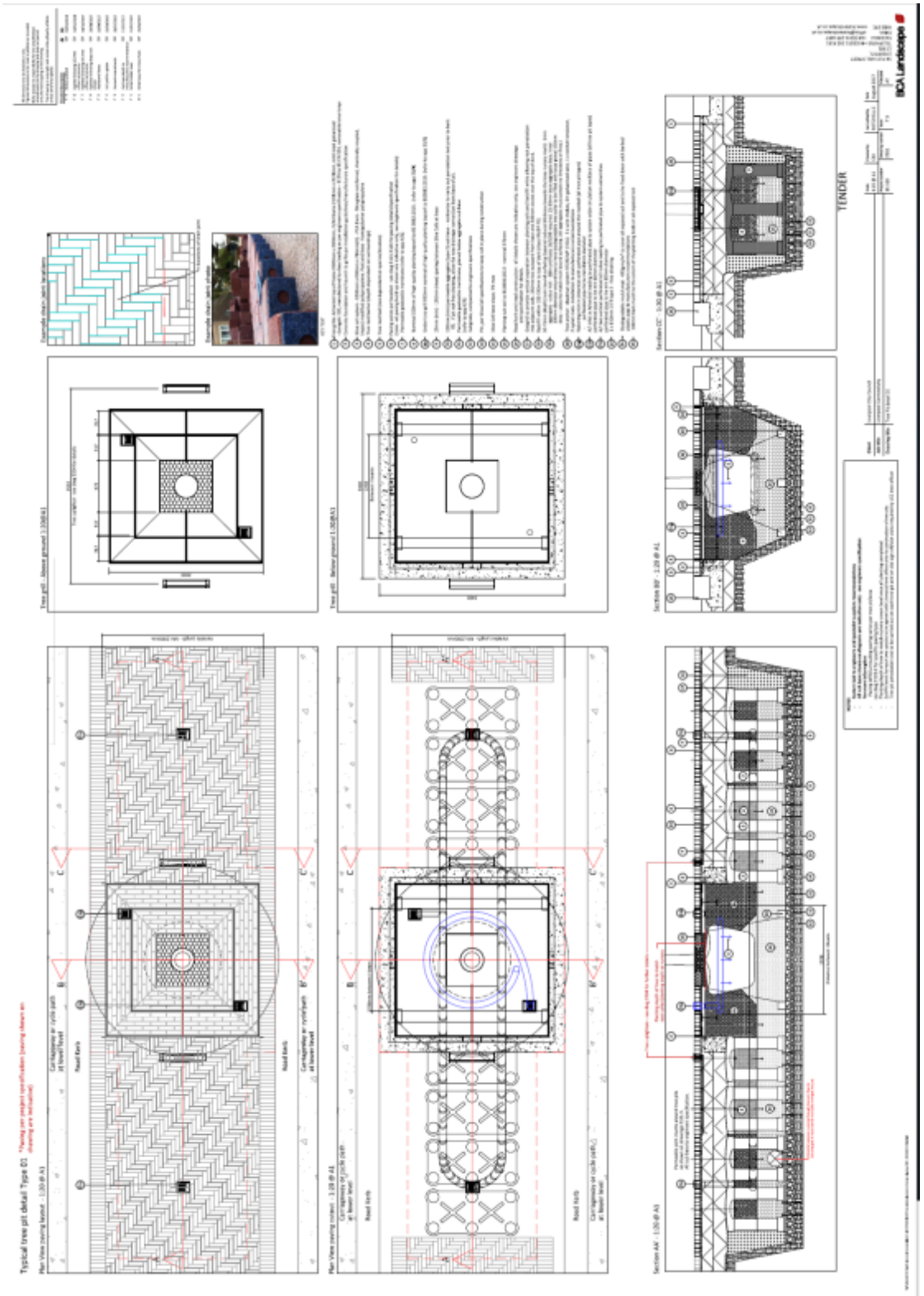


Figure 20 Sample of technical drawing for Urban GreenUP Urban Catchment Forestry tree pit design

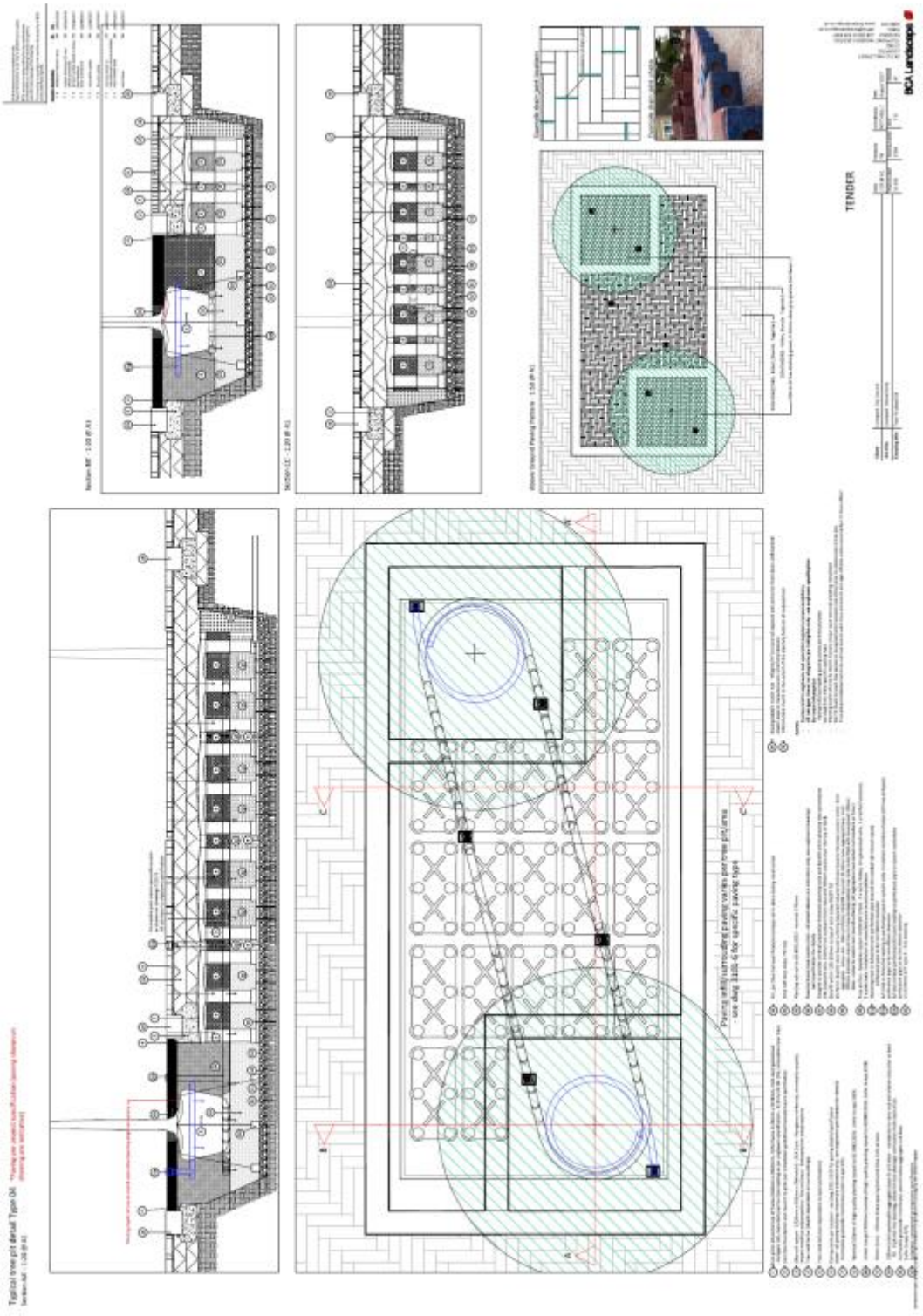


Figure 21 Sample of technical drawing for Urban GreenUP Urban Catchment Forestry tree pit design with several trees in trench planting system

3.5.4 Operational and Maintenance Considerations

Following establishment, the trees and pits will be managed by Liverpool CC. The trees are part of a wider programme of public realm and transport infrastructure improvements across the city

3.5.5 Economic Specifications

Table 13 Urban Catchment Forestry economic specification

Location	Item	Actual budget	Comment
Strand	30 trees planned as part of Urban Catchment Forestry programme on the strand	€328,916	Links to programme of road improvements on the Strand.
Identified in bid	30 trees	€328,916	

3.6 LAc13- Pollinator walls/vertical

3.6.1 General Description

The pollinator wall in the BID demo area will be installed along the façade of one the major shopping areas in the city centre. The pollinator wall will cover an area of 75m^2 and provide an impact in a major route through the city. The wall will also link to the work Williamson Square, helping to improve green infrastructure connectivity through the city.

Expected impacts

The addition of pollinator planting (together with the introduction of pollinator homes where possible) will establish new sustainable systems of food sources for pollinator insects. The introduction of these ecologically selected plantings will ensure that they can attract and sustain insect and pollinator populations and increase biodiversity.

These interventions together with LAc12 and 14 will contribute to a 15% increase in pollinator habitat connectivity, contribute to increase the pollinator activity by 45% and will provide 15,000 visits (human) over the two years of post-intervention monitoring.

Related KPIs

Table 14 Pollinator wall KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	**Tonnes of carbon stored in vegetation**	**1**
Environmental (physical)	**Heatwave risk**	**9**
Social indicators (benefits)	**Increased connectivity to existing GI**	**76**
Environmental (chemical)	**Annual mean levels of fine particulate matter**	**83**
Environmental (biological)	**Increase in density and seasonal spread of floral resources for pollinators**	**1004**
Environmental (chemical)	**Trends in levels of NOx and SOx**	**84**
Environmental (biological)	**Pollinator species increase**	**77**

Environmental (biological)	**Increased opportunity for species movement in response to climate change as a result of NBS**	**1001**
Environmental (biological)	**Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS**	**1006**

3.6.2 Location

The pollinator wall will be located on the Marks and Spencer's building in the BID. This is an anchor store for the city, providing high profile for this intervention.

The walls are currently bare and are in a connecting route between Williamson Sq. and the main shopping street in the city.

Figure 22 Pollinator walls

The wall has been offered for use by Marks and Spencer's who will take on the long term management of the wall. Another site, St John's, is also a possible site for the intervention if resources allow.

Map

Figure 23 Image of the existing wall

Figure 24 Example of impact on another M&S Store

3.6.3 Technical Specifications

The technology for green roofs is now well established. The Pollinator Wall/Green Wall installations in Liverpool as part of the Urban GreenUP programme have a primary purpose of providing increased habitat for pollinators.

The following provides information that will be provided to potential tendering organisations for the installation of green walls. However, we have not been prescriptive in this section recognising that green wall installation is normally carried out by system developers who will provide specific technical specifications for each green wall that is to be delivered.

This technical specification is also provided on the basis that the contractor will need to satisfy the building owner that the structure of the building has been assessed and the necessary calculations on building load, irrigation volumes and rates and any other relevant engineering and structural issues have been made and agreed with the building owner.

Our specification provides the basis for a manufacturer/installer to provide details on how our requirements will be met in a design, build and establish framework, with long term management agreed with and resourced by Marks and Spencer's and potentially St John's if that wall is also in the programme.

- Plant selection

The focus for the green wall intervention is to provide additional habitat for pollinator species. The plants need to be suitable to the system selected. The Royal Horticultural Society (RHS) suggests that selection should be kept simple, choosing plants with similar light and moisture requirements. In addition, the aesthetic of the green wall will be important as the wall is located on a high profile anchor store in the main Liverpool shopping area.

- Growing medium and nutrition

There are a range of types of wall that the contractor may consider.

In modular walls, planting is rooted in a growing medium which is irrigated. The planting medium is a mixture of compost and inert material which needs to be non-biodegradable to ensure its longevity. The medium supports the plant, permitting water, air and nutrient delivery, creating a buffer that reduces the constant management prevalent in hydroponic systems.

Irrigation is mandatory for living walls and moisture levels are to be digitally monitored. Use of rainwater and rainwater harvesting will increase the sustainability of the green wall.

With pocketed systems, large vertical panels are sub-divided into roughly 3 metre panels with separate drainage channels. The irrigation system supplies moisture and can also remove excess. As with the above, emitter spacing, water flow rate, application frequency and retention are linked to ensure moisture uniformity, to prevent desiccation.

Modular systems can use weep hose drip irrigation; emitter pipes with capillary mats are an alternative. Irrigation can be distributed on a multi-level basis at one metre intervals or split into module heights. Drainage at the base of each panel can be integral.

The design of system needs to ensure that plants and the growing medium are held firmly in their pockets or sleeves; to resist wind erosion and plant loss. With modular systems this can be achieved with a capillary mat, around which roots are wrapped, to ensure plants are secured and vandal proof.

- Weight

This information is based on manufacturer's estimate and should be verified.

As described above all structural calculations and requirements will have to be agreed with building owner to ensure long term building integrity, the safe installation and long term safeguarding of health and safety of those using the roadway beneath the structure(s).

- Ecological benefits

To promote biodiversity, broadening the variety of plants will attract a more diverse array of insects and birds.

An article by AECOM (The journal of the Landscape Institute – Summer 2013) suggests that there is a clash between keeping a striking green appearance throughout the year with the use of evergreen species and the ability to improve biodiversity; colonization and succession by native species and seasonality are desirable but this will result in brown patches and dead material.

Certain species, such as Ivy, will have a tendency to dominate slower growing competing species, therefore creating a mono-culture. Publication 'Designing for biodiversity' gives guidance on creating the right conditions for attracting wildlife onto buildings – an overview of the large array of planning and other legislation that affects wildlife is provided along with a programme of when, on a project, biodiversity needs to be considered.

The focus for the wall is to attract pollinator species, but given the location, aesthetics will also be important.

- Maintenance aspects

Green walls all require maintenance get the best out of the planted material. Maintenance is required to manage growth that is intruding into building services or fabric and to keep the planted material in good health and looking its best. With some plants regular pruning is advised and deadheading of flowers can encourage regrowth. Maintenance will include periodic checking of the layers of felt systems, replacement of dead plants and checking of the irrigation system.

Some manufacturers recommend two primary maintenance visits a year; these will include a calibration of the irrigation system.

- Fire load

The Department for Communities and Local Government (DCLG) carries guidance of fire performance of green roofs and walls in the UK on the gov.uk website. It is suggested that whilst growing medium, with the exception of organic material, is unlikely to contribute to flame spread, HDPE plastics used on modular living walls systems are capable of igniting.

The DCLG document 'Fire performance of green roofs and walls' states that there has been 'no significant fire testing of green wall systems'. It suggests for fire prevention that considerations are made for:

- Increasing the non-combustible content of the growing medium
- Decreasing the organic content of the growing medium
- Preventing the system from drying out

For fire prevention the document suggests that use of grasses and mosses is avoided and plants with high moisture/ low resin content be used. A recommendation for fire breaks, supporting standards and a summary of compliance requirements to the (English) Building Regulations is offered.

3.6.4 Operational and Maintenance Considerations

Following establishment of the green wall at Marks and Spencer's, the company has agreed to take on the long-term maintenance of the wall and this will be built into the contract that is made with the company.

Marks and Spencer's have green walls on other stores in the UK and have a track record and experience of management of these structures.

3.6.5 Economic Specifications

Table 15Pollinator wall economic specification

Location	Item	Actual budget	Comment
Marks and Spencer's	Suspended green wall 100m^2	€273,544	Priority site. These costs will cover design, delivery and establishment of the green wall as well as the structural surveys and engineering calculations that will be required to ensure the integrity of the building is safeguarded.
St John's Centre	Suspended green wall – this may be a backup or additional scheme	TBC	Site is being seen as a potential back up or for smaller scale intervention if budget allows.

Identified in bid	200m^2	€273,544	

3.7 LAc14- Pollinator roofs

3.7.1 General Description

Pollinator roofs with a total area of 50m^3 are to be located at Royal Court and Marks and Spencer's. These form stepping stone links between areas such as St Georges Gardens and some of the green infrastructure assets that already exist in the BID area.

Expected impacts

The addition of pollinator planting on the roofs at Royal Court and the Marks and Spencer's store (together with the introduction of pollinator homes where possible) will establish new sustainable systems of food sources for pollinator insects. The introduction of these ecologically selected plantings will ensure that they can attract and sustain insect and pollinator populations and increase biodiversity.

The green roof trial will enable the direct engagement of commercial businesses in testing the value of NBS. It is estimated that pollinator activity will increase and that there will be 15,000 human (!) visitors who will see the pollinator roof.

Related KPIs

Table 16 Pollinator roof KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Economic	Volume of water removed from water treatment system	38
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Trends in levels of NOx and SOx	84
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS	1001
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS	1006

3.7.2 Location

The pollinator roof will be located on Royal Court building in the BID. This provides a high profile for this intervention.

The theatre is on a connecting route between Williamson Sq. and the main shopping area in the city.

There are also opportunities to look at pollinator roof interventions by Marks and Spencer's and St John's if the budget permits.

Figure 25 Pollinator rooves

3.7.3 Technical Specifications

The Pollinator Roof will consist of two elements.

1. Plants in containers or structures. Plants to be selected to attract pollinator species.
2. Structures that may provide homes for pollinator species.

Figure 26 an example of a pollinator roof structure

Procurement will ask contractors to design, build, establish and maintain the green roof areas to meet our requirements in terms of impacts, ensure the building owner is comfortable with the design and maximise the value to pollinators, without causing too much disturbance neither to the building owner nor to those using the building.

Examples of suitable plants to choose from can be found in these publications by the Royal Horticultural Society.

Figure 27 Guidance on Plants for Pollinators

3.7.4 Operational and Maintenance Considerations

Following establishment the Pollinator roofs will be maintained by the building owner/occupier, with written agreement for the management in place. Procurement will include the costs of long term management to be paid by the building owner/occupier.

3.7.5 Economic Specifications

Table 17 Pollinator roof economic specification

Location	Item	Actual budget	Comment
Royal Court Theatre	Green roof designed to attract pollinator species and provide an attractive outside area for people attending the theatre. 50 m^2	€54, 648	Main site. These costs will cover design, delivery and establishment of the pollinator roof as well as the structural surveys and engineering calculations that will be required to ensure the integrity of the building is safeguarded.
Marks and Spencer's	This may be a back		Back up site, or

	up scheme		additional site to link to work on pollinator wall.
Identified in bid	50 m^2	€54, 648	

3.8 LAc15- Mobile gardens (Forest)

3.8.1 General Description

In the BID area, the mobile garden intervention will consist of;

- A mobile tree intervention in Williamson Square Sq.
- A mobile garden at Royal Court funded by Royal Court and linked to the other Urban GreenUP interventions in the BID.

The mobile trees will consist of containerised trees that will form part of the day to day landscape of the square but which, for specific activities and events can be moved to create more open space. The trees can also be moved from time to time to create new and interesting vistas to and from Williamson Square.

Figure 28 Pop up Forest created in Williamson Square as part of EU Green Week 2018

The Mobile garden will smaller scale container based intervention which will be installed to one side of the Royal Court Theatre. These will demarcate important access routes for the theatre as well as providing green links from nearby green spaces such as St Georges Gardens and the smaller scale greening that has taken place in the theatre courtyard.

Expected impacts

The mobile garden and forest will provide additional connectivity to existing green infrastructure as well as providing shade and cooling benefits to reduce the urban heat island effect and an increase in pollinator habitat.

The movement of the garden and trees will also provide a focal point for events and activities such as that which took place in 2018 EU Green Week, involving a "pop up" forest. This generated interest and discussion about the role of trees and other vegetation in the city, to improve image and provide a range of nature-based solutions.

The mobile forest will generate opportunities for citizen engagement and education about NBS and the role of nature in the city, contributing to bio-phylia concept. It is anticipated that the mobile forest will be seen by 250,000 visitors/year.

Related KPIs

Table 18 Mobile Forest KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Projected maximum surface temperature reduction	13
Social	Accessibility of urban green spaces for population	53
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (biological)	Pollinator species increase	77

Economic	Value of air quality improvements	88
Social	Perceptions of citizens on urban nature	115

3.8.2 Location

Williamson Square is a traditional square with flag paving. It was initially laid out as a residential square in 1745. The main focus in the square today is the Liverpool Playhouse theatre, which stands on the east side of the square. The Square is also a focus for shopping and is a through route from the attractions around St Georges Hall to the main shopping and business areas in the BID.

Figure 29 Williamson Sq. moving trees

The square has stalls as well as the main shops and from time to time stages events. There is some tree planting around the perimeter of the square. The new intervention will provide for more trees that can be moved from to allow for the other uses of the square and also provide a framework for future events and activities.

Figure 30 Williamson Square - schematic layout

3.8.3 Technical Specifications

The Moving Trees intervention will consist of two main elements and one exploratory element.

3. Air pruned tree stock.

In line with the existing planting in the square, Ginko and Liquidamber trees in air prune pots. An air pruning container works by having slots or holes in its walls along with a system of ribs or other devices to force the root to grow out of the slot / hole. When the root grows out of the slot into relatively dry air its tip is desiccated or killed. Once this first root is air pruned it loses its dominance and many secondary roots develop to replace it, these are then in turn air pruned and again they are replaced by even more roots. Air pruning therefore trains a root system with a very large quantity of young vigorous roots.

This is good as it creates a lot of secondary roots right up the side of the rootball which means that after transplanting there are a much larger number of roots establishing and also more quickly in comparison to a traditional pot grown plant. Additionally, new roots emerge up the sides of the rootball and not just around the base.

The net result is that the plant will establish more quickly with a higher % survival rate and more uniform growth plant to plant. It is also expected that plants will develop a mature root system earlier and also top growth has been reported to be 20% to 25% greater than for plants in a traditional pot. The reason for this is that if a better root system is developed with a large quantity of younger more vigorous roots which can feed / drink more and support more top

growth. Raising the pot off the base of the container allows dryer air to circulate around the outside of the cell to "kill" the emerging root tips.

Trees will be 16-20cm girth, supplied in line with UK Biosecurity standards and BS>>>>

Figure 31 contrasting root growth in traditional and air pruned pots

Figure 32 Nursey Grown air pruned trees

4. Mobile container

A secure, attractive and robust container for the air pruned pot with the tree. This will be a bespoke design to accommodate the 16-20cm trees and allow for ease of movement of the container.

In addition, the container will function to capture, store and release water from overland flow in the square to the tree through capillary action. In built water monitoring will alert when moisture levels are low and the container may need watering.

Incorporation of BIochar into the tree soil will also form part of this intervention (LAc11), helping to improve the soil health, the lock up of carbon, reduce need for fertilizer and improve the growth of the trees. The soil mix within the container/air pruned pot should also include appropriate mycorrhizae through inoculation or addition prior to placement in William Square. The purpose of these additions is to try to imitate as closely as possible (but mindful of the artificial nature of the intervention) a healthy forest soil.

Air pruned tree stock will eventually need to be planted into a long term site to allow the tree to fully establish. A new air pruned tree will replace the one that is removed to a permanent home. The Mersey Forest will identify the long term sites for these trees that are taken from the containers.

Figure 33 Example 1 of potential "base" container for trees which will be adapted for the Mobile Forest

Figure 34 Example 1 of potential "base" container for trees which will be adapted for the Mobile Forest

5. Moving the Forest

The use of robot to move the container will develop ideas that are common in warehouse and other industrial locations and adapt for use in a situation such as Williamson Square.

The robot can be programmed or directed to shift the trees and containers to set patterns at specified times.

Health and safety, risk and other considerations will form part of this element of the specification for the Mobile Forest.

This option will be explored as part of the Urban GreenUP programme.

3.8.4 Operational and Maintenance Considerations

Following establishment the trees will be maintained as part of the general maintenance of Williamson Square by Liverpool CC. The Mersey Forest team will arrange for the replanting and replacement of the air pruned trees when they become ready for planting out in a woodland or more permanent urban tree setting.

The movement of the tree containers from time to time, to allow for event and activities, or to reframe the square using the trees will be carried out and coordinated by Liverpool CC.

Following establishment the trees will be maintained as part of the general maintenance of Williamson Square by Liverpool CC. The Mersey Forest team will arrange for the replanting and replacement of the air pruned trees when they become ready for planting out in a woodland or more permanent urban tree setting.

The movement of the tree containers from time to time, to allow for event and activities, or to reframe the square using the trees will be carried out and coordinated by Liverpool CC.

3.8.5 Economic Specifications

Table 19 Mobile Forest economic specification

Location	Item	Actual budget	Comment
Williamson Square	Delivery of mobile forest to provide a flexible resource for William Sq. and helps to reduce flood risk. 2 units.	€52800	
Identified in bid	2 units	€52800	

3.1 Summary Demo Site B City Centre, Liverpool BID

ACTION	Intervention	Total Cost (Including Co-Financing)	EU Contribution	Municipality Contribution	Output
Re-naturing urbanization					
LAc2	LAc2- Green travel route	€5,594	5,594	0	1 route
LAc5	LAc5- Shade trees. Species to spread canopies	€18, 975	18, 975	0	2 trees
LAc6	LAc6- Cooling trees. Species to maximise cooling effect	€18, 975	18, 975	0	2 trees
Water Interventions					
LAc4	LAc4- Urban Catchment forestry	€328, 916	328, 916	49,417	30 trees
Singular Green Infrastructures					
LAc13	LAc13- Pollinator walls/vertical	€273, 544	273, 544	0	200m2
LAc14	LAc14- Pollinator roofs	€54, 648	54, 648	0	50m2
LAc15	LAc15- Mobile gardens	€52, 800	52, 800	0	2 mobile units

4 Definition of the Interventions in Sub-Demo C – Otterspool /Jericho Corridor

4.1 Overview

This suburban site is already perceived as a green area with extensive biodiversity but it has drainage issues and associated pedestrian connectivity issues and some local air quality concerns.

The proposed Jericho Lane/Otterspool corridor links three key city greenspaces: Princes Park, Sefton Park and Otterspool Promenade. In addition to linking the three sites to provide improved pedestrian connectivity between them, there are a number of localised drainage issues in Princes Park and an opportunity to create a blue (water) corridor within a green corridor by linking work on water quality and water drainage from Princes Park, through Sefton Park to Otterspool Promenade.

Opportunity exists along this corridor to additionally address lake overflow issues in Sefton Park and historic drainage problems close to Otterspool where the existing drainage infrastructure is reaching the end of its life. Proposals at Otterspool are focussed on designing and trialling a natural drainage solution with waters being opened up in a 'parkland' setting as a SUD project. There are also similar drainage issues nearby in Princes Park and there is an opportunity to create a blue corridor within a green corridor by linking work on water quality and water drainage from Princes Park, through Sefton Park to Otterspool Promenade; and in doing so to also seek to address issues of pedestrian connectivity between these sites. This would be contrasted with both a previously implemented SUD project which has proved very successful and with a similar one that has not been as successful to learn and share lessons. To ensure that the areas water systems are functional a process of de-culverting, where feasible, will be considered to reinstate the areas waterways and provide additional areas of open water.

Although the area has good biodiversity there will be the opportunity at the SUDS site to provide public access to the open water site and to enhance existing biodiversity through appropriate aquatic planting.

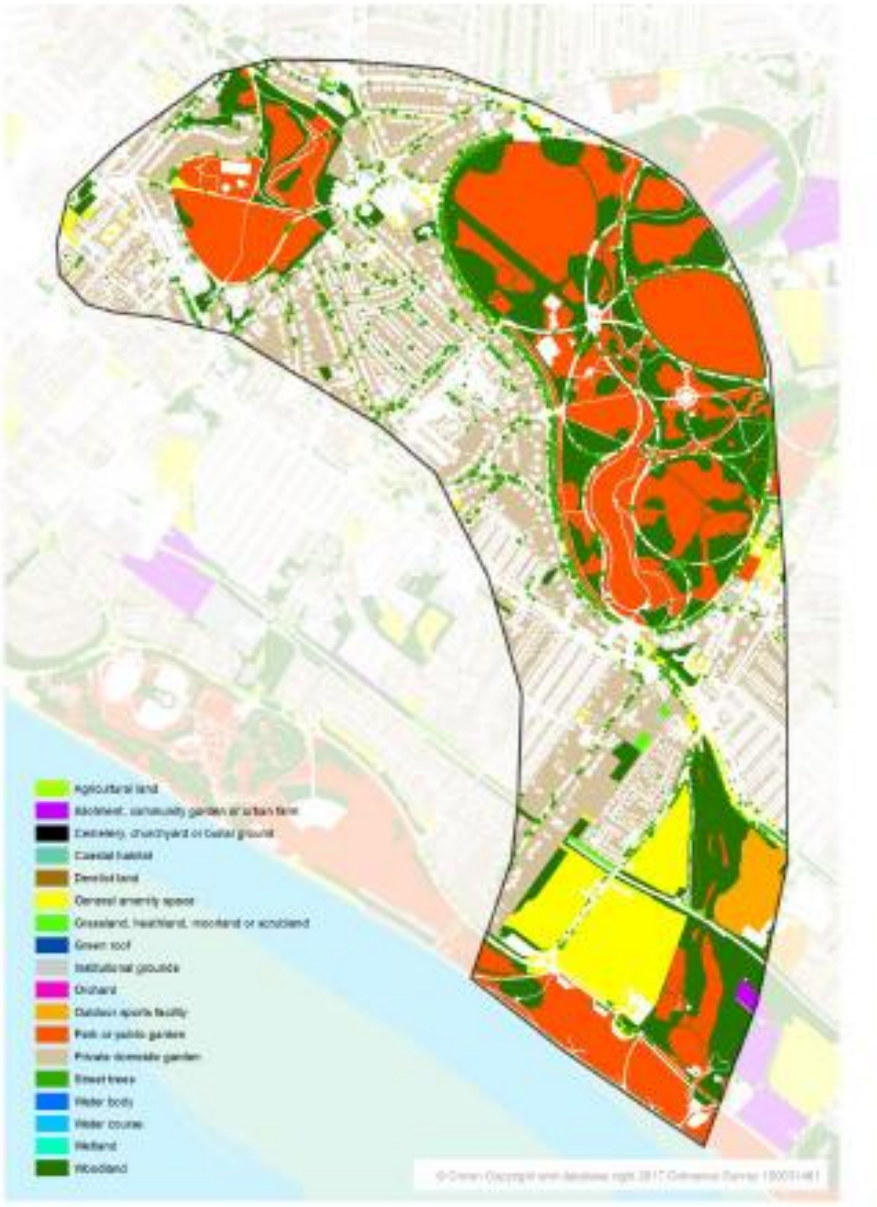


Figure 1 Otterspool/Jericho Green Infrastructure Typology

There are 8 technical and 12 non-technical interventions planned for the Otterspool/Jericho Lane demonstration area as part of Urban GreenUP.

Re-naturing urbanization	Water interventions	Singular Green Infrastructures	Non-technical interventions
LAc1 New pedestrian and cycle way green route	**LAc8 – SUDS**	**LAc11- Enhanced nutrient managing and releasing soil**	**LAc18- Wood allotments**
LAc3 Road junction pedestrian improvements	**LAnew- Floating reed beds**	**LAc12- Pollinator verges and spaces**	**LAc19- GI for Education**
LAC7 – Urban Carbon		**LAc13 Pollinator walls**	**LAc20- Forest School**

sink		**/vertical**	
			LAc20 Forest School
			LAc21- Engagement Portal for citizens
			LAc 21 – Engagement Portal for citizens
			LAc 23 Forest Church
			LAc24 – Bioapp
			LAc25- GI for physical Health
			LAc26 – GI for Mental Health
			LAc27- Promotion of Ecological Reasoning/Intelligence
			LAc28 – Single window/desk for RUP deployment
			LAc 29- Support to citizen project of NBS
			LAc30 – City mentoring strategy

Table 35 List of interventions in Sub-Demo C

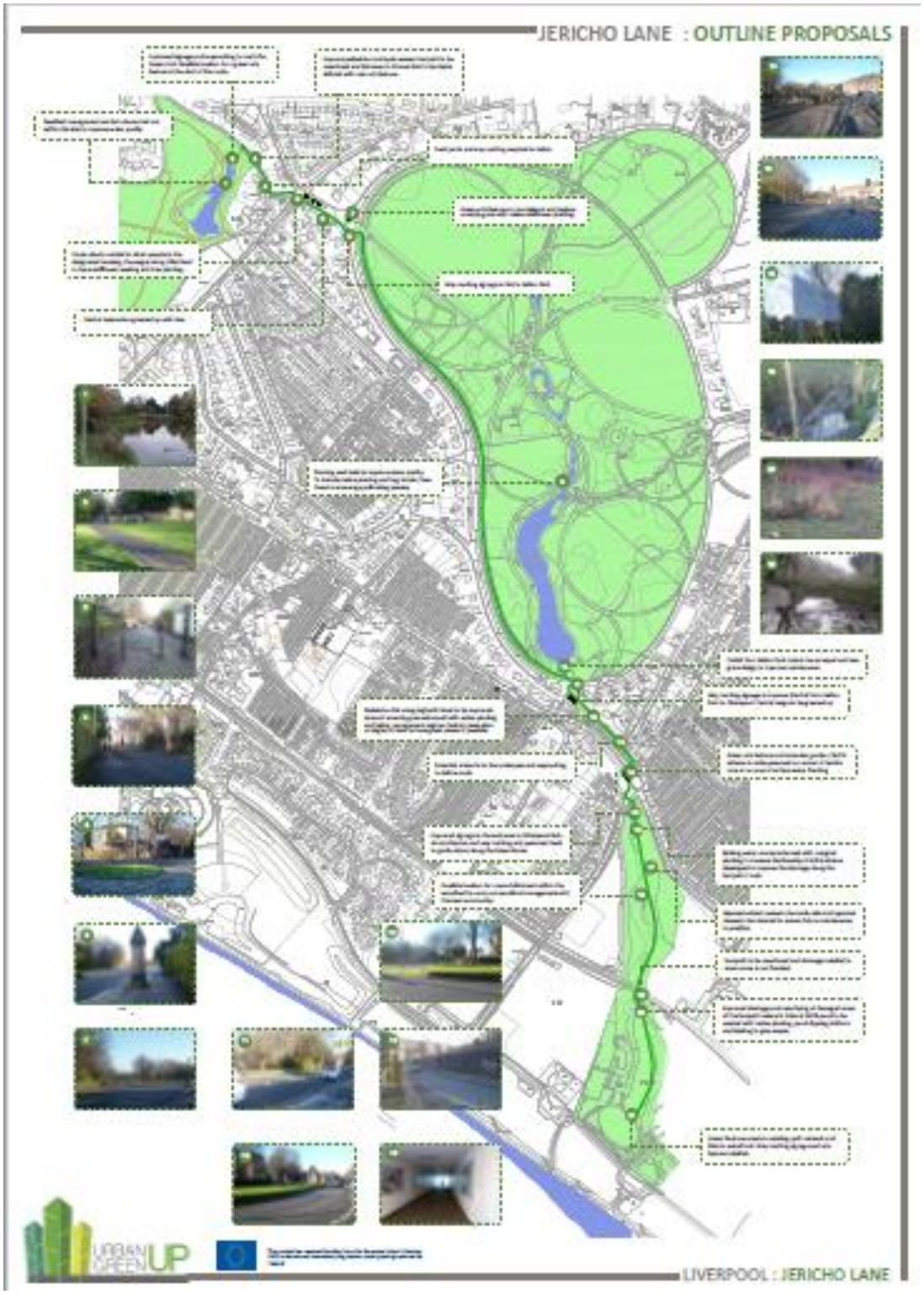


Figure 36 Location Map of the Sub-Demo C Interventions

Sub-Demo C RENATURING URBANIZATION

4.2 New Pedestrian and cycleway green route (LAc1) and road junction improvements (LAc3)

4.2.1 General Description

The planned pedestrian and cycle route at this site differs from that in Demo site A as it links a number of existing parks. In total the length or route being actively linked is estimated to be c4.8 km and comprise of access roads, B roads, A roads and parks. At either end of the intervention area there are further pedestrian and cycle linkages.

Expected impacts

Improving the linkages between these intervention sites will help to improve local connectivity for pedestrian and cyclists. Extending the linkage beyond Princes Park to Princes Avenue and Princes Road will also help to provide a direct green route and better connection from the Otterspool waterfront to the edge of Toxteth and the city centre. The provision of clearer designated crossing access and the promotion of the green cycle and pedestrian corridor is expected to result in an increase in local footfall and the planting of green interventions along the connecting roads should help with local air quality improvements. NBS improvements to the parks will also provide a more biodiverse and interesting green route.

The expected impact from LAc1 across demonstration area A and C, is for more (20% increase) people to cycle and/or walk the green route, reducing local vehicle movements. 4.8tCO_2 equiv. will be saved through increased active travel. Along with LAc2 & 3, this intervention will engage 160,000 people and create 400m^2 of new green space.

Related KPIs

The pedestrian and cycle route will contribute to a number of KPIs:

Table 2 New pedestrian and cycleway green route KPI

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Accessibility of urban green spaces for population	53
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84

Social	Assessment of typology, functionality and benefits provided	109
Social	Increase in walking and cycling in and around areas of interventions*	139
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.2.2 Location

The pedestrian and cycle route links the Otterspool waterfront to the edge of the city centre, via 3 parks which act as green stepping stones along the proposed route. The 3 parks are linked by a number of access and main roads. From the south at Otterspool Park the route passes through an underpass to run alongside the A561 Aigburth Road into Sefton Park. On leaving the top of Sefton Park the route follows the A5173 into Princes Park. On exiting Princes Park the route runs along the central reservation of the B5175, Princess Road and Princes Avenue. From here there are links for key routes into the city centre and city waterfront.

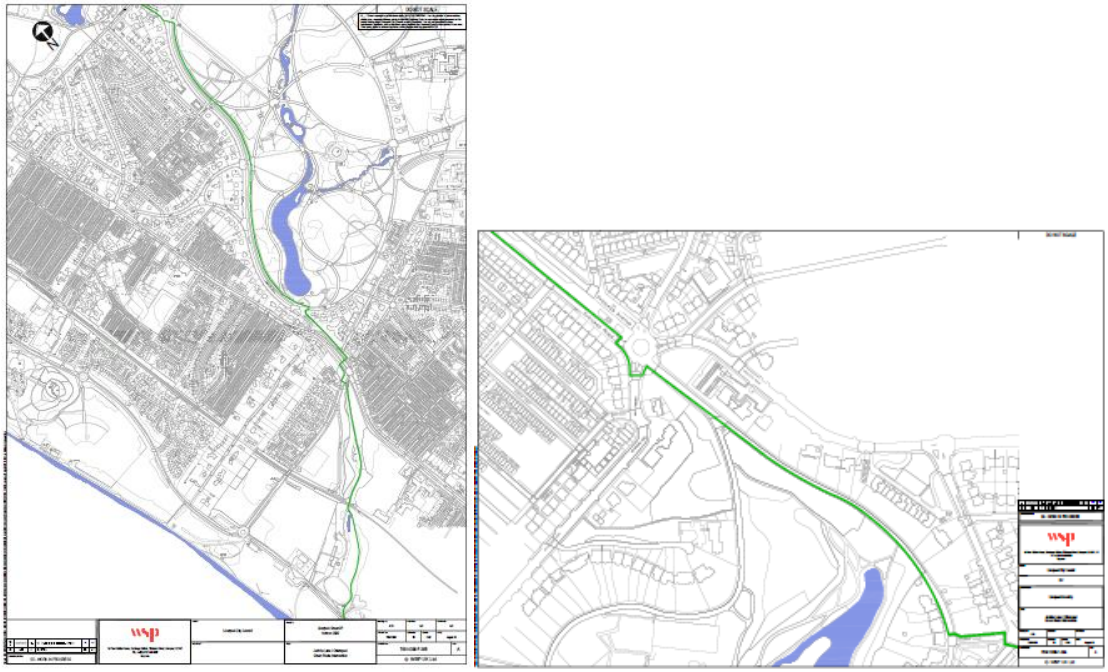


Figure 3 Proposed pedestrian and cycle way green route

From Otterspool Promenade to Princes Park

From Princes Park along Princes Avenue

2.2.3 Technical Specifications

The key technical specifications for the pedestrian and cycle way will involve clear way marking. The details of the way marking are still under discussion and will be determined through the tender process, which will hopefully permit a creative approach to the delivery of this element of the work. A number of road junction improvement works are planned that include improvements to the road and pavement along the green route. In addition a number of dropped kerbs are planned in the Princes Park – Sefton Park linkway to improve general accessibility and a single dropped kerb and some highways improvements are planned in the Jericho Lane to Sefton Park section. Technical specifications and illustrations for this work are shown below.

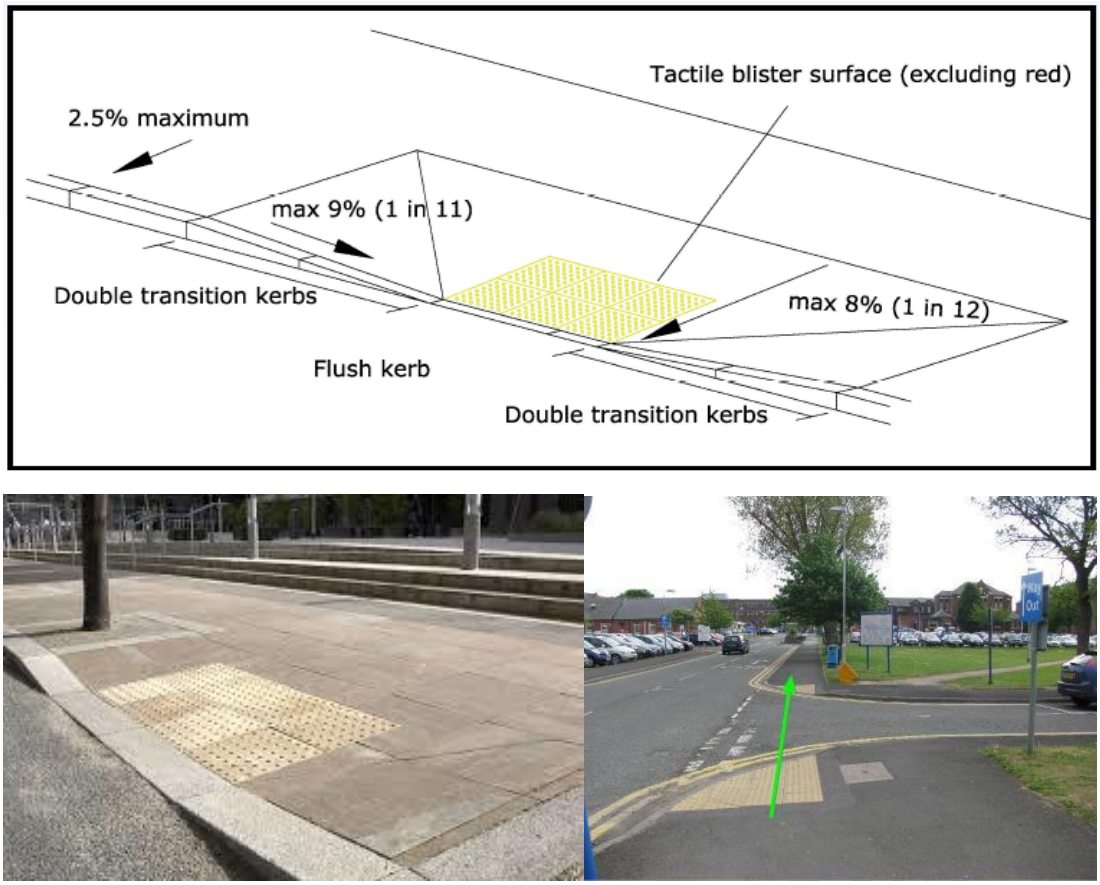


Figure 4 Example technical specifications and images of an accessible dropped kerb.

2.2.4 Operational and Maintenance Considerations

The pedestrian and cycle way will be maintained through the city council highways department for the publically adopted roads/pavements.

2.2.5 Economic Specifications

Available €45,540

Table 3 New pedestrian and cycle way green route economic specifications

Location	Item	Actual cost	Notes/Comments
Proposed length of route	Waymarking at identified locations tbd	Waymarking and accessibility works	
Establish/connect cycle and pedestrian route – drop kerbs and other	4.8 km 7 dropped kerbs; 2 with aco drainage and H marking (Sefton); one in a	Waymarking and accessibility works	Additional surface improvements on route to be pursued through Highways maintenance

	conservation area (Princes)		programme
Identified in bid	**200m pedestrian and cycleway**	**Available budget €45,540**	

2.3 Urban carbon sink (LAc7)

2.3.1 General Description

An Urban Carbon Sink is created through planting trees and vegetation. To define and green the proposed corridor a number of trees will be planted to maximize carbon sequestration and reduce the effects of climate change. Aquatic vegetation planting in the SUDS schemes and orchard planting at Otterspool will also contribute to this intervention.

Expected impacts

Tree and vegetation planting is known to capture carbon. Other benefits of tree and vegetation planting include:

- increasing shadow surface area to help to reduce the effects of heat island and to help improve local air quality through removing Nitrogen Dioxide (NO_x), Sulphur Dioxide (SO_x), and particulate matter
- reducing urban heat island effects
- regulating storm water infiltration
- providing food and habitats for many species,
- providing recreation and nature education for the city dwellers.

A mixture of various types of trees will line the green route and where possible these will be located in soft landscaped areas.

Collectively all the tree planting is expected to contribute equivalent to 5.55t/CO2 sequestration per year.

Floating reed beds (LAcnew) in Sefton Park lake will also contribute to carbon capture but will also help to take up nutrients from the lake and its inflow to reduce the potential for algal blooms and fish kills. The reed beds will provide both habitat and contribute to biodiversity.

Aquatic planting (within LAc8) in both the small pond and the larger SUD in Otterspool will contribute to carbon capture in addition to improving water quality and contributing to new habitats and biodiversity.

In addition, the wider “One tree per child” programme discussed in the Demonstration area Baseline document (WP3, D3.2), will lead to the planting of 4,000 new trees, creating 8ha of new green surface and 2.8ha of shadow, lock up 44t of carbon dioxide, reduce ambient temperature by 2^{o}c and attract 2000 visitors per year.

Related KPIs

Table 4 Urban Carbon sink KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number	Associated NBS
Environmental (physical)	Tonnes of carbon stored in vegetation	1	Tree related actions; vertical and horizontal green infrastructure; SUDs and raingardens; Urban Carbon sink
Environmental (physical)	Heatwave risk	9	Vegetated NBS (horizontal and vertical) for evaporative cooling; Trees NBS for evaporative cooling and the effects of shading
Environmental (physical)	Projected maximum surface temperature reduction	13	
Economic indicators (benefits)	Economic value of carbon sequestration by vegetation	6	Tree related actions; vertical and horizontal green infrastructure; SUDs and raingardens; Urban Carbon sink
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16	Tree related actions; SUDs and raingardens; Urban Carbon sink; horizontal GI
Economic	Volume of water removed from water treatment system	38	SUDs and raingardens; tree related GI; horizontal GI, smart soils
Social	Accessibility of urban green spaces for population	53	Vertical & Horizontal Infrastructure; Tree related actions; Amenity green space, cycle and footpaths, and plazas/public spaces with urban greening.
Economic	Volume of water slowed down entering sewer system	39	
Economic	Economic benefit of reduction of stormwater to be treated in public sewer system	1002	

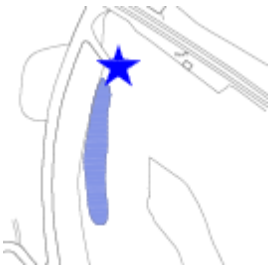
Social indicators (benefits)	Increased connectivity to existing GI	76	All accessible GI NBS in each of the three Liverpool sub-demo areas.
Environmental (biological)	Increase in plant species richness and functional diversity as a result of NBS*	1005	
Social	Assessment of typology, functionality and benefits provided	109	All NBS interventions
Social	Diversity of NBS (land use and functionality)	95	All technical and non-technical interventions
Social	Perceptions of citizens on urban nature	115	
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001	All GI NBS in each of the three Liverpool sub-demo areas.
Social	Engagement with NBS (sites/projects)*	117	
Social	Perceptions of health and quality of life*	1007	Green cycle lane; Vertical green interventions; Horizontal green interventions; SUDs

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.3.2 Location

A range of various planting is to be delivered under this initiative in a number of locations as detailed below.

Table 5 Urban Carbon Sink Locations

Location/s	Number	Proposed Location	Notes/Comment
Otterspool Park	9		Orchard and Fruit trees/foraging area
Roadside verge of Ullet Road and Aigburth Drive	6 +2		Infill gaps
Aigburth Drive	5		Northern entrance/exit to Sefton park
Aigburth Road	3		Southern entrance/exit to Sefton park
Sefton Park	1		LAcnew -Floating Reed Bed at inflow of Jordan River/Green Bank tributary
Otterspool	Various		LAc8-Aquatic vegetation in SUD Small pond at park entrance
Otterspool	Various		LAc8- Aquatic vegetation in SUD Main SUD

Trees will be planted along the length of the green route corridor. 9 fruit trees will provide a publically accessible orchard for the local community, and others will fill gaps in an existing tree lined sections and help create new entrances/exits to the parks.

Floating reed beds (LAcnew) will be located in Sefton Park Lake at a suitable location close to the incoming tributaries of the River Jordan and Green Bank Lake inflow.

Aquatic vegetation planting (LAc8) will be located around the periphery of both the small open water pond in Otterspool and also around the edges of the large SUD.

2.3.3 Technical Specifications

The selected trees will be chosen for a range of attributes including:

- Carbon capture
- Anti allergy species
- Edible fruit bearing for the orchard area

The trees will be 14cm-16cm girth. These trees are young enough to be forgiving and adapt to their new, harsher environment outside the nursery and they have the vigour to establish better than bigger trees and are reasonably snap proof.

Trees will be pre-selected at the nursery by Liverpool City Council.

- Biosecurity

The latest guidance on biosecurity and the sourcing of trees and plant material should be followed through the procurement process[5].

- Watering

Watering of the trees may be required during periods of dry weather and this will be incorporated into the procurement. The use of in soil water monitors that will indicate the need for watering is being investigated and will form part of the specification for all tree interventions.

- Replacement

Any trees that fail within a five year period will need to be replaced by the contractor as part of the intervention contract. The choice of species for replacement planting will be based on a discussion between Liverpool CC and the contractor and will aim to reduce the risk of future failures. The initial specification for planting and establishment is aimed at minimising risk of failure and reducing need for establishment and longer term maintenance interventions.

[5] https://www.trees.org.uk/Trees.org.uk/media/Trees-org.uk/Documents/AA-Biosecurity-Policy.pdf

Floating reed bed and SUD specification are detailed under their respective document headings.

2.3.4 Operational and Maintenance Considerations

Many of the proposed interventions will be located within existing city council highways or public parkland and will be maintained by the city council. Newly planted trees will require irrigation and pruning. The floating red bed may require regular checks and removal of vegetation if it begins to encroach the open water area. Aquatic planting will need seasonal maintenance to ensure there is a diverse assemblage and both submerged and emergent encroaching species will need to be cut back and removed to retain flow and open water conditions.

For trees planted as part of the One Tree per Child programme the schools will be asked to sign up to long term management of the trees after establishment and will sign a "site agreement" for the planting.

2.3.5 Economic Specifications

Available budget €19,734

Table 6 Urban Carbon Sink economic specifications

Location	Number of interventions	Actual Costs	Notes/Comment
Otterspool Park	9 trees	Planting and establishment costs	Fruit trees/foraging area
Roadside verge of Ullet Road and Aigburth Drive	6 +2 trees		Infill gaps
Aigburth Drive	5 trees		Northern entrance/exit to Sefton park
Aigburth Road	3 trees		Southern entrance/exit to Sefton park
Sefton Park	1	Not included here	Floating reed bed Island
Otterspool	Various plantings	Not included here	Within SUDs scheme
Otterspool	Various plantings	Not included here	Within SUDs scheme

Identified in bid	**I unit**	**Available budget €19,734**	

SUB DEMO C WATER INTERVENTIONS

2.4 SUDS (LAc8)

2.4.1 General Description

SuDS are drainage systems that are considered to be environmentally beneficial, causing minimal or no long-term detrimental damage. They are designed to efficiently and sustainably drain surface water, while minimising pollution and managing the impact on water quality of local water bodies.

The Jericho-Otterspool corridor contains a blue (water) corridor within the planned green corridor route which provides an opportunity to implement some NBS based around water issues. There are 2 planned SUD initiatives for this demo site. The first is to open up the waterway at the northern entrance to Otterspool Park and to create an open water area that can retain an increased volume of water which will help with surface water flood alleviation. The size of this site is estimated to be c.300m^2 including peripheral planting. The second is to create a SUD in Otterpool Park at a location south of the railway where surface water regularly floods in wet weather. This SUD is estimated to be c 400m^2. Some additional upstream works will be required for improved flow and maintenance.

Expected impacts

The first open water storage area at the northern part of the park will provide some additional water storage capacity during periods of wet weather and slow the downstream flow. The opening up of this area will allow for peripheral planting with aquatics and pollinator species to create a more diverse habitat. The aquatic vegetation will also contribute to carbon capture for the urban carbon sink NBS. To ensure that this area works effectively some additional works will be carried out at the outflow of the Sefton Park Lake. This outflow regularly blocks with twigs, leaves and detritus in the water and an improved filter screen will be fitted at this point. The improved filter screen will ensure free flow of excess water under the road into the small pond that is to be formed at the northern point of Otterpool.

The second larger SUD will provide a naturally engineered water storage area in an open part of the park. This site is regularly flooded and impassable at times but the engineered redesign will ensure that excess water is safely held in a designated space, away from access paths and infrastructure networks. Submerged and emergent vegetation planting will provide habitat biodiversity, pollinator species and contribute to carbon capture for the carbon sink NBS. To ensure that the culvert feeding this SUD can be properly maintained and managed some remedial works will be required to make the access chamber safe.

Related KPIs

Table 7 SUDS KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38
Social indicators (benefits)	Increased connectivity to existing GI	76
Social	Assessment of typology, functionality and benefits provided	109
Social	Diversity of NBS (land use and functionality)	95
Social	Perceptions of citizens on urban nature*	115
Social	Engagement with NBS (sites/projects)*	117
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.4.2 Location

Both of the proposed SUD locations are in existing soft ground.

The first intervention lies at the top entrance to Otterspool path and whilst visible is not easily accessible. The second intervention lies at the other end of Otterspool Park in an open space with some scrub planting.

Table 8 SUD locations

Location/s	Number	Proposed Location	Notes/Comment
Entrance to Otterpool	300m^2		Small SuD - Open water pond with peripheral planting
Otterspool Prom	500m^3		Larger SuD with peripheral planting

2.4.3 Technical Specifications

The upstream works required for this scheme consist of installing a new screen to Sefton Park Lake and a safe access and maintenance chamber to the culvert running between the two proposed SUD systems.

The small open water pond at the top of the park will require excavation to shape the wetland area and increase the capacity for water retention and storage. The existing site will also require the removal of self-seeded trees, scrub and other vegetation. Pre-planted coir rolls can be introduced to provide appropriate habitat for emergent vegetation at the edges of the water body created and some additional plug planting will complement this in the woodland. A native wet meadow seed mix can be used. The open pond will additionally require a new stone headwall to the culvert.

Figure 5 Example of open water vegetated pond to be created to detain local flood water.

The larger SUD will require excavation to shape the new area and a liner for the wetland. A French drain will need to be installed to the footpath and the culvert will need link into the wetland. Pre planted coir matting can be used with plug planting for emergent aquatic vegetation and a native wetland meadow seed mix can also be applied. A new path and a boardwalk or access platform will complete the scheme.

Figure 6 Natural open water SUD with peripheral vegetation

2.4.4 Operational and Maintenance Considerations

Operational and maintenance considerations for these SUDs schemes will involve the following regular maintenance:

- Removal of litter and/or debris
- Cleaning of the inlet and outlet
- Management of the vegetation
- Sediment monitoring and removal when required.

4.3.5 Economic Specifications

Available budget €341,550

Table 9 SUDs economical specifications

Location	Interventions	Actual cost	Notes/Comment
Sefton Park Lake outflow	New filter screen	Installation and associated works	Required to prevent blockage and flooding
Top of Otterspool Park	Open water pond with peripheral planting 300m^2	Planting and establishment	Retain and hold flood waters
Culvert between SUD	Installation of	Installation and	Safe inspection for blockages

interventions	maintenance chamber for safe access	associated works	
Towards Otterspool promenade	Larger open water SUD 400m^2 with peripheral planting	Planting and establishment	Retain flooding in naturally engineered location
Identified in bid	**1500m^3**	**Available budget €341,550**	

4.5 Floating Reed Beds (LAcadd3)

2.5.1 General Description

Floating reed beds consist of a buoyant tubular framework of welded UV protected polyethylene, supporting a coir mattress, sandwiched between two layers of plastic mesh into which the reeds are planted. The primary purpose of artificial floating reedbeds is to improve water quality through biofiltration, preventing algal blooms through denitrification and plant nutrient uptake, with a secondary benefit of habitat provision. Artificial floating reedbeds are commonly anchored to the shoreline or bottom of a water body, to ensure the system does not float away in a storm event or create a hazard.

Expected impacts

The reed root systems grow down through the water column reducing effluent flow and increasing solids knock down, capture and settlement whilst providing effluent polishing for BOD and nutrient removal. The roots of the wetland plants encourage settlement of solids and provide a polishing treatment for BOD and nutrients, but they can also be used for the treatment of metals.

Floating reed beds provide enhanced effluent polishing for the following contaminants:

- Suspended Solids
- BOD
- Nutrients
- Metals

Related KPIs

Table 10 Floating Reed Beds KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number	Associated NBS
Environmental (chemical)	Nutrient abatement and abatement of pollutants	30	SUDs and raingardens; Green filter area; smart soils, natural waste water treatment
Social indicators (benefits)	Increased connectivity to existing GI	76	All accessible GI NBS in each of the three Liverpool sub-demo areas.
Environmental (biological)	Increase in plant species richness and functional diversity as a result of NBS*	1005	
Environmental (biological)	Pollinator species increase	77	Pollinator verges; pollinator walls vertical; SUDs (Rain garden); Pollinator roofs; SUDs (open water)

Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006	All biophysical NBS (pre-intervention/post-intervention) including floating gardens (up to 10 m from surveyor).

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

4.5.2 Location

The floating reed bed will be introduced to Sefton Park Lake at the point at which both the Jordan and Greenbank tributaries enter the lake system. The area is open water with emergent edging vegetation and will comfortably accommodate an 8-12m^2 floating island.

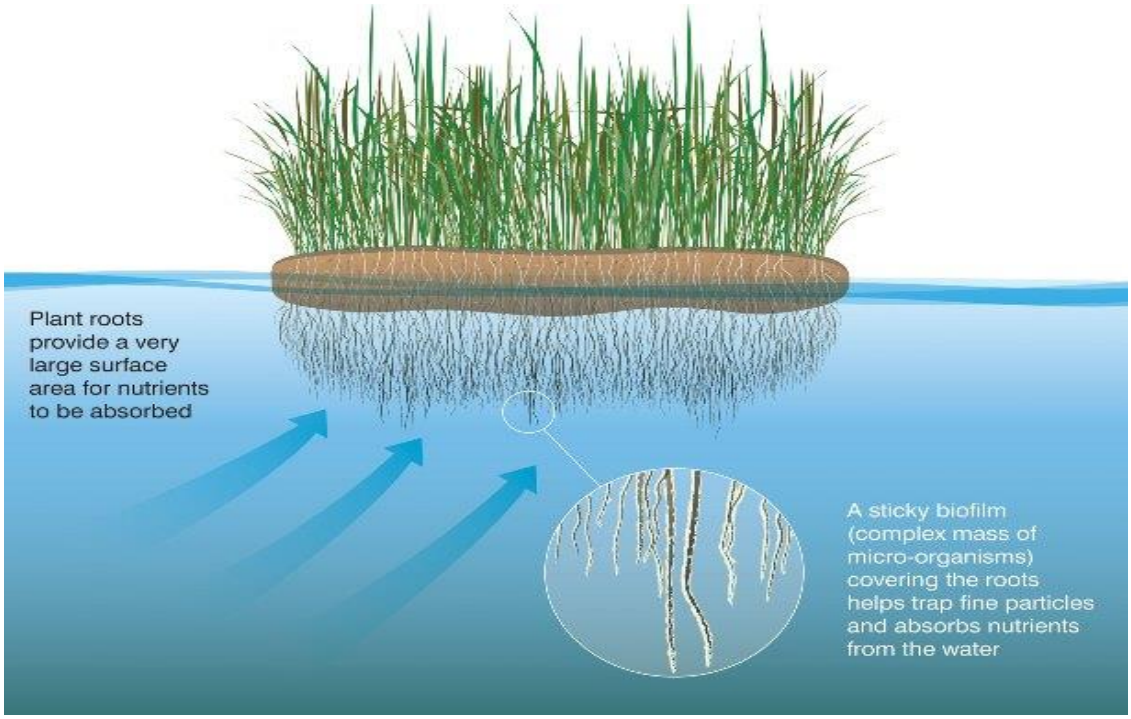
Table 11 Floating Reed Bed location

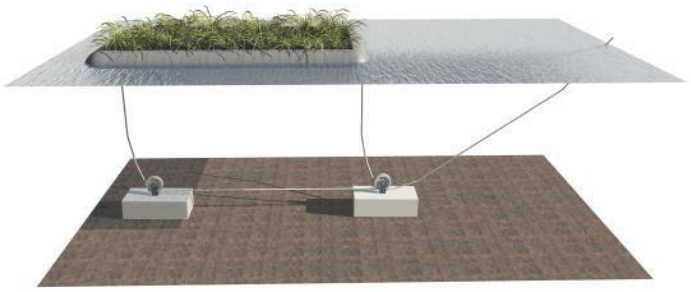
Location/s	Number	Proposed Location	Notes/Comment
Sefton Park Lake	8-12m^2		

4.5.3 Technical Specifications

Floating reed beds consist of a buoyant tubular framework of welded UV protected polyethylene, supporting a coir mattress, sandwiched between two layers of plastic mesh into which the reeds are planted. Constructed in 4m² units, the floating reed beds are modular in design and can be created in a variety of permutations to meet any area size or shape requirement. They can be installed on sludge lagoons, storm water lagoons, ponds, lakes, reservoirs and canals. They are inexpensive, easily installed, require little maintenance and provide a multifunction low energy “Soft Engineering” solution to effluent treatment. The raft system is anchored to prevent displacement of the reed raft by water flow or wind. A coir mattress provides an ideal growing medium for the wetland plants to establish.

Figure 7: Illustrations of floating reed bed construction and tethering





4.5.4 Operational and Maintenance Considerations

Floating gardens should be relatively self-sustainable, but may require weeding and restoration after storm events. Where reed bed growth is rapid due to high eutrophication of the waters, excess reed material may need to be periodically removed.

4.5.5 Economic Specifications

Available €0

Table 12 Floating Reed bed economic specification

Location	Item	Actual cost	Notes/Comments
Sefton Park Lake	8-12m^2 floating reed island	Installation and associated works	
Identified in bid	**_**	**Available budget €0**	**Costs to be accommodated within SuDs work**

SUB DEMO C SINGULAR GI

4.6 Enhanced Nutrient Managing and Releasing Soil (LAc11)

4.6.1 General Description

These types of soils are mainly biochar, which is defined as a solid material obtained from thermochemical conversion in an oxygen limited environment. This highly porous charcoal material, is usually produced by pyrolysis of biomass. Ongoing research suggests biochar added to soils may provide long-term stable storage of carbon in addition to improving soil fertility; its porous structure enabling increased absorption of pollutants from urban surface-water run-off and the slow release of plant nutrients. Biochar can improve soil functioning; providing soil nutrients for increased vegetation growth in NBS (increased net primary productivity), which in turn will provide enhanced carbon sequestration in vegetation and soils.

Expected impacts

The use of biochar is expected to improve soil physicochemical and biological properties and increase soil water holding capacity and high cation exchange capacity (CEC). As a result plant growth is expected to increase, along with the sequestration of carbon.

It is anticipated that the biochar will capture 385kg of NO_2 per year from the atmosphere and avoid the need for fertilizer application on the trees/plants.

Related KPIs

Table 13 Enhanced Nutrient Managing and Releasing Soil KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (chemical)	Nutrient abatement and abatement of pollutants	30

4.6.2 Location

The intervention will be delivered across the other technical interventions, with a selection of the tree and plants having biochar incorporated into the soil. The trees/plants without this intervention will act as a control for the intervention.

4.6.3 Technical Specifications

Biochar will be incorporated into soils used to plant some of the trees and other plants at a rate of 5-10%, and incorporated into the soil.

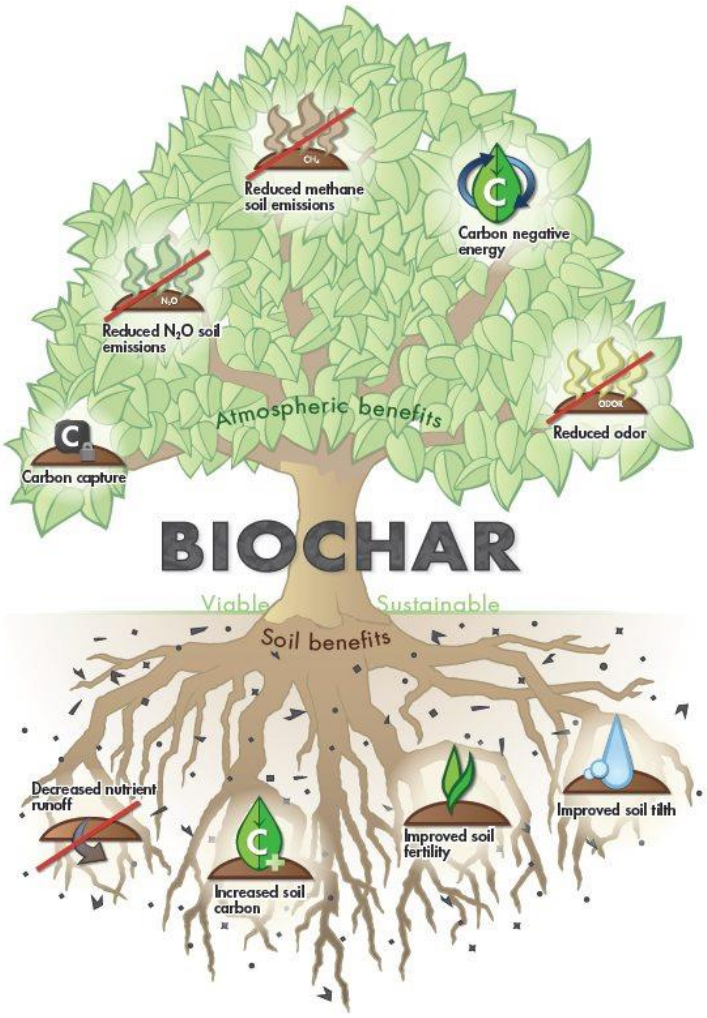


Figure 8 Benefits of Biochar

4.6.4 Operational and Maintenance Considerations

There is no ongoing need for maintenance. Additional Biochar may be added in later years, but this will be beyond the timescale of the Urban GreenUP project.

4.6.5 Economic Specifications

Available budget €0

Table 14 Nutrient Managing and Releasing Soil economic specifications

Location	Item	Actual budget	Notes/Comments
Various tbd	Biochar addition	Low cost item	
Identified in bid	**Nutrient Managing and Releasing soil**	**Available budget €0**	

4.7 Pollinator verges and spaces (LAc12)

4.7.1 General Description

Pollinator verges will play an important role in the biodiversity element to the URBAN GreenUP project. These new or existing linear features (verges) or patches (spaces) of green space, sown with a wildflower-rich grassland seed mix, will provide nectar and pollen to attract foraging insect pollinator species. In addition they can be usefully used to help define the green corridor and link neighbouring Nature Based Solutions as well as link areas of flower-rich green space, both new and existing, to create sustainable networks of pollinator habitat within the urban area. The choice of pollinator verges can also reduce the need and costs associated with traditional maintenance.

Expected impacts

Pollinator species are known to provide a sustainable food source for pollinating insects, as well offering other benefits such as water absorption and being aesthetically pleasing and contributing to good mental wellbeing. In this location the planting will also play an important role is linking together the 3 existing parks. It is envisaged that a colour theme or various types of planting can act as colour way markers to guide pedestrians and cyclists along the green route.

In conjunction with LA13 & 14, this intervention will provide

- 7200m^2 of green space, 840m^2 of which will be pollinator species
- 45% increase in pollinator activity
- 15,000 opportunities to see or visit the intervention.

Related KPIs

Table 15 Pollinator verges KPI

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38

Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (biological)	Pollinator species increase	77
Social	Assessment of typology, functionality and benefits provided	109
Social	Diversity of NBS (land use and functionality) (KPI 95)	95
Social	Perceptions of citizens on urban nature	115
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

2.7.2 Location

There are a number of locations identified for pollinator planting and these run the length of the corridor. The following opportunities have been identified for planting:

- the roundabout at the entrance to Princes Park on Princes Avenue,
- the highway verge along Ullet Road,
- the roundabout at the top of Sefton Park,
- on amenity grass along Aigburth Road at the exit from Sefton Park

Table 16 Pollinator verge locations

Location/s	Size	Proposed Location	Notes/Comment
Princes Park on Princes Avenue	280m2		
Ullet Road and also at the top of Sefton Park	590m2 + 223m2		
Aigburth Road	1996 m2		

Amenity grass sites identified for sowing will need to be treated and the existing grass will need to be removed. The soil will need to be prepared and suitable seeds sown. The seed mix used should contain a mixture of indigenous pollinator species that will be visually aesthetic.

For sowing on the slip way, the existing weed growth and vegetation will need to be cleared from the slipway and the embankment will need to be hydroseeded with pollinator species that are both low growing and attractive.

Where possible, insect pollinator homes will be incorporated into the schemes.

Figure 9 Example Insect Pollinator Homes

2.7.4 Operational and Maintenance Considerations

Maintenance of these areas will be carried out by the city council. The sites may require occasional watering in hot weather. A clear 1m wide strip should be mowed around the edge of the pollinator areas during their flowering and this should be maintained as they die back in autumn, until such time as the seed has set and the site can be fully mown for the winter. The clear strip indicates that the site, although wild in appearance, is still cared for and being maintained. This is especially important during the Autumn, when die back before the seed has set can cause the areas to look unsightly and uncared for. Explanatory signage can help to alleviate concerns over maintenance.

4.7.5 Economic Specifications

Available €4,554

Table 17 Pollinator verge economic specification

Location	Item	Actual costs	Notes/Comments
Roundabout at the entrance to Princes Park on Princes Avenue,	280m^2	Spray off amenity grass, prepare soil, sow seeds, establish and associated works	Create planting theme to link route
Highway verge along Ullet Road,	590m^2		
Roundabout at the top of Sefton Park,	223m^2		
Amenity grass along Aigburth Road at the exit from Sefton Park	1996 m^2		

Identified in bid	200m^2	Available budget €4,554	

4.8 Pollinator walls (LA13)

4.8.1 General Description

Vegetated 'green' or 'living' walls, supporting flowering plants, can provide nectar and pollen to attract foraging insect pollinator species.

It is anticipated that there is scope for a green wall close to the Otterspool underpass which will help to make this safe crossing point more attractive to users. A 30m^2 pollinator wall could be implemented here.

Vegetated 'green' or 'living' walls, supporting flowering plants, can provide nectar and pollen to attract foraging insect pollinator species.

Expected impacts

The pollinator wall will provide greenery for local air quality improvements at a busy traffic junction. Located around the entrance to an underpass with a main road above it signposts a safe and accessible crossing point to effectively link the park sites. Species selection and pollinator housing can also contribute to local biodiversity.

Vegetation on the wall will store carbon and protect the building from direct sun; thereby contributing to lower ambient temperatures. The green façade will also provide connectivity between other Nature Based Solutions and act as a natural air filter; contributing to improvements in local air quality. In addition there are a number of socio and economic benefits that will be investigated to determine any changes in the perception of well-being for those nearby, any increase in footfall, dwell time, and wider issues such as property value increases and crime reduction.

The addition of pollinator planting (together with the introduction of pollinator homes where possible) will establish new sustainable systems of food sources for pollinator insects. The introduction of these ecologically selected plantings will ensure that they can attract and sustain insect and pollinator populations and increase biodiversity.

In conjunction with LA12 & 14, this intervention will provide

- 7200m^2 of green space, 840m^2 of which will be pollinator species
- 45% increase in pollinator activity
- 15,000 opportunities to see or visit the intervention.

Related KPIs

Table 18 Pollinator wall KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Tonnes of carbon stored in vegetation	1

Environmental (physical)	Heatwave risk	9
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (biological)	Increase in density and seasonal spread of floral resources for pollinators*	1004
Environmental (chemical)	Trends in levels of NOx and SOx	84
Environmental (biological)	Pollinator species increase	77
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention

4.8.2 Location

The green wall is to be located close to the underpass entrance at Otterspool. This is currently a large concrete wall which is unsightly and urban.

Table 19 Green/Pollinator wall location

Location/s	Size	Proposed Location	Notes/Comment
Aigburth road underpass	30m^2		

4.8.3 Technical Specifications

Plant species selection will be important to support local pollinator species and the wall will contain some small insect hotels that provide habitat for pollinator insects.

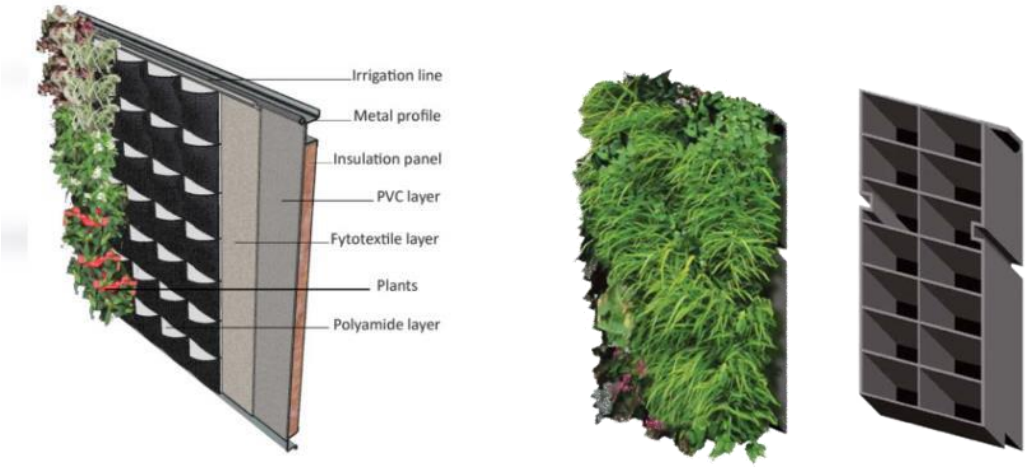


Figure 10: Examples of green modular walls.

An irrigation system is required to deliver water and nutrients to the pants. If possible a grey water irrigation system will be considered. Final designs of the modular walls and irrigation system will form part of a design and build tender specification.

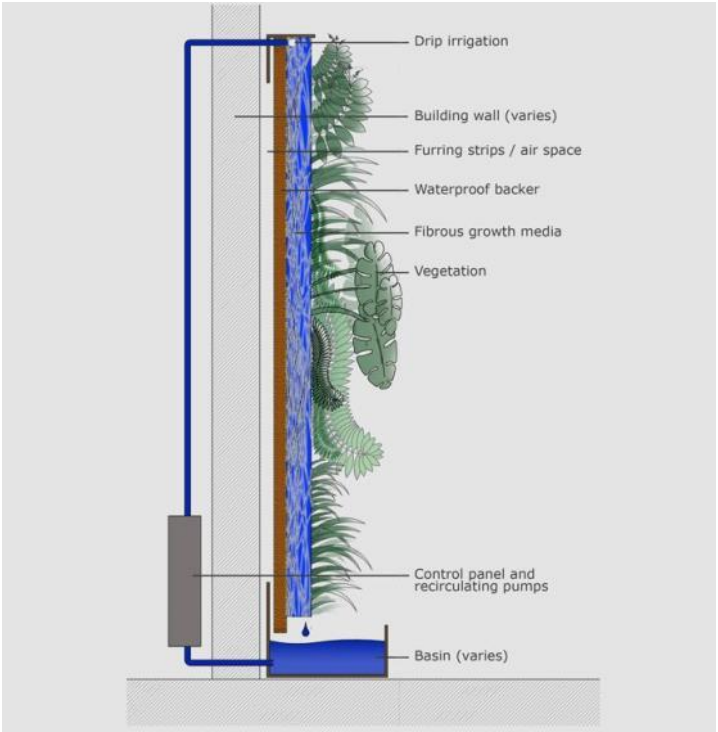


Figure 11: Green wall irrigation system

The technology for green roofs is now well established. The Green Wall installations in Liverpool as part of the Urban GreenUP programme have a primary purpose of providing increased habitat for pollinators.

The following provides information that will be provided to potential tendering organisations for the installation of green walls. However, we have not been prescriptive in this section recognising that green wall installation is normally carried out by system developers who will provide specific technical specifications for each green wall that is to be delivered.[6]

This technical specification is also provided on the basis that the contractor will need to satisfy the building owner that the structure of the building has been assessed and the necessary calculations on building load, irrigation volumes and rates and any other relevant engineering and structural issues have been made and agreed with the building owner.

Our specification provides the basis for a manufacturer/installer to provide details on how our requirements will be met in a design, build and establish framework.

- Plant selection

The focus for the green wall intervention is to provide additional habitat for pollinator species. The plants need to be suitable to the system selected. The Royal Horticultural Society (RHS) suggests that selection should be kept simple, choosing plants with similar light and moisture requirements. In addition, the aesthetic of the green wall will be important as the wall is located on a high profile anchor store in the main Liverpool shopping area.

- Growing medium and nutrition

There are a range of types of wall that the contractor may consider.

In modular walls, planting is rooted in a growing medium which is irrigated. The planting medium is a mixture of compost and inert material which needs to be non-biodegradable to ensure its longevity. The medium supports the plant, permitting water, air and nutrient delivery, creating a buffer that reduces the constant management prevalent in hydroponic systems.

Irrigation is mandatory for living walls and moisture levels are to be digitally monitored. Use of rainwater and rainwater harvesting will increase the sustainability of the green wall.

With pocketed systems, large vertical panels are sub-divided into roughly 3 metre panels with separate drainage channels. The irrigation system supplies moisture and can also remove excess. As with the above, emitter spacing, water flow rate, application frequency and retention are linked to ensure moisture uniformity, to prevent desiccation.

Modular systems can use weep hose drip irrigation; emitter pipes with capillary mats are an alternative. Irrigation can be distributed on a multi-level basis at one metre intervals or split into module heights. Drainage at the base of each panel can be integral.

The design of system needs to ensure that plants and the growing medium are held firmly in their pockets or sleeves; to resist wind erosion and plant loss. With modular systems this can be achieved with a capillary mat, around which roots are wrapped, to ensure plants are secured and vandal proof.

- Weight

This information is based on manufacturer's estimated and should be verified.

As described above all structural calculations and requirements will have to be agreed with building owner to ensure long term building integrity, the safe installation and long term safeguarding of health and safety of those using the roadway beneath the structure(s).

- Ecological benefits

To promote biodiversity, broadening the variety of plants will attract a more diverse array of insects and birds.

An article by AECOM (The journal of the Landscape Institute – Summer 2013) suggests that there is a clash between keeping a striking green appearance throughout the year with the use of evergreen species and the ability to improve biodiversity; colonization and succession by native species and seasonality are desirable but this will result in brown patches and dead material.

Certain species, such as Ivy, will have a tendency to dominate slower growing competing species, therefore creating a mono-culture. Publication 'Designing for biodiversity' gives guidance on creating the right conditions for attracting wildlife onto buildings – an overview of the large array of planning and other legislation that affects wildlife is provided along with a programme of when, on a project, biodiversity needs to be considered.

The focus for the wall is to attract pollinator species, but given the location, aesthetics will also be important.

- Maintenance aspects

Green walls all require maintenance get the best out of the planted material. Maintenance is required to manage growth that is intruding into building services or fabric and to keep the planted material in good health and looking its best. With some plants regular pruning is advised and deadheading of flowers can encourage regrowth. Maintenance will include periodic checking of the layers of felt systems, replacement of dead plants and checking of the irrigation system.

Some manufacturers recommend two primary maintenance visits a year; these will include a calibration of the irrigation system.

- Fire load

The Department for Communities and Local Government (DCLG) carries guidance of fire performance of green roofs and walls in the UK on the gov.uk website. It is suggested that

whilst growing medium, with the exception of organic material, is unlikely to contribute to flame spread, HDPE plastics used on modular living walls systems are capable of igniting.

The DCLG document 'Fire performance of green roofs and walls' states that there has been 'no significant fire testing of green wall systems'. It suggests for fire prevention that considerations are made for:

- Increasing the non-combustible content of the growing medium
- Decreasing the organic content of the growing medium
- Preventing the system from drying out

For fire prevention the document suggests that use of grasses and mosses is avoided and plants with high moisture/ low resin content be used. A recommendation for fire breaks, supporting standards and a summary of compliance requirements to the (English) Building Regulations is offered.

4.8.4 Operational and Maintenance Considerations

The green wall at Otterspool is anticipated to take the form of a cable green wall. This type of green wall is similar to a trellis, and a latticework of cables is created on the wall to provide support for plants. The cables guide a plant's runners to cover a wall. Green walls using cable systems are cheaper, easier to irrigate, but generally take longer to create the green wall than a panel system. A modular trellis panel system uses a lightweight 3D steel frame in order to anchor plants slightly away from the actual facade of the building or avoiding some problems possible with root growth. This system can be used both as a cover to an existing facade, be used to span a distance or be a freestanding structure. This type of system can also be installed in sections and shaped, allowing it to fit to almost any facade. The final technical specifications will be confirmed through a design and deliver tender specification.

Figure 12: Examples of the trellis green wall for the Otterspool underpass entrance

Maintenance of green wall cable structures is considered to be easier and cheaper than for modular green walls. Irrigation is often simpler and many walls, once established, only require occasional trimming. A regular inspection of the cables is also recommended.

4.8.5 Economic Specifications

Available €36,432

Table 20 Green wall/pollinator economic specification

Location	Item	Actual budget	Notes/Comments
Aigburth road underpass	Green cable wall 30m^2	Installation and establishment	
Identified in bid	**40m^2 green wall**	**Available budget €36,432**	**To include green screens as well**

4.9 Green screens - LAcadd2

4.9.1 General Description

Green fences provide vertical green surface/s that can reduce the negative effect of vehicle pollution on adjacent roads. These self- supporting structures can be located anywhere in the city, as long as they can be irrigated. They can also be used to define areas and provide both physical and mental wellbeing benefits.

Expected impacts

The green screens are expected to deliver a number of impacts. A key benefit is thought to be the ability of green screens to act as natural air filters with the vegetation metabolizing harmful toxins while releasing oxygen and filtering out some particulate matter.

Related KPIs

Table 21 Green screen KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Heatwave risk	9
Economic	Volume of water removed from water treatment system	38
Economic	Economic benefit of reduction of stormwater to be treated in public sewer system	1002
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (chemical)	Trends in levels of NOx and SOx	84
Economic	Value of air quality improvements	88
Social	Assessment of typology, functionality and benefits provided	109
Social	Perceptions of citizens on urban nature*	115
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS*	1001

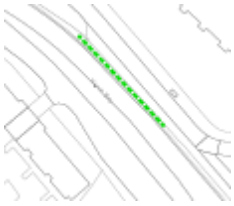
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS*	1006
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention

4.9.2 Location

An opportunity exists to use a green screen along Aigburth Road to help define the green route to /from the underpass and to block out the vehicles and emissions from the main road.

Table 22 Green screen location

Location/s	Size	Proposed Location	Notes/Comment
Aigburth road underpass	50m2		

4.9.3 Technical Specifications

The green screens will be free standing and constructed from a weather proof self-supporting structure. The following criteria should be considered:

- A metallic, self-supporting structure with an irrigation system that soaks the substrate
- Vegetation plants with little nutrient and water needs. These should also be species resistant to local climate that are suitable for growing in an irrigated soil or inert substrate such as rock wool.
- A water collection/irrigation system during establishment and hot weather.


Figure 13: Example green screens

4.9.4 Operational and Maintenance Considerations

The green screens will need to be robustly fixed in place to avoid falling or being toppled. They will require irrigation and pruning as they grow. The planting containers and support framework should be of a durable material.

4.9.5 Economic Specifications

Available €36,432

Table 23 Green screen economic specification

Location	Item	Actual budget	Comment
Aigburth Road	Green screen 50m^2	Installation, planting and establishment	
Identified in bid	**40m^2 green wall**	**Available green walls and green screens €36,432**	

4.10 Summary Demo Site C Otterspool/Jericho

Table 24 Summary of Otterspool/Jericho Interventions

ACTION	Intervention	Total Cost (Including Co-Financing)	EU Contribution	Municipality Contribution	output
RENATURING URBANISATION					
LAc1 LAc3	LAc1- pedestrian and cycle way green route LAc3 Road junction improvements		45540	Tbd	4.8km 7 dropped kerbs One crossing point Highways improvements
LAc9 LAc5 LAc6	Urban Carbon Sink Shade trees Cooling trees		19734	Tbd	34 trees (20 into ground, 14 in containers) Planting in SUDs
WATER INTERVENTIONS					
LAc8	SuDS x2		341550		300m^2 1500M^3 SUD
LAcnew	LAc new Floating reed beds		0	Included within any underspend	8-12m^2
LAc11	Enhanced Nutrient managing and releasing Soil		0	Tbd	At various locations Tbd
SINGULAR GREEN INFRASTRUCTURE					
LAc12	LAC12 – Pollinator verges		4554		3091m^2
LAc13	LAc13- Pollinator walls/vertical		36432		30m^2 wall
LAcnew	Green Screens		Budget in pollinator walls		50m^2 screen
NON TECHNICAL INTERVENTIONS					
LAc18	Wood Allotments		11385		1 no.
			459195		

5 Non-Technical Interventions

5.1 Green Filter Area (LAc 17)

The Green Filter areas are located on the periphery of the specific Urban GreenUP technical interventions described in this document.

The Green Filter will consist mainly of urban tree planting and where possible targeted hedge planting to reduce particulate levels in the city and so help to improve air quality.

A number of areas where this Green Filter area may be delivered have been identified.(Fabric District, Lime St, wider area of the Strand)In addition there will be ongoing discussions with landowner, such as the Universities about possible delivery of Green Filter areas.

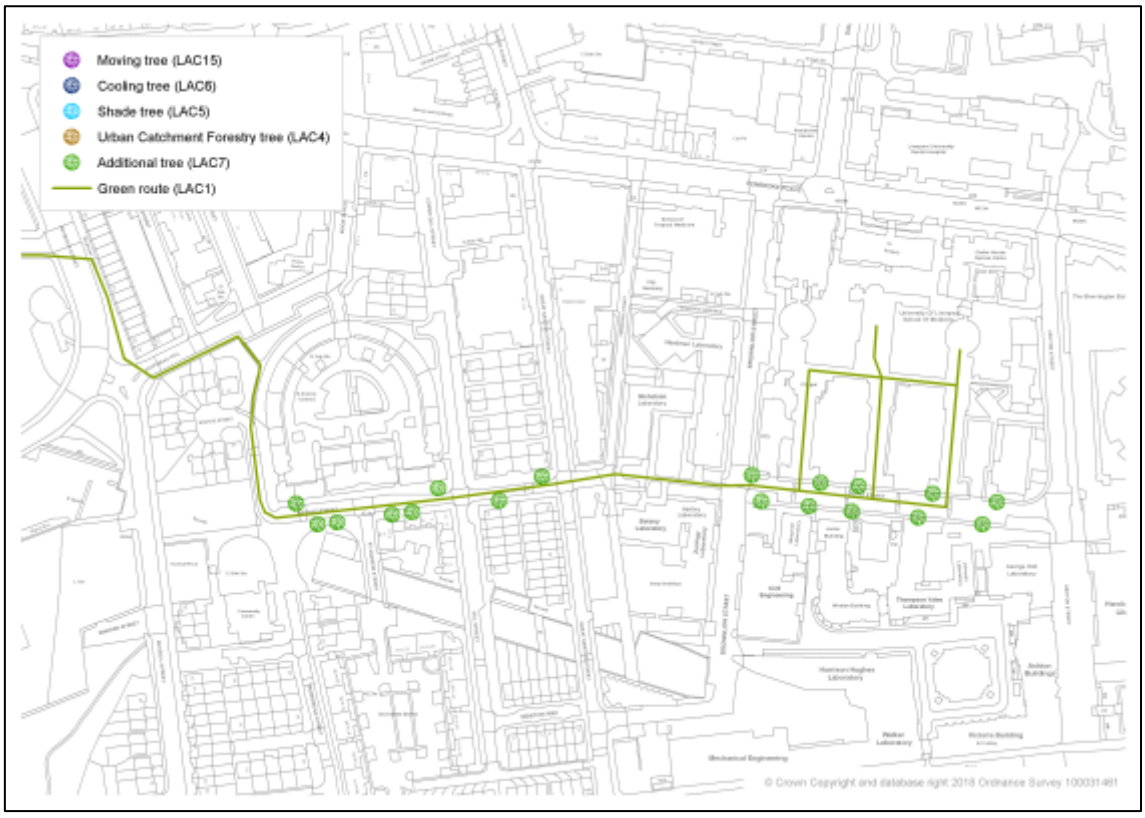


Figure 37 Green Filter in Fabric District

Expected impacts

87x10^{6} particles absorbed.

Related KPIs

Table 20 Green Filter KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number

Environmental (physical)	Tonnes of carbon stored in vegetation	1
Environmental (physical)	Heatwave risk	9
Environmental (physical)	Projected maximum surface temperature reduction	13
Economic indicators (benefits)	Economic value of carbon sequestration by vegetation	6
Environmental (physical)	Run-off coefficient in relation to precipitation quantities	16
Economic	Volume of water removed from water treatment system	38
Environmental (chemical)	Nutrient abatement and abatement of pollutants	30
Economic	Volume of water slowed down entering sewer system	39
Economic	Economic benefit of reduction of storm water to be treated in public sewer system	1002
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (chemical)	Annual mean levels of fine particulate matter	83
Environmental (biological)	Pollinator species increase	77
Economic	Value of air quality improvements	88
Environmental (biological)	Increased opportunity for species movement in response to climate change as a result of NBS	1001
Environmental (biological)	Increase in Insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS	1006

Social	Perceptions of health and quality of life	1007

5.1.1 Technical Specifications

See tree specification, **Error! Reference source not found.** for examples of the type of tree that ill be planted.

5.1.2 Economic Specifications

Table 21 Green Filter economic specification

Location	Item	Actual budget (estimated)	Comment
Areas adjacent to Liverpool Demonstration areas A and B	Urban tree planting to assist in reducing air pollution.	€37, 924	Local resources

5.2 Wood Allotments (LAc18)

5.2.1 General Description

An initiative to involve volunteer labour in managing young woodland, providing wood fuel for participants, ensuring woodland thinning operations are carried out at low cost. The intervention also increases community connectivity to woodlands and improved community cohesion. Woods allotments are an innovative community involvement in the long term management of NBS.

Expected impacts

It is anticipated that 250 volunteers per year will be involved in the management of young woodland and the wood allotment area. Wood Allotments will lead to 20% reduction in fossil fuel use by the participants and produce heating to the value of 1000kWh[7].

Related KPIs

Table 25 Wood Allotments KPI

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

5.2.2 Technical Specifications

The concept was originally piloted on a 15 year old plantation in partnership with the 'Friends of Anderton and Marbury Country Park' in Cheshire. Interested "Friends" were trained in tree felling and then offered a license to cut the specially marked trees in a given number of identified rows for which they pay a small fee. While the Site Ranger keeps an eye on the work from time to time and marks up new areas for cutting, the wood is essentially self-managed and generates a small amount of income.

Through the Wood Allotments website, we now have mechanism to identify

- Woodland Owners who wish to be involved

[7] 304 to 386 grams of firewood to equate to 1 kWh of electric heat, 350t = 1000kWh.

- Individuals/groups who would like to cut their own firewood

For Urban GreenUP the programme will be rolled out in the Jericho Lane demonstration area. The programme will support the development of a Wood Allotment Association, legally constituted, that will affiliate to Community Forest Trust and, working with Liverpool City Council, undertake agreed, small scale woodland management activity.

This will be governed by a legal agreement that will safeguard the landowner and the individual wood allotment volunteers.

This agreement will include provisions that ensure individuals are;

1. Cutting trees for their personal domestic use only and not to assign or sublet the rows/plot to another person(s) or organisation.
2. That wood should be seasoned for a year before burning and that in a Smoke Control Area it should be used in an “Exempt” appliance.
3. Fully paid up member of The Association for the period covering this agreement.
4. Must comply at all times with the Constitution of The Association and notify The Association of any change of address.
5. That they have undertaken an induction course in the safe felling of trees using hand tools.
6. That they only fell marked trees in line with the level of training they receive. The initial course covers trees up to maximum trunk size of 15cm Diameter Breast Height (DBH) and/or the maximum acceptable height is 20 foot (6 metres).
7. That they have visited the site prior to signing this agreement, have identified and potential risks and undertake to work in a safe manner taking responsibility for themselves and others.
8. No power tools are to be used or brought onto site. Only hand tools are to be used to fell and process the trees.
9. Only the trees clearly marked are to be removed.
10. No fires shall be lit on site.
11. No litter or refuse to be brought or left on site.
12. No structures to be erected on site or the ground dug or disturbed in any manner except that which one would expect felling and removing trees.
13. Not to cause or permit any nuisance or annoyance to other cutting wood or members of the public who have access to the site.
14. Must at all times observe and comply fully with all enactments, statutory instruments, local, parochial or other byelaws, orders or regulations affecting the site.

5.2.3 Economic Specifications

Table 26 Wood Allotments' economic specification

Location	Item	Actual budget	Comment
Otterspool	1 Wood Allotment Group formed	€11,385	Aspiration is for this to lead to the long term development of a group, which may grow and take on wood allotments programmes in other, nearby areas.
Identified in bid	**1 Wood Allotment Group formed**	**€11,385**	

5.3 GI for Education (school and community groups) (LAc19)

5.3.1 General Description

GI for Education (School and community groups) is aimed at increasing awareness amongst the wider community about the value of GI in urban areas. The programme promotes the understanding of GI in urban areas through active engagement with schools/community groups. LAc19 will include site visits, exhibitions, consultation and talks/seminars as well as planting of small areas of new woodland planting on school grounds.

Expected impacts

LAc19 will deliver one new green area in a school.

A Social Return on Investment model has been developed that will be used to assess the impacts of this non-technical intervention. The model looks at a range of outcomes and impacts and provides an economic evaluation based on wider evidence and values. A sample of the output is provided in Figure 38 Extract (sample) of output from GI for Education SROI Model.

Figure 38 Extract (sample) of output from GI for Education SROI Model

Related KPIs

Table 22 GI for Education KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Environmental (physical)	Heatwave risk	9
Social indicators (benefits)	Increased connectivity to existing GI	76
Environmental (biological)	Pollinator species increase	77
Social	Social learning concerning NBS	113
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.3.2 Technical Specifications

A programme of tree planting will be developed in the halo area identified in the Baseline Document for the demonstration areas. A running total of trees planted, schools involved, pupils engaged and case studies will highlight the impacts of the programme.

Programme structure

Table 23 GI for Education programme structure

Area of Focus	Project design
Planting trees with schoolchildren	We will work with state primary schools, promoting the opportunity to plant new trees and learn about trees as part of the national curriculum and outdoor learning. We will provide design advice, support with planting and ensure that plans are in place for long term management and use.
Children free to plant trees in their schools or local/surrounding community land where they have owner's permission;	We will work with schools to identify the best options for where to plant trees. Where there is limited or no scope for planting within the school, we will help to identify other nearby, suitable areas for planting and work with neighbouring landowners to gain permissions for planting and long term use of the site by the school. We will identify opportunities for schools to make more use of local community woodlands.
Connecting children with nature, inspiring this generation to love and understand the outdoors/natural environment/trees ;	The Mersey Forest team has a great deal of experience of working with state primary schools to encourage outdoor learning, re-connecting children with nature and increasing knowledge and understanding of out trees and woodlands. We will use this experience, with additional input from teachers and the children involved to ensure that the tree planting is part of a wider, enjoyable, learning experience that supports the new national curriculum. Where possible we will use initiatives such as Eco-Schools and Forest School to add value to the tree planting activities. We have developed good partnerships with teacher training institutes and will make use of this relationship to increase knowledge and awareness of new teachers about the opportunities for tree planting as an opportunity to teach the national curriculum as they move into work. We can also use this relationship to ensure that our engagement with the national curriculum blends well with current teaching methods. We also have a wealth of information that will assist in teaching children about trees, their name and how to identify them. We will also, where appropriate, signpost schools to wider citizen science projects that use IT to engage people (including young people) with trees and woodlands.
Encouraging outdoor learning/ getting children outdoors;	
Inspiring children to learn about the trees they're planting;	
Supporting new national curriculum (science, maths etc. – all children to know real names of trees etc.)	

The programme will be tailored to individual needs of schools, but will follow a general pattern

1. Promotion of the programme –We will use existing contact and networks to contact schools with a clear offer to be involved in the programme of tree planting. We will set out the overall aim of the project, the benefits that we hope that the programme can offer and also the support that can be provided. This offer of support will be in the

form of a menu of options. For example, not all schools will need support with scheme design, but we will offer this for those that do.

2. We will provide information to schools on key issues to consider when planting new trees or preparing planting sites. We will highlight opportunities to link to the national curriculum and wider opportunities to understand the importance of trees in our world.
3. The menu of options includes
    a. Design - provided whether the scheme is on the school site or on a nearby area where permission to plant has been given in writing.
    b. Specification - including assessment of site services and identifying the objectives for the scheme, is it an aesthetic improvement, part of a biodiversity area, or the start of a programme to develop Forest School. Design will identify the need for tree protection and will provide an opportunity to inform the organisation carrying out the maintenance on site of the tree planting so that they can build in to future management planning and ensure that trees are not damaged.
    c. Full planning and coordination of the planting event, including risk assessment and commitment from the school and/or landowner that the trees will be looked after.
    d. Coordination of the planting event which will also include activities to provide information about the programme tailored to specific age ranges. We will also provide links to the national curriculum so that teachers can carry on the focus on the importance of trees in their day to day lessons. This is seen as the most important element of the programme, providing opportunities to learn more about trees and woodlands and gain more knowledge about the trees and woodlands around them.
    e. We will look to follow up the winter planting with summer activities, allowing children to check how the trees are growing and giving more opportunities to identify tree species and reflect on their involvement in the project.
    f. We will provide an opportunity for children to “pledge” an environmental action linked to the project, to plant a tree next year or learn how to identify an oak tree – or all trees in their neighbourhood, for example.
    g. We will signpost children, through the teachers, to ongoing activities, local education network groups, appropriate websites and where suitable and where resources are available, continue to work with the school, for example, developing forest school or encouraging an increase in the amount of environmental education provision in the school.

5.3.3 Economic Specifications

Table 24 GI for Education economic specification

Location	Item	Actual budget	Comment
Various Schools in Liverpool	6 School grounds improvement programmes	€36, 432	Not from EU – local contribution

5.1 Forest School (LAc20)

5.1.1 General Description

Forest School Links NBS into the day to day work of schools. Forest School is an innovative, self-led learning approach adaptable for all age groups in a woodland setting, supported by a trained Forest School Leader, linking to delivery of national curriculum and wider health and social benefits for children and teachers. By participating in engaging, motivating and achievable tasks and activities, in a woodland environment, each participant has an opportunity to develop intrinsic motivation, sound emotional and social skills.

Expected impacts

500 students/year are expected to participate in action LAc20. Forest School will provide the possibility of new concept of teaching based on biophylia. Likewise, Lac20 will generate 1 new green area. In the same way, the volunteer works to manage young woodland are foreseen in 250volunteer/year, which will be involved in the care of woodlands. This action will contribute to reduce of fuel displacement in 20% and to produce bio-energy (equivalent to 1,000kW/h cumulative with LAc19 and LAc18).

Related KPIs

Table 30 Forest School KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Engagement with NBS (sites/projects)*	117
Social	Social learning concerning NBS*	113
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention.

5.1.2 Technical Specifications

Forest School consists of a 12 week programme of teaching in an outdoor, Forest School environment. The programme is led by a specialist, trained to Level 3 in Forest School.

Lesson Plans guide the delivery of Forest School and these are written by the Forest School Leader, based on knowledge of the site, the objectives for the lesson and knowledge of the children involved.

A typical session will often involve many things. It usually begins with the same routine - always getting ready to go outside - dressing in appropriate clothing, wellies and waterproofs. The class will gather at a seating circle of logs and catch up with what happened at the last session, what the weather is like, what they plan to do at this session. Forest School sessions usually run for a minimum of one and a half hours, most are two hours, but many last longer.

Participants in Forest School are free to choose amongst many activities; some will have been introduced by the leader, for example bug hunting, mud painting, collecting, and counting. Many are child-initiated and these are as varied as the children and participants involved; some examples include building a dam, creating an assault course, shelter building.

Forest School also uses hand tools to master a variety of tasks under the tutoring of the leader, Forest School participants can learn how to use the tools and use them to help them with their existing projects/activities - e.g. use a saw to cut wood to the right length to use in a shelter. They can also use the tools to create new activities - e.g. making items from wood - a mallet, a kazoo, a coaster etc. Activities using tools can be very simple or take many weeks to complete something more intricate and with more skill involved.

Many Forest School sessions will have a snack time, which is a nice way to get everyone back together to share what they've been doing. It may also be a good time to have a campfire and heat some water for a hot drink, perhaps cook some food on the fire.

5.1.3 Economic Specifications

Table 31 Forest School economic specification

Location	Item	Actual budget	Comment
St Vincent's School	1 Forest School programme	€12, 903	Not from EU. Local contribution

5.2 Engagement Portal for Citizens (LAc21)

5.2.1 General Description

Engagement Portal for citizens will assist in engaging the community with the Urban GreenUP programme by providing online, real time information about the Urban Green UP interventions in Liverpool. This will be a web based, user friendly interface, incorporating social media, to inform and link people to the GI interventions by showing the impacts on air and water quality and associated impacts on health and wellbeing.

Expected impacts

The increased awareness of NBS is anticipated to lead to more use of green spaces across the city and improvements to the wellbeing for people using sites more often.

Related KPIs

Table 25 Engagement Portal KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Increase in walking and cycling in and around areas of interventions	139
Social	Social learning concerning NBS	113
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.2.2 Technical Specifications

Dedicated page on The Mersey Forest website (www.merseyforest.org.uk) to be constructed. This will be promoted through social media to local communities and to a range of partners on the Local Nature Partnership – Nature Connected.

Details of monitoring and real time feedback of data where possible will be incorporated onto the site alongside a progress tracker for Urban GreenUP intervention delivery.

Information on events will be incorporated and programme of citizen science, such as Bee monitoring, will be promoted on the site.

5.2.3 Economic Specifications

Table 26 Engagement Portal economic specification

	Item	Actual budget (estimated)	Comment
Website/portal	Web page portal developed and promoted	€64 000	Not from EU. Local contribution

5.3 Green Art (LAc22)

5.3.1 Green Art General Description

An initiative to bring together all the different stakeholders in the Baltic corridor in a community arts project that helps to create ownership of the new green corridor and to celebrate the green interventions and improvements. An opportunity exists to harness the Baltic creative community to create a lasting arts legacy that can potentially sign post or way mark the route, add interest and information to the route – and if linked to opportunities with the Bioapp the arts project can incorporate technological or digital aspects to the final scheme.

Expected impacts

It is expected that representatives from the various Baltic stakeholders can be involved in the consultation for the design. Community involvement will be essential to creating a unique, innovative and lasting arts legacy to celebrate the Baltic NBS.

Related KPIs

Table 35 Green Art

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life*	1007

*The common SE indicators are relevant to many of the planned interventions and will be measured at the city or demo scale to look for an overall shift in knowledge and action as it would be impossible to attribute causality to one intervention

5.3.2 Technical Specifications

The technical specification for this intervention will be broad to encourage as much innovation as possible. Local groups will be encouraged to bid for the tender so that the community is fully involved. The specification will request that the work includes community cohesion, NBS understanding and interpretation and considers way marking and digital opportunities as well.

5.3.3 Economic Specifications

Table 36 Green Art economic specification

Available €30360

Location	Item	Actual budget	Comment
Baltic Corridor	Innovative community led green arts programme to be established that promotes local community cohesion, NBS understanding, waymarking and innovation.	€30,360	Opportunity exists where funding is available to extend and apply the ideas generated to the other sub demo areas.
Identified in bid	**I project**	**£30,360**	

5.4 Forest Church (LAc-23)

5.4.1 General Description

For LAc23- Forest Church, the Forest School concept will be extended in a unique trial to work across age groups with the community engaged within the local church. Transfer of the Forest School concept and ways or working to faith communities in the City Centre.

Expected impacts

See Specification for Forest School. This intervention SROI has a strong element of health monitoring that will support this non-technical intervention.

Related KPIs

Table 34 Forest Church KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115
Social	Social learning concerning NBS	113
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.4.2 Technical Specifications

Forest Church consists of a 12 week programme of teaching in an outdoor, Forest School environment. The programme is led by a specialist, trained to Level 3 in Forest School.

This non-technical intervention will link closely with the Forest School work – see 5.1.2

5.4.3 Economic Specifications

Table 35 Forest Church economic specifications

Location	Item	Actual budget (estimated)	Comment
St Vincent's	Development and delivery of one Forest Church project	€12 903	Not from EU. Local contribution.

5.5 Bioapp(LAc24)

5.5.1 General Description

Bringing together local stakeholders to design and develop a locally based bio app that can assist with monitoring the increased local biodiversity and engage a new community. This tool will include BIO - hackathon, to create new solutions to help to monitor and explain NBS in the City.

Expected impacts

500,000 users of the BioApp

Related KPIs

Table 27 BIOApp KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115
Social	Social learning concerning NBS	113
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.5.2 Technical Specifications

Stage 1 – Project Specification development

The BIoApp will make use of the potential links to the creative cluster of businesses in the Baltic Corridor to identify;

- How best to develop the BioApp
- What Apps are already in place that could provide data/links/added value for the work that Urban GreenUP is delivering?

The requirements for the App will include;

- Ease of use for the general public
- Clear links to the Urban GreenUP programme priorities
- Compatibility with a wide range of smart phones
- Based on industry best practice
- Linked to the Engagement Portal for Citizens

- Capability of longer term evolution of the App, which might include links to other long term projects and programmes included in Urban GreenUP, such as Forest School and other LCC and Mersey Forest programmes

Stage 2 – App development

Based on the results from Stage 1, the technical, specification for the design and implementation of the BioApp will be developed and delivered.

5.5.3 Economic Specifications

Table 28 BIoApp economic specifications

Location	Item	Actual budget (estimated)	Comment
Cross City	Stage 1 – Development of product specification Stage 2 Design, Development and implementation of BIoApp	€22,400	

5.6 GI for Physical Health (LAc25)

5.6.1 General Description

LAc25- GI for Physical health (Sub- Demo A-B). Leader: CFT. Use of strategic GI to encourage more physical activity, creating places where "Health is a Natural Choice". LAc25 will be supplemented by community engagement and links to the wider initiatives to increase physical activity across the city. LAc25 will focus on how to get young people more active more often, aiming to create intrinsic motivations for life long improvements to health and wellbeing through physical activity.

Expected impacts

See Specification for Forest School (**5.1**). Forest School SROI has a strong element of health monitoring that will also support this non-technical intervention.

125,000 people will be engaged through this activity. This may be achieved through promotion and publicity.

Related KPIs

Table 29 GI for Physical Health KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115
Social	Social learning concerning NBS	113
Social	Increase in walking and cycling in and around areas of interventions	139
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.6.2 Technical Specifications

A programme of expert led walking activities tailored to individual needs and designed to help meet target exercise and physical activity levels.

Walking is one of the easiest ways to get more active, lose weight and become healthier. Walking is ideal for people of all ages and fitness levels who want to be more active. Organised walking activities in a group can help people start walking, make new friends, reduce social isolation and stay motivated.

Activities are arranged to make use of local greenspace and encourage individuals to make use of the community assets available to them.

The target client groups are shown in the table below.

Table 30 GI for Physical Health client groups

Client Group	Outcomes
Families	Improved lifestyles, healthy choices
Older People	Reducing Preventable Conditions
People with Disabilities	Improved fitness & mobility
Local Community Groups	Prevention of obesity
Volunteers	Volunteering Opportunities
Socially isolated	Reducing social isolation
People with mild to moderate mental health issues	Improved mental capital, mental wellbeing, emotional wellbeing

5.6.3 Economic Specifications

Table 31 GI for Physical Health economic specifications

Location	Item	Actual budget (estimated)	Comment
All three Liverpool demo areas	Promotion of green infrastructure health benefits	€82,000	Not from EU funds, Local contribution.

5.7 GI for Mental Health (LAc26)

5.7.1 General Description

GI interventions designed to provide a setting which promotes improved mental health and/or provides a setting for nature based activity to maintain good mental health and develop new coping strategies for mental health issues for people living and working in an urban location. This intervention is focused on a combination of mindfulness and GI.

Expected impacts

125,000 people will be engaged through this activity. This may be achieved through promotion and publicity.

Related KPIs

Table 32 GI for Mental Health

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115
Social	Social learning concerning NBS	113
Social	Increase in walking and cycling in and around areas of interventions	139
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.7.2 Technical Specifications

Mindfulness is a form of meditation, which has been proven to have a variety of benefits. Mindfulness refers to heightened awareness of what is going on within and around you, in the present moment, in a non-judgemental way.

Mindfulness practised outside is particularly beneficial because of the well-documented health benefits associated with spending time in nature, particularly woodlands and forests. It strengthens our connection with the natural world, which itself has been shown to be beneficial to health and wellbeing. It also reminds that we humans are part of something larger, that we have impact on through our actions and that also impacts on us. We can also draw inspiration from nature by observing how it does things to help us solve a problem or

find a way forward. There is considerable evidence showing how closely our sense of wellbeing is linked to feeling connected to the natural world.

The benefits of practising mindfulness include:

- Enhanced cognitive skills: concentration, memory, creative thinking, openness, flexibility
- Enhanced psychological skills: emotional intelligence, coping with stress, communication and interpersonal relationships, self-confidence
- Improved health and wellbeing: stress reduction, illness prevention, improved sleep quality, emotional resilience

5.7.3 Economic Specifications

Table 33 GI for Mental Health economic specifications

Location	Item	Actual budget (estimated)	Comment
Liverpool City BID	Delivery of Mindful Contact with Nature programme	€22,700	Local resources

5.8 Opportunities to learn about the role of green infrastructure in the city. (Promotion of Ecological Reasoning/intelligence)(LAc27)

5.8.1 General Description

Promotion of ecological reasoning and intelligence (to improve knowledge and understanding of NBS) by the development of awareness activities (school ecological workshops, thematic meetings and diffusion material). Ecological intelligence lets apply what people learn about how human activity impinges on ecosystems so as to do less harm and once again to live sustainably in niches.

Expected impacts

It is expected that this interventions will reach 500,000 recipients.

Related KPIs

Table 34 Opportunities to learn KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Social learning concerning NBS	113
Social	Perceptions of citizens on urban nature	115
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.8.2 Technical Specifications

LAc27 will be delivered through a series of public events including

- Seminars
- Lectures
- Site visits

The programme for these activities is shown below.

Table 35 Opportunities to learn programme

Event	Date	Lead

Duncan Society Lecture	Sept 2019	CFT
NW Forest Forum	November 2019	CFT
Green Infrastructure Partnership (North)	May 2019	CFT
Urban GreenUP open day	April 2020	LCC/CFT/UoL/
Pop up Forest II	May 2019, 2020	CFT
National Tree Week	November 2018, 2019, 2020	CFT
European Urban Forest Forum 2020	May 2020	CFT
Urban GreenUP promotion in local media	Ongoing	LCC/CFT

In addition, Urban GreenUP will both support and make use of the national and local focus on 2019 as a "Year of the Environment"

5.8.3 Economic Specifications

Table 36 Opportunities to learn economic specification

Location	Item	Actual budget (estimated)	Comment
All Demo areas	Delivery of a programme of events and activities that will increase understanding of nature based solutions the importance of nature in the city	€80,900	Local resources

5.9 Information point for Urban GreenUP and the RUP - Single window/desk for RUP deployment (LAc28)

5.9.1 General Description

The Liverpool team from the three partner organisations will work collaboratively to provide information to planners, engineers and others who may be able to design, propose or in other way support the use of NBS in the city. The link to planners and the use of the RUP will help to embed NBS into plans and strategies.

Expected impact

- Increased understanding of RUP and how they might support sustainable development in the city, in particular how it may assist with climate change resilience.
- Increased reference to green infrastructure interventions in plans and strategies for the city and by developers and investors in the city.

Along with LAc29 and 30 it is anticipated that 250,000 people will have the opportunity to hear about the work in Liverpool to develop NBS.

Related KPIs

Table 37 Information point KPI

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115

5.9.2 Technical Specifications

This non-technical intervention will be provided through the Liverpool Demonstration area partners, each of who will act as support for deployment of the RUP.

This support will be promoted to colleagues and to potential wider project sponsors across the city including;

- Planners
- Economic regeneration professionals
- Transport infrastructure engineers
- Politicians
- Green space and woodland managers

5.9.3 Economic Specifications

Table 38 Information point economic specification

Location	Item	Actual budget (estimated)	Comment
Liverpool City BID	Project team provide a point of contact for the promotion of NBS, supporting a range of colleagues and other organisations to develop NBS.	€95,000	Local resources

5.10 Online tool to gather NBS project ideas from communities. (Support to citizen project of NBS) LAc29)

5.10.1 General Description

This action complements activity developed in Valladolid as part of their "Urban Platform". Liverpool will promote and facilitate the development of NBS projects that are suggested by citizens and private companies.

Expected impacts

Increased number of project suggestions from local communities.

It is expected interventions LAc28, LAc29 and LAc30 will reach 250,000 recipients.

Related KPIs

Table 39 Online tool KPI

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Perceptions of citizens on urban nature	115
Social	Engagement with NBS (sites/projects)	117
Social	Perceptions of health and quality of life	1007

5.10.2 Technical Specifications

This non-technical intervention will promote the use of the online tool within the Mersey Forest website that allows citizens to register their interest in specific sites or highlight where they may wish to see some new green infrastructure developed to meet a specific local need.

https://www.merseyforest.org.uk/about/plan/

5.10.3 Economic Specifications

Table 40 Online tool economic specification

Location	Item	Actual budget (estimated)	Comment
Across Liverpool City	Development and promotion of online tool to register	€101,000	Local resources

	citizen ideas for NBS projects.		

5.11 City mentoring strategy (LAc30)

5.11.1 General Description

Liverpool City partners will provide mentor support for partners within the Urban GreenUP project and in turn will welcome mentoring from colleagues in other organisations in order to exchange and build good practice for NBS. In the course of WP1 and WP6 activities, a number of good practices from Liverpool will be selected for mentoring purposes.

Expected impacts

It is expected interventions LAc28, LAc29 and LAc30 will reach 250,000 recipients.

Related KPIs

Table 41 City mentoring KPIs

Type of Indicator	KPI	Urban GreenUP KPI Number
Social	Engagement with NBS (sites/projects)	117

5.11.2 Technical Specifications

A mentoring Strategy document will be developed by the Liverpool Partners in Urban GreenUP. This document will be produced in conjunction with the other lead cities and the follower cities.

The Strategy will take into account work that is already underway to develop collaborative results. For example, the work in WP 5 looking at the development of the GI – Val Toolkit which may be used to provide data on the impacts of the Urban GreenUP interventions.

The Strategy will reflect the fact that follower cities in many instances have much to share in terms of NBS planning and delivery and so the mentoring is across all partners.

The main sections of the document will cover

- Scope of mentoring
- Roles of the partners
  - Who will be involved?
  - Who will mentor whom?
  - Key issues to cover
- Programme of mentoring
- Framework for measuring the programme

We will look to co-produce this document with

- Demo cities
- Follower cities
- Associate cities, such as Kyoto, Adelaide

Figure 39 Mentoring programme example of process to go through

5.11.3 Economic Specifications

Table 42 City mentoring economic specification

Location	Item	Actual budget (estimated)	Comment
Across Liverpool City	Develop mentoring strategy	€42,000	Local resources

6 Conclusions

The Technical Specification sets out details for each of the 7 technical interventions and 9 non-technical interventions in the Liverpool Demonstration Areas of Urban GreenUP.

The Specification takes into account the reduced budget for delivery. Whilst all attempts have been made to deliver to agreed outputs related to full budget it is possible that outputs may be reduced accordingly in line with available budget and all outputs subject to tender outcomes re affordability.

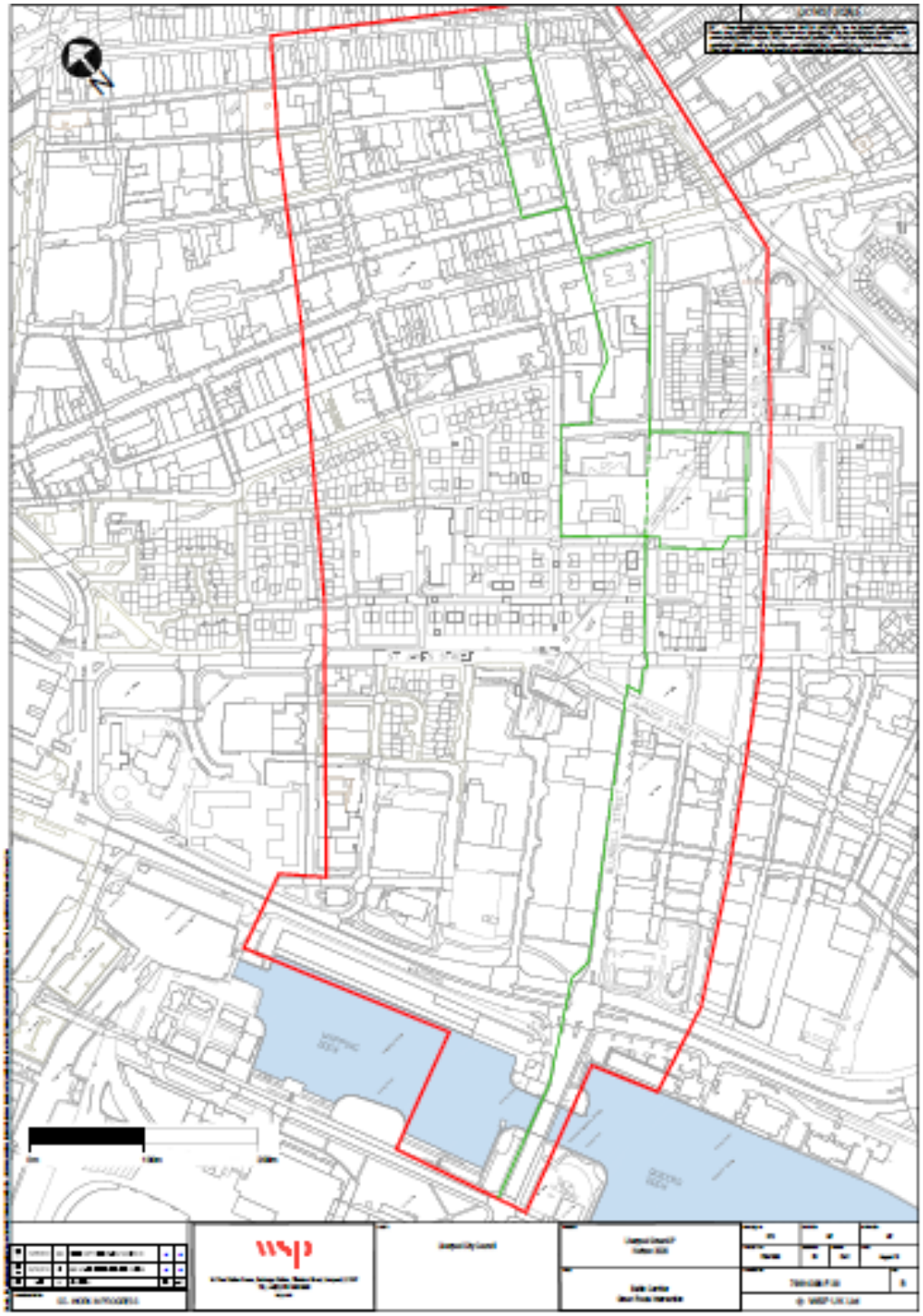
The specification is considered correct at the time of writing. However, the procurement process, which will follow D3.4, will call for a design, build and establish pricing for the interventions.

This may lead to some revisions, both upward and downward in the costs of interventions. We believe that there is flexibility within the programme to allow these variations and deliver the overall intended programme.

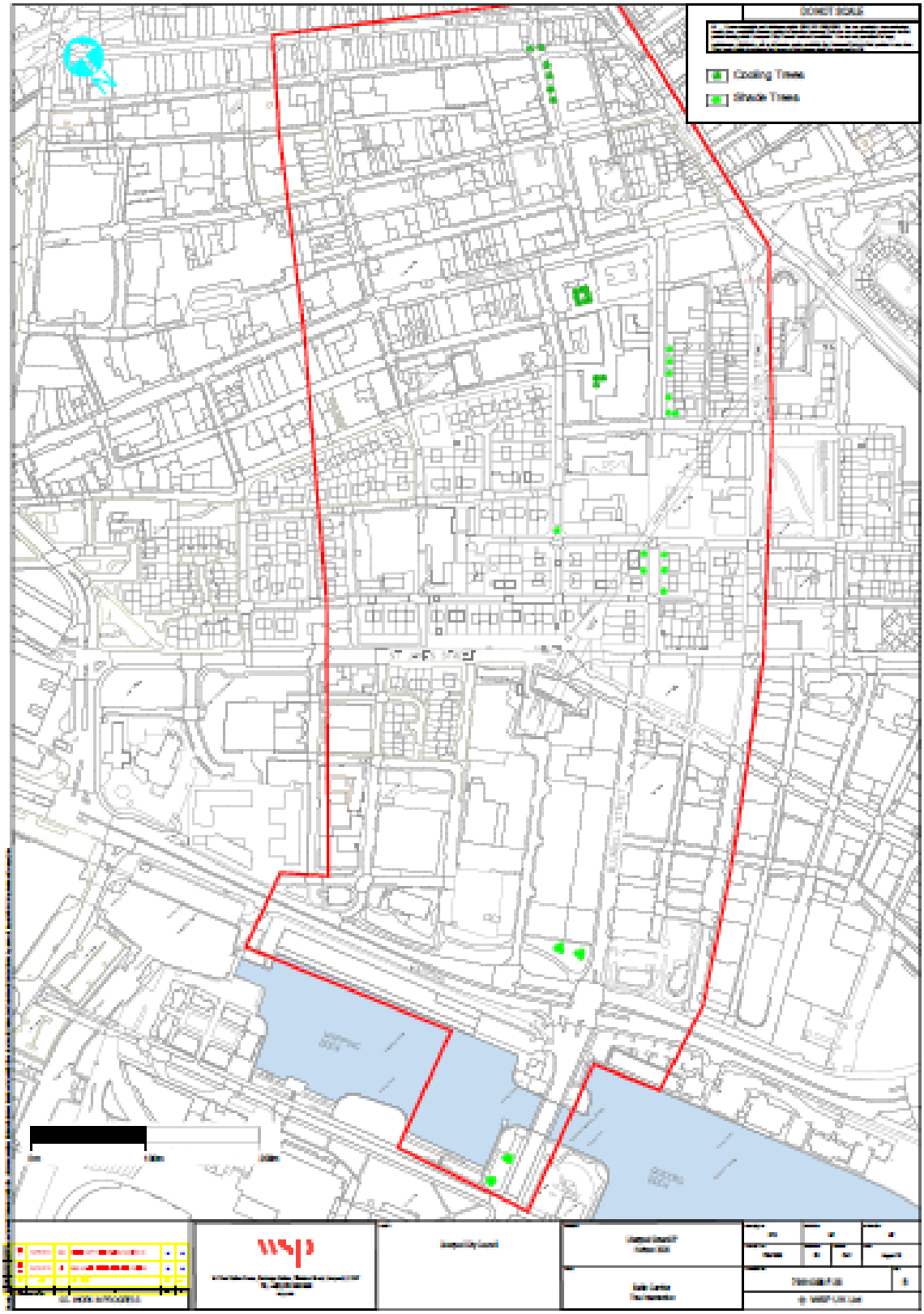
This document provides the basis for the next step in the project, procurement.

7 Appendix 1 - Overview Plans for Interventions - BALTIC Sub Demo A

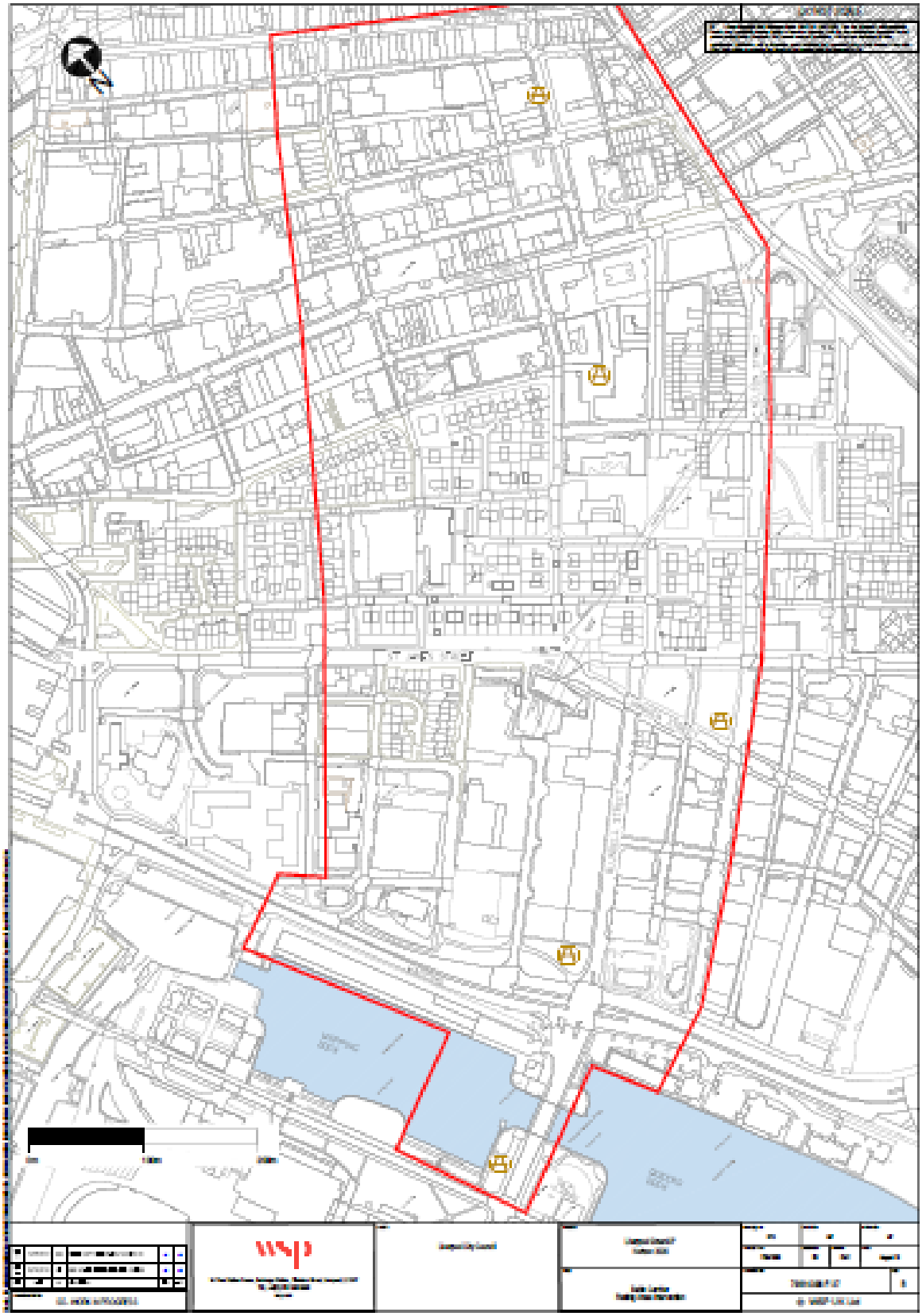
7.1 LAc1 Pedestrian and cycleway green route



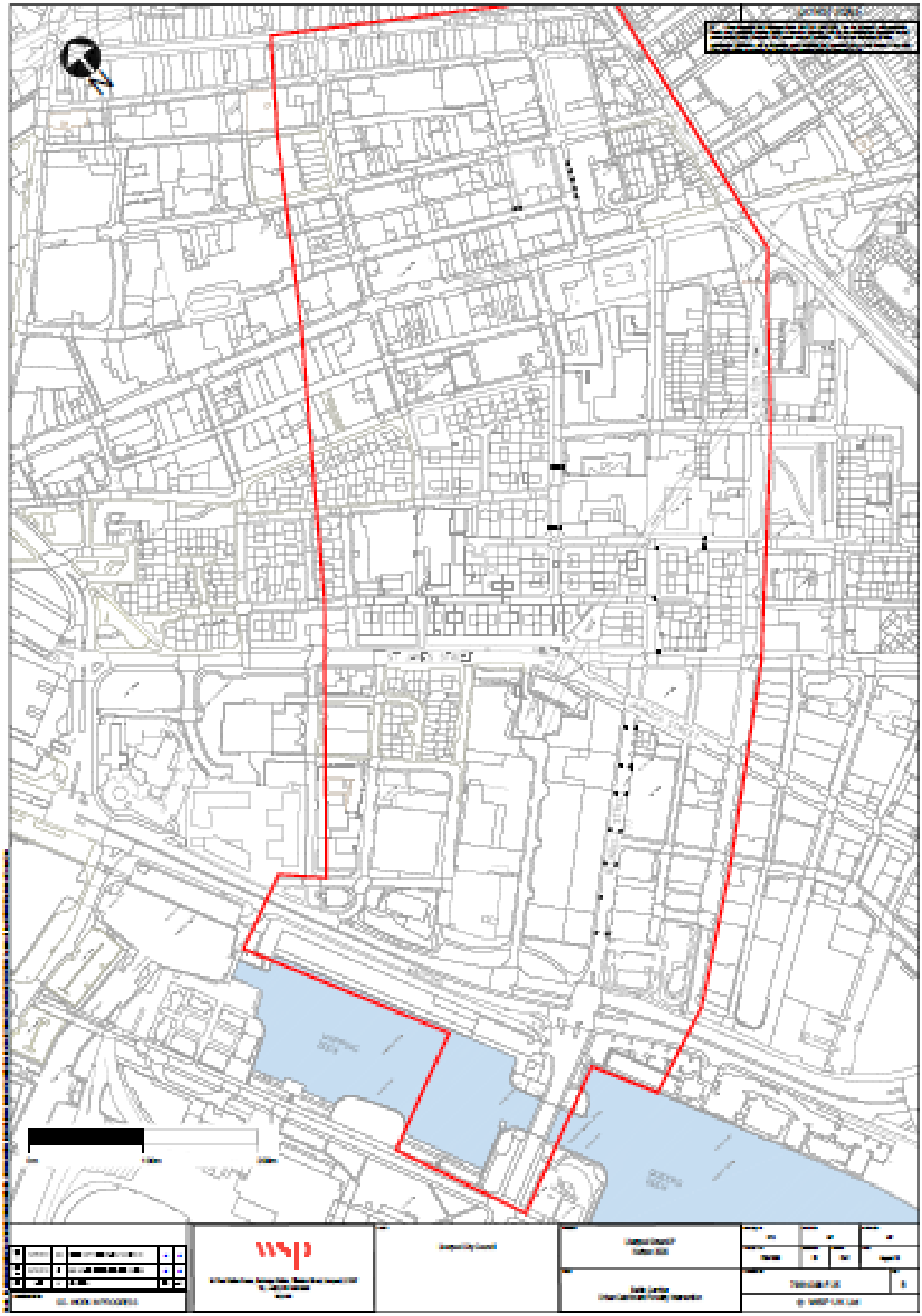
7.2 LAc5 Shade Trees and LAc6 Cooling Trees



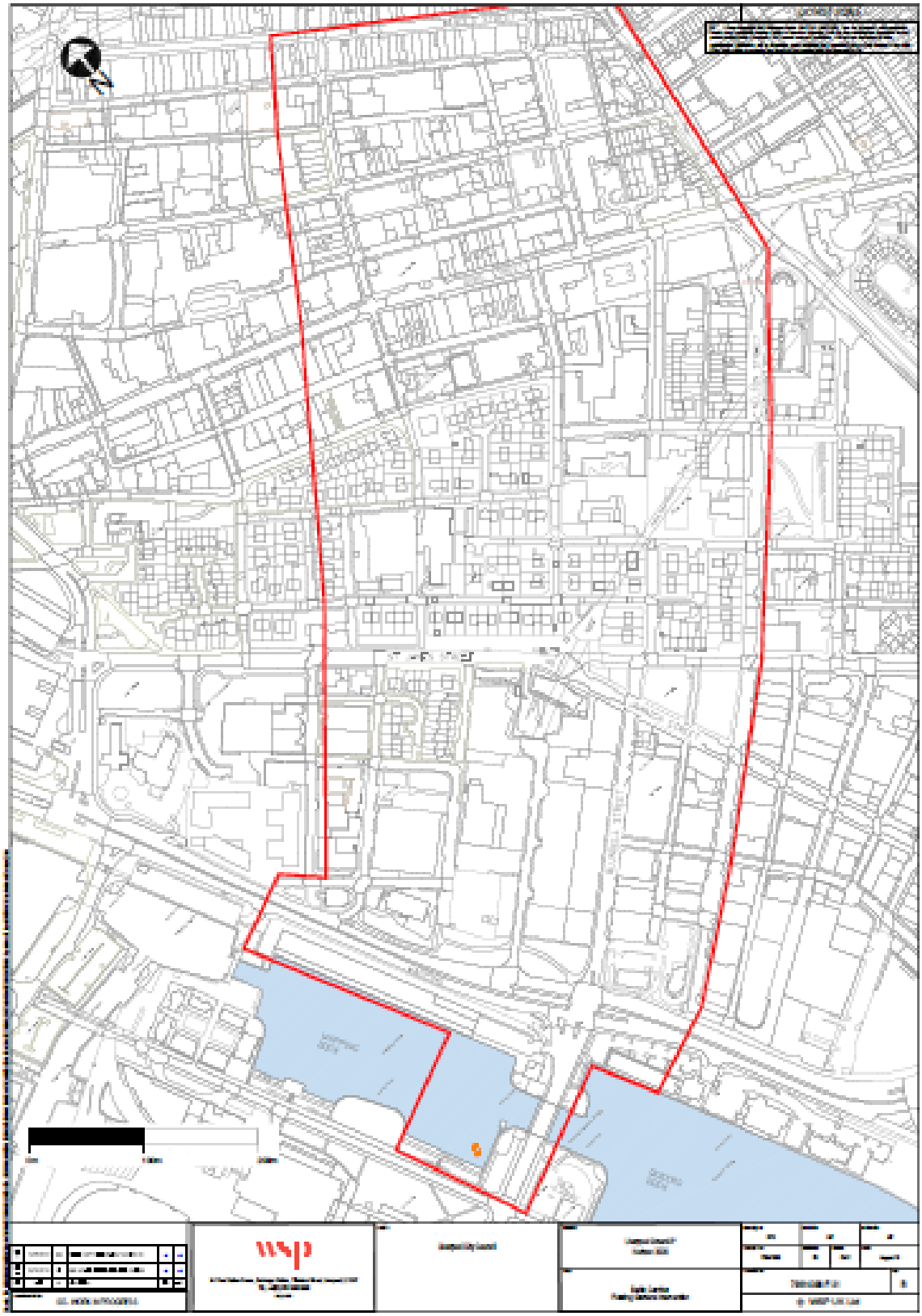
7.3 LAC new Green Resting Areas



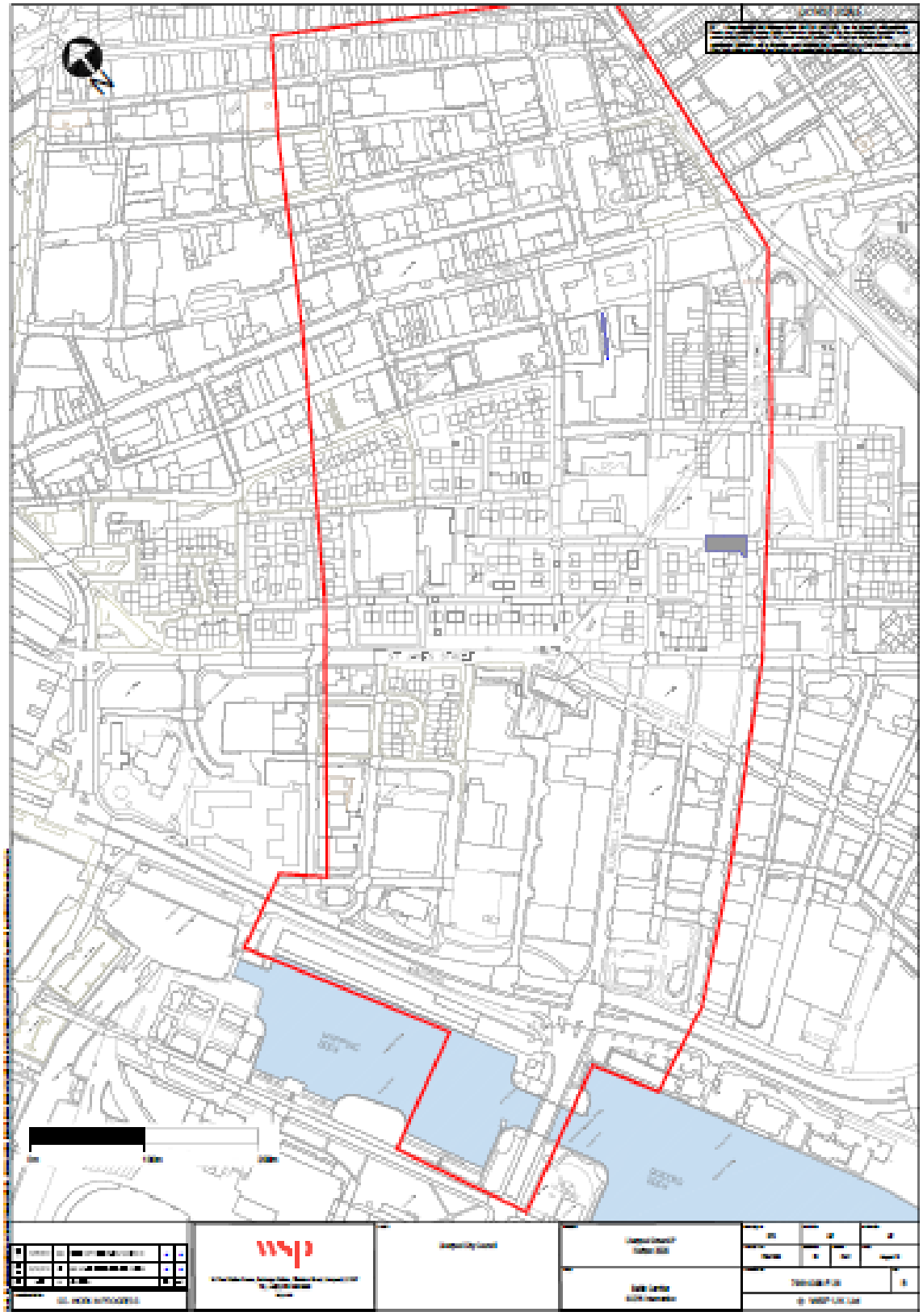
7.4 LAc4 Urban Catchment Forestry



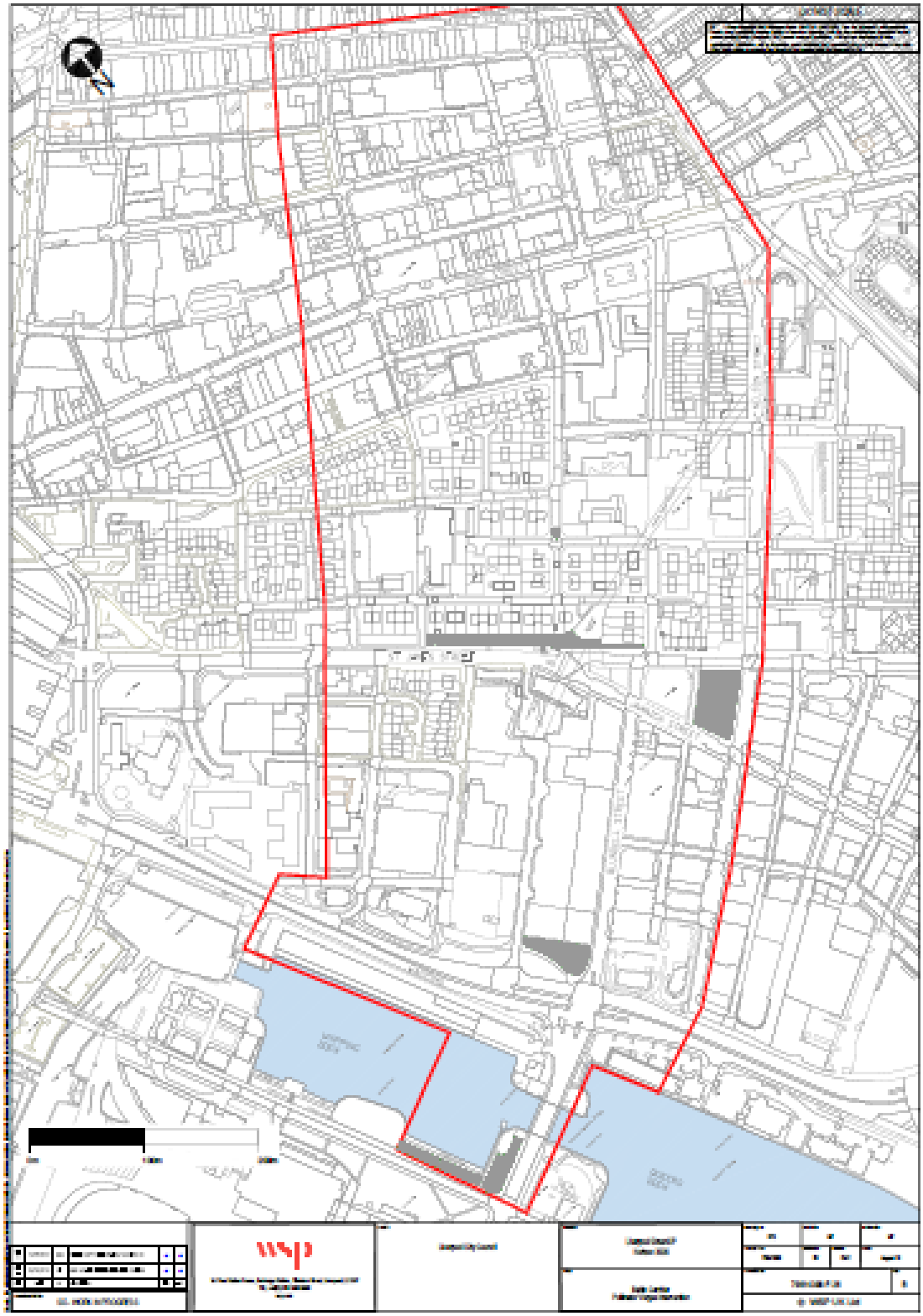
7.5 LAc16 Floating Garden



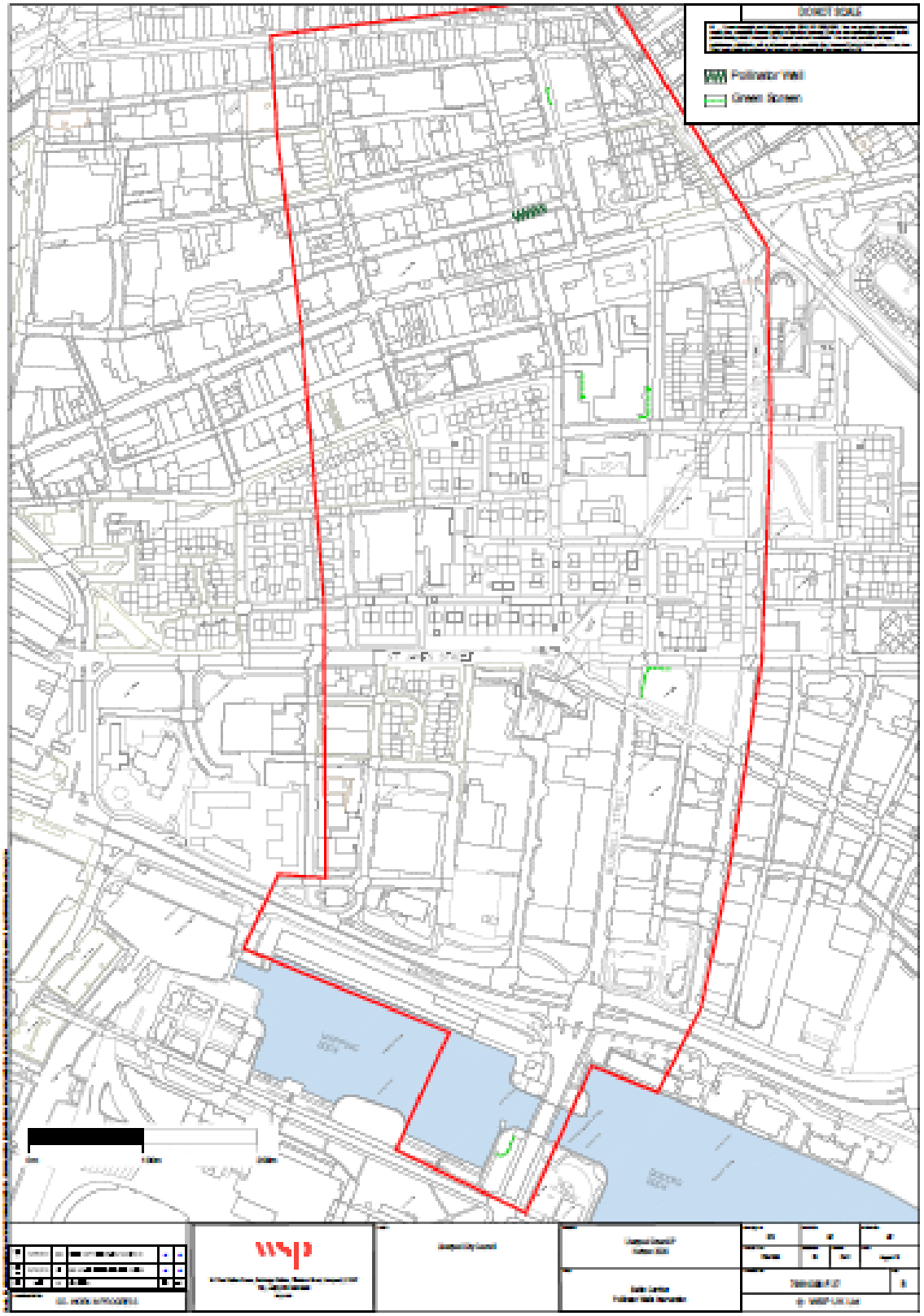
7.6 LAC8 and LAc10 SUDs and Hard Drainage Pavements



7.7 LAc12 Pollinator Verges and Spaces



7.8 LAc13 Pollinator Walls and LAcnew Green Screens



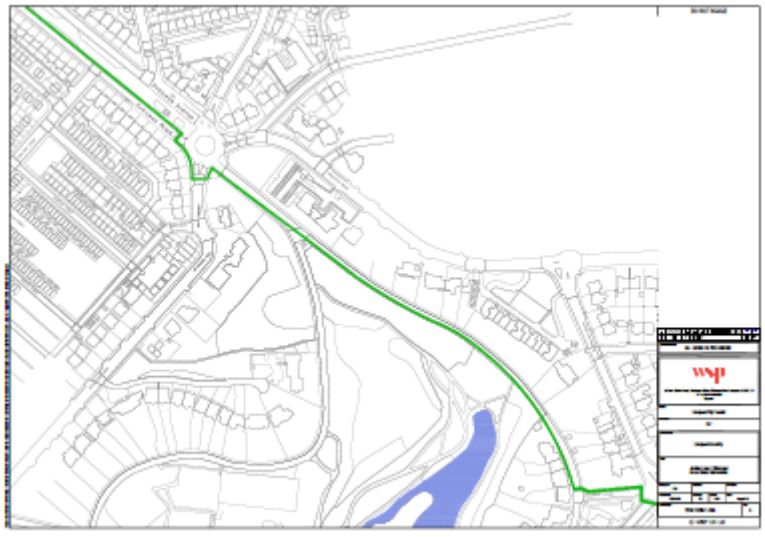
8 Appendix 2 Overview Plans for Interventions in Liverpool BID

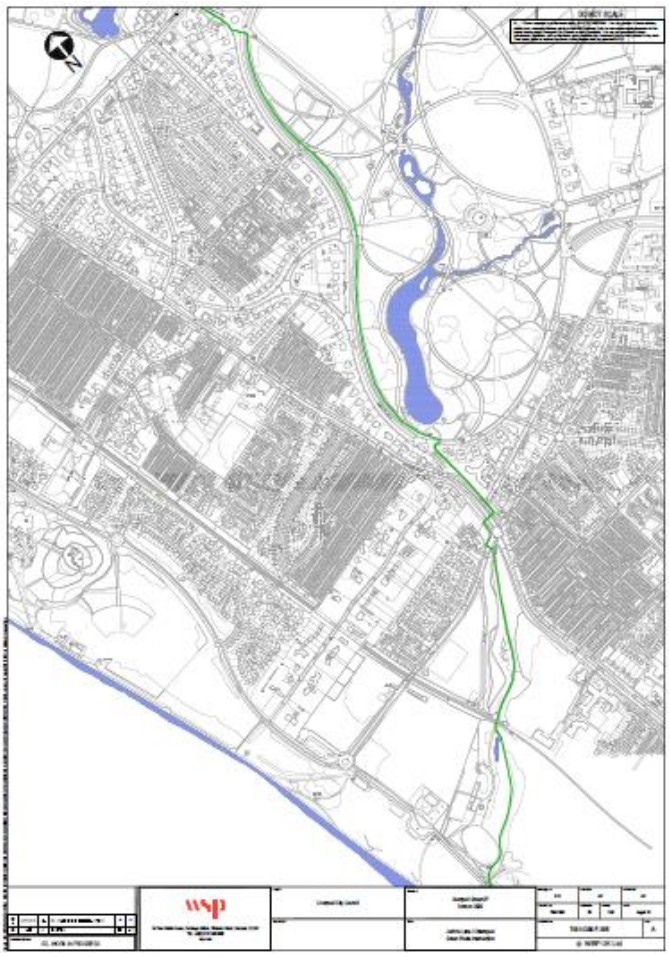
8.1 Appendix 2 Interventions in and around Williamson Square

8.2 Appendix 3 Marks and Spencer's

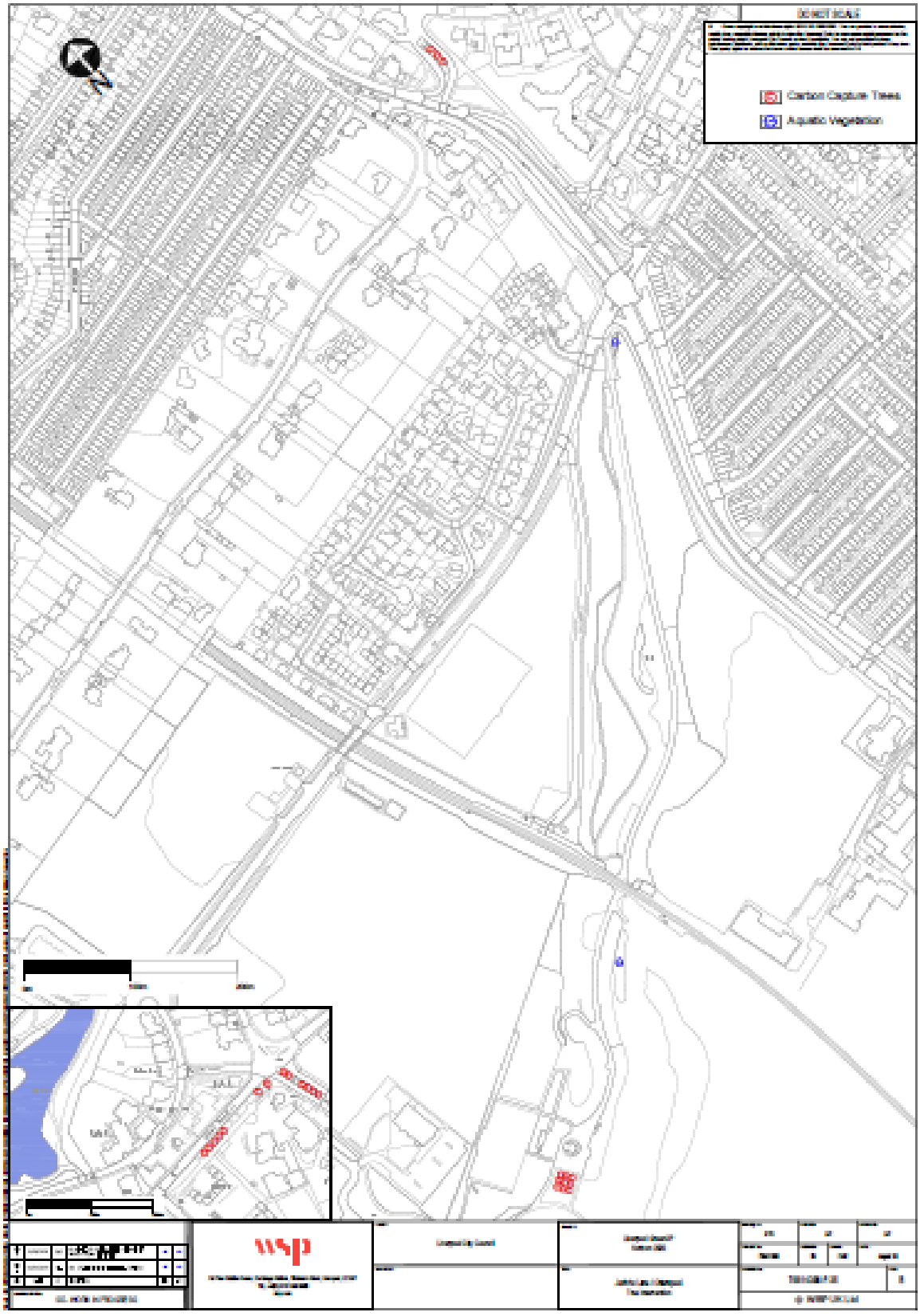
9 Appendix 3 Overview Plans for Interventions- Otterspool Sub Demo C

9.1 LAC1 Pedestrian and cycleway green route

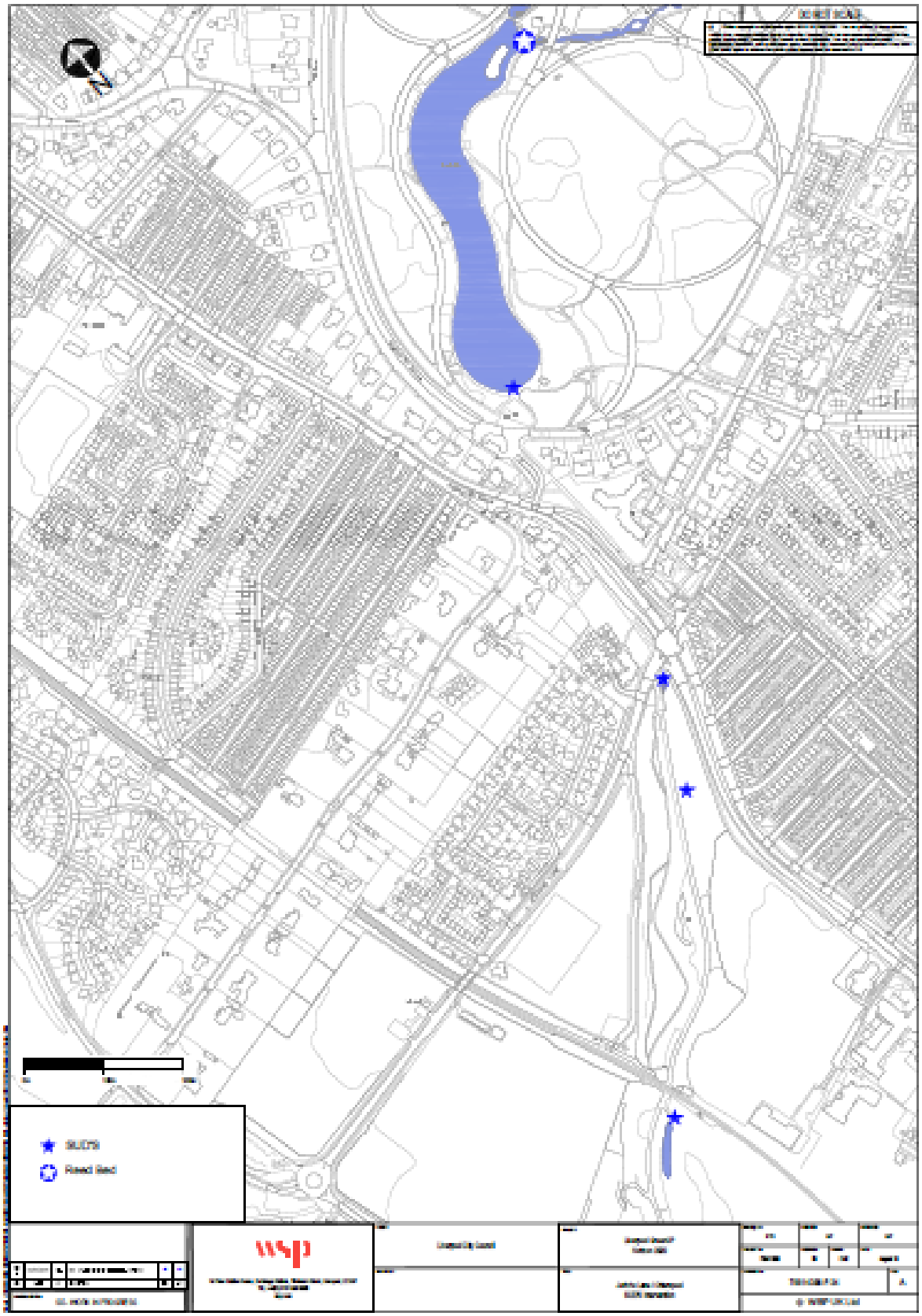




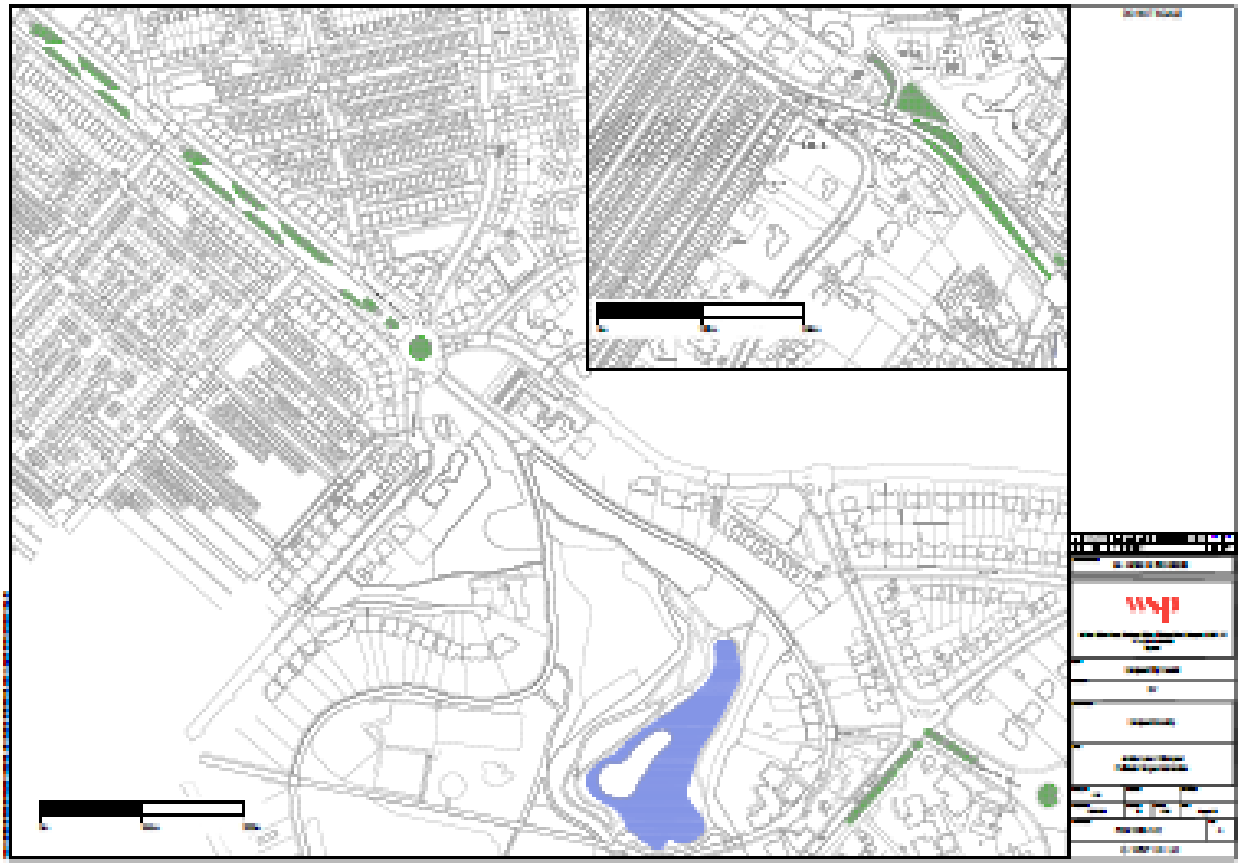
9.2 LAc7 Urban Carbon Sink



9.3 LAc8 SUDS and LAcnew Floating reed beds



9.4 LAc 12 Pollinator Verges and Spaces



9.5 LAc13 Pollinator Walls and LAcnew Green Screens