City of London
City Public Realm Materials Review

Sustainability in Public Realm Design

Design Notes





Thames Water




Contents

1 Introduction - Key Principles

The 'Design Notes' should be read in conjunction with the 'Scoring Matrix' by the 'material selector/ reader'. A good starting point is to first go through the key questions set out on page 7. These will allow the reader to develop a holistic thinking and set the scene, enabling improved decision making whilst using the Scoring Matrix.

Furthermore, for readers benefit, the diagrams below list the materials that are included in the matrix along with the exclusions. The diagram on the right summarises the initial list of 8 key principles along with the additions.

The images on the right summarise material qualities that are quantitative or qualitative when making comparisons. Some properties will be objective and others subjective and therefore more design focused. These could be used to shape the human experience of the public realm and are linked with social value.

Material list:

List of materials received from CoL to be included in the matrix:

– Scoutmoor Yorkstone (Blade)
– Scoutmoor Yorkstone (Wire)
– Whitworth (Blade)
– Whitworth (Wire)
– Kiruna Sandstone (Sawn)
– Granite Paving (Kreuzberg) (Flamed)
– Granite Paving (Chinese) (Flamed)
– Pennant Blue (Sawn)
– Granite Paving (Portuguese)(Flamed)
– Mastic Asphalt

Exclusions
– Urban/street furniture

Key principles for material assessment:

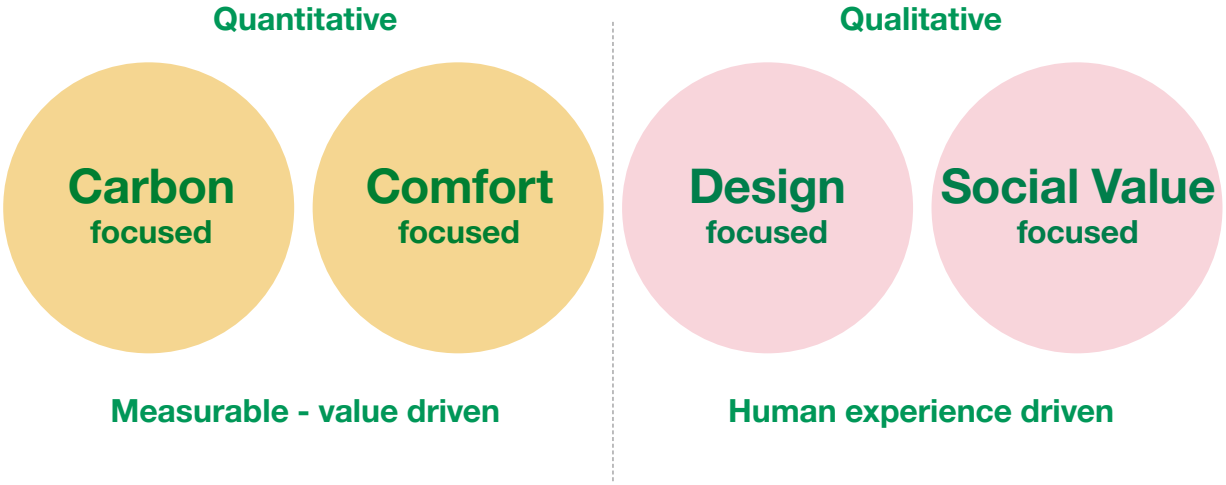
Initial list of 8

1. Embodied carbon
2. Ethical sourcing
3. Climate resilience and heat absorption
4. Lifespan
5. Maintenance impacts
6. Recyclability/reuse
7. Aesthetics
8. Cost

Additions

9. Flooding
10. Water stress
11. Overheating
12. Biodiversity loss
13. Pests & diseases
14. Disruption to infrastructure

What can and cannot be measured?



Grouping key principles - Quantitative and Qualitative

Carbon focused	Comfort focused	Design focused	Social value focused
1. Embodied carbon 2. Ethical sourcing 4. Lifespan 5. Maintenance impacts 6. Recyclability/reuse	3. Climate resilience and heat absorption 10. Water stress 11. Overheating	7. Aesthetics 9. Flooding 12. Biodiversity loss 14. Disruption to infrastructure	7. Aesthetics 2. Ethical sourcing 13. Pests & diseases

Measurable - value driven (Quantitative)

Human experience driven (Qualitative)

8. Cost

Asking key questions early on!

Be curious about the whole life cycle of materials and the impact on people, nature and planet...

2 Start by asking important questions...

Lets start with some important questions,

Do we need to use virgin materials at all?

Are there opportunities to use re-used/ reclaimed or recycled materials? Any innovative material solutions available?

Does the material selection complement its use type?

Making sure right materials type is used for pedestrian areas, heavy vehicle zones etc..

Prioritise nature and planet friendly materials?

Materials, products and details that respond to flooding, outdoor comfort, biodiversity

Are we staying local or going global?

Where is material coming from? Is it sourced locally vs globally? What is the impact of current political situation on material availability? How is it transported to site?

Initial carbon footprint vs long term benefits?

Material thickness - Longevity and maintenance over initial carbon? Long term benefits?

Is the carbon comparison like for like?

Are latest EPDs available for the products? Are they comparable and reporting the same figures? Is there additional data available that could be used?

Have qualitative vs quantitative factors been balanced?

Ensuring the selection in not purely based on the values but its impact on the design

Are people involved treated fairly?

Is it ethically sourced? Any methodology in place to measure ERI? Reputation of the supplier and their involvement in sustainability initiatives?

Is there a known plan for the end-of-life for the quarry?

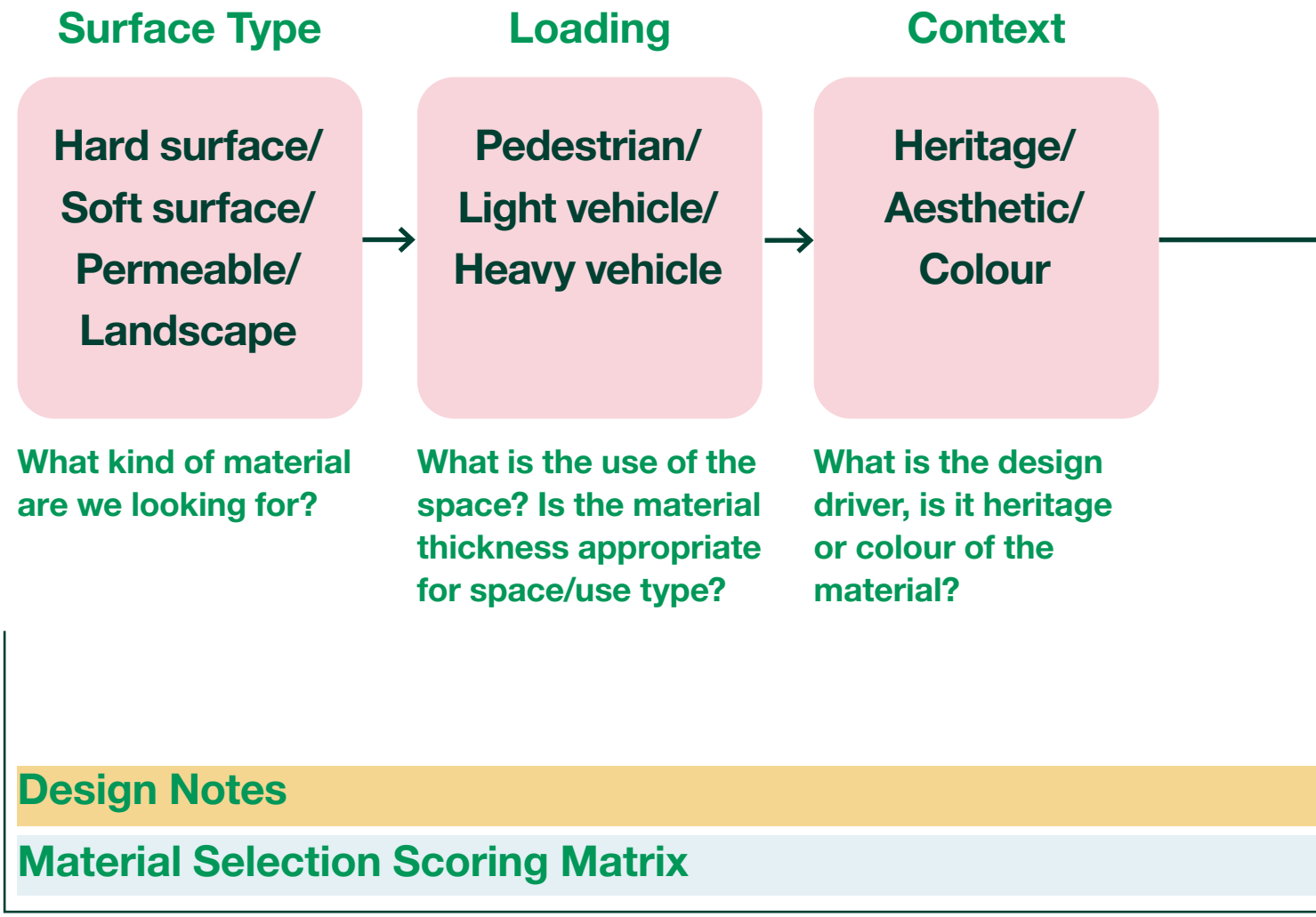
And to complete the cycle it is good to be aware of what is happening to the quarry after the material extraction process. Are there any strategies, standards and policies in place to protect the local environment and community?

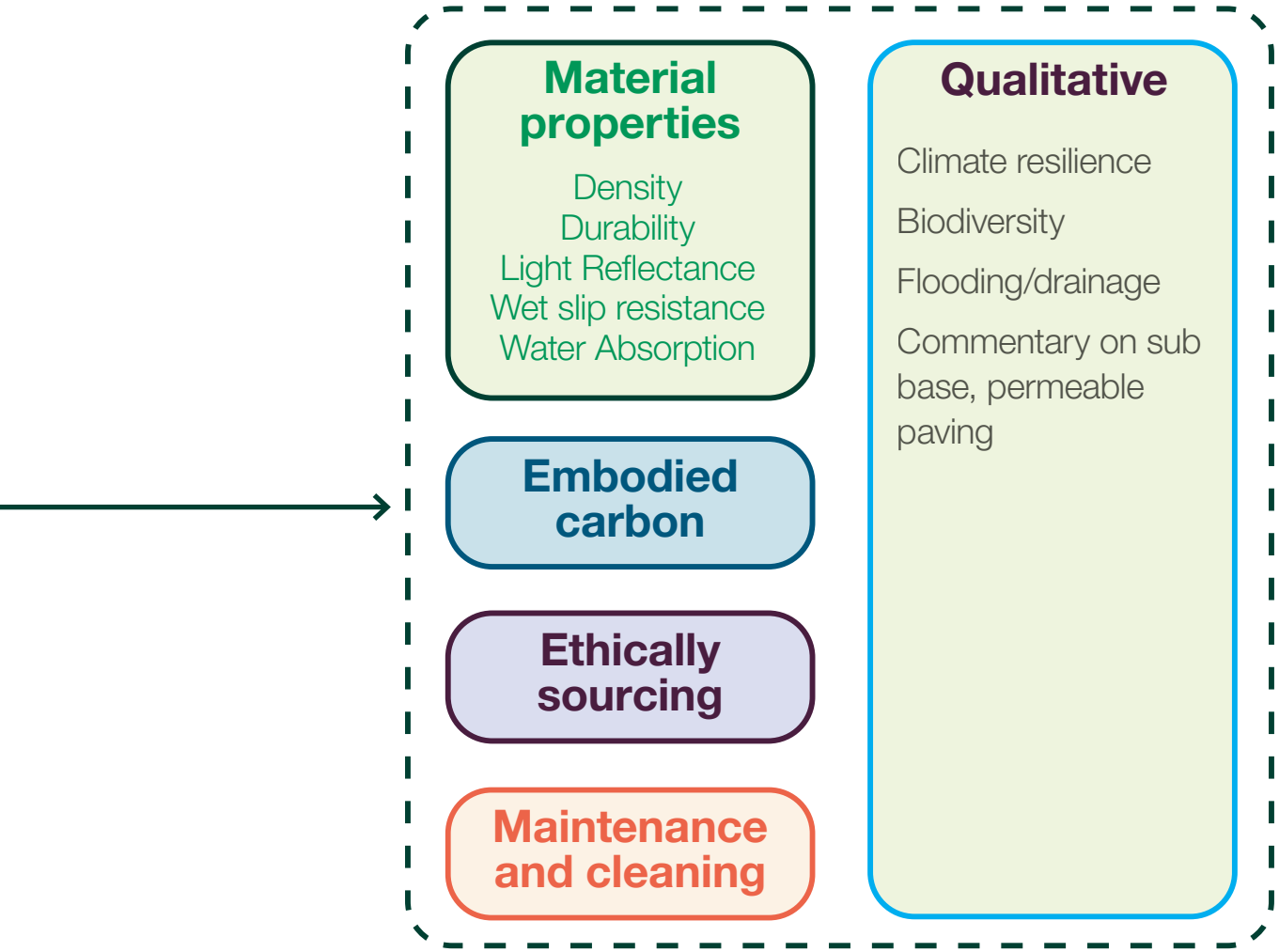
3 The ‘PROCESS’ of material selection

It was agreed to assess materials based on their carbon footprint, material properties, maintenance and cleaning regime, and alongside provide design notes covering the key principles through the following headings where possible:

- Carbon calculation commentary including any project specific issues
- Albedo and climate resilience
- Biodiversity
- Drainage/flooding
- Lifespan and durability
- Ethical sourcing
- Maintenance and cleaning
- Additional material commentary

The flowchart below maps out the expected way to use both ‘Design Notes’ and ‘Scoring Matrix’ simultaneously for the material selection.




Material properties
Density
Durability
Light Reflectance
Wet slip resistance
Water Absorption
Embodied carbon
Ethically sourcing
Maintenance and cleaning
Qualitative
Climate resilience
Biodiversity
Flooding/drainage
Commentary on sub base, permeable paving

4 Carbon

4.1 Cost versus carbon

Commonly, efforts are made to push for materials with the lowest possible levels of carbon. Care should be taken to ensure that a holistic consideration is taken of materials across the design, some materials or new technologies can come at a notable premium and may be favoured owing to their laudable credentials. In such instances where considerable uplifts in the cost of sourcing of material may apply, consider the below points:

Key points to be considered:

- Limited finances will likely always apply, and the best overall reduction in energy and carbon used should be sought across the scheme
- Give attention to the largest volume, count, or area of material to be used; and focus efforts on reducing the environmental impact with respect to this aspect of the design, as small gains over large extents may have a greater impact than small items with significant improvements. Excess spend in may prohibit sourcing of better materials or products elsewhere.
- Some products and technologies can attract a greater premium when in the infancy of their implementation. With increased use and demand these prices can fall with time, such as with continued reduction in costs of energy from PV solar panels. Consider trialling new strategies or materials as these may foster greater adoption in time and lower costs in future.
- New technologies may also be untrialled; a pilot project may be sensible. There could be possible issues or defects as such systems are refined. Early replacement of elements prior to the envisaged service life will result in a significant increase in total carbon use so best to eliminate issues on a smaller area.

4.2 Construction Industry methods of measuring carbon

The life cycle embodied carbon of a material or product requires reviewing carbon emissions throughout all life-cycle stages including product, construction, in-use and end of life stage. The potential for re-use can also be reflected, closing the loop and bringing in Circular Economy principles.

Key points to be considered:

- Most EPDs sourced for this review focus on the upfront carbon of the material, so there is a gap in Whole Life Carbon data
- The Scoring Matrix focuses on A1-A3 (product stage) embodied carbon,
- The largest other impacts will be from maintenance and replacement cycles. With the right specification of materials, these impacts can be reduced.
- CoL recognises they have a huge opportunity to encourage the re-use of materials across the borough and potentially London, which will reduce the emissions generated by manufacture of virgin materials.
- We recommend reviewing the product stage embodied carbon of the material (A1-A3 Summary of A-C module boundaries & EPDs).
- Check if the manufacture is recovering materials at end-of-life stage to reuse or re-purpose into new products.

4.3 Accuracy of carbon measurements

EPD (Environmental Product Declarations) are the industry norm in documenting the credentials of materials in use. These are costly and time-consuming to prepare and certify by third parties. They have a 5-year lifespan after which they will require renewal, so will reduce in accuracy towards the end of their calculation period.

Putting exact values against measurements is a complex process. Numbers cited often rely on multiple assumptions, which can be of varying degrees of accuracy, and still subject to change through ongoing impacts from world events or technologies.

World events can create some variations in the accuracy of EPDs. For example, the pandemic or conflict in Ukraine has had significant implications on international energy markets. In some instances, this may result in greater fossil fuel use and emissions from coal fired energy over gas; yet in other instances the increased costs of fossil fuels have pushed some suppliers to invest in sourcing of renewable energy supplies as this becomes less economically challenging and ethically preferably. However, with the progress of time, process and fuel sources are largely improving so future EPDs when renewed are likely to improve with time as grid energy supplies de-carbonise and societal efforts to improve technologies embedded.

Within the supply of public realm materials EPDs have appeared less common, so may not always be available. Some manufactures have their own internal systems of measurement, and may be misrepresentative[1]. Of key consideration is whether like for like values are being compared:

- One manufacturer may quote 20kgCO2e /kg to source a m2 of material, from a quarry and stock it for sale (A1-3)

1 Discussions on sourcing of materials with larger industry suppliers such as Marshalls and BBS have provided higher levels of confidence in their best endeavours to demonstrate an accurate number.

– Another might offer a value to supply and install the product 40kgCO2e/kg (A1-5) measurement, whilst
– Another might provide a value for the full life cycle to install and dispose of the product (A-C- inclusive of fabrication, install, use, maintenance, replacement and disposal) at 120kgCO2e/kg.

Different measuring boundaries can produce significant variations, but products may actually be comparable, they are simply viewed through a different lens. In a similar fashion, the units declared can vary for what the kg equivalent of carbon is cited to. Materials can be quantified in terms of their volume, mass in kilograms or tonnes, or use per m2. Accordingly, care should be taken to ensure like for like values are being used. Otherwise some products may be misvalued, particularly with respect to m2 usage and thickness of materials uses which can vary to account for differences in pedestrian, light and heavy vehicular traffic loading requirements.

Given the cost and effort to prepare an EPD, they demonstrate a significant selection bias. Those who invest in such documentation are likely to make considerable efforts to improve the product they supply. Suppliers who cannot provide data when requested are likely to not be comparable to those who can. Caution should be taken in considering materials which are like for like, do not offer an EPD or similar industry certification of their product.

Key points to be considered:

– Ask for current EPDs (updated every 5 years)
– Check measurement methodology and make sure like to like figures are compared

4.4 Selection of materials

For a high level of accuracy, the EPD values can be translated into project specific comparisons based on actual, expected material quantities.

For materials within the public realm the initial focus will likely be on the comparison of surfacing materials. However, the sub-base design required can also be appraised. [2.]

Key points to be considered:

– The extraction of natural stone materials is relatively low energy intensity in comparison to it's mass, even taking into account the cut with saws, and mill or flamed finished. So often a decision is made based on the performance characteristic's sought, such as cleanability, or slip resistance over embodied carbon and energy use in extraction and preparation.
– There is a broad correlation in regards higher carbon emissions and increased transport distances, but the vehicle also has an effect. Transport by water is the lowest, then rail, then road.
– Some materials such as those with excessive density may be cause intensive wear on cutting equipment, such as with Italian Porphyry stone. However, this density leads to an excellent life long durability. Such long lifespan will likely make the material favourable with respect to maintenance, replacement and potential re-use.

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2 Aggregate markets are quire variable in material sourcing, subject to supply raw materials or waste products are commonly interchangeable or mixed which can result challenges in attributing accurate values to the quantum of material use and its sourcing. It may be favourable in lieu of this to attempt to directly source waste product only, or where possible reuse local waste or crush from demolitions rather than import new materials.

5 Albedo and climate resilience

Creating cool micro-climates to tackle urban heat island effect

Public spaces in the City of London are much valued and highly used throughout the year. Creating comfortable human micro-climates is essential for success. Paved ground surfaces in public areas have a role to play, as exposed hard surfaces and their material properties have a direct impact on the local environment. For example using darker materials in a highly exposed space can elevate air temperature, leading to heat stress.

Additionally, we need to also consider the impact of material choices on usability of outdoor spaces in extreme climatic conditions. London experienced its hottest extended 3 months of dry summer in 2022. However, trends suggest 2022 might be comparatively cooler compared to predictions.

A further challenge related to heat waves is water stress and flash flooding. Therefore, it is crucial to consider the permeability of materials and sustainable drainage strategy for the wider area along with albedo and emissivity of the materials.[1]

To mitigate the urban heat island effect caused by materials for a well-designed public space it is important to consider the following:

Light reflectance of the surface materials (albedo):

- Materials with higher albedo (lighter surfaces) reflect more sunlight and solar radiation instead of absorbing it. This helps to limit the amount of heat re-emitted, making local temperatures comfortable to be used during late evenings.
- Material selection should be aligned with the surroundings, areas shaded with buildings and vegetation could have materials with lower albedo as they are protected from direct solar exposure, whereas highly exposed surfaces should have high albedo and reflectance properties.
- Additionally, it is important to consider risk of glare while selecting materials with lighter surface finishes. Excessively lighter surfaces can cause glare and visual discomfort both at the pedestrian level and in some cases at building scale.

Emissivity:

- The other key material property to factor in is thermal emissivity of the materials. Some materials start re-radiating as soon as they absorb heat instead of storing it for longer. The colour and finish of the material play a key role in this.

Solar Reflectance Index:

- SRI is a measure of both solar reflectance and emissivity of the materials. This is a good measure to use when selecting materials.
- There is currently a gap in the market on this subject but some suppliers have started to measure these values as part of technical specifications.

Permeability:

- Whilst it could be challenging for larger public realm areas to be provided with permeable surfaces due to loading requirements (heavy foot fall and traffic), It is important to consider key areas where permeable base and sub-base could be strategically positioned to allow water to infiltrate. This should not be limited to only permeable material choices but should be explored with sustainable drainage systems.

Integrating blue and green infrastructure:

- There are multiple environmental and micro-climatic benefits of integrating water features and vegetation to public spaces. The evaporative cooling effect in combination with evapotranspiration from vegetation has proven to create a positive impact on the micro-climate and external air temperature, factors that affect outdoor comfort and usability of external spaces.
- The market is continually evolving around this subject and it is good practice to find and use products and materials that allow integration of vegetation and biophilia.
- A combination of cool micro-climates can be created using strategies such as material reflectance in combination with vegetation, shading from surrounding buildings, adaptive shading and water features such as water fountains etc..

To mitigate climate change effects:

- Selection to be based keeping in mind global forecast of increasing temperatures.

1 https://www.cityoflondon.gov.uk/assets/Services-Environment/thermal-comfort-guidelines-for-developments-in-the-city-of-london.pdf

6 Biodiversity

Encouraging biodiversity uplifts and natural habitats

There are multiple benefits of increasing biodiversity in any given area to mitigate continued erosion of the delicate balance of biological systems, stemming from human action on the natural environment. Nature can help mitigate changes in climatic patterns, through maintenance of cooler temperatures, flood mitigation and habitat generation.

Within our urban realm, development is favoured over natural habitats, with only isolated pockets of parks and urban greening retained. However, increasingly, this approach is recognised for the lack of value it delivers (citation needed). Increasingly, the benefits of natural landscaping, and planting on health and wellbeing and biodiversity increases is being recognised. Mental health benefits and stress reduction is also noted.

Lastly, there is much focus on reducing embodied carbon of materials, however vegetation and plantation is the a sustainable way to capture carbon.

Below are ways of integrating biodiversity in public areas to address general, yet key concerns.

Creating biodiversity for all:

- Identify areas and opportunities for nature to flourish in multiple ways for the benefit of humans and ecosystems.
- Identify green spaces (of various scales) that positively support the wellbeing of people; spaces that could be used for restoration, contemplation, leisure, walks, or exercise.
- The other end of the spectrum is provision of habitats and ecosystems for different species. Vegetation provides a habitat for other species to establish themselves within. Key to this is creating biological 'green' highways for species to move between and establish natural hierarchies[1].
- Biodiversity uplifts have been reflected in various spatial development frameworks, varying from city to building scale, including 'The London Plan'.
- Additionally, there are opportunities for productive planting, could urban farming be tested at the heart of the City?

Improving air quality and effective noise barriers:

- Finding a quiet and calm space in the middle of the city is highly valued. These spaces could be created by strategic location of vegetation and trees. One way to approach this could be by identifying highly affected zones/ areas such as public spaces adjacent to the vehicular traffic where vegetation could be used as green barriers. This creates buffering between sources of pollution and public spaces[2], which improves health by reducing exposure to pollutants such as NOx, SOx and particulates.
- The selection of the species should be carried out with the help of landscape designers and ecologists, identifying species that can actively break down pollutants, further improving air quality.

Natural carbon capture:

- Plants naturally absorb carbon dioxide from the atmosphere through photosynthesis, therefore forests (old and young) act as a carbon sink. A forest can't be replicated in city spaces can't be compared but larger volumes of plants and trees can be proposed that can sequester small volumes of carbon[3].

Mitigating flooding through SuDS and rain gardens (See section 8):

- Creation of softer landscaping and areas for extents of permeable, more sustainable drainage for rainfall & surface water to drain percolate to ground water
- Vegetation can draw on surface water for hydration to mitigate surface water run-off and flooding concerns

Use trees to create cooler environments:

- Vegetation can provide seasonal shade, reducing solar gains reaching the built environment or paved surfaces. Stopping points should have an option of shaded area that allows people to choose as per their requirements.
- Parking areas and pedestrian routes would highly benefit from the shading that vegetation could provide.
- Vegetation provides evapo-transpiration by releasing water and providing cooling to spaces where present, reducing the impact of urban heat islands and providing a variation of scenarios for users to enjoy.

1 For example, patches of vegetation can support insect populations better with varied

2 https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/british-trees/tackling-air-pollution-with-trees

3 Urban environments will likely restrict growth of roots, access to light, which in tandem with pruning for management will likely limit the meaningful quantum of carbon sequestered versus those in natural habitats.

7 Drainage/flooding

Causes of flooding and mitigation
Extreme weather patterns are one of the consequences of global climate change. This includes strong heat waves and heavy or excessive rainfall in short period of time (flash floods).

Existing drainage systems were not designed to accommodate such large amounts of water. Many parts of inner London have sewer systems that carry rainwater as well as sewage. These Victorian 'combined sewer systems' were designed for a city of four million people. But with sewage from almost nine million people, the network is now at more than 80% capacity, even in dry weather[1].' Furthermore, 'Climate projections predict that London will experience warmer and wetter winters, as well as more frequent and intense rainfall events. This will increase the risk of the drainage system being overwhelmed.'

Below is a list of strategies to be considered to mitigate flooding:

Identify issues:
- Start by assessing the current SuDS strategy for the public area, any issues and concerns regarding continuous rainwater collection areas/points that need addressing.
- This would help identify potential/ most suitable areas to integrate SuDS features, hence improving its effectiveness. Focus should be given to forming an overall area and site wide landscape strategy so an ecosystem could be created.

Hard-engineered water management (Grey SuDS):
- Hard paved surfaces, decking, concrete, asphalt, surfaced paved for roads, parking spaces, public plazas etc. reduces the amount of rainwater seeping through to the soil underneath, increasing further strain on the existing drainage/ sewage system resulting in flooding. It is possible to increase the surface permeability through permeable block paving that not only allows the water to seep through but also traps vehicle pollutants.
- Further hard-engineered solutions include permeable paving, attenuation tanks or soakaways that hold the water and release it in a managed way to reduce the pressure on sewers.

Nature based solutions (Green SuDS):
- There are amenity and biodiversity benefits that green SuDS can bring to a site.
- Nature based, green SuDS include rain gardens, swales/channel/rill, wetlands etc.
- Standard piped gulley drainage systems can be replaced with modular rain gardens, which filter out contamination (e.g.. micro plastics and carbon from transport) and contribute to the landscape setting. Seating can also be included.

SuDS inter-linked benefits:
- Carbon reduction opportunities exist as many SuDS products on the market now include recycled type 3 materials for permeable paving and below rain gardens.
- Climate change mitigation benefits including control of urban heat island effect and improved micro-climate.

1 https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/climate-change/surface-water/sustainable-drainage-london?ac-39384=39383

8 Ethical sourcing

Ethical sourcing is a social responsibility - learn about your material supply chain
Understanding the full supply chain in the Natural Stone sector is a challenging but crucial step.

While Net Zero Carbon remains a key focus, we need to ensure that social value, ethical sourcing and material procurement are given attention. This includes awareness around modern slavery and the health and safety of workers involved in the process right from the quarry to the material reaching on site and construction.

There has been lack of transparency around processes involved in material procurement, which are often difficult to measure or quantify. There are many helpful methodologies and frameworks based on questions and commitments that are used to calculate an Ethical Risk Index.

Marshalls have set their own framework with the aim towards creating full supply chain transparency (especially when the materials are imported from other countries which lack policies). They respect the requirements of international law, the UN Global Compact principles, the Ethical Trading Initiative base code, and compliance with the Modern Slavery Act 2015[1].

Below, are example questions to be asked of suppliers:

Social responsibility
- Ask suppliers if they are members of Ethical Trading Initiative (ETI) and to confirm that all the plants/ factories they source materials from are audited via ETI.
- Encourage only working with suppliers that are ETI members.
- Ask suppliers regarding their commitment in increasing awareness around the Modern Slavery Act.
- Work with suppliers who can provide transparency of supply chain of the raw material.
- Check if the suppliers have policies and frameworks that ensure health and safety precautions and welfare of workers, that their salary is fair, and exploitation is eliminated through excessive unpaid hours.
- Are initiatives taken to improve the social well-being of the workers and any opportunities to connect to or benefit the wider community within which the business operates?

Environmental impact
- One of the biggest concerns raised during discussions with suppliers was about lack of national legislation regarding the ground holes at the end of the life. Queries can be raised on this before procuring material.

Further concerns to ask suppliers to respond to include:
- Mitigation and regeneration of damage to local biodiversity and natural habitats around the extraction sites
- Impact on the water quality,
- Impacts on air quality through smoke generated
- Fuel types (are processes powered by renewable energy?)
- What is the operating company approach to Net Zero Carbon or Carbon Neutrality?

Sustainable economics
- Create opportunities for value creation in the selection process.
- Design, keeping in mind longevity and adaptability.
- Encourage and develop new economic models that benefit environment and community.
- Encourage use of local materials (low embodied) with low carbon manufacturing and transportation.
- Promote and encourage local partnerships, innovation and entrepreneurship.
- Continue to research and introduce materials from up-coming start up businesses that use low embodied carbon and recycled materials. This will encourage to create new business opportunities and new generation of manufactures and service providers who build business models around circular economy principles.
- Reduce transport distance and supply chain lengths.

1

9 Lifespan and durability

Balancing material efficiency, life cycles and end of life to reduce carbon emissions

Materials with high density and greater thickness are preferred for public realm as they are expected to have higher durability and longer life span.

If we directly translate that into embodied carbon terms, then the thicker the material, the higher the associated carbon emissions. Therefore, it is key to ensure that material thickness responds to the function of the space. For example, areas with only pedestrian movement don't necessarily require the same thickness and material properties as for heavy vehicle zones.

The other key aspect to remember is the replacement and maintenance cycle, optimising the material thickness to avoid having to replace them every few years. Focus on the installation methods and details, as at times install methods will fail before the material, typically with hard and dense materials.

Lastly and most importantly, make material selection based on the circular economy principles: elimination of waste and pollution, circulation of products and materials and regeneration of nature.

Further key points to be considered in regards to durability and longevity of materials:

Designing right:

– Right design for the right allocation, don't over design, but also don't under design. You might exceed the regulatory performance requirements, but if heavy loading access is restricted, then we can relax the material thickness.[1]

– Natural stone is a dense, and heavy product, but lower carbon to extract. As such, the shipping and transportation of materials contributes a greater quantum of embodied carbon. This contrasts with other materials used in the industry which tend to be of lower volume and density, but often feature a greater use of energy to extract and process the materials.

Cost vs longevity:

– There are benefits of preferring longevity over saving on initial material cost. Good quality, the correct thickness, robust installation methods, maintenance and cleaning regimes helps promote longevity of the materials.

Discussion with the engineers:

– Before the material selection, ask engineers for input on material optimisation opportunities and installation methods. Reducing the depth of sub-base can save carbon/ cost, maintenance etc.

Think about circularity:

– Could the starting point be re-using existing materials and then designing for deconstruction/after-use of the material.

– Invest in locally sourced materials and high-quality workmanship

Think about afterlife of the material - Material Recyclability:

– There is a huge reclaim market where reused materials can be sold. Kerbs are highly reused.

– Excessively damaged materials can be crushed and reused for aggregates or concrete mix.

1 Meeting notes - BBS and Marshalls

10 Maintenance and cleansing

Cleaning regimes impact the material properties and performance

Discussions with suppliers (BBS and Marshalls) highlighted the importance of maintaining cleaning regimes based on cost and practicality. For example, dry ice for cleaning can be both expensive and carbon intensive. Certain stone types like buff granite absorb dirt and are difficult to keep uncontaminated. Other considerations are slip resistance and texture.

Below are further considerations:

Slip Resistance

- All public realm material will need cleaning to remove contamination including rainwater, liquid spillages, oil, grease, dust or product wrapping[1].
- Cleaning could have an impact on the thickness and roughness of the material. Slip resistance can vary with the life of the flooring material. The texture of the stone never fully erodes but can get impacted by the cleaning regime. The manufacturer or supplier recommended cleaning regimes should be adhered to.
- It was advised to avoid buff granite, due to discolouration. In general granite should be sealed to protect the top 3mm layer and avoid dirt percolating into the stone. Power washers tends to push the dirt into the stone, so important to protect the top 3mm layer.[2]

Management issues with vegetation:

Planting is largely seasonal, so deciduous planting will result in the shedding of biological matter such as leaves or fine organic material. This can have multiple implications which require appropriate maintenance:

- Blockages of surface water drains
- Staining or surfaces which can create a lower quality aesthetic environment
- Contamination of surfaces with biological matter which can create a reduction in the performance of a materials slip resistance

Creation of natural habitats will also serve to support 'species of least concern' such as pigeons, rats or other vermin. These will accordingly need appropriate management:

- Means to hinder infestation for example management of food sources or refuse which foster population growth.
- Cleaning of droppings in areas where particular species may congregate such as roosts or perches for pigeons.

Management of habitats – during construction:

- Natural habitats can be significantly impacted by displacement, noise, vibration, dust and drought associated with construction works. Temporary measures should preserve existing habitats, as required in emerging policies within London - see policy Westminster Code of Construction Practice (2016) Item 3.7.1[6], with green hoarding systems.[3]

Management of habitats – during construction:

- A balance should be struck with consideration as to how natural habitats might be managed.
- Ongoing human disruption can serve to hinder biodiversity, for example frequent pruning back of vegetation so that plants look presentable may hinder the development of specific insect populations. A natural habitat by contrast would be largely untouched. Landscape architects and urban planners should give consideration to the diversity of planting and it's management to best support longevity and ecological balance. This may drive a difference in approach to the aesthetic of soft landscaping, where homogeneous low maintenance species are avoided in favour of more seasonal and varied mixes.

1 https://app.croneri.co.uk/feature-ar-

2 Meeting notes - BBS and Marshalls

3 https://davisla5.files.wordpress.com/2014/03/general-gordon-square-woolwich-step-in-planting.jpg

Vertical Green hoarding system:

11 Additional material commentary

List of Additional Materials	Can the product contain recycled material	Potential to recycle material after use	Response to climatic concerns (UHI effect/ SuDS compliant/ biodiversity)	Usability
Bound gravel	Yes	Yes (Unless resin is the binding agent)	Permeable - complaint with SuDS, Water flows freely through the small stones and into the ground	Sub-base is essential, depending on the installation type could be suitable for walking, cycling etc. For vehicle use it has to be resin bound.
Permeable paving[1]	Yes	Yes	UHI, SuDS compliant, Biodiversity friendly	More suitable for public walkways.
Rubber crumb[2]	Yes	Yes	Increases UHI as it absorbs direct sunlight and heats up	Concerns regarding tyre rubber on the health and wellbeing and soil, water contamination[3]
Coloured asphalt	Range of products available[4]	Range of products available[5]	Options available in porous asphalt to support sustainable drainage[6]	Suitable for pedestrian and vehicle use.

1 https://www.sudstech.co.uk/ceramapave/

2 e.g. ecosurface https://www.ecosurface.co.uk/rubber-mulch/?gclid=EAIaIQobChMIj8HroP_7-wIVTtPtCh06RwbiEAAYAiAAEgJ65_D_BwE, https://easeals.co.uk/rubber-recycling/

3 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9003429/

4 https://tarmac.com/products/asphalt/recycled-asphalt/

5 https://tarmac.com/products/asphalt/recycled-asphalt/

6 https://tarmac.com/products/asphalt/ulticolour/?cs1_c=52.486243%2C-1.890401&cs1_z=7&cs1_p=