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Carbon reduction and planning of active travel projects

Translating good practice and international standard
into specific guidance for active travel infrastructure construction in Scotland

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Abstract

Given the critical role of carbon dioxide in global warming and the need for net-zero emissions to stabilize climate change, this study evaluates the carbon footprint associated with different stages of greenway (traffic free route) projects, from material selection to construction processes. The research identifies potential areas for carbon reduction and environmental improvements throughout the life cycle of active travel infrastructure.

The methodology involves using the Life Cycle Assessment (LCA) method and the study examines both "Build Over Existing Infrastructure" and "Newly Built" projects to compare their carbon footprints.

The results indicate that refurbishing existing infrastructures typically results in significantly lower carbon emissions compared to new constructions, highlighting the potential of "Build Less" strategies in achieving substantial carbon savings. Additionally, the inclusion of green infrastructure, such as planting large trees, was shown to provide significant carbon offsets, with projects incorporating tree planting offsetting up to 49.05% of their total carbon footprint.

The analysis of different pavement options reveals that permeable blocks and concrete flags offer the lowest carbon emissions, although they may not always be suitable for all types of active travel paths. Warm mix asphalt, while offering moderate carbon reductions, presents a balanced option with lower emissions compared to traditional asphalt.

The research concludes that integrating circular economy practices, such as using recycled materials and considering environmental impacts during the planning stages, can substantially enhance the sustainability of active travel infrastructure. The findings provide insights for policymakers and practitioners aiming to promote sustainable and low-carbon active travel solutions.

Keywords “Active travel projects”, “green ways”, “carbon emission reduction”, “life cycle assessment”

Originality statement. I hereby declare that this Master’s dissertation is my own original work, does not contain other people’s work without this being stated, cited and referenced, has not been submitted elsewhere in fulfilment of the requirements of this or any other award.	**Signature**

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Nevertheless, I hope its content will eventually help future students, especially those fortunate enough to experience the unparalleled journey that is Murcs.

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1. Introduction

1.1 Rationale

Carbon dioxide is the main gas responsible for greenhouse gas emissions and accounts for more than 80% of global warming and its net emissions must be zero in order to stabilize climate change (Secretary-General of the OECD, 2018). For hundreds or perhaps thousands of years, CO_2 remains in the atmosphere. As long as people continue to produce more carbon dioxide than nature has the ability to filter through its sinks (oceans, forests, and other vegetation), atmospheric CO_2 concentrations will continue to rise and the climate will continue to warm (Fay et al., 2015). The Paris Climate Agreement temperature objective must be achieved in order to keep the increase of the global surface temperatures below 1.5°C, and even if these increases are kept well below 2°C, people and ecosystems would still have to adjust to potentially serious adverse effects. This would decrease the chance of "severe, pervasive, and irreversible" alterations. 136 nations have now included building emission reduction in their Nationally Determined Contributions, and 80 countries have developed building energy regulations to help guide emission reduction in the building sector in order to fit in with the Paris conversation and achieve the net-zero target until 2100 (Secretary-General of the OECD, 2018).

On the other hand, there is no indication of a slowdown in the trajectory of carbon emission. It makes sense that countries that are urbanizing—which often signify a more vibrant market for the construction industry—would have higher rates of Carbon Footprint (CF) than nations that are already heavily urbanized. The construction sector, which is a major driver of economic growth in developing nations, had a 67% average global rise in 2020 (Onat and Kucukvar, 2020). Over 16% of the country's carbon emissions in the United Kingdom are attributed to the phases of infrastructure construction and operation (Construction Leadership Council, 2013). Building operations accounted for 37% of all energy-related CO_2 emissions globally in 2020, which has the potential to significantly exacerbate the current climate problem. The assessment and improvement of CF management techniques in the built environment for carbon reduction can have numerous positive social effects on society because emissions are linked to serious environmental and health externalities (Fang et al., 2023).

Regarding to the transport industry, it is one of the primary anthropogenic sources of CO_2 emissions in the atmosphere as it is the greatest end-use consumer of energy. Urban transportation is the part of this sector that has the most issues. In addition to the threat posed by climate change, a heavy reliance on fossil fuels for daily transportation in cities has a severe social impact and damages the ecosystem. The quality of life for urban residents as well as the local and global environment depends on decisions made about local transportation development (Mrkajic et al., 2015).

Infrastructure needs to be resilient to the effects of a changing climate while also being consistent with low-greenhouse gas (GHG) transitions. Because infrastructure assets have a lengthy lifespan, decisions made now that don't take these effects into account will lock in vulnerability. In order to keep up with development, it is anticipated that USD 6.3 trillion would need to be invested in infrastructure annually between 2016 and 2030 (Secretary-General of the OECD, 2018). This is a substantial magnitude of investment decisions and this estimative excludes costs associated with adaptation or mitigation. The majority of investment requirements in low- and middle-income nations will result from the growth of metropolitan regions. In order to make sure that those assets are prepared for climatic fluctuation and change, their location, design, and management must all be taken into account.

It is frequently questioned if, by end of the century, all economic activity will be fully carbon neutral. One thing that is really important to stress is that decarbonization or carbon neutrality don't necessarily imply zero emissions. Natural carbon sinks and negative emissions from other sectors and nations can partially offset positive emissions in some industries and countries (Sovacool et al., 2022). Decarbonization entails both stabilizing emissions of short-lived greenhouse gases like methane, which disappear from the environment in a matter of days, weeks, or decades, as well as achieving zero net CO_2 emissions (Rozenberg et al., 2015).

In this perspective, the Scottish Government announced record funding for active travel in its draft budget proposal for 2023–2024, allocating nearly £190 million for the purpose. Additionally, the Scottish Government and the Scottish Green Party agreed in the Bute House Agreement of 2021 that by 2024–2025, active travel would receive at least £320

million, or 10% of the total transport budget, set aside for it. (Department for Transport, 2021)

According to the Department for Transport (2022), roads will become calmer, safer, and more appealing for people to walk, ride, and stroll—a positive feedback loop—when more people travel actively. Also, making all autos, public transportation, and heavy goods vehicles (HGVs) nearly zero emissions is a part of the solution.

Active travel describes forms of transportation that call for some degree of exertion. Although the terms "active travel" and "walking/cycling" are frequently used interchangeably, wheelchair, mobility scooter, adapted cycle, e-cycle, scooter, and cycle sharing programs can also be considered forms of active transport (Welsh Government, 2022). According the document Wheels for Wellbeing (2020) cycling encompasses a broad variety of cycle styles, including: bicycles, handcycles, tricycles, recumbent tricycles, go-karts, cycles for 2 (tandem, side by side, wheelchair tandem and duet bikes).

The benefits of walking and cycling for short trips (48% of trips in urban towns and cities are under 2 miles) will be matched by notable gains in public health and wellbeing, as well as reductions in carbon emissions, air pollution, noise pollution, and traffic. According to the transport decarbonization strategy, active travel can save between 1 and 6 million tons of CO2e between 2020 and 2050 (Department for Transport, 2022).

Promoting active travel has received significant attention, both during the COVID-19 lockdown and currently as part of COVID-19 recovery initiatives. Many people used active transportation throughout the lockdown, including walking and cycling for exercise and local shopping. Active travel is now viewed as a better method to keep people moving in a way that can benefit public health, avoid traffic, worsening air pollution, and rising carbon emissions when we break out of lockdown and public transportation is restricted to only necessary trips. In order to achieve this, the UK government established an emergency travel fund in May 2020 to encourage active travel as part of its COVID recovery plans (University of Leeds, 2020).

In addition, according to the Carbon Management Guidance for Projects and Programmes, if is required funding from the Scottish City Region and Growth Deal projects, it’s mandatory that every project must account for the impact of carbon emissions and the minimisation of carbon must form a demonstrable part of the decision-making process (Scottish Government, 2022).

However, there is a lack of specific guidance for sustainable infrastructure building, particularly in the context of active travel projects, despite the increasing recognition and adoption of circular economy and sustainable construction practices. While there is growing advocacy for better and more sustainable methods and materials, this guidance gap hinders the implementation of innovative practices and limits the potential for maximizing the positive impact of active travel infrastructure.

Given the crescent focus on sustainability and the urgent necessity to reduce carbon emissions, studying the lack of specific guidance for sustainable infrastructure construction in the context of active travel projects becomes strongly pertinent and the research outcomes have the potential to shape future practices, enhance the positive impact of active travel infrastructure, and contribute to the larger goals of sustainability, circular economy, and carbon reduction in the built environment.

1.2 Aims and Objectives

The aim of this research is to **inform sustainable practices on decarbonizing the planning and construction of active travel infrastructure**. From this, it is possible to derive a series of objectives to be addressed by this research:

- Evaluate the carbon footprint associated with different stages of active travel infrastructure projects, including materials selection and construction processes
- Identify potential areas for carbon reduction and environmental improvements within the life cycle of active travel infrastructure.
- Develop specific recommendations for carbon footprint decision-making approaches for active travel projects, integrating sustainable principles, circular economy concepts, and carbon reduction strategies

2 Literature review

Three search strategies were utilized in the literature study to discover pertinent industry materials and academic papers published between 1996 and 2023. This comprehensive approach ensured a thorough exploration of the available research and practical information related to active travel, cycling routes, and carbon emission reduction.

In the first method, a search of renowned literature repositories such as Web of Science, ResearchGate, Scopus Science Direct and finally Google Scholar was conducted. These platforms were chosen due to their widest coverage of academic literature for different scientific topics. The search used inputs such as "active travel", "cycling route", "green way", “pavements", “sustainability”, “sustainable infrastructure”, “carbon emission reduction” and “life cycle assessment”. This method ensured the wide net necessary to identify the broad swath of key academic publications.

The second method was to search for publications related to the field of sustainability in construction, environmental science and civil engineering. This was used to target papers by using the above-mentioned keywords in various combinations. Some of those journals are the International Journal of Life Cycle Assessment, The Energy and Buildings Journal and also the Cleaner Production. This strategy proved to be useful in identifying relevant and peer-reviewed research in particular subject areas.

In the third method, relevant industry publications, websites, pilot studies and government reports were manually searched. It was key to find practical software, technology and database information on commercial carbon footprint management practices. This approach also explored non-academic sources to ensure the insights were industry specific.

According to the Construction Leadership Council (2013), there are some key definitions for carbon emissions used in technical literature in the UK:

Carbon is used as shorthand for the carbon dioxide equivalent of all greenhouse gases (GHGs).

CapCarb (or Capital Carbon): refers to greenhouse gas (or carbon) emissions associated with the construction of an asset. Previously known as embodied or embedded carbon, capital carbon is being adopted within the infrastructure sectors because it accords with the concept of capital cost.

OpCarb (or Operational Carbon): describes greenhouse gas (or carbon) emissions associated with the operation of an asset.

Whole life carbon: describes greenhouse gas (or carbon) emissions associated with the whole life of an asset. Whole life carbon includes CapCarb and OpCarb. CapCarb relates to the emissions for constructing and maintaining an asset.

UseCarb (or End User Carbon): describes greenhouse gas (or carbon) emissions from the end users of infrastructure assets. Although not directly controlled by infrastructure asset owners, UseCarb can be influenced.

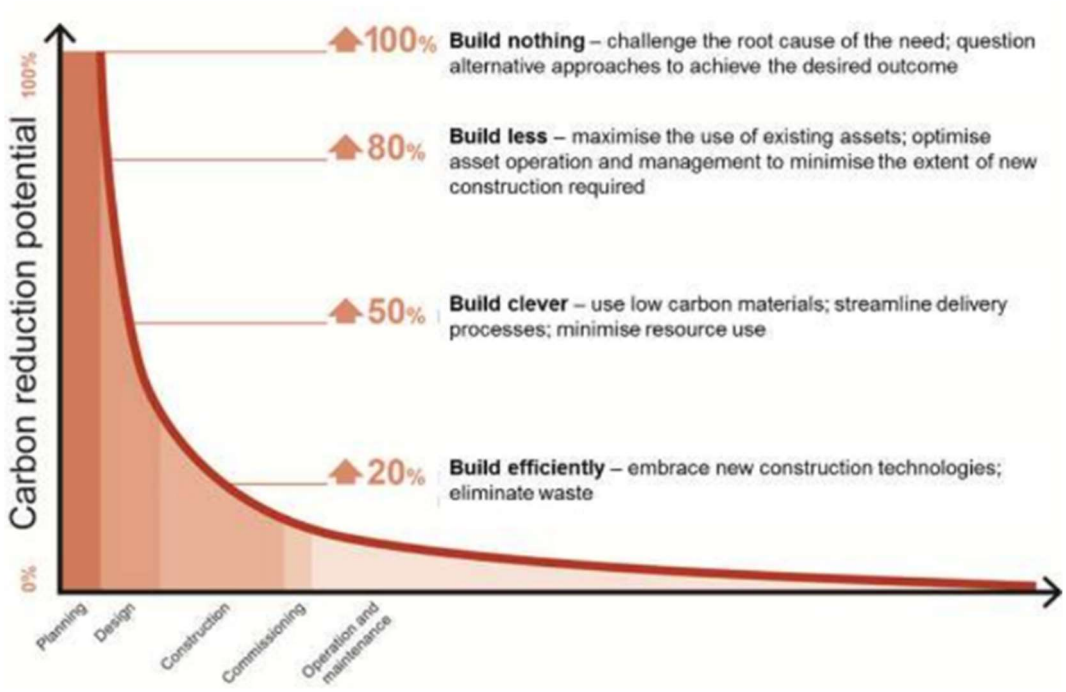


Figure 1 - Carbon reduction curve (Construction Leadership Council, 2013)

"Asset intensive" infrastructure sectors like water, transportation, and some parts of the power industry have the potential to lessen their CapCarb impact by using the "Build nothing" or "Build less" approaches, even though these are motivated by cost savings. This

is because CapCarb reduction is primarily associated with resource efficiency. In particular, there is a larger chance to reuse existing assets to accomplish the same service outcomes from new infrastructure when renovating or sustaining current infrastructure assets. When compared more conventional infrastructure delivery methods, such techniques, if implemented during the project's planning stage, might result in CapCarb savings of up to 50% (Construction Leadership Council, 2013).

In 2021, Sustrans released the document *Paths for everyone*, focusing on explaining how the National Cycle Network master plan will ensure the Network connects communities and focuses on enhancing connectivity for residents in more impoverished places as it grows to better connect metropolitan areas. It has a section related to the decarbonization of UK transport, where it says that by 2050, the UK government hopes to have achieved net zero carbon emissions and cars accounted for 55% of domestic transport emissions in 2018, making surface transportation the sector that contributes the most to carbon emissions in the country. It also mentions the Network is located within Air Quality Management Areas for around 619 miles but it does not touch the topic of the Network's construction decarbonization (Sustrans, 2021).

Aryan et al (2023) says that studies relevant to life cycle assessments of road infrastructure and pavement have increased significantly in recent years. LCA is essentially a cradle to grave assessment technique that examines the environmental effects of any process or product, beginning with the extraction of raw materials and continuing through manufacture, production, and construction, operation and maintenance, and final disposal (Azarijafari et al., 2016). Using a variety of impact indicators, LCA provides a thorough framework for determining the environmental implications. The procedures of LCA have been now standardized as a part of the ISO 14000 Environmental Management Standards (EMS) (Azarijafari et al., 2016). The methodological framework is given by ISO 14040 and ISO 14044 defines four inter-related stages of LCA.

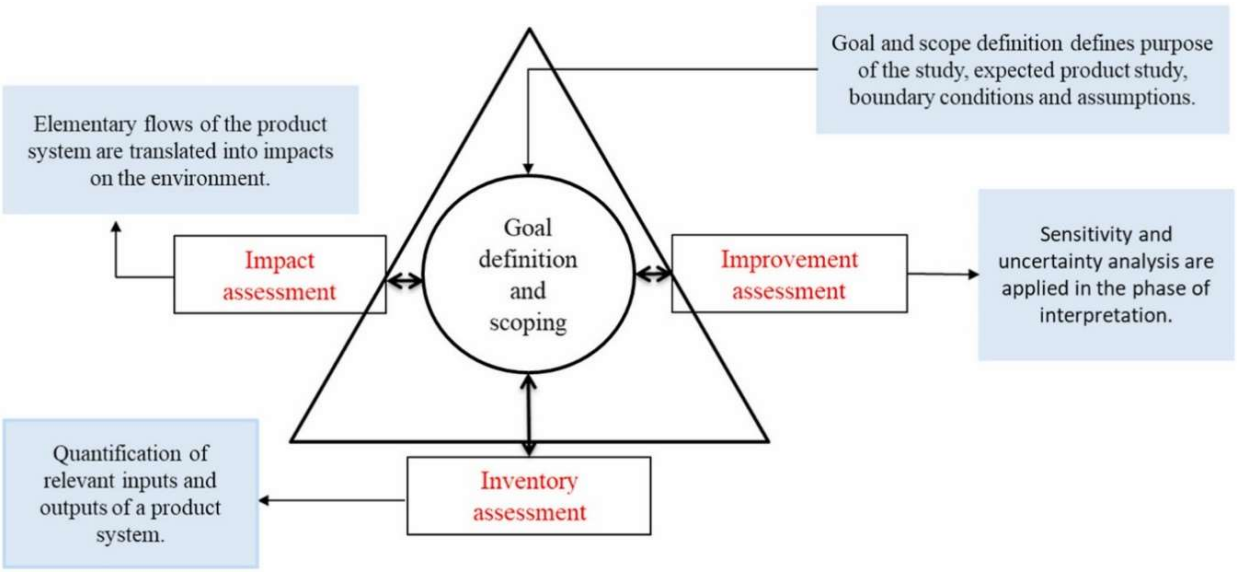


Figure 2- LCA framework as per ISO 14044 (ILCD, 2010).

In the US, Roudebush (1996) carried out the first life cycle assessment comparing the environmental effects of concrete and asphalt highway pavements (Yu, 2013). Many life cycle assessments have been carried out in the last thirty years to evaluate the environmental effects of rigid and flexible pavement by a number of researchers, including Park et al. (2003), Zapata and Gambatese (2005), Horvath and Hendrickson (1998), Häkkinen and Mäkelä (1996), etc. In their life cycle assessments, researchers began to take into account supporting road infrastructures in addition to pavement in the early 2000s.

In order to create a life cycle inventory (LCI) for road infrastructure, Stripple (2001) carried out an LCA analysis, which involved comparing the energy consumption, resource usage, and emissions resulting from the hot-mix and cold-mix methods for asphalt roads to those for concrete roads. Road infrastructure, traffic signals, road markings, lighting, and system boundaries, were included in the study.

Grael et al. (2021); Singh et al. (2020); Bizarro et al. (2021), are also studies that have examined life cycle analysis and LCA based on the carbon footprints of road surfaces. Some of these studies have even concentrated on specific stages, like the preservation and reconstruction of road surfaces (Jiang et al., 2020; Liljenström et al., 2022, Kiihnl et al., 2021). A number of other investigations have assessed the impact from different angles, examining intriguing aspects like the extension of land use changes (Mroueh et al., 2000), and material decomposition and recycling Gulzar et al., (2023); Tarsi et al., (2020); Enfrin et al., (2022).

While these papers provide valuable data on new materials that can be utilized in active travel projects to achieve carbon reduction, they fall short in addressing this particular segment of infrastructure. Specifically, there is a noticeable gap in research when it comes to the application of carbon calculation tools for sustainable cycle network design. This gap is highlighted by the lack of studies comparable to the work of Manton et al. (2012). Most notably, Manton's study enters in the specifics of on-road cycling routes, dedicated cycle lanes, and greenways (traffic-free routes), providing analysis of the carbon footprint associated with each.

Much valuable literature has already been published on integrating circular economy into the construction sector, for instance the Circular Built Environment Playbook (2023), developed by World Green Building Council. This is a comprehensive guide to a regionally focused, resource-efficient approach aiming on transforming current homebuilding. One of the key recommendations is to embed circular design early on in planning and designing practices. Identifies recycled materials suitable for use in infrastructure construction and considers strategies to maximize resource use (e.g. reduction of waste, extending the life cycle).

The playbook is not only theoretical in nature but also includes a range of case studies and examples from around the world as best-practices. This collection of real-world exemplars outlines the successful deployment sites for following Circular Economy principles with construction projects and useful lessons learned from their application. The cases data further shows that adopting flow-through practices contributes to economic and environmental benefits - cost savings, less resource depletion, lower ecosystem destructions as well as infrastructure preparedness.

Moreover, the presented playbook also helps to gain insights applicable to the active travel construction and design process. With the aid of circular economy principles discussed in the document, it is possible to achieve higher sustainability, efficiency, and project longevity. The examples provided in the playbook can be used to address specific challenges experienced during the lifetime of the building and construction project and help professionals from the mentioned sector purpose effective solutions.

Finally, a recent study published by Fang et al. (2023) delved into developing a decision-making framework focused on carbon footprint management (CFM) for infrastructure projects. The framework aims to connect carbon footprint management strategies by decision-makers across both the building and civil engineering industries. It provides a logical approach to carbon footprint oversight and allows for more informed choices at each phase of a project's lifespan. The framework is used as a flexible tool that permits project leaders to adopt or re-evolute CFM approaches as they are evolving to case-specific and the next phase in the project cycle is approached. The report provides insight on the variations and linkages between CF management in buildings versus infrastructure, explaining that although LCA is a common method used in both sectors, there are far more types of CF treatments applied within building sector. This framework, implemented in a decision tree-style system context scenario, method and project-based information that could be used more systematically to improve management of CFs while encouraging sustainable infrastructure development can directly inform an active travel design process.

3 Methodology

3.1 Decision making process of Carbon Footprint (CF) Management

In this study was adopted the development of a five-staged CF management adoption decision-making process flow made by Fang et al (2023), which was based on Gu and London's (2023) BIM adoption framework, with additional inspiration from the interpretation of LCA's four-stage (Fenner et al., 2018) and the improved three organizational CF themes (Robinson et al., 2023). The process flow structure that has been created delineates the crucial phases at which the Architecture, Engineering, Construction, and Facilities Management (AECFM) organizations and associated stakeholders engage in the process of implementing CF management tools and practices for their sustainable built environment projects. This new structure has the following stages for CF decision-making:

Project Drafting

The first step begins by setting exactly what the CF project will involve: its scope, functional units and specific points in operation. A set of conditions needs to be agreed upon by the participants over such aspects as what kind it should involve (e.g., road), where (e.g., Holland), and the expected life-span it will have (e.g., 30-50 years). This agreement assures that all involved are looking at more or less the same thing when they evaluate the project.

Methodology Choosing

In this stage, the CF project leader should define what precise project requirements and boundaries are: for example, embodied and operational carbon emissions. Based on such criteria, it is chosen a CF analysis method from the available ones (LifeCycle Assessment (LCA), Environmental Cost Management (ECM), simulation with Monte Carlo (MC), Multi-Criteria Decision Making (MCDM) etc.). This choice is crucial to ensure that you get an appropriate methodology which suits your project's particular needs and constraints.

Data Collection

This phase concerns collecting data from all aspects of a project, such as materials and energy flow. Data sources may include material databases, invoices, models and/or drawings. Reliable CF analysis requires complete data collection because this stage both constitutes the basis for following stages and itself enters as a condition into the model output.

CF Analysis

This is where the CF management method approach and structure are evaluated, and re-evaluated as required. This can happen due to unpredicted situations as problems with implementing data collection as planned or discrepancies between the intentions of

the project and what was effectively achieved. In other cases, if the data collected is unusable, then the project decision-maker may utilize this support to guarantee the analysis was continuous and correct.

CF Visualization

A fifth and last step is the approval of interpretation's method and visualization. This includes deciding how will the CF data and results be shown, such as with graphs or models. Effective visualization is vital for presenting clearly the findings and helping stakeholders make informed decisions.

3.2 Selected tool and analysis framework

The tool used for assessing carbon emissions of active travel paths projects in this study is One Click LCA online software, which is an automated life cycle assessment tool providing the calculation and reduction strategies around building, infrastructure and renovation projects. It delivers an extensive database of over 200,000 construction LCA datasets, supporting compliance with more than 80 international standards and certifications, including LEED, BREEAM, GRESB, and others. One of the key strengths of the tool is its vast library of generic data generated for modelling mechanical, electrical, and plumbing (MEP) systems, as well as other elements for which publicly available environmental data is extremely scarce. In addition to this comprehensive generic data, the platform also incorporates all global Environmental Product Declaration (EPD) data and a wide range of governmental and commercial databases (One Click LCA, 2023).

Environmental Product Declaration (EPD) is a standardized, third-party verified document that communicates transparent and comparable information about the life-cycle environmental impact of products (ISO 14040, 2006). The purpose of these declarations is to deliver objective and quantifiable data on the environmental performance of a product by measuring potential impacts such as global warming effect, ozone depletion effects, acidification or resource depletion (Passer et al., 2015). The main purpose for which EPDs are used is to underpin sustainable procurement, green building certification and corporate

sustainability reporting (Gelowitz & McArthur 2017). For example, EPDs are mandatory for credit achievement through green building rating tools, such as LEED, BREEAM and Green Globes fulfilments (Minkov et al.,2015). Furthermore, they facilitate identifying hotspots in the production and encourage eco-innovation by manufacturers (Minkov et al.,2015).

EPDs enable transparent communication in the supply chain, which is essential for environmental-friendly decision making based on sound aggregation analysis (Strazza et al., 2016). Product comparisons within the same category foster competition and EPD works mainly to enhance environmental performance as well (Ibáñez-Forés et al., 2016). Additionally, they provide compliance with regulation and can demonstrate fulfilment of environmental regulations and standards (Del Borghi 2013). From the market side, EPDs have contributed to improve a company's image, product differentiation and a potential increase of its share (Bergman et al., 2014). The rising popularity of the need for sustainable products keeps driving EPDs to higher importance as tools used by organizations in their environmental communication and response, satisfying governments, consumers and investors (Passer et al.,2015).

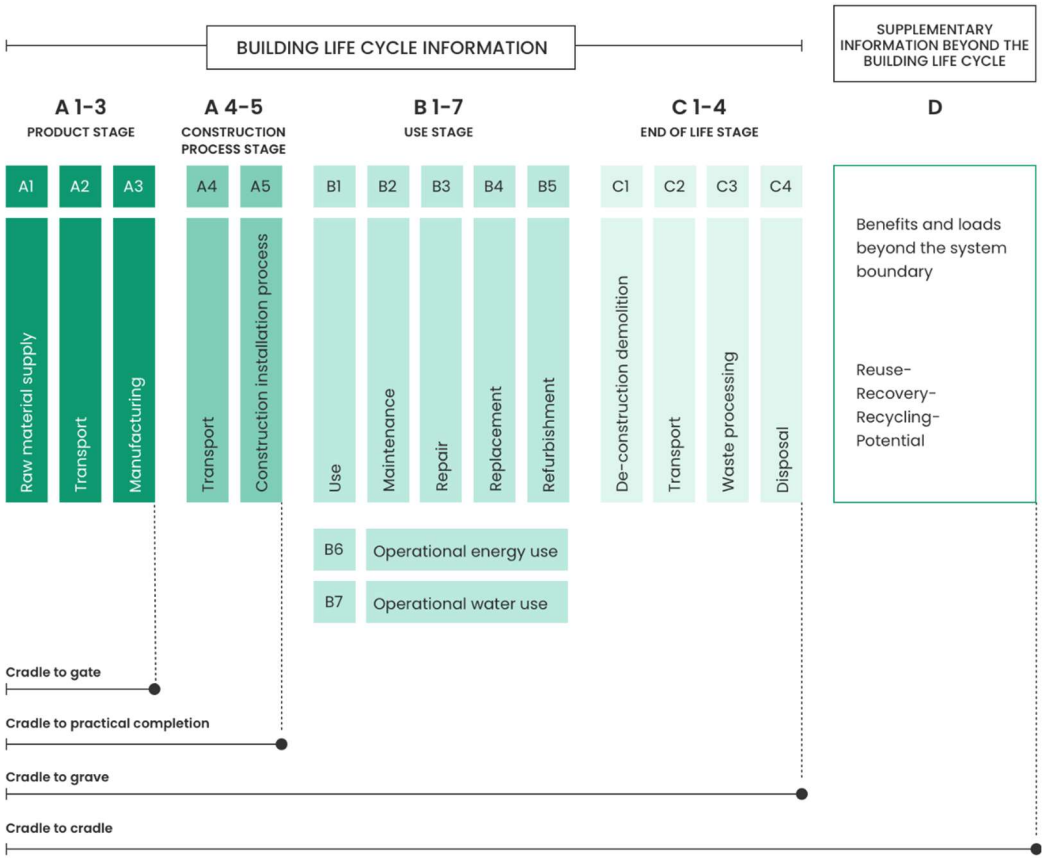


Figure 3 - Life-cycle stages according to the EN standard (One Click LCA, 2023)

Each stage of the LCA offers a detailed view of the environmental impacts associated with a product throughout its entire life cycle. Within the calculator, these stages are organized into specific categories and impacts, which include:

Pre-Construction

Pre-Construction Work - A0

Comprehends pre-construction activities, such as surveys, activities associated with the design of the asset but also site clearance.

Earthworks and Mass Hauling

Masses sourced for the project - A1-A4

Masses that will be bought from external sources should be defined in the profile as either reused waste from some other project or virgin materials

Excavated and removed masses - A4

Masses that will be transported for future use should only. These emissions will be accounted for under site impacts.

Masses that can be reused in the project - A4

Materials that will be reused in the same project may require transport and processing before they can be reused. The emissions and impacts associated with this transport and processing will be allocated to site impacts.

Construction Materials

Foundations and geotechnical structures

Materials listed in this section are assumed to be durable and will not require replacements, regardless of the assessment period length

Technical structures, construction works and systems

This category encompasses bridges, load-bearing structures, noise protection barriers, and all other permanent structures associated with the project.

Surface and pavement layers

This includes all surface and pavement layers involved in the project. These layers are essential components of the infrastructure, providing the necessary surface for transportation and other activities.

Materials used on the construction site - A5

This category encompasses all materials utilized on the construction site

Construction site operations

Energy use on the site

This comprehends site electricity consumption, Site district heating consumption, site fuel consumption and Machine operation hours.

Construction site water use

Comprises water consumption of the site

Waste generated on the site

This covers different types of waste generated on site, their respective amounts and transportation details

Additional trips for the transport to the construction site

This includes additional road or sea transport trips not described in the building materials

Use Phase

Maintenance - B2

Including general and seasonal maintenance. Winter: plowing, salt, sand/gravel and other solutions. Permafrost repairs. Summer: cutting seasonal growth

Repair - B3

This comprehends all materials required for repair during the use phase.

Energy use - B6

Energy use of the building or infrastructure, per year

Water Use - B7

Water use of the building or infrastructure, per year

Users' utilization of infrastructure, per year - B8

Users' utilization of infrastructure, per year. This impact category is an extension to the EN 15804 defined in EN 17472.

Emissions and removals

Refrigerant

Covers the total installed amount as well as annual leakage rate and service life of equipment containing it

Carbonisation

Involves the Carbonisation of cementitious materials. Cementitious materials, such as concrete, cement and mortar, absorb carbon dioxide when exposed to air. This process is the chemical reversal of the cement production process calcination phase. The amount of carbon dioxide absorbed depends on exposure of the material, duration of the exposure as well as the initial amount of cement.

Vegetation carbon withdrawals

Includes the calculation of carbon withdrawals for vegetation and landscaping during the project´s lifetime. Carbon withdrawal from vegetation is accounted for in the biogenic

carbon storage category only. These removals are not persisted and are lost, unless the project is set up in way to preserve vegetation at its eventual demolition.

For the purpose of this study, whenever possible, UK sources and data were prioritized to enhance the accuracy and relevance of the LCA results for the Scottish active travel path projects. However, in instances where UK-specific data was unavailable, European sources were consulted as a supplementary reference. This data sourcing criterion was adopted in an effort to improve the precision and applicability of the tool's outcomes for the case studies examined.

Although Scottish Government recommends the use of the PAS 2080 standard (Scottish Government, 2022), limitations regarding obtaining licenses were imposed and the specific LCA methodology employed in the One Click LCA tool for this study is the 'Infrastructure Carbon, EN17472' standard, which is aligned with the FprEN 17472 standard for the Sustainability of Construction works - Sustainability Assessment Civil Engineering Works - Calculation Methods. EN 17472 is a European standard that provides a harmonized methodology for calculating the greenhouse gas emissions (including carbon dioxide, CO2) associated with infrastructure works across their entire life cycle. This comprehensive standard accounts for emissions arising from the construction, operation, maintenance, and end-of-life phases of infrastructure projects (Narassimhan et al., 2018).

A notable advantage of the One Click LCA tool is its ability to utilize Type III Environmental Product Declarations (EPDs) based on the CML methodology, as well as its unique capability to accept EN15804+A2 EPDs. This feature enables more accurate and detailed modelling of infrastructure projects by incorporating high-quality, standardized environmental data from reputable sources.

By leveraging the robust capabilities of the One Click LCA software, the EN17472 methodology, and prioritizing regionally relevant data sources, this study aims to provide a comprehensive and context-specific assessment of the carbon emissions associated with the selected Scottish active travel path projects. The software was used to receive information of four active travel paths projects in Scotland to evaluate their performance.

The Cycle Network will feature a diverse range of path types, including on-road routes, dedicated cycle lanes, and greenways or traffic-free trails (Sustrans, 2019). On-road routes and cycle lanes are established on existing road surfaces, mainly requiring the addition of signage and line painting, resulting in minimal carbon emissions. In contrast, greenways are exclusive, traffic-free trails often developed on disused railways, canal towpaths, and riverbanks. These routes demand more extensive construction efforts (Manton et al., 2012), making them the focus of the project analysis due to their more relevant environmental and infrastructural impacts.



Figure 4- Example of a typical Sustran's greenway (Sustrans,2019).

This included both "Build Over Existing Infrastructure" projects and "Newly Built" developments picked by the team at Sustrans. It is important to note that the projects featured in this case study do not intend to form a representative sample of all active travel project activity taking place across Scotland. Instead, the goal is to get a first cut at the rough order of magnitude and range for carbon emissions impacts associated with Scottish active travel path investments.

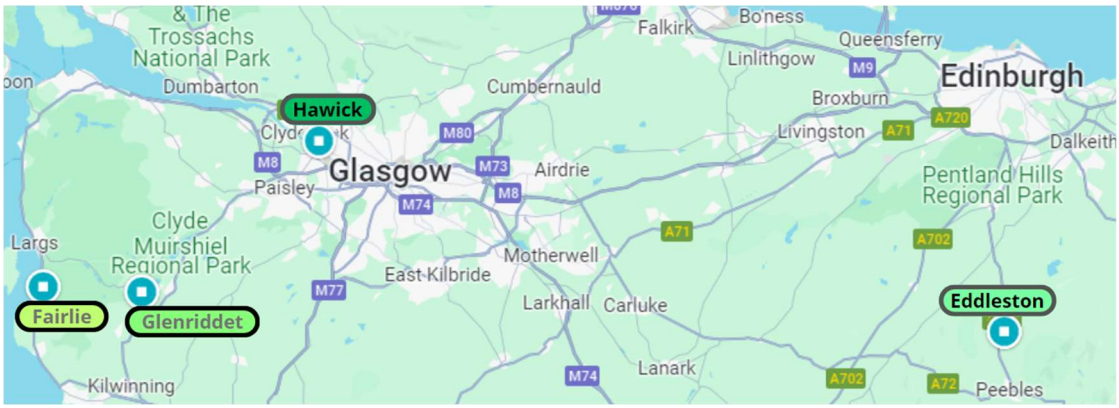


Figure 5- Location of each assessed project (Created by author, 2024).

Mapping and accurately identifying all relevant emissions sources across a project's life cycle is the critical first step towards effectively managing and reducing carbon emissions. When a project is able to definitively account for all the carbon it emits, both quantitatively and qualitatively, emission reduction strategies as well as projects that sequester or avoid emissions can be appropriately developed. That being said, because measuring the total carbon footprint of a project is incredibly time and resource intensive (in other words even more than most building owners would ostensibly be willing to fork out for in monetary terms), it makes economic sense that rather than estimating absolutely everything right down to insignificant emissions sources as part of their primary LCAs. By focusing on the leading sources of a project's carbon footprint, this will allow for targeted emissions reductions to be made in the areas which represent significant contributors without requiring high levels of expenditure into quantification and management efforts aimed at low emitting emission sources (Matthews et al, 2008).

The carbon assessment incorporated various design details, which encompassed:

- Earthworks information necessary for the project
- Specific pavement specifications for different project sections
- Drainage filter material
- Kerbs

- Safety barriers
- Boundary fencing
- Signage
- Road markings
- Fuel usage for plant and site vehicles
- Transportation of waste and materials
- Material replacement
- Vegetation
- Waste treatment

The data regarding these details were obtained from a bill of quantities and computer-aided design (CAD) drawings from each project. For the sake of results comparability, here it was employed a standard functional unit of 1 kilometre-built road. As pointed out by Cass and Mukherjee (2011), the functional unit selected can affect the results, based on a number of other factors that relate specifically to each project such as road type, terrain/category in terms of topography and overall length for this particular case.

Regarding the machinery, data about the types used in the construction was collected from literature, such as Manton et al. (2012), and from technical reports that provide information on such equipment. Material transportation distances were standardized at 41.6 km to ensure comparability among the options. This distance was derived from the average haulage distance reported in three trials conducted by Transport Scotland (Fox et al., 2011).

Projects currently under construction and activities that occur during maintenance often lack precise and detailed information. As a result, estimations are made based on the

experience and data provided by the software. Despite the above figures being most approximate, they offer informative proposals regarding the carbon assessment undertaking. Therefore, apart from simple maintenance activities, the listed factors allow the completion of a more profound review. Finally, it adds the CO2 absorption impact of environmental systems that had been restored, given their capacity to lower carbon releases.

Furthermore, the assessment takes into consideration the process of carbonation, which occurs in the materials used in road construction. A well-known example is concrete, which actually partially captures carbon dioxide over time. According to Galán et al. (2010), concrete is capable of absorbing up to 3800 kg of CO2 on its carbonation over a century. It also takes account of the lifecycle and its service life alongside this carbon absorption capacity to create a complete picture of environmental defacement. Regarding repairs, is considered a time span of 50 years. This duration takes into consideration a full assessment of the current carbon emissions occurring and extensive actions during the maintenance phase. Although the available data may have limitations due to incomplete or unknown information, the estimation process based on industry expertise and statistical analysis ensures an informative carbon assessment.

Some elements may be left out of the evaluation in some designs, once the information was either unknown or insufficient. Among these exclusions are:

- Utilities consumption on-site, including fuel usage, electricity, and water.
- Operational electricity consumption.
- Emissions linked to maintenance activities.

4 Scenario-Based Evaluation

Various scenarios were constructed to provide a full assessment and support the decision-making process by the central decision-maker in which different alternatives could be studied side-by-side with respect to carbon emission criteria. These three separate case study researches conducted in line with each of its focus area:

1.Whole life cycle carbon reporting - Summary of results and methodology to accurately measure the construction stage emissions for 4 active travel projects (green ways or traffic-free routes) where Build Over Existing Infrastructure is compared with Newly Built.

2. Pavement Option Analysis: Carbon emissions by 5 alternative pavement design options for hypothetical new build active travel route up to a nominal 1 km segment. This analysis is done for the entire life-span of 50 years of a pavement.

3. Transportation and Recycled Content Analysis: examines the likely effects of implementing a specification requiring some proportion within its materials to consist of recycled content.

4.1. Background information

An in-depth analysis of Sustrans project details, supplemented by insights from relevant experts in the subject area, enabled the establishment of specific assumptions and limitations for this carbon assessment. Active travel projects inherently require maintenance, but unlike major infrastructure projects, they typically do not necessitate frequent replacement of items or materials. Consequently, replacement activities are excluded from this study.

Complex components, such as bridges, were excluded from the assessment due to their significant impact on the baseline assessment. These elements can be evaluated separately, as they are specific to individual projects and do not contribute uniformly to the overall carbon footprint of standard active travel projects.

Additionally, items listed under "Series 100: Preliminaries" in the bill of quantities of each project were omitted from the assessment. These items primarily involve pre-construction activities, such as surveys and activities associated with the design of the asset. For infrastructure assessments these activities normally have unsignificant impact.

The service life and end-of-life (EOL) processes of the materials were determined by the Environmental Product Declarations (EPDs) specific to each item. This approach ensures that the assessment accurately reflects the lifecycle impacts of the materials used in the projects, from production through to disposal or recycling. All the bills of quantities, drawings and the complete carbon reports for each project are included in Annex A.

4.2. Scenario 1 - Whole life cycle carbon reporting

4.2.1. Build Over Existing Infrastructure

4.2.1.1 - Hawick Active Travel Network

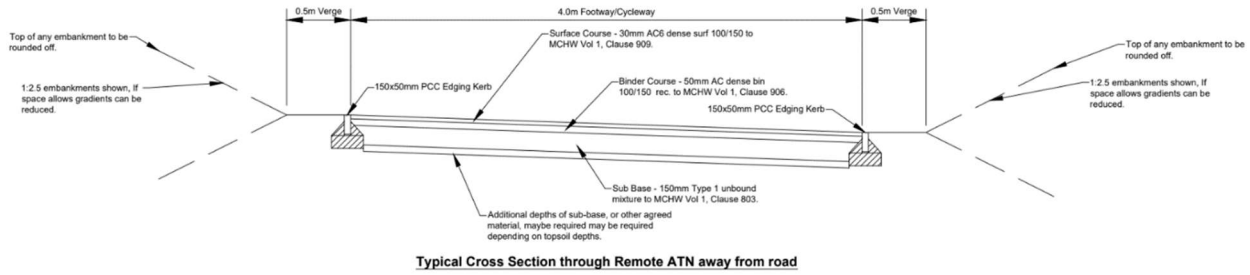


Figure 6- Typical cross section through remote ATN away from road for the Hawick project (Sustrans, 2024).

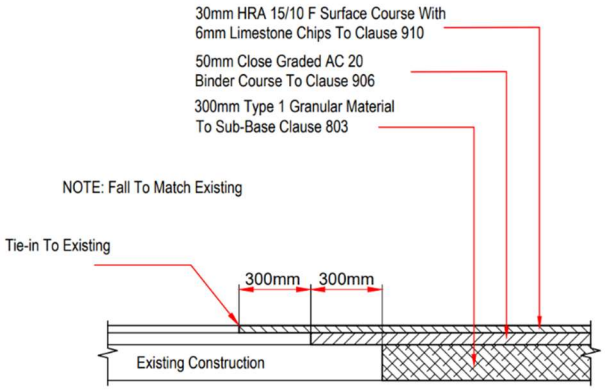


Figure 7- New/Existing footpath tie-in detail section for the Hawick project (Sustrans, 2024).

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	104
A1-A3	Product stage	24 172
A4-full	Transport	4 185
A5	Construction process	569
B4-B5	Material replacement and refurbishment	13 567
C1-C4	End of life	1 093
D	External impacts (not included in totals)	−5 550
	Total	**43 690**

Figure 8- Whole life Carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments – Hawick (Created by author, 2024).

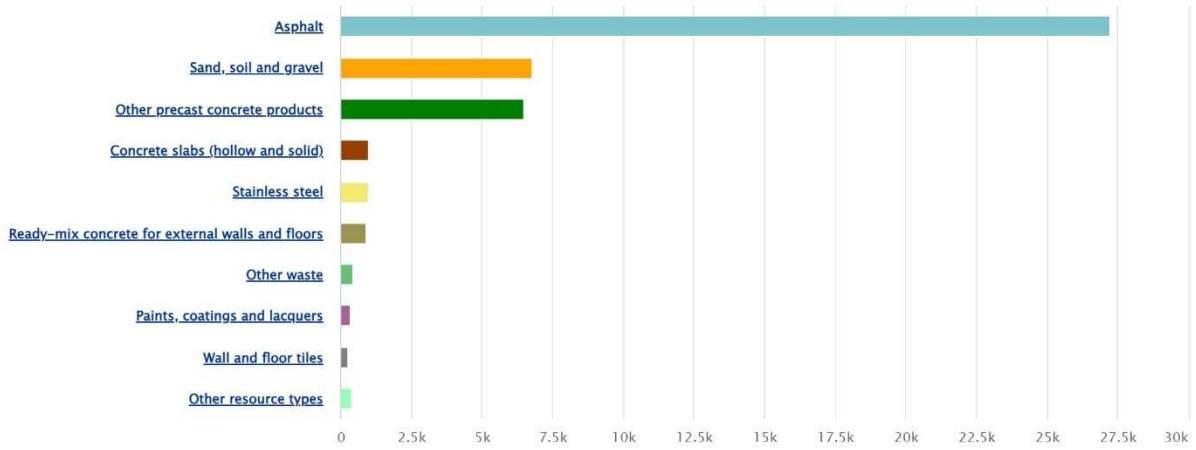


Figure 9 - Hawick's Global Warming Potential fossil kg/CO2e - Resource types

The Hawick Active Travel Network project is a refurbishment located in Glasgow and is a 4m wide and 350m long path, which is laid down in three layers. These include the surface layer, which consists in Close Graded Asphalt Concrete AC10 Close Surf 70/100 and 30mm depth, the base layer of 50mm depth of Close Graded AC 20 Binder Course Dense bin 40/60 and a capping layer of 150mm depth of Type 1 Granular Material (Figure 6). Tactile paving is not included as an accessibility asset.

After inputting the data, the assessment shows that the whole project emissions accounts for 43.690 kgCO2, which would make 1km account for 124.828,5 kgCO2. The highest numbers of emissions are in the “product stage” phase, where 88% of the total emissions are from *surface and pavement layers* and 7% responds for other technical

structures, construction works and systems (gullies, pipes and bollards). This phase is followed by the “Material replacement and refurbishment” and “Transport”. The hotspot materials are mainly “Asphalt”, “Sand, soil and gravel” and “Other precast concrete products”.

Although the project didn’t get any biogenic storage, it achieved an environmental benefit of -5550kgCO2, result from the end of life assigned to the path’s base and surface asphalt, which is reuse via reprocessing, recycling of the bollards and electrical conduits.

4.2.1.2. Glenriddet Path

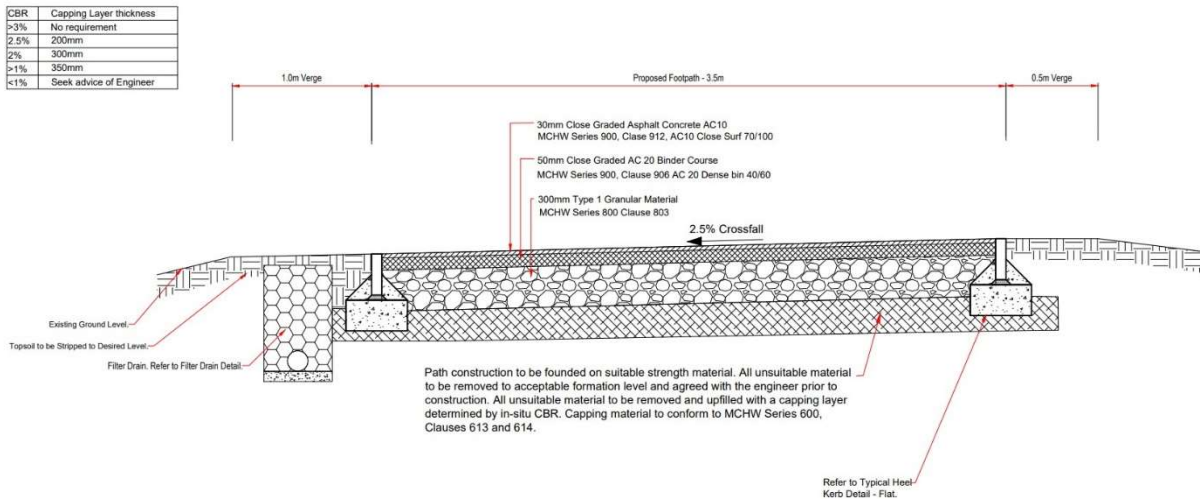


Figure 10 - Glenriddet's typical section B-B of proposed footway construction (Sustrans, 2024)

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	1 065
A1-A3	Product stage	16 610
A4-full	Transport	9 256
A5	Construction process	22 101
B4-B5	Material replacement and refurbishment	11 140
B7	Operational water use	200
C1-C4	End of life	777
D	External impacts (not included in totals)	−1 890
	Total	**61 149**

Figure 11 - Glenriddet's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024)

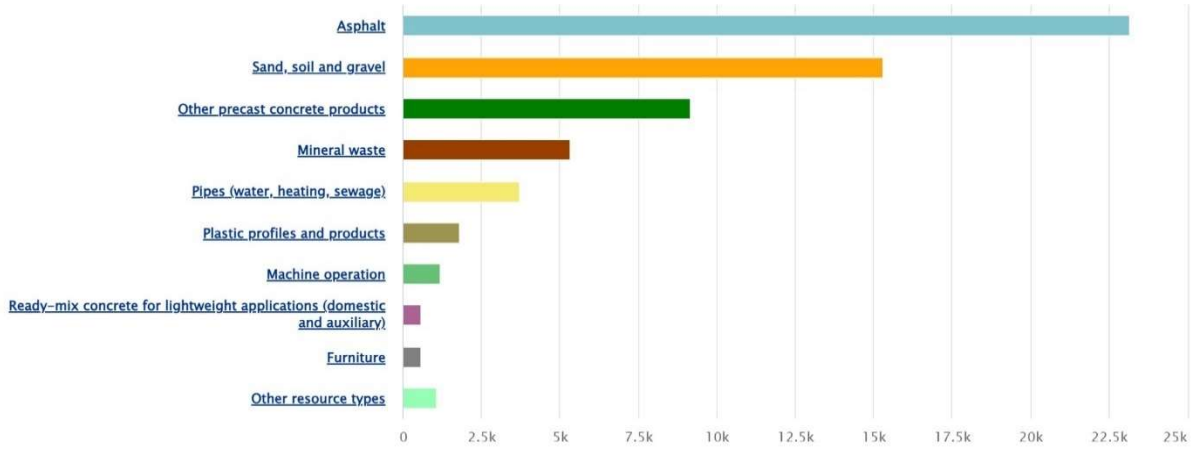


Figure 12- Glenriddet's Global Warming Potential fossil kg/CO2e - Resource types (Created by author, 2024).

The Glenridett project is a refurbishment located in Kilbirnie and is a 3.5m wide and 400m path, which is laid down in three layers. These include the surface layer, which consists in hot rolled asphalt 15/10 F surface course with 6 mm limestone chips and 30mm depth, the base layer of 50mm depth of dense asphalt concrete binder course with 20 mm aggregate and a capping layer of 300mm depth of granular material (Figure 10). It includes the plantation of trees and the water usage included is just regarding this item. Tactile paving is included as an accessibility asset.

After inputting the data, the assessment shows that the whole project emissions accounts for 61.149 kgCO2, which would make 1km account for 152.872,5 kgCO2. The highest numbers of emissions are in the "Construction Process" phase, where 44% of the total emissions are from *surface and pavement layers* and 27% responds for other *materials in the construction site*. This phase is followed by the "Product stage" and "Material replacement and refurbishment". The hotspot materials are mainly "Asphalt", "Sand, soil and gravel" and "Other precast concrete products".

The project achieved an environmental benefit of -1890kgCO2, result from the end of life assigned to the path's base and surface asphalt which is reuse via reprocessing and also accounted a biogenic storage of 12.204 kgCO2 during its entire lifecycle, a result from the plantation of 8 units of large trees.

4.2.2. Newly Built

4.2.2.1 - Eddleston Water Path Phase 4

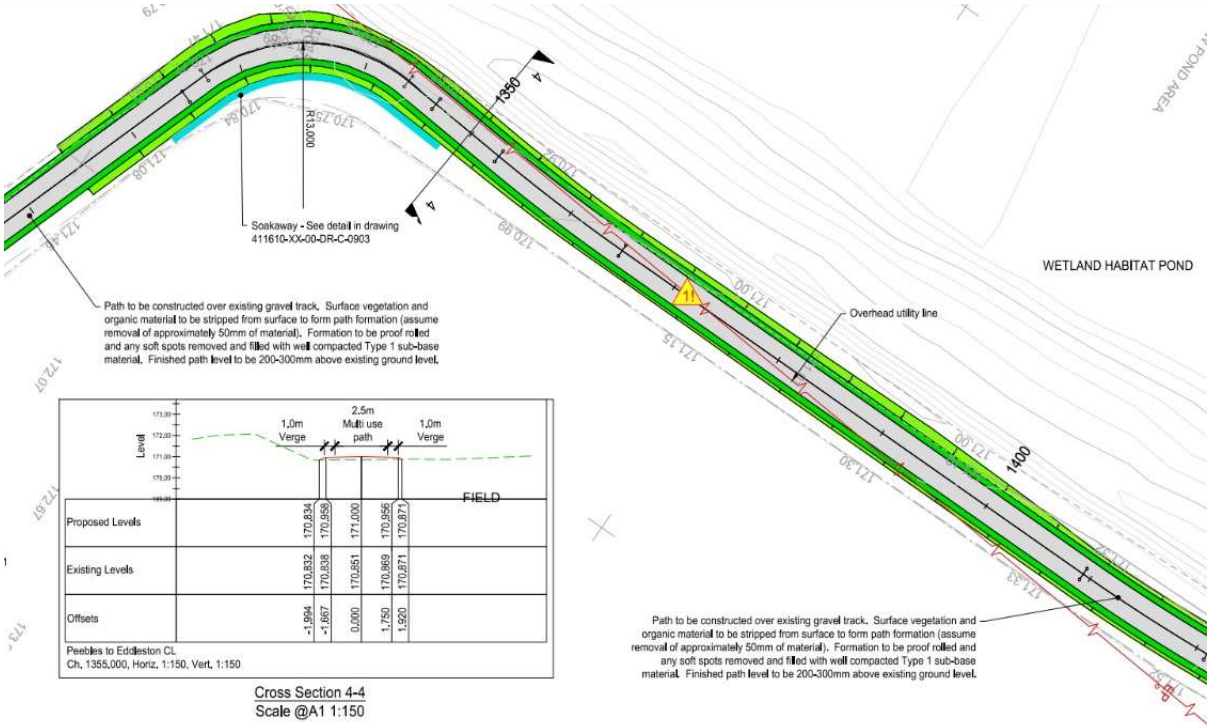


Figure 13 - Eddleston's cross section 4-4 (Sustrans, 2024)

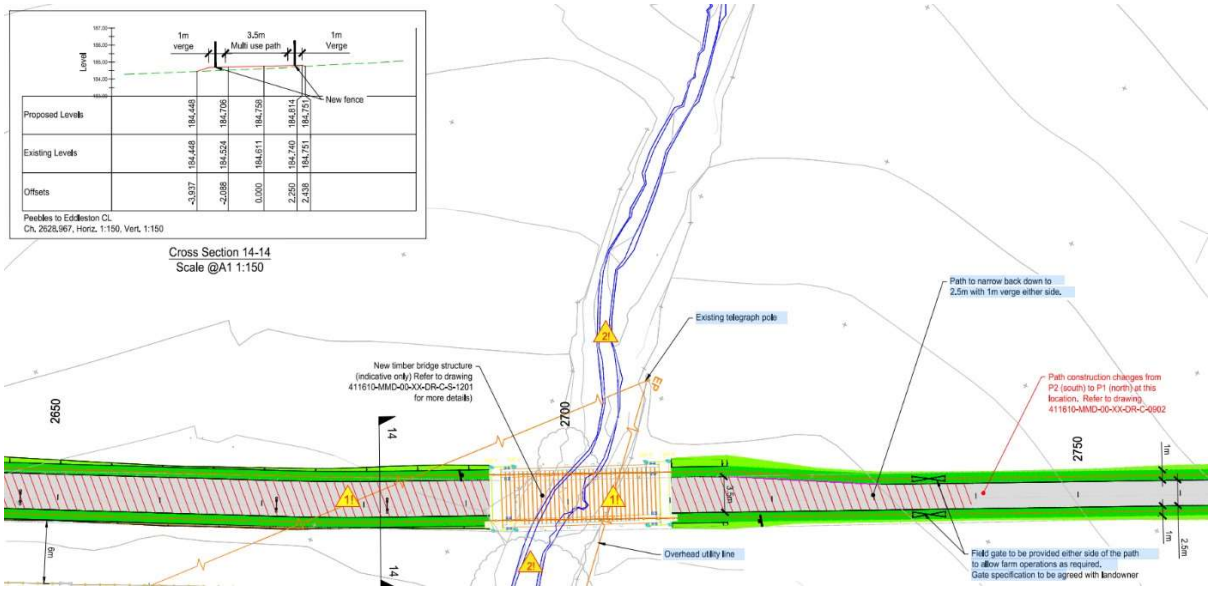


Figure 14 - Eddleston's cross section 14-14 (Sustrans, 2024)

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	389 214
A1-A3	Product stage	660 853
A4-full	Transport	114 851
A5	Construction process	280 027
B4-B5	Material replacement and refurbishment	553 238
C1-C4	End of life	34 613
D	External impacts (not included in totals)	−118 315
	Total	**2 032 795**

Figure 15 - Eddleston's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024)

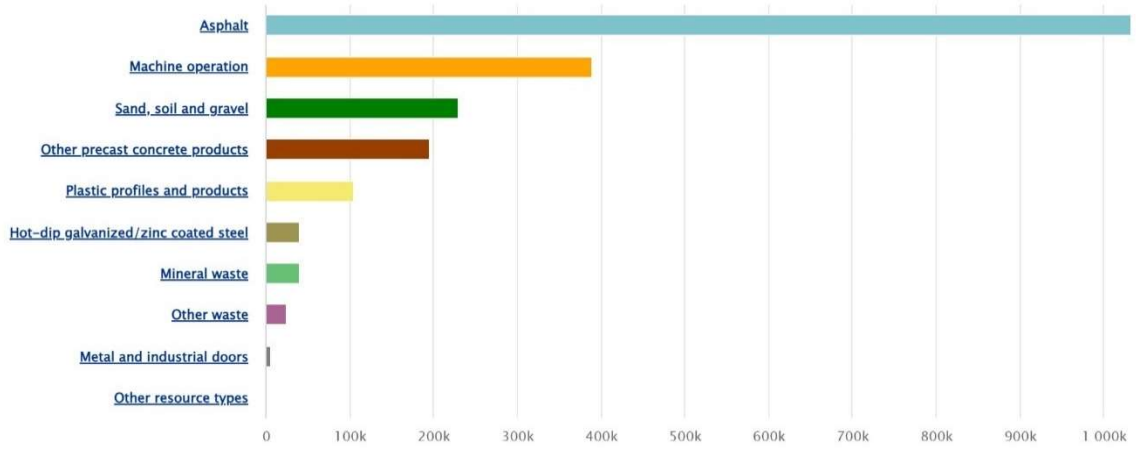


Figure 16 -Eddleston 's Global Warming Potential fossil kg/CO2e - Resource types (Created by author, 2024).

The Eddleston Water Path Phase 4 project is a new multi-use path located in Glasgow. Its width varies between 2,5m - 3,5m and is 5380m long, with a three-layer composition. This includes the surface layer, which consists in a 30mm depth Hot Rolled Asphalt surface course, a 50mm depth Asphalt concrete base course and a capping layer of 100mm depth of 1 unbound material (Figure 13 and 14). It has some timber bridge structures, which were not considered in the assessment. It includes items regarding to landscape and ecology and tactile paving as an accessibility asset.

After inputting the data, the tool shows that the whole project emissions accounts for 2.032.795 kgCO2, which would make 1km account for 377.842,9 kgCO2. The highest numbers of emissions are in the “Product stage” phase, where 55% of the total emissions are from *surface and pavement layers*, 10% responds for *other materials used on the*

construction site (kerbs, signage, topsoil for vegetation). This phase is followed by the "Material replacement and refurbishment" and "Pre-construction", once there is a lot of mass movement involved in this construction. The hotspot materials are mainly "Asphalt", "Machine Operation" and "Sand, soil and gravel".

Although it has considered landscaping and ecology items, it did not account for biogenic storage, once it only considers grass and no trees plantation. However, it achieved an environmental benefit of -118.315 kgCO2, result from the end of life assigned to the path's base and surface asphalt, which is reuse via reprocessing, recycling of the steel of concrete structures and signage and the pipes used in the drainage system.

4.2.2.2 - Fairlie Coastal Path Phase 3

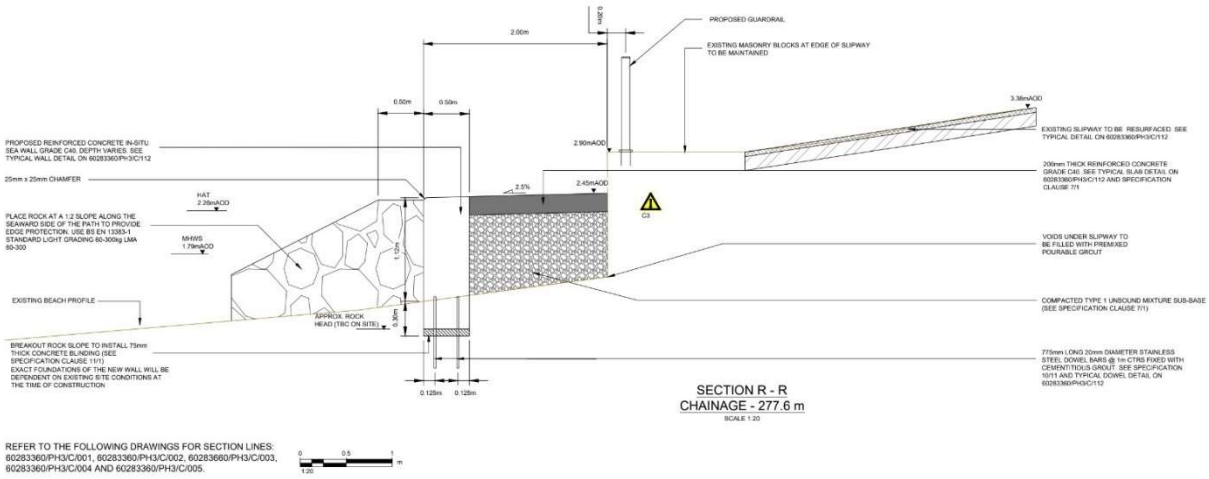


Figure 17- Fairlie's typical section R-R of proposed construction (Sustrans, 2024)

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	15
A1-A3	Product stage	2 793
A4-full	Transport	2 423
A5	Construction process	107 187
B4-B5	Material replacement and refurbishment	115
C1-C4	End of life	0
	Total	**112 533**

Figure 18 - Fairlie's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

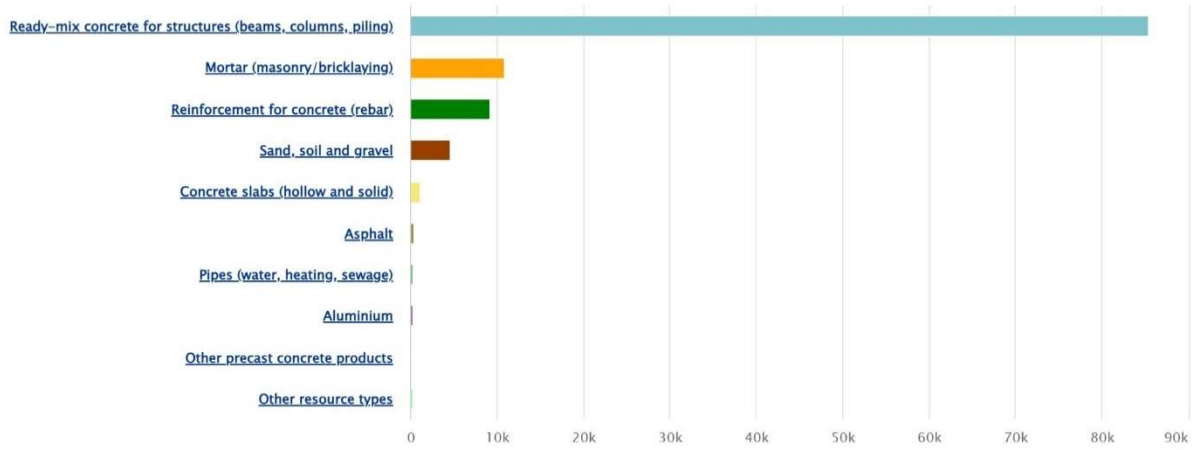


Figure 19 - Fairlie's Global Warming Potential fossil kg/CO2e - Resource types (Created by author, 2024).

The Fairlie Coastal Path Phase 3 project is a new 2m wide and 371m long path located in the west coast of Scotland, with a two-layer composition. This includes the surface layer, which consists in a 200mm thick reinforced concrete grade C40 slabs and a capping layer of variable depth of type 1 unbound material (Figure 17). It includes tactile paving as an accessibility asset.

After inputting the data, the tool shows that the whole project emissions accounts for 112.533 kgCO2, which would make 1km account for 303.323,4 kgCO2. The highest numbers of emissions are in the "Construction process" phase, where 2% of the total emissions are from *surface and pavement layers*, 95% responds for *other materials used on the construction site* (concrete, steel, cement). This phase is followed by the "Product stage" and "Transport", both presenting very little emissions compared to the "Construction Process". The hotspot materials are mainly "Ready-mix concrete", "Mortar" and "Reinforcement for concrete (rebar)". This is due to the fact that, as a coastal path, it requires a lot of concrete retaining walls and also to the choice of paving, which is also made of concrete.

Despite of the project not achieving any environmental benefit, it accounted a biogenic storage of 55.215 kgCO2 during its entire lifecycle, a result from the plantation of 20 units of large trees.

4.3. Scenario 2 - Pavement Option Analysis

While specific active travel infrastructure projects may vary based on local conditions, expected usage, and available materials, Sustrans has provided a standardized cross-section of their typical Dense Bitumen Macadam (DBM) path. This standard serves as a benchmark for comparing alternative options for a theoretical, new-build, 1 km length of this type of route (greenway or traffic free).

The alternative designs and pavement layer depths were calculated following the guidelines set forth in the Active Travel Act Guidance (Welsh Government, 2022). These calculations ensure that the infrastructure meets the specific requirements for pedestrian-only footways and cycle-only cycleways.

Pavement construction options and thickness design

The pavement construction options and design thicknesses corresponding to the pavement loading categories shall be selected from the tables presented below.

Table 3.18a Pedestrian-only footways and cycle-only cycleways

<table>
<tr><td rowspan="2">Layer</td><td colspan="5">Surface options</td></tr>
<tr><td>Asphalt</td><td colspan="2">Pavers/setts</td><td>Flags/slabs</td><td>Concrete</td></tr>
<tr><td rowspan="2">Surfacing</td><td rowspan="2">20 mm surface course
50 mm binder course</td><td>≥ 50 mm clay pavers</td><td>≥ 60 mm concrete blocks</td><td>≥ 50 mm</td><td rowspan="2">150 mm unreinforced</td></tr>
<tr><td colspan="2">30 mm laying course</td><td>25 mm laying course</td></tr>
<tr><td>Subbase</td><td colspan="5">100 mm</td></tr>
<tr><td>Subgrade</td><td colspan="5">≥ 2.5% CBR</td></tr>
</table>

Figure 20 - Pavement construction options and thickness design (Welsh Government, 2022)

The document provides guidelines for categorizing and designing pedestrian and cycle paths. They should present the following characteristics:

- The pedestrian/cycle-only category shall be used where the footway/cycleway is physically separated from the carriageway.
- The footway/cycleway shall be considered to be physically separated from the carriageway where:

- there is a barrier or other permanent obstruction (e.g. bollards) such that vehicular traffic cannot mount the footway/cycleway; or
- there is a verge of width 3m or greater.

- The pedestrian/cycle-only category shall be used where the footway/cycleway is not physically separated from the carriageway but where there can be no use or overrun by vehicles, including cleaning or maintenance vehicles.

4.3.1. Standard 1km path

The model for the standard path comprehends:

1. Path width: 3000mm (3 meters)
2. Surface layer: 60mm x 3.0m AC 20 surf 100/150 (machine laid)
3. Base layer: 150mm x 3.3m well-graded type 1 granular fill or similar approved
4. Geotextile layer: 3.3m wide, 100 g/m²
5. Ground preparation: 50mm (max) x 3.3m excavation to clear vegetation and level existing ground
6. Total construction width: 3.3m
7. Cross fall/camber: 2.5% for drainage

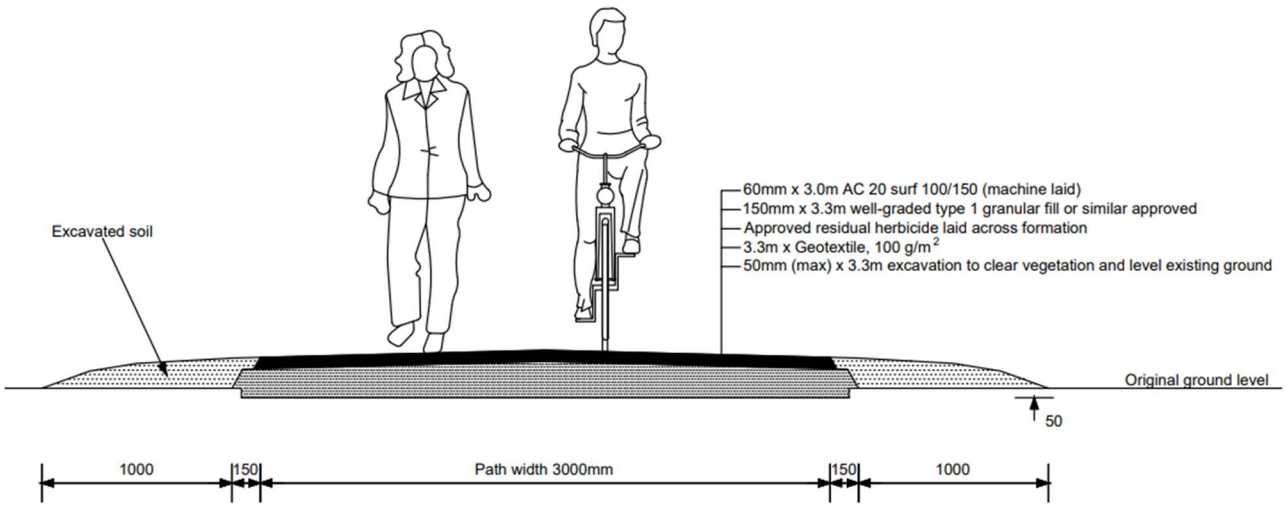


Figure 21 -Standard DBM path cross section (Sustrans, 2024)

Construction Context

1. The analysis encompasses the pavement layers and the machinery required for their construction. It excludes additional materials and services such as kerbs, road markings, drainage systems, landscaping, and other ancillary road construction elements. This focused scope allows for a targeted examination of the core pavement components and their associated construction processes.
2. Machinery for site clearance: medium power bulldozer (60-330 kW) load factor 35-50%, diesel fuelled.
3. Machinery for site asphalt compaction: roller compactor, P=55 kW, operating weight: 7t, roller width: 1.45m, effective rolling capacity: 690 m^2/h, diesel fuelled.
4. Vegetation Clearance: Soft and woody vegetation is to be cleared 2 meters from the edges of the path and 3.5 meters above the path surface.
5. Minimal Excavation: The design aims to minimize excavation, with arisings used to support path edges.
6. Surface Quality: The finished surface should be free-draining, without undulations or steps, and should not pond water.
7. Herbicide Application: An approved residual herbicide is laid across the formation.
8. The considered material transportation distance is also 41.6km, which was obtained from an analysis of three separate studies carried out by Transport Scotland, as documented by Fox et al. (2011) study.

Environmental Implications

1. Vegetation Management:
    - Cleared vegetation is to be chipped and spread locally, minimizing waste.
    - Larger timber is to be supplied to the landowner or stacked into habitat piles, supporting local ecosystems.
2. Soil Disturbance:
    - Excavation is kept to a minimum, reducing soil disturbance.
    - Excess spoil is to be spread locally, minimizing transportation and associated emissions.
3. Material Use:

- The use of geotextile and well-graded granular fill suggests a focus on path longevity, potentially reducing future maintenance needs.
- The AC 20 surf 100/150 surface layer is machine-laid, which may increase efficiency but also requires heavy machinery.

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295
A1-A3	Product stage	27 516
A4-full	Transport	6 196
A5	Construction process	172
B4-B5	Material replacement and refurbishment	22 106
C1-C4	End of life	2 144
D	External impacts (not included in totals)	−4 600
	Total	**58 431**

Figure 22 - Stardard path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

The analysis of the whole life cycle for a 1km path construction reveals a total of 58.431 kgCO2 emitted. The “Product stage” accounts for the majority of these emissions, where the asphalt accounts for 70% of the emissions, granular fill accounts for 21% and the geotextile membrane for 6%. The second highest source of emissions is attributed to the category “Material replacement and refurbishment”. The project demonstrates an environmental benefit of -4.600 kgCO2, resulting from the end-of-life reuse of the path's base and surface asphalt through reprocessing, and the recycling of the geotextile membrane. It's worth noting that the calculation does not account for any biogenic carbon storage in this and the other alternative paths.

4.3.2. 1km Open graded asphalt

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295
A1-A3	Product stage	27 188
A4-full	Transport	7 162
A5	Construction process	172
B4-B5	Material replacement and refurbishment	31 124
C1-C4	End of life	2 427
D	External impacts (not included in totals)	−6 230
	Total	**68 369**

Figure 23 - Open graded asphalt path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

The analysis of the whole life cycle for a 1km path construction reveals a total of 68.396 kgCO2 emitted. The “Material replacement and refurbishment” accounts for the majority of these emissions, where the asphalt base course accounts for 39,9% of the emissions, granular fill accounts for 33,2%, the asphalt bound gravel surface course accounts for 23,4% and the geotextile membrane for 3,5%. The second highest source of emissions is attributed to the category “Product stage”. The project demonstrates an environmental benefit of -6.230 kgCO2, resulting from the end-of-life reuse of the path's base and surface asphalt through reprocessing, and the recycling of the geotextile membrane.

4.3.3. 1km Clay pavement

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	126
A1-A3	Product stage	89 060
A4-full	Transport	8 751
A5	Construction process	4 020
B4-B5	Material replacement and refurbishment	1 721
C1-C4	End of life	1 752
D	External impacts (not included in totals)	−2 470
	Total	**105 431**

Figure 24 -Clay pavement path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

The analysis of the whole life cycle for a 1km path construction reveals a total of 105.431 kgCO2 emitted. The “Product stage” accounts for the majority of these emissions, where the clay pavers accounts for 85.9% of the emissions, granular fill accounts for 10%, the crushed gravel of the base layer for 2,7%, the asphalt bound gravel surface course accounts for 23,4%, the sand layer for 0,4% and the geotextile membrane for 1%. The second highest source of emissions is attributed to the category “Transport”. This kind of paving material is not machine laid; therefore, the assessment just accounts the machinery for site clearance. The project demonstrates an environmental benefit of -2.470 kgCO2, resulting from the end-of-life reuse of the clay pavers through reprocessing into aggregate, and the recycling of the geotextile membrane.

4.3.4. 1km Permeable blocks

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	126
A1-A3	Product stage	10 206
A4-full	Transport	5 980
A5	Construction process	172
B4-B5	Material replacement and refurbishment	1 721
C1-C4	End of life	2 132
D	External impacts (not included in totals)	−19 811
	Total	**20 337**

Figure 25 - Permeable blocks path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

The analysis of the whole life cycle for a 1km path construction reveals a total of 20.337 kgCO2 emitted. The “Product stage” accounts for the majority of these emissions, where the permeable blocks accounts for 10% of the emissions, granular fill accounts for 60%, the sand layer for 4% and the geotextile membrane for 18%. The second highest source of emissions is attributed to the category “Transport”. This kind of paving material is not machine laid; therefore, the assessment just accounts the machinery for site clearance. The project demonstrates an environmental benefit of -19.811 kgCO2, resulting from the end-of-life reuse of the blocks through reprocessing into aggregate, and the recycling of the geotextile membrane.

4.3.5. 1km Concrete Flags

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	126
A1-A3	Product stage	12 255
A4-full	Transport	5 265
A5	Construction process	172
B4-B5	Material replacement and refurbishment	1 721
C1-C4	End of life	809
D	External impacts (not included in totals)	−1 989
	Total	**20 349**

Figure 26 - Concrete Flags path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

The analysis of the whole life cycle for a 1km path construction reveals a total of 20.349 kgCO2 emitted. The “Product stage” accounts for the majority of these emissions, where the granular fill accounts for 72,7%, concrete flags accounts for 17,5% of the emissions the sand layer for 2,2% and the geotextile membrane for 7,6%. The second highest source of emissions is attributed to the category “Transport”. This kind of paving material is not machine laid; therefore, the assessment just accounts the machinery for site clearance. The project demonstrates an environmental benefit of -1989 kgCO2, resulting from the recycling of the geotextile membrane and steel bars and also from turning the concrete into aggregate.

4.3.7. 1km Warm Asphalt

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295
A1-A3	Product stage	21 585
A4-full	Transport	5 809
A5	Construction process	172
B4-B5	Material replacement and refurbishment	18 510
C1-C4	End of life	2 117
D	External impacts (not included in totals)	−4 534
	Total	**48 489**

Figure 27 - Warm Asphalt path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

This scenario presents the most similar choices to the standard path, making the following changes:

- Average granular fill is replaced by crushed rock / gravel mix (50-50 %), wet bulk density, 2000 kg/$m^{3;}$
- The asphalt base course is the same, but made with a warm mix process instead of hot mix;
- The hot rolled asphalt (hot mix) is replaced by thin surfacing course system asphalt concrete (TSCS (AC)), warm mix, 10 mm nominal aggregate size.

Thus, the analysis of the whole life cycle for a 1km path construction reveals a total of 48.489 kgCO2 emitted. The “Product stage” accounts for the majority of these emissions, where the crushed rock / gravel mix accounts for 30,3%, the base asphalt accounts for 42,3% of the emissions, the thin surfacing course system for 23,1% and the geotextile membrane for 4,3%. The second highest source of emissions is attributed to the category “Transport”. This kind of paving material is not machine laid; therefore, the assessment just accounts the machinery for site clearance. The project demonstrates an environmental benefit of -4.534 kgCO2, resulting from the recycling of the geotextile membrane and asphalt layers.

4.4. Scenario 3 – Transportation distances and Recycled Content Analysis

The Scottish government's Construction Procurement Manual, specifically Section 7, provides important guidelines for sustainable construction practices. For projects valued at over £1 million, it recommends that a minimum of 10% of the total material value should be derived from recycled or reused sources (Scottish Parliament, 2005). This recommendation aims to promote sustainability in the construction industry by encouraging the use of recycled materials and reducing waste. However, the implementation of this guideline is not as straightforward as it might initially appear.

Within the framework of a standard pathway, four cases were developed to examine the relationship between the percentage of recycled content in asphalt and various transportation distances. The goal is to determine whether the environmental benefits of using recycled materials are negated by the emissions from transporting these materials.

4.4.1. Case 1 – No asphalt recycled content, 15km distance

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295 | 0 %
A1-A3	Product stage	27 516 | 0 %
A4-full	Transport	5 356 | −14 %
A5	Construction process	172 | 0 %
B1	Use phase	
B2	Maintenance	
B3	Repair	
B4-B5	Material replacement and refurbishment	21 265 | −3,8 %
B6	Operational energy use	
B7	Operational water use	
B8	Users utilization of infrastructure, per year	
C1-C4	End of life	2 144 | 0 %
D	External impacts (not included in totals)	−4 600 | 0 %
	Total	**56 749**
	Comparing total results with: 2 - - Standard 1km path -	
	2 - - Standard 1km path - Total	58 431
	2 - 15km 0 recycled Standard 1km path compared with 2 - - Standard 1km path -	−2,9 %

Figure 28 - No asphalt recycled content, 15km distance path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

By maintaining the same materials as the standard path, which includes no recycled content, and solely reducing the transportation distance of the asphalt to 15 km, the total emissions account for 56.749 kgCO2, a reduction of 2.9%.

4.4.2. Case 2 – 15% asphalt recycled content, 60km distance

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295 | 0 %
A1-A3	Product stage	20 090 | -27 %
A4-full	Transport	6 778 | +9,4 %
A5	Construction process	172 | 0 %
B1	Use phase	
B2	Maintenance	
B3	Repair	
B4-B5	Material replacement and refurbishment	15 262 | -31 %
B6	Operational energy use	
B7	Operational water use	
B8	Users utilization of infrastructure, per year	
C1-C4	End of life	2 144 | 0 %
D	External impacts (not included in totals)	−4 091 | -11 %
	Total	**44 742**
	Comparing total results with: 2 - - Standard 1km path -	
	2 - - Standard 1km path - Total	58 431
	2 - 15 - 60km Recycled Asphalt - Standard 1km path compared with 2 - - Standard 1km path -	−23 %

Figure 29 - 15% asphalt recycled content, 60km distance path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

Despite increasing the transportation distance to 60km, using warm mix asphalt with 15% recycled content reduces total emissions to 44.742 kgCO2. This represents a 23% decrease in emissions compared to the baseline scenario.

4.4.3. Case 3 – 37% asphalt recycled content, 120km distance

	Result category	Global Warming Potential fossil-A2 kg CO2e
A0	Pre-construction	295 | 0 %
A1-A3	Product stage	17 066 | -38 %
A4-full	Transport	8 674 | +40 %
A5	Construction process	172 | 0 %
B1	Use phase	
B2	Maintenance	
B3	Repair	
B4-B5	Material replacement and refurbishment	14 134 | -36 %
B6	Operational energy use	
B7	Operational water use	
B8	Users utilization of infrastructure, per year	
C1-C4	End of life	2 144 | 0 %
D	External impacts (not included in totals)	−3 345 | -27 %
	Total	**42 486**
	Comparing total results with: 2 - - Standard 1km path -	
	2 - - Standard 1km path - Total	58 431
	2 - 37 - 120km Recycled Asphalt - Standard 1km path compared with 2 - - Standard 1km path -	−27 %

Figure 30 - 37% asphalt recycled content, 120km distance path's whole life carbon assessment according to EN15804:2013+A1 and 2019+A2 amendments (Created by author, 2024).

Even when doubling the transportation distance to 120km, replacing only the asphalt layer with warm mix asphalt containing 37% recycled content reduces total emissions to 42.486 kgCO2. This represents a 27% decrease compared to the standard design.

5. Discussion, conclusions and future recommendations

5.1. Whole life cycle emissions discussion

Although transitioning to cycling has the obvious potential for reducing carbon emissions in the transportation sector, improving health and economic returns (at a minimum), there is also the climate cost of building new cycling routes, mainly greenways. This cost should be considered as early on during the route selection stage when developing cycling networks, mainly when carbon efficiency in infrastructure projects will become a critical factor for evaluating the Climate Change Plan's (Scottish Government, 2018) emissions reduction targets. In order to support this, the present work aims on defining a method for assessing the different route options against their potential carbon impact.

After assessing the projects chosen by Sustrans, it is possible to infer that the whole life carbon emissions for 1 kilometre of the refurbishing ones is, in average, 36,7% of the newly built's, endorsing the estimations for the "Build less" savings scenarios (Construction Leadership Council, 2013).

Newly Built	**Length (m)**	**Width (m)**	**Total Life Cycle Carbon Emissions ($kgCO_2e$)**	**Carbon Emission per km ($kgCO_2e$/km)**	**Total Life Cycle Environmental benefit (kgCO2)**	**Total Life Cycle Biogenic storage (kgCO2)**
Eddleston Water Path Phase 4	5380	2,5 - 3,5	2.032.795	377.842,9	-118.315	0
Fairlie Coastal Path Phase 3	371	2	112.533	303.323,4	0	55.215 (20 trees)
Built Over	**Length (m)**	**Width (m)**	**Total Life Cycle Carbon Emissions ($kgCO_2e$)**	**Carbon Emission per km ($kgCO_2e$/km)**	**Total Life Cycle Environmental benefit (kgCO2)**	**Total Life Cycle Biogenic storage (kgCO2)**
Hawick Active Travel Network	350	4	43.690	124.828,5	-5550	0
Glenriddet Path	400	3,5	61.149	152.872,5	-1890	12.204 (8 trees)

Figure 31 - Newly Built and Built Over Project's information summary table (Created by author, 2024).

Stage	Hawick (%)	Glenriddet (%)	Eddleston (%)	Fairlie (%)
A0	0.24	1.74	19.15	0.01
A1-A3	55.33	27.16	32.51	2.48
A4-full	9.58	15.14	5.65	2.15
A5	1.30	36.14	13.78	95.25
B4-B5	31.05	18.22	27.22	0.10
C1-C4	2.50	1.27	1.70	0.00
D	-12.70	-3.09	-5.82	0.00

Figure 32 – Comparison table of the percentage of each stage's contributions to the total emissions among the projects (Created by author, 2024).

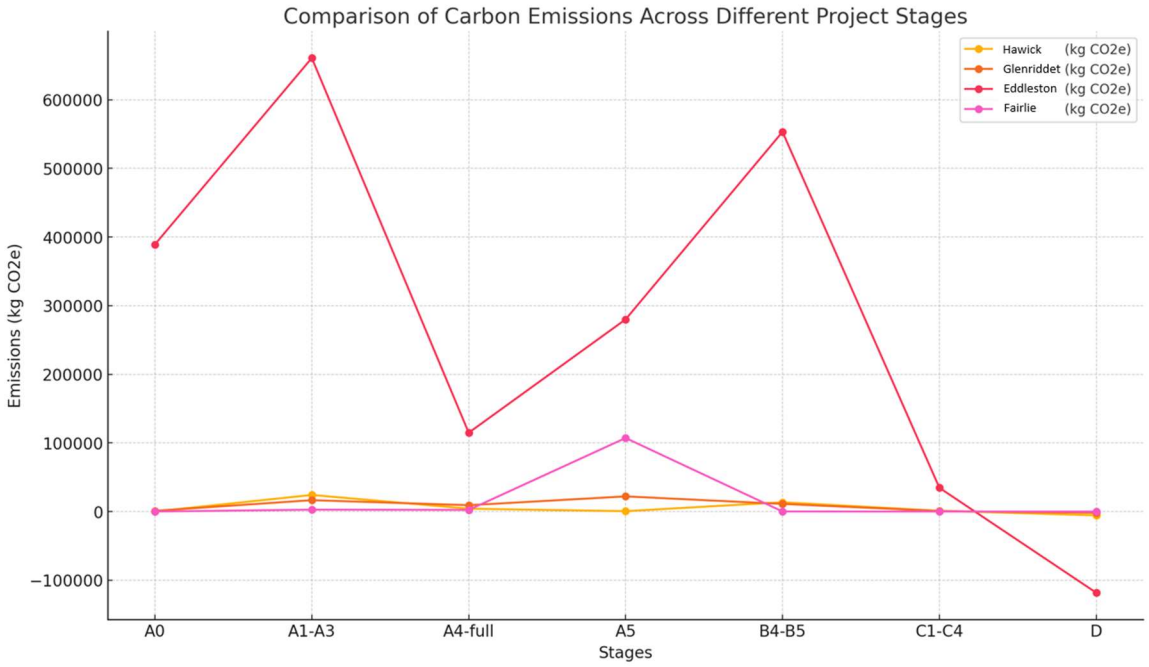


Figure 33 - Graph showing the comparison of carbon emissions across diferent projects stages (Created by author, 2024).

The results from the analysis of carbon emissions across different project stages provide a number of important insights and assumptions that are crucial for apprehending the carbon footprint of active travel infrastructure. They vary due to the diverse locations, terrain conditions and ancillary materials and services related to the construction. Some of the main relevant ones are:

- For the Fairlie project, the construction process (A5) contributes with the majority of the emissions (95.25%). This implies that the construction phase can be a critical area for emission reduction strategies once, as a coastal path, it includes a lot of retaining concrete walls, which require more *in situ* work.

- The projects exhibit notable variations in the product stage (A1-A3), with variations ranging from 2.48% to 55.33% of the overall emissions. This emphasizes how crucial manufacturing procedures and material choices are to total carbon footprint.

- The Material Replacement and Refurbishment (B4-B5) stage accounts for a considerable portion of emissions in most projects, especially the Eddleston project (27.22%) and Hawick project (31.05%). This suggests that long-term repair plans can substantially influence the total carbon emissions.

- The percentage of emissions contributed by the transport stage is smaller but still significant; it ranges from 2.15% to 15.14%. Local sourcing and effective logistics may be able to lower these emissions.

- The end-of-life stage (C1-C4) contributes relatively low emissions across all projects, with the highest being 2.50% in Hawick project. This indicates that disposal and recycling processes are less impactful in terms of emissions compared to other stages.

- Negative values for external impacts in the Hawick, Glenriddet, and Eddleston projects indicate that certain mitigation measures are in place, reducing the whole carbon footprint. However, for these carbon offsets to happen in reality, it needs to be ensured actual recycling practices, especially for materials like asphalt.

- The pre-construction stage (A0) has a minimum impact on the total emissions, indicating that the machine operation (mostly related to site clearance) have less influence on the overall carbon footprint, as this kind of infrastructure require.

- The only projects that achieved biogenic storage were the ones including large trees plantation on its scope. The Fairlie project was able offset the astounding mark of 49,05% of its whole carbon footprint by incorporating 20 trees, while the Glenriddet project stored 19,95% of its entire life cycle of carbon emissions. Thus, incorporating new green infrastructure with active travel projects must be prioritized, whenever possible, once it provides an outstanding compensation for the emissions created within the creation of the assets.

5.2. Pavement options discussion

Regarding the pavement options analysis, the assessment of the 1-kilometre standard green way path, designed according Sustrans, accounted 58.431 kgCO2 for its whole life cycle, which is similar to the value of 60.400 kgCO2 achieved by Manton et al. (2012).

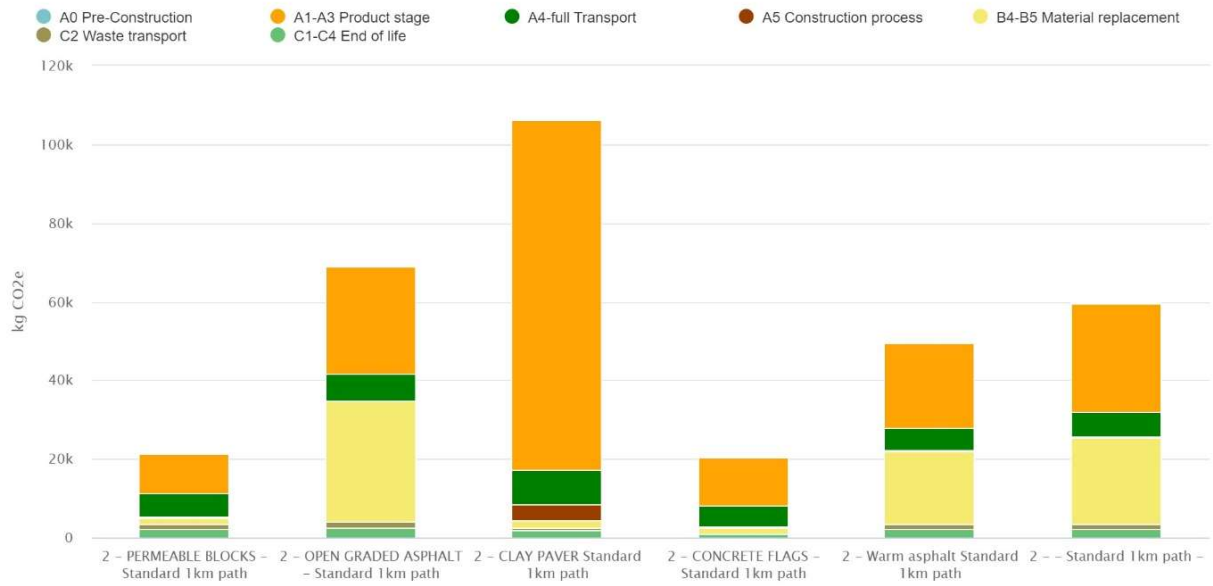


Figure 34 - Graph of the Infrastructure carbon, EN 17472 - Global Warming Potential fossil-A2, kg CO2e - Elements and life-cycle stages (Created by author, 2024).

Pavement Option	Total Emissions (kg CO2)	Variation in emissions in relation to the standard path (%)
Open graded asphalt	68.396	+17,7
Clay pavement	105.431	+80,43
Permeable blocks	20.337	-65,19
Concrete Flags	20.394	-65,18
Warm Alternatives	48.489	-17

Figure 35 - Summary table of the pavement option emissions (Created by author, 2024)

Even though the use of all those materials is officially recommended for this kind of path (Highways England, 2020), when considering its construction in Scotland, it is important to weigh both the environmental impact and the performance characteristics of each pavement type, which are examined as follows:

Open Graded Asphalt

Advantages:

- Smooth surface for cycling.
- Excellent drainage characteristics that minimize standing water on the surface (Setyawan et al., 2017)

Disadvantages:

- Extra carbon emissions as compared to the standard pathway of 17,7%
- While OGA performs well initially, its durability under repeated freeze-thaw conditions needs improvement (Si et al., 2014)
- Fossil fuel-dependent petroleum-based

Clay Pavement

Advantages:

- Aesthetical and natural looking
- Made out of natural materials (Weiss et al., 2017).

Disadvantages:

- Largest carbon emissions per option
- More than likely to crack and often poorly equipped for carrying heavy loads, or subjected to freeze-thaw cycles (Amakye et al., 2022).
- The installation can be arduous and expensive

Permeable Blocks

Advantages:

- Lowest carbon emissions (-65.19% compared to the standard path)
- Good drainage traits, thereby decreasing surface runoff and flooding damage (Das et al., 2023)
- Long life service (50 years)

Disadvantages:

- Not as smooth as asphalt, giving you a bumpier ride for those on two wheels.
- May need regular maintenance to control weed growth and settling (Marchioni et al. 2015).
- Roads generally cost more to install than in-situ roads as the sub-base must be well prepared (Weiss et al., 2017).

Concrete Flags

Advantages:

- Very low carbon emissions (-65.18% compared to the standard path)
- Long life service (50 years)
- High load-bearing capacity suitable for heavy foot traffic.

Disadvantages:

- Slippery when wet, dangerous for cyclists
- Means installation is lengthy, yet laborious.

- Damaged by freeze-thaw cycles - one of the biggest causes for failure (Das et al., 2023)

Warm mix asphalt

Advantages:

- It can achieve comparable performance to hot mix asphalt with a lower carbon footprint (Al-Hdabi et al., 2014).
- Less carbon emission than the traditional asphalt (-17% compared to the standard path).
- Allows for laydown at lower temperatures, concentrating on energy consumption during installation (Diab et al., 2016).

Disadvantages:

- Relies on petroleum-based materials
- Needs heavy machinery on setup (Diab et al., 2016)

Permeable blocks and concrete flags are, by far the best options in terms of lower carbon emissions, draining qualities, and reasonable longevity. However, they could be an uncomfortable or even dangerous surface for cycling. Also, they have a higher maintenance level compared to some other options, once they are more susceptible for damage in higher levels of higher precipitation and frosting (Weiss et al., 2017).

Warm asphalt alternatives sit in the middle, with a life span of 30 years, offering less maintenance – therefore, less costly for its whole lifecycle – and also offering moderately lower emissions than traditional asphalt, advantage that can be enhanced with recycled options as well (Tarsi et al., 2020).

Also, it is important to emphasize the value of appropriate maintenance to ensure the materials can make the most of their lifecycle in good conditions. For this, Sustrans (2019) have a guidance that can be summarized in some main points:

- Regular Inspections: Routine inspections shall be established to assess the condition of the route and further a risk-based reporting system, triggering corrective action plans when necessary.
- Inspections of Trees: Tree inspections should be included in the maintenance to ensure trees are not hazards and that path width is being maintained.
- Structural Inspections: Facilitates should be inspected occasionally for condition, path/track surface over facilitates shall be routinely inspect.
- Feature Inspections: Routinely inspect and clean route features such as artwork, benches etc. to help retain attraction values

Maintenance Plans

- Routine tasks: Maintenance plan should include verge cutting, overhanging vegetation clearance, tree works/pathway sweeping/ drain clearing/litter picking. Carry out any vegetation clearance at times when birds do not have nests.
- Maintenance for the Structure: Older structures are always in need of a little more TLC. Inspection of anti-slip treatments on wooden bridge decks to eliminate slipperiness.
- Maintenance: Channels, Gullies, Ditches and Pipes Hazards to driver Keep clear of drains.

Vegetation Management

- Control Overgrowth: Continued maintenance must take place to control vegetative impact and ensure sunlight reaches the route.
- For Safety and Accessibility: Trimmed vegetation improves one's safety allowing for a short tunnel effect. When required, employ special instrumentations.
- Structural Protect: Trim plants around structures to enable observation and prevent damage.
- Ecology: Leave a strip 1m wide alongside the edge of path will not affect flora and fauna. Permitting important plant species to seed before mowing.

Maintenance Access

- Design with Access in Mind: While planning, account for maintenance access and types of vehicles needing to pull off the street (service trucks require different turning radiuses).
- Allow vehicles to wait in safe areas at access point locations without dismantling the controls.
- Vehicle Load Assumptions: If vehicle access is required, make sure the paths are designed to take the assumed vehicular loadings so that they do not break up prematurely.

5.3. Transportation and Recycled Content Discussion

According to Tarsi et al. (2020), the RAP material is one of the most widely reused construction products globally. In 2018, about 88% by weight in the USA and 72% by weight in Europe were utilized as aggregates for Hot, Warm, and Cold Asphalt Mixtures, as well as for unbound layers. Numerous studies have indicated favourable outcomes for recycled asphalt mixtures containing high or very high levels of RAP. However, standard practices in many countries typically restrict the RAP content in recycled asphalt mixes to an average of 15–20% by weight.

Case	Description	Asphalt's emission factor (kg CO2e/kg)	Total Emissions (kg CO2)	Reduction
Case 1	No recycled content, hot mix, 15km distance	0,0431	56.749	2.9%
Case 2	15% recycled asphalt, 60km distance	0,021	44.742	23%
Case 3	37% recycled asphalt, 120km distance	0,014	42.486	27%

Figure 36 - Summary table of the Transportation and Recycled Content scenario (Created by author, 2024)

The results show that, even with a substantial increase in the distance, the use of recycled asphalt significantly reduces the emissions associated with the standard path construction. It states a different outcome than the achieved by Fox et Al. (2011), where is said that it is shown that the amount of recycled material in asphalt has a negligible effect

on embodied emissions when weighed against the possibility of longer transport routes. Fox et Al. (2011) states that the average emission factor for recycled asphalt is 0.0432 kg CO2/kg, more than the double of the factor considered in this present study. According to Yaro et al., (2023) this is due to the increasing importance of developing innovative recycling methods for asphalt pavement. A wider variety of materials, including recycled and bio-based materials as well as materials produced from industrial wastes like slag from the steel industry or fly ash from coal power plants, can be used as alternative materials when it comes to sustainable asphalt pavement materials (Al-Sabaeei et al., 2022). Additionally, new sustainable materials have been developed as a result of developments in materials science and engineering. Examples of these materials include carbon-neutral materials and geopolymer additives for asphalt concrete (Aryan et al., 2023).

Moreover, electric construction equipment and biomass-based fuel are able to lower carbon and greenhouse gas emissions by 36–90% and 67–95%, respectively. Nevertheless, before a variety of the recycled waste materials and techniques could be extensively used in asphalt industry, several critical challenges need to be overcome such as cost concerns, performance and durability concerns, standardization and regulations, availability, integration with existing facilities, and insufficient field and long-term data (Yaro et al., 2023).

5.4. Monitoring and Evaluation

There is a need on an ongoing basis to track and measure active travel routes and schemes in order that their performance can be understood and demonstrate efficacy for future investment. It also offers guidance on how it should be done and the Welsh Government (2022) states its importance by defining all its processes, that can be briefly summarized as follows:

- A performance-based approach to actively monitor mode shifts should be established by the authorities, which would provide a baseline that can easily measure benefits of better policies.
- Usage levels, collision statistics, modal share changes and demographic characteristics are examples of data that could be monitored.

- Authorities have to record and report on changes in active travel route use every three years.
- Monitoring can be applied to the projects since the beginning.

Purpose of monitoring and evaluating

- Support current plans and schemes, accommodate new proposals, or explore future possibilities
- Used to compare and prioritize scheme design options and assess if schemes represent value for money.
- Helps review experimental schemes and decide on their permanence.
- Measures alterations in travel habits after effective implementation and function of novel schemes.
- The use of baseline data can also help to identify proposals for active travel and inform the decision on whether there should be an intervention that is on-road or off- carriageway.
- Proof of impact post-implementation emphasises the case for upcoming funding and support during public inquiries.

5.5. BIM Integration

Stepping in with Building Information Modelling (BIM) could also be a powerful enhancement both on the designing and evaluation processes. Initially, it is crucial to define a scope for the carbon footprint management and choose a tool for the emissions calculation. Planning with a specific tool in mind and setting up standard materials can speed up the proceedings and minimize errors (Oreto et al., 2022).

Empower cooperation using BIM's collaborative capabilities is useful to attract all of the players, whether it is an architect or engineer; contractor and environmental mentor. Keeping up with the evolution of the design, by updating the BIM model and re-running their LCA in the chosen tool will provide an overall sustainable approach across the entire project stage.

Furthermore, appropriate reporting and documentation are critical and many tools, like One Click LCA, can automatically generate detailed environmental impact reports and share with stakeholders as part of a plan that will both show compliance, allowing to fulfil the sustainability goals amidst meeting regulatory requirement. Documenting all decisions and modifications to the BIM model based on an LCA is useful for future undertakings as well as substantiating environmental claims (Schinabeck et al., 2023).

A workflow example could be to start in design phase with the initial BIM model, export it to the tool for preliminary LCA and then follow through optimization based on results. The BIM model is further developed at this point, with more components and materials added as well as higher reliability over refinements in the first phase; The LCA is rectified once again to accommodate even greater design enhancements; The highest level of detail and accuracy (LOD 500) of the BIM model in the construction phase will provide integration into planning of works, incorporating LCA considerations during all processes (Feng et al., 2023). Then, during operations stage, it is possible to utilise the same BIM model for maintenance planning and conduct a post-construction LCA to calculate actual environmental impact (Oreto et al., 2022).

5.6. LCA benefits and influence in design

Following the LCA requirements can influence an infrastructural project design in many ways discussed next:

Early Integration for Maximum Impact

Using LCA in the initial stages could engage designers to make informed decisions and achieve a remarkable environmental performance of the project (Buyle et al., 2013).

Design and Material Optimization

LCA is an important tool for the comparison and selection of materials in infrastructure projects. This enables designers to assess the ecological impacts of materials from extraction to deletion (Häfliger et al., 2017).

Process Optimization

LCA reviews the whole process of an infrastructural project which indicates opportunities for improving on environmental performance at different stages. Such changes can affect construction processes as a whole, potentially reducing energy and waste generated while at the same time global environmental impacts (Cabeza et al., 2014).

Compare Design Alternatives

LCA allows designers to compare, or weigh in terms of environmental performance the different design options for infrastructural projects. That capability enables data driven decision making in the choice of environmentally friendly design solutions (Hollberg and Ruth 2016).

Dealing With Specific Environmental Problems

LCA outputs can help identify certain parts of infrastructural projects as top areas with environmental concerns, for example high energy use in construction or much emissions during the phase of usage. This information can assist designers in identifying the problems and concentrating efforts on these aspects, which could result in creative design solutions (Meneghelli 2018).

Enabling the Circular Economy

When with regard to infrastructural projects, LCA can be useful for realizing circular economy principles. It can help designers recognize when material reuse, recycling opportunities and waste reduction to occur at which project phases or life cycle stages (Ingrao et al., 2018).

Improve decision-making tools

LCA is being included in infrastructure planning decision support systems more and more. This could be useful for allowing planners and designers to gain a fast overview of the potential environmental impacts more quickly than they are currently able to do (Eleftheriadis, et al., 2017).

5.6. Limitations

While this study has given valid insights on carbon emission reduction on active travel projects, there are a few limitations that must be acknowledged. Appropriate data was accessible from the project's bills of quantity; yet, certain elements should be available to provide more efficient and specific data collection at the source and to facilitate data auditing in the future. The following are a few examples:

- Material suppliers: in order to guarantee that this best practice is recorded and reported along the supply chain and that the advantages are included in carbon reporting, supply contracts should expressly require that batch records and material testing certificates declare any recycled content in materials.

- Delivery tickets: if appropriate, they should mention the amount of recycled material content and the distance travelled from the supply source to the site.

- Laying records: Keeping track of material sources and batch numbers on a daily basis creates a useful audit trail; noting recycled content would strengthen it.

- Plant returns: more accurate carbon reporting would be possible if a daily or weekly fuel consumption field was added to the return, as these often include the plant item and the number of hours it is used each day.

- Waste transfer records: Similar to delivery tickets, a field recording the distance between the construction site and the disposal or transfer site would be helpful for carbon reporting and audits.

5.7. Conclusions

When developing active travel networks, the route selection step should take the climate cost of building additional paths - especially greenways - into account. The approach

for evaluating and contrasting the possible carbon costs of different route options is described in this study. The primary findings derived from the case study and the metric are:

1. Whole Life Cycle Carbon Reporting:

- Build Over Existing Infrastructure projects (Hawick and Glenriddet) presented, in average, 40,7% less carbon emissions per km compared to Newly Built projects (Eddleston and Fairlie).
- The Construction Process and Product Stage phases typically accounted for the highest emissions across projects – respectively 36,6% and 29,3%.
- Asphalt, gravel, and concrete products were common hotspot materials for emissions.
- Some projects achieved environmental benefits through end-of-life reuse/recycling of materials and biogenic storage.
- Tree planting is very effective in offsetting the emissions related to the construction of a path - 49,05% for the Fairlie and 19,95% for the Glenriddet projects.

1. Pavement Option Analysis:

- Six different pavement options for a 1km path were analyzed: Standard, Open graded asphalt, Clay pavement, Permeable blocks, Concrete flags, and Warm asphalt.
- Emissions varied significantly between options, from 20,337 kgCO2 (Permeable blocks) to 105,431 kgCO2 (Clay pavement).
- The Product Stage was typically the highest source of emissions.
- All options showed some environmental benefits from end-of-life material reuse/recycling.

1. Transportation and Recycled Content Analysis:

- Four cases were examined to assess the relationship between recycled asphalt content and transportation distances.
- Increasing recycled content in asphalt reduced overall emissions, even when transportation distances increased significantly.

- The case with 37% recycled asphalt content and 120km transportation distance showed a 27% decrease in emissions compared to the standard design, despite the longer distance.
- Prioritizing emission reduction technologies can help cut down on emissions from the material production and construction phases. These technologies include lowering the temperature at which materials are mixed, using recycled materials and recycling procedures, and substituting energy in equipment.
- Create and incorporate a carbon footprint management framework to make the design process faster and more effective, including the integration of BIM if possible.
- Increase the efficiency of data collection at the source and facilitate future data audits – including adding a clause regarding this in contracts with contractors.

5.8. Suggestions for further research

- Enhanced guidelines for sustainable infrastructure construction specific to active travel projects based on the findings of this study and further research.
- Get a better handle on the carbon savings via modal shift, taking into account more detailed features relating to user behaviour, route characteristics & possible rebound effects.
- Explore opportunities to integrate nature-based solutions and green infrastructure within active travel projects to facilitate carbon sequestration and additional environmental benefits.
- Economic cost-benefit analysis of different carbon emissions reduction measures in active travel infrastructure to help policy making and project planning.

References

Al-Hdabi, A., Nageim, H. and Seton, L., 2014. Superior cold rolled asphalt mixtures using supplementary cementitious materials. Construction and Building Materials, 64, pp.95-102. Available at: https://doi.org/10.1016/j.conbuildmat.2014.04.033 [Accessed 27 March 2024].

Al-Sabaeei, A.M., Al-Fakih, A., Noura, S., Yaghoubi, E., Alaloul, W., Al-Mansob, R.A., Khan, M.I. and Yaro, N.S.A., 2022. Utilization of palm oil and its by-products in bio-asphalt and bio-concrete mixtures: A review. Construction and Building Materials, 337, p.127552.

Amakye, S., Abbey, S., Booth, C. and Oti, J., 2022. Performance of sustainable road pavements founded on clay subgrades treated with eco-friendly cementitious materials. Sustainability, 14, p.12588. Available at: https://doi.org/10.3390/su141912588 [Accessed 27 March 2024].

Aryan, Y., Dikshit, A.K. and Shinde, A.M., 2023. A critical review of the life cycle assessment studies on road pavements and road infrastructures. Journal of Environmental Management, 336, p.117697. Available at: https://www.sciencedirect.com/science/article/pii/S0301479723004851 [Accessed 29 Mar 2024].

AzariJafari, H., Yahia, A. and Ben Amor, M., 2016. Life cycle assessment of pavements: reviewing research challenges and opportunities. Journal of Cleaner Production, 112(Part 4), pp.2187-2197. Available at: https://doi.org/10.1016/j.jclepro.2015.09.080 [Accessed 26 June 2024].

Bergman, R., Fava, J., Fenves, S.J., Frischknecht, R., Huppes, G., Jolliet, O., Norris, G., Prox, M., Storer, M., Suh, S. and Thoma, G., 2014. Making LCA relevant and feasible for organizations: the path forward. The International Journal of Life Cycle Assessment, 19(2), pp.241-245.

Bizarro, D.E.G., Steinmann, Z., Nieuwenhuijse, I., Keijzer, E. and Hauck, M., 2021. Potential Carbon Footprint Reduction for Reclaimed Asphalt Pavement Innovations: LCA Methodology, Best Available Technology, and Near-Future Reduction Potential.

Sustainability, 13(3), p.1382. Available at: https://doi.org/10.3390/su13031382 [Accessed 26 March 2024].

Bueno, C. and Fabricio, M.M., 2018. Comparative analysis between a complete LCA study and results from a BIM-LCA plug-in. Automation in Construction, 90, pp.188-200.

Buyle, M., Braet, J. and Audenaert, A., 2013. Life cycle assessment in the construction sector: A review. Renewable and Sustainable Energy Reviews, 26, pp.379-388.

Cabeza, L.F., Rincón, L., Vilariño, V., Pérez, G. and Castell, A., 2014. Life cycle assessment (LCA) and life cycle energy analysis (LCEA) of buildings and the building sector: A review. Renewable and Sustainable Energy Reviews, 29, pp.394-416.

Cass, D., and Mukherjee, A., 2011. Calculation of greenhouse gas emissions for highway construction operations using a hybrid life cycle assessment approach: a case study for pavement operations. Journal of Construction Engineering and Management, 137(11), 1015-1025.

CoMoUK, 2021. Bike Share Annual Report GB 2021. [online] CoMoUK. Available at: https://www.como.org.uk/documents/bike-share-annual-report-gb-2021 [Accessed 13 April 2024].

Committee on Climate Change (2023). Progress in reducing emissions in Scotland: 2023 Report to Parliament. Available at: https://www.theccc.org.uk/wp-content/uploads/2024/03/Progress-in-reducing-emissions-in-Scotland-2023-Report-to-Parliament.pdf [Accessed: 23 June 2024].

Construction Leadership Council (2013). Infrastructure Carbon Review Technical Report. [pdf] Construction Leadership Council. Disponível em: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2019/06/Infrastructure-Carbon-Review-Technical-Report-25-11-13.pdf [Accessed in 04 March 2024].

Das, A., 2023. Analysis of Pavement Structures. 2nd ed. CRC Press. Available at: https://doi.org/10.1201/9781003190769 [Accessed 20 July 2024].

Department for Transport, 2022. Active travel: local authority toolkit. [online] GOV.UK. Available at: https://www.gov.uk/government/publications/active-travel-local-authority-toolkit/active-travel-local-authority-toolkit [Accessed 27 July 2023].

Department for Transport. (2021) Transport decarbonisation plan. Available at: https://www.gov.uk/government/publications/transport-decarbonisation-plan [Accessed: 23 June 2024].

Department of Energy and Climate Change (DECC) and Department for Environment, Food and Rural Affairs (Defra) (2011) Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting. London: DECC and Defra.

Diab, A., Sangiorgi, C., Ghabchi, R., Zaman, M. and Wahaballa, A., 2016. Warm Mix Asphalt (WMA) technologies: Benefits and drawbacks—a literature review. In: International Conference on Sustainable Design, Engineering and Construction. Available at: https://doi.org/10.1201/9781315643274-127 [Accessed 27 March 2024].

Eleftheriadis, S., Mumovic, D. and Greening, P., 2017. Life cycle energy efficiency in building structures: A review of current developments and future outlooks based on BIM capabilities. Renewable and Sustainable Energy Reviews, 67, pp.811-825.

Enfrin, M. and Giustozzi, F., 2022. Recent advances in the construction of sustainable asphalt roads with recycled plastic. Polymer International. Available at: https://doi.org/10.1002/pi.6405 [Accessed 26 March 2024].

Fang, Z., Yan, J., Lu, Q., Chen, L., Yang, P., Tang, J., Jiang, F., Broyd, T., and Hong, J., 2023. A systematic literature review of carbon footprint decision-making approaches for infrastructure and building projects. Applied Energy, 335, p.120768. Available at: https://doi.org/10.1016/j.apenergy.2023.120768 [Accessed 27 June 2023].

Fay, M., Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Narloch, U. and Kerr, T., 2015. Decarbonizing Development: Three Steps to a Zero-Carbon Future. Washington, DC: World Bank. doi:10.1596/978-1-4648-0479-3.

Fenner, A.E., Kibert, C.J., Woo, J., Morque, S., Razkenari, M., Hakim, H. and Lu, X., 2018. The carbon footprint of buildings: A review of methodologies and applications. Renewable and Sustainable Energy Reviews, 94, pp.1142-1152. Available at: https://doi.org/10.1016/j.rser.2018.07.012 [Accessed 27 March 2024].

Feng, Y., Bouman, R.W., and Guo, Z., 2023. 'Systematics and evolution of the mycoheterotrophic family Triuridaceae', Perspectives in Plant Ecology, Evolution and Systematics, 59, p. 125697. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1474034623000897 (Accessed: 21 June 2024)

Fet, A.M., Skaar, C. and Michelsen, O., 2009. Product category rules and environmental product declarations as tools to promote sustainable products: experiences from a case study of furniture production. Clean Technologies and Environmental Policy, 11(2), pp.201-207.

Fox, J., Bell, D., Edmond, G., Cummings, P. e Langstraat, J., 2011. A practical tool for low-carbon road design and construction. *Proceedings of the Institution of Civil Engineers - Transport*, 164(3), pp.165-179. doi: 10.1680/tran.2011.164.3.165.

GHG Protocol, 2019. Bath Inventory of Carbon and Energy (ICE). Available at: https://ghgprotocol.org/Third-Party-Databases/Bath-ICE [Accessed 12 July 2024].

Glasgow City Council, 2023. £3.6m boost for active travel in Glasgow. [online] Available at: https://www.glasgow.gov.uk/index.aspx?articleid=30142 [Accessed 27 July 2024].

Grael, P.F.F., Oliveira, L.S.B.L., Oliveira, D.S.B.L., and Bezerra, B.S., 2021. Life cycle inventory and impact assessment for an asphalt pavement road construction—a case study in Brazil. The International Journal of Life Cycle Assessment, 26, pp.402-416. Available at: https://doi.org/10.1007/s11367-020-01842-5 [Accessed 26 March 2024].

Gu, N. and London, K., 2010. Understanding and facilitating BIM adoption in the AEC industry. Automation in Construction, 19(8), pp.988-999. Available at: https://doi.org/10.1016/j.autcon.2010.09.002 [Accessed 27 March 2024].

Gulzar, S., Fried, A., Preciado, J., Castorena, C., Underwood, S., Habbouche, J. and Boz, I., 2023. Towards sustainable roads: A State-of-the-art review on the use of recycling agents in recycled asphalt mixtures. Journal of Cleaner Production, 406, p.136994. Available at: https://doi.org/10.1016/j.jclepro.2023.136994 [Accessed 26 July 2024].

Häfliger, I.F., John, V., Passer, A., Lasvaux, S., Hoxha, E., Saade, M.R.M. and Habert, G., 2017. Buildings environmental impacts' sensitivity related to LCA modelling choices of construction materials. Journal of Cleaner Production, 156, pp.805-816.

Häkkinen, T. and Mäkelä, K., 1996. Environmental adaption of concrete: Environmental impact of concrete and asphalt pavements. Valtion teknillinen tutkimuskeskus (VTT).

Highways England (2020) Design Manual for Roads and Bridges: CD 239 Footway and cycleway pavement design. Revision 1, March 2020. Available at: https://www.standardsforhighways.co.uk (Accessed: 15 Fev 2024).

Hollberg, A. and Ruth, J., 2016. LCA in architectural design—a parametric approach. The International Journal of Life Cycle Assessment, 21(7), pp.943-960.

Horvath, A. and Hendrickson, C., Comparison of Environmental Implications of Asphalt and Steel-Reinforced Concrete Pavements. Available at: https://www.semanticscholar.org/paper/Comparison-of-Environmental-Implications-of-Asphalt-Horvath-Hendrickson/ed9293315171ea67b79aca594397f24e9a299232 [Accessed 26 March 2024].

Ibáñez-Forés, V., Pacheco-Blanco, B., Capuz-Rizo, S.F. and Bovea, M.D., 2016. Environmental Product Declarations: exploring their evolution and the factors affecting their demand in Europe. Journal of Cleaner Production, 116, pp.157-169.

Ingrao, C., Messineo, A., Beltramo, R., Yigitcanlar, T. and Ioppolo, G., 2018. How can life cycle thinking support sustainability of buildings? Investigating life cycle assessment applications for energy efficiency and environmental performance. Journal of Cleaner Production, 201, pp.556-569.

ISO 14025, 2006. Environmental labels and declarations - Type III environmental declarations - Principles and procedures. International Organization for Standardization, Geneva, Switzerland.

Jiang, R., Wu, C., Song, Y. and Wu, P., 2020. Estimating carbon emissions from road use, maintenance and rehabilitation through a hybrid life cycle assessment approach – A case study. Journal of Cleaner Production, 277, p.123276. Available at: https://doi.org/10.1016/j.jclepro.2020.123276 [Accessed 26 March 2024].

Johnsson, F., Karlsson, I., Rootzén, J., Ahlbäck, A. and Gustavsson, M., 2020. The framing of a sustainable development goals assessment in decarbonizing the construction industry – Avoiding "Greenwashing". Renewable and Sustainable Energy Reviews, 131. Available at: https://doi.org/10.1016/j.rser.2020.110029 [Accessed 27 July 2023].

Kiihnl, L., and Braham, A., 2021. Exploring the influence of pavement preservation, maintenance, and rehabilitation on Arkansas' highway network: an education case study. International Journal of Pavement Engineering, 22(5), 570-581. Available at: https://doi.org/10.1080/10298436.2019.1628960 [Accessed 26 March 2024].

Liljenström, C., Björklund, A. and Toller, S., 2022. Including maintenance in life cycle assessment of road and rail infrastructure—a literature review. International Journal of Life Cycle Assessment, 27, pp.316-341. Available at: https://doi.org/10.1007/s11367-021-02012-x [Accessed 26 March 2024].

Marchioni, M. and Becciu, G., 2015. Experimental results on permeable pavements in urban areas: A synthetic review. International Journal of Sustainable Development and Planning, 10(6), pp.806-817. Available at: https://doi.org/10.2495/SDP-V10-N6-806-817 [Accessed 27 March 2024].

Matthews, H., Hendrickson, C. and Weber, C., 2008. The Importance of Carbon Footprint Estimation Boundaries. *Environmental Science & Technology*, 42, pp.5839-5842. Available at: https://doi.org/10.1021/es703112w [Accessed 29 July 2024].

Meneghelli, A., 2018. Whole-building embodied carbon of a North American LEED-certified library: Sensitivity analysis of the environmental impact of buildings materials. Building and Environment, 134, pp.230-241.

Minkov, N., Schneider, L., Lehmann, A. and Finkbeiner, M., 2015. Type III Environmental Declaration Programmes and harmonization of product category rules: status quo and practical challenges. Journal of Cleaner Production, 94, pp.235-246.

Mroueh, U.-M., Eskola, P., Laine-Ylijoki, J., Wellman, K., Mäkelä, E., Juvankoski, M. and Ruotoistenmäki, A., 2000. Life cycle assessment of road construction. Available at: https://www.researchgate.net/publication/237683954_Life_cycle_assessment_of_road_construction [Accessed 26 July 2024].

Mrkajic, V., Vukelic, D. and Mihajlov, A., 2015. Reduction of CO2 emission and non-environmental co-benefits of bicycle infrastructure provision: the case of the University of Novi Sad, Serbia. Renewable and Sustainable Energy Reviews, 49, pp.232-242. Available at: https://doi.org/10.1016/j.rser.2015.04.100.

Narassimhan, E. et al., 2018. Carbon market challenge. Cambridge: Cambridge University Press. Available at: https://www.cambridge.org/core/elements/carbon-market-challenge/9261122253200C956EAF02B5C9AF53C8 [Accessed: 15 June 2024].

Onat, N.C. and Kucukvar, M., 2020. Carbon footprint of construction industry: A global review and supply chain analysis. *Renewable and Sustainable Energy Reviews*, 124, p.109783. Available at: https://doi.org/10.1016/j.rser.2020.109783 [Accessed 29 June 2023].

Oreto, C., Biancardo, S.A., Veropalumbo, R., Viscione, N., Russo, F., Abbonati, F. and Dell'Acqua, G., 2022. BIM-LCA Integration Framework for Sustainable Road Pavement Maintenance Practices. International Journal of Transport Development and Integration, 6(1), pp.1-11. Available at: http://www.witpress.com/journals [Accessed 19 June 2024].

Park, K., Hwang, Y., Seo, S. and Seo, H., 2003. Quantitative assessment of environmental impacts on life cycle of highways. Journal of Construction Engineering and Management, 129, pp.25-31.

Passer, A., Lasvaux, S., Allacker, K., De Lathauwer, D., Spirinckx, C., Wittstock, B., Kellenberger, D., Gschösser, F., Wall, J. and Wallbaum, H., 2015. Environmental product declarations entering the building sector: critical reflections based on 5 to 10 years experience in different European countries. The International Journal of Life Cycle Assessment, 20(9), pp.1199-1212.

Robinson, O.J., Tewkesbury, A., Kemp, S. and Williams, I.D., 2018. Towards a universal carbon footprint standard: A case study of carbon management at universities. Journal of Cleaner Production, 172, pp.4435-4455. Available at: https://doi.org/10.1016/j.jclepro.2017.02.147 [Accessed 27 March 2024].

Roudebush, W.H., 1996. Environmental Value Engineering (EVE) Environmental Life Cycle Assessment of Concrete and Asphalt Highway Pavement Systems. Portland Cement Association.

Rozenberg, J., Davis, S.J., Narloch, U. e Hallegatte, S., 2015. Climate constraints on the carbon intensity of economic growth. *Environmental Research Letters*, 10(9), p.095006. Available at: https://iopscience.iop.org/article/10.1088/1748-9326/10/9/095006/meta [Accessed 27 March 2024].

Röck, M., Hollberg, A., Habert, G. and Passer, A., 2018. LCA and BIM: Visualization of environmental potentials in building construction at early design stages. Building and Environment, 140, pp.153-161.

Schinabeck, M., Krug, D., Wagener, R., Scharf, H., Bensmann, B. and Morbach, A., 2023. Building Information Modeling-Based Building Life Cycle Assessment: Practical Application and Potential for Integration with Digital Planning Tools. Materials, 16(3), p.1047. Available at: https://www.mdpi.com/1996-1944/16/3/1047 [Accessed 19 June 2024].

Scottish Government, 2019. Scottish Household Survey 2019 - Annual Report. [online] Available at: https://www.gov.scot/publications/scottish-household-survey-2019-annual-report/ [Accessed 20 June 2024].

Scottish Parliament (2005) Construction Procurement Manual – Section 7: Sustainability. Her Majesty's Stationery Office, Edinburgh, UK. See http://www.scotland.gov.uk/Publications/ 2005/11/28100404/04108

Scottish Parliament (2018) Climate Change (Emissions Reduction Targets) (Scotland) Bill. Edinburgh: Scottish Parliament. Available at: https://www.parliament.scot/bills-and-laws/bills/climate-change-emissions-reduction-target-scotland-bill (Accessed: 23 June 2024).

Secretary-General of the OECD, 2018. Climate-resilient Infrastructure. Policy perspectives. [online] Available at: https://www.oecd.org/environment/cc/policy-perspectives-climate-resilient-infrastruture.pdf [Accessed 27 July 2024].

Setyawan, A., Suryoto, Sumarsono, A. and Widyastuti, S., 2017. Open graded asphalt mixture design for environmentally friendly road. IOP Conference Series: Materials Science and Engineering, 176, p.012025. Available at: https://doi.org/10.1088/1757-899X/176/1/012025 [Accessed 27 March 2024].

Singh, A., Vaddy, P. and Biligiri, K.P., 2020. Quantification of embodied energy and carbon footprint of pervious concrete pavements through a methodical lifecycle assessment framework. Resources, Conservation and Recycling, 161, p.104953. Available at: https://doi.org/10.1016/j.resconrec.2020.104953 [Accessed 26 March 2024].

Si, W., Ma, B., Li, N., Ren, J.P. and Wang, H.N., 2014. Reliability-based assessment of deteriorating performance to asphalt pavement under freeze–thaw cycles in cold regions. Construction and Building Materials, 68, pp.572-579. Available at: https://doi.org/10.1016/j.conbuildmat.2014.07.004 [Accessed 27 March 2024].

Soust-Verdaguer, B., Llatas, C. and García-Martínez, A., 2017. Critical review of bim-based LCA method to buildings. Energy and Buildings, 136, pp.110-120.

Sovacool, B.K., Newell, P., Carley, S. et al., 2022. Equity, technological innovation and sustainable behaviour in a low-carbon future. *Nature Human Behaviour*, 6, pp.326–337. Available at: https://doi.org/10.1038/s41562-021-01257-8 [Accessed 29 July 2024]

Strazza, C., Magrassi, F., Gallo, M. and Del Borghi, A., 2016. Environmental product declaration in the construction sector: a comparative life cycle assessment. Journal of Environmental Management, 167, pp.236-242.

Stripple, H., 2001. Life Cycle Assessment of Road: A Pilot Study for Inventory Analysis. Gothenburg, Sweden: IVL.

Sustrans, 2019. Sustrans Traffic-Free Routes and Greenways Design Guide. Available at: https://www.sustrans.org.uk/for-professionals/infrastructure/sustrans-traffic-free-routes-and-greenways-design-guide [Accessed 12 Jul. 2024].

Tarsi, G., Tataranni, P., and Sangiorgi, C., 2020. The Challenges of Using Reclaimed Asphalt Pavement for New Asphalt Mixtures: A Review. Materials, 13(4052). Available at: https://www.mdpi.com/1996-1944/13/18/4052 [Accessed 10 June 2024].

Transport Scotland, 2017. Transport and Travel in Scotland 2017: 7 Walking and Cycling. [online] Available at: https://www.transport.gov.scot/publication/transport-and-travel-in-scotland-2017/7-walking-and-cycling/ [Accessed 20 June 2024].

University of Leeds, 2020. What is 'active travel'? [online] Available at: https://activetravelgroup.leeds.ac.uk/what-is-active-travel/ [Accessed 27 July 2024].

Welsh Government (2022). Active Travel Act Guidance. Available at: https://www.gov.wales/sites/default/files/publications/2022-01/active-travel-act-guidance.pdf [Accessed: 15 June 2024].

Wheels for Wellbeing, 2020. Types of Cycles. [online] Wheels for Wellbeing. Available at: https://wheelsforwellbeing.org.uk/types-of-cycles/ [Accessed 13 April 2024].

World Green Building Council, 2019. Bringing embodied carbon upfront. [online] Available at: https://worldgbc.org/advancing-net-zero/embodied-carbon/ [Accessed 27 July 2024].

Yaro, N., Sutanto, M., Baloo, L., Habib, N., Usman, A., Yousafzai, A.K., Ahmad, A.H., Birniwa, A. and Jagaba, A.N., 2023. A Comprehensive Overview of the Utilization of Recycled Waste Materials and Technologies in Asphalt Pavements: Towards Environmental and Sustainable Low-Carbon Roads. Processes. Available at: https://www.mdpi.com/2227-9717/11/7/2095 [Accessed 20 June 2024].

Ye, L., Qi, C., Hong, J. and Ma, X., 2017. Life cycle assessment of polyvinyl chloride production and its recyclability in China. Journal of Cleaner Production, 142(4), pp.2965-2972. Available at: https://doi.org/10.1016/j.jclepro.2016.10.171 [Accessed 29 Mar 2024].

Yu, B., 2013. Environmental Implications of Pavements: A Life Cycle View. Graduate Theses and Dissertations, pp.1-236.

Zhu, L., Li, J., Xiao, F., 2024. Carbon emission quantification and reduction in pavement use phase: A review. Journal of Molecular Structure, [online] Available at: https://www.sciencedirect.com/science/article/pii/S2095756424000060?via%3Dihub [Accessed 13 April 2024].

Appendix A: Bills of quantities of the assessed projects

Hawick's Bill of Quantities

SCOTTISH BORDERS COUNCIL - TRAFFIC AND ROAD SAFETY				BILL OF QUANTITIES	
Project:	Hawick Flood Defence Works - WS58	Prepared by:		Jon Ruddiforth	
Code:		Approved by:			
Version:	1	Date:		3rd April 2023	
Series 100: Preliminaries					
Item	**Description**	**Bill Qty**	**Unit**	**Rate**	**Amount (£)**
	TEMPORARY ACCOMMODATION				
NC					
1,01	Erection, servicing and dismantling of offices and messes for the contractor	13	weeks	£600,00	£7.800,00
1,02	Erection, servicing and dismantling of stores and workshops for the contractor	13	weeks	£300,00	£3.900,00
1,03	Site management	13	weeks	£650,00	£8.450,00
1,04	Heras fencing, barriers, segregation etc.	13	weeks	£200,00	£2.600,00
	TRAFFIC SAFETY and MANAGEMENT				
1,05	Traffic Safety and Management	6	weeks	£500,00	£3.000,00
				Series 100	**£25.750,00**
Series 200: Site Clearance					
	SITE CLEARANCE				
2,01	Strip existing topsoil and dispose on site (prov qty)	500,00	m^3	£40,20	£20.100,00
2,02	Create bund and grade to suit levels leaving 4m flat area		m^3		included
2,03	Remove existing footpath surfacing and kerb	90,00	m^2	£12,50	£1.125,00
	TAKE UP OR DOWN AND SET ASIDE FOR RE-USE OR REMOVE TO STORE OR TIP OFF SITE				
2,03	HB2/BN/ transition kerbs to be taken up and removed to tip off site (put as excavator hours)	80	m	42,90	£3.432,00
				Series 200	**£24.657,00**
Series 600: Earthworks					
	EXCAVATION				
6,00	Break out existing tarmac surfacing	200	m^2	£11,00	£2.200,00
6,01	Excavation in hard material (rate only)	1	m^3	£45,00	£45,00
	DISPOSAL				
6,02	Disposal of tarmac surfacing	40	m^3	£65,00	£2.600,00
6,03	Disposal of acceptable material excluding Class 5A (rate only)	1	m^3	£65,00	£65,00
				Series 600	**£4.910,00**
Series 700: Pavements					
	Pavements				
7,01	Supply and install Type 1 sub-base 150mm thick	208	m^3	£116,00	£24.128,00
				Series 700	**£24.128,00**

SCOTTISH BORDERS COUNCIL - TRAFFIC AND ROAD SAFETY					BILL OF QUANTITIES
Series 1100: Kerbs, Footways and Paved Areas					
	KERBS, CHANNELS, EDGINGS, COMBINED DRAINAGE AND KERB BLOCKS AND LINEAR DRAINAGE CHANNEL SYSTEMS				
11,01	Precast Concrete Edgings (250x50mm) flat topped (K3)	774	m	£36,90	£28.560,60
11,02	Precast Concrete Kerbs (125x255/178mm) dropper kerbs (K2T)	12	m	£117,60	£1.411,20
11,03	Precast concrete Kerbs (125x155) bullnose (K4)	8	m	£157,20	£1.257,60
11,04	Supply and install new gully along new carriageway line	1	no.	£572,70	£572,70
11,05	New drainage pipe to link 2no. New gullies	20	m	£74,40	£1.488,00
11,06	New ductwork for street lights	150	m	£44,10	£6.615,00
	FOOTWAYS AND PAVED AREAS				
11,07	Tactile Paving - Buff Coloured	11	m^2	197,60	£2.173,60
11,08	Corduroy Paving - Buff Coloured	12	m^2	272,25	£3.267,00
11,09	Sandstone Setts	8	m^2	586,00	£4.688,00
11,10	50mm AC20 Dense Bin 100/150	1388	m^2	£18,70	£25.955,60
11,11	30mm AC6 Dense Surf 100/150	1388	m^2	£14,70	£20.403,60
11,12	Supply and install new concrete slab over existing drain	51	m^2	£62,75	£3.200,25
				Series 1100	**£99.593,15**
Series 1200: Traffic Signs And Road Markings					
	TRAFFIC SIGNS				
12,01	Allowance for new traffic signs	1	item	750,00	£750,00
12,02	Supply and install new benches	3	no.	2.350,00	£7.050,00
12,03	Supply and install new bollards (prov qty)	10	no.	325,00	£3.250,00
12,04	Street light works	1	item	£7.500,00	£7.500,00
	ROAD MARKINGS				
12,05	Anti skid surfacing	20	m^2	£95,00	£1.900,00
				Series 1200	**£20.450,00**
				TOTAL	£199.488,15

Eddleston's Bill of Quantities

PEEBLES COMMUNITY TRUST		EDDLESTON WATER PATH
GENERAL NOTES		
1	This Bill of Quantities / Activity Schedule has been prepared using the information and specification provided on the Stage 4 (Tender) drawings. This information has been provided as a guide for pricing only. Prospective tenderers / estimators must ensure that they are satisfied with the items and quantities provided and update as necessary as part of their submission.	
2		
a		
b		
c	The Bill of Quantities / Activity Schedule has been prepared generally in accordance with the principles used in the Method of Measurement for Highway Work published by the Stationery Office as Section 1 of Volume 4 of the Manual of Contract Documents for Highway Works.	
d		
3	Series 2600 (Miscellaneous) contains a number of items which have not been quantified in accordance with the MMHW as noted below:	
4	Utility diversions are required to facilitate construction of the path. Quotations have been received as part of the NRSWA C3 process which details the works required. The Contractor must seek detailed costs through liaison with the affected providers as part of the NRSWA C4 process and allow for consultation and management of the associated works.	
	Access control provisions are to be included at the locations shown on the Sterry- Walters Partnership Ltd design drawings. These drawings should be used to develop a price to complete item (2600.004).	
	Re-meander of existing watercourse to the north of Rosetta Road. 60m in length with a new channel width of 1.2m at low flow areas tapered out to 5.5m thereafter. Refer to General Arrangement drawing 411610-MMD-00-XX-0705 for more detail to develop a price to complete item (2600.005).	
	Street Lighting - relocation of 4 lighting columns in the town of Eddleston. This work is being designed by Scottish Borders Council and their detailed design drawings should be used to develop a price to complete item 2600.006. This price should include all associated works including existing columns removal, electrical work and provisions for re-installation at new locations.	
	For the purposes of Series 600, the existing topsoil is assumed to be 150mm depth. Topsoil to be stripped prior to construction of earthworks and path.	
	No allowance has been made for excavation and filling of soft spots and other voids that may be encountered.	

SERIES 100 – PRELIMINARIES

Number	Item Description	Quantity	Unit	Rate
NC	**Temporary Accommodation**			
100,001	Erection of offices and messes for the Contractor	1	Item	
100,002	Servicing of offices and messes for the Contractor	1	Item	
100,003	Dismantling of offices and messes for the Contractor	1	Item	
100,004	Erection of stores and workshops for the Contractor	1	Item	
100,005	Servicing of stores and workshops for the Contractor	1	Item	
100,006	Dismantling of stores and workshops for the Contractor	1	Item	
	Traffic Safety and Management			
100,007	Traffic safety and management	1	Item	

To be carried forward to General Summary Series 100

PEEBLES COMMUNITY TRUST				EDDLESTON WA
SERIES 200 – SITE CLEARANCE				
Number	Item Description	Quantity	Unit	Rate
	Site clearance			
200,001	General Site clearance	6,00	Ha.	
200,002	General Site Clearance - South of Eddleston Chainage 5470m to 5800m. Includes felling of large mature trees within dense woodland.	0,40	Ha.	
	Take Up or Down and Remove to Tip off Site			
200,003	Take up or down and dispose of offsite post and rail fence 1200mm high. (9716.4kg)	675	m	
200,004	Take up or down and dispose to tip concrete kerbs any type. 460 kg	60	m	
200,005	Take up or down and remove to tip single steel field gate 3600mm x 1175mm	5	no.	
200,006	Take down brick wall <1m in height and remove to tip off site.	5	m	
200,007	Take up or down and remove to tip traffic sign including posts not exceeding 0.25m2	3	No.	
200,008	Take up or down and remove to tip illuminated traffic sign including posts not exceeding 0.5m2	1	No.	
200,009	Take up or down and remove to tip traffic sign post	2	No.	
	Take Up or Down and Set Aside for Reuse			
200,010	Take up or down and set aside for reuse steel tubular frame single field gate	2	No.	
200,011	Take up or down and set aside for reuse timber single field gate	1	No.	
200,012	Take up or down and set aside for reuse street furniture: bench	1	No.	
200,013	Take up or down and set aside for re-use traffic sign not exceeding 0.25m2	2	No.	
	To be carried forward to General Summary Series 200			

PEEBLES COMMUNITY TRUST **EDDLESTON WATER PATH**

SERIES 300 - FENCING

Number	Item Description	Quantity	Unit	Rate
	Fencing, Gates and Stiles			
300,001	Four rail timber fence 1.4m high as per standard detail on drawing 411610-MMD-XX-00-DR-C- 0904.	4.365	m	
300,002	Allowance for 1.4m high post and wire fence. Fence in accordance with Specification of Highway Works, Highway Construction Detail (HCD) H13.	50	m	
300,003	Steel tubular frame single field gate as per standard detail on drawing 411610-MMD-XX-00- DR-C-0904 (HCD H17).	12	No.	
	Remove from Store and Re-erect Fencing,			
	Gates and Stiles			
300,004	Remove from store and re-erect steel tubular frame single field gate JÁ COLOCOU	2	No.	
300,005	Remove from store and re-erect timber single field gate JÁ COLOCOU	1	No.	

To be carried forward to General Summary Series 300

PEEBLES COMMUNITY TRUST			EDDLESTON WATER PATH	
SERIES 500 - DRAINAGE AND SERVICE DUCTS				
Number	**Item Description**	**Quantity**	**Unit**	**Rate**
500.001 500.002 500.003	**Filter Drain** Type B Filter Material for soakaway north of Rosetta Road. Includes geotextile surround as per detail on drawing 411610-MMD-00-XX-DR-C- 0903 **Renewal, Raising or Lowering of Covers and Gratings on Existing Chambers and Gullies** Raising or lowering of covers on existing chambers not exceeding 150mm **Drainage** Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres	10 4 20	m^3 No. m	Type B Filter Material for soakaway considered Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3
To be carried forward to General Summary Series 500				

PEEBLES COMMUNITY TRUST				EDDLESTON WATER PATH
SERIES 600 - EARTHWORKS				
Number	**Item Description**	**Quantity**	**Unit**	**Rate**
600.001	**Excavation**	4,750	m^3 m^3	
600.002	Excavation of acceptable material Class 5A	250	m^3	
600.003	Excavation of acceptable material excluding Class 5A (assume 5% of all	100	m^3	
600.004	excavated material)	2,690	m^3	
600.005	**Excavation in hard material**	250	m^3	
600.006	Extra over excavation for excavation in Hard Material in cutting and	6,820	m^3	
600.007	other excavation (assume 2% of all excavated material)	6,820	m^3	
600.008	**Disposal of Material**	13,733	m^2	
600.009	Disposal off site of acceptable material Class 5A	2,060	m^3	
600.010	Disposal off site of acceptable material excluding Class 5A	17,285	m^2	
	Imported Fill			
	Imported acceptable material Class 1 in embankments and other areas of fill			
	Compaction of Fill			
	Compaction of acceptable material Class 1 in embankments and other areas of fill CONSIDERING 1000kg/m3			
	Topsoiling and Storage of Topsoil			
	Topsoiling 150mm thick in new verges to surfaces sloping at 10 degrees or less to the horizontal			
	Storage of topsoil for reuse			
	Completion of Formation and Sub-Formation			
	Completion of formation on material other than Class 1C, 6B or rock in cuttings			
		To be carried forward to General Summary Series 600		

PEEBLES COMMUNITY TRUST EDDLESTON WATEI

SERIES 700: PAVEMENTS GENERAL

Number	Item Description	Quantity	Unit	Rate
			m^2 m m^2	
700,001	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).	24		
700,002	Saw cutting 100mm deep	80		
700,003	Tack coat	24		

To be carried forward to General Summary Series 700

PEEBLES COMMUNITY TRUST			EDDLESTON WATER PATH	
SERIES 1100 - KERBS, FOOTWAYS AND PAVED AREAS				
Number	**Item Description**	**Quantity**	**Unit**	**Rate**
1100.001	**Kerbs, Channels, Edgings, Combined Drainage and**	19	m	
1100.002	**Kerb Blocks**	80	m	
1100.003	**and Linear Drainage Channel Systems**	18	m^2	
1100.004		16605	m^2	
1100.005		680	m^2	
1100.006	Precast concrete 'transition' kerbs 255x125mm,	441	m^3	
1100.007	laid straight or curved to any radius.	1	No.	
	Precast concrete 'dropped' bullnosed kerbs			
	125mm x 175mm, laid straight or curved to any radius.			
	Footways and Paved Areas			
	Buff coloured precast concrete tactile paving slabs 400x400x65mm t hick on washed sand bedding course 30mm thickness, ST4 concrete base 150mm thickness and type 1 sub-base 100mm thickness,			
	Construction Type P1: Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, an Ho Rolled Asphalt surface course 20mm thickness. Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.			
	Additional Type 1 sub-base material to form path shoulders (300mm wide)			
	Remove from Store and Re-erect Street Furniture			
	Remove from store and re-erect street furniture: bench			
	To be carried forward to General Summary Series 1100			

PEEBLES COMMUNITY TRUST **EDDLESTON**

SERIES 1200 - TRAFFIC SIGNS AND ROAD MARKINGS

Number	Item Description	Quantity	Unit
	Traffic Signs		
1200,001	Permanent retroflective traffic sign as non-lit sign unit not exceeding 0.25m2 in area on one 76mm diameter tubular steel post.	46	No.
1200,002	Permanent retroflective traffic sign as non-lit sign unit not exceeding 0.25m^2 in area on any size existing lighting column or post.	52	No.
1200,003	Permanent 76mm diameter tubular steel post	2	No.
	Remove from Store and Re-erect Traffic Signs		
1200,004	Remove from store and re-erect traffic sign not exceeding 0.25m2 onto new post (item 1200.003).	2	No.
	Road Markings		
1200,005	Intermittent line in white thermoplastic screed with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).	34	m applied solid glass
1200,006	Intermittent line in white thermoplastic screed with line and 2m gap (TSRGD Ref. 1004)	33	m applied solid glass
1200,007	Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B	13	No.
1200,008	Arrow in white thermoplastic screed with applied solid glass beads 1m long straight/right/left to Traffic Signs Regulations and General Directions Diagram No. 1059.	23	No.
1200,009	Symbols in white thermoplastic screed with applied solid glass beads 1215mm high to Traffic Signs Regulations and General Directions Diagram No. 1057.	43	No.
	Marker Posts		
1200,010	Right of way timber marker posts (to be agreed with SBC)	3	No.

PEEBLES COMMUNITY TRUST | EDDLESTON WATER PATH

DO NOT CONSIDER

SERIES 1700 - STRUCTURAL (BRIDGE CROSSINGS)

Number	Item Description	Quantity	Unit	Rate
1700.001			Item	
1700.002	Rosetta Rd Bridge - Refer to Structures drawings		Item	
1700.003	1101 to 1107		Item	
1700.004			Item	
1700.005	Windylaws Burn Bridge - Refer to Structures		Item	
	drawings 1201 to 1206			
	Cringelitie Footbridge – Refer to Structures			
	drawings 1301 to 1303			
	Milkieston Footbridge – Refer to Structures			
	drawings 1401 to 1403			
	Eddleston Village Footbridge – Refer to Structures			
	drawings 1501 to 1504			
	To be carried forward to General Summary Series 1700			

PEEBLES COMMUNITY TRUST			E
SERIES 2600 - MISCELLANEOUS			
NC			
Number	**Item Description**	**Quantity**	**Unit**
	Utility Diversions		
2600,001	BT Utility Diversions (as per NRSWA C3 consultations).	1	Quote
2600,002	Scottish Power Diversions (as per NRSWA C3 consultations).	1	Quote
2600,003	Liaison with all Statutory Undertakers to programme and manage the works associated with the utility diversions required.	1	Item
	Access Control Provision		
2600,004	Refer to Sterry-Walters Partnership Ltd detailed design drawings for details of proposed access controls.	1	Item
	Re-Meander Works		
2600,005	Re-meander of existing watercourse to the north of Rosetta Road. 60m in length with a new channel width of 1.2m at low flow areas tapered out to 5.5m thereafter. Refer to General Arrangement drawing 411610-MMD-00-XX-0705 for more detail.	1	Item
	Street Lighting Works		
2600,006	Relocation of 4 lighting columns (Eddleston). Refer to Scottish Borders Council detailed design drawings for details of proposed amendments to the existing street lighting provision within Eddleston.	1	Item
		To be carried forward to General Summary Series 2600	

PEEBLES COMMUNITY TRUST				EDDLESTON WATER PATH
SERIES 3000 - LANDSCAPE AND ECOLOGY				
Number	**Item Description**	**Quantity**	**Unit**	**Rate**
3000.001	**Ground Preparation and Cultivation**	20,350	m^2	
3000.003		20,350	m^2	
	Final preparation of soils			
	Seeding and Turfing			
	Grass seeding			
	To be carried forward TO General Summary Series 3000			

Glenriddet's Bill of Quantities

People for Everyone Active Travel Paths

Work Package - Glenriddet Footpath, Kilbirnie

General Summary

Series	General Description	Amount
100	General Preliminaries	£ -
200	Site Clearance	£ -
300	Fencing	£ -
500	Drainage and Service Ducts	£ -
600	Earthworks	£ -
700	Pavements	£ -
1100	Kerbs, Footways and Paved Areas	£ -
1200	Traffic Signs & Road Markings	£ -
1700	Structural Concrete	£ -
2700	Accomodation Works, Works for Statutory Undertakers, Provional Sums and Prime Cost Items	£ -
3000	Landscape and Ecology	£ -
	Total	£ -

	Series 100 : Preliminaries				
Item No.	Description	Quantity	Unit	Rate	Total
NC ALL					
	Traffic Safety and Management				
100.0003	Installation of 2 way traffic signals up to 300 metres in length on single carriageway road with speed limit of 40 mph or less	1	Item		
100.0009	Maintenance and operation of 2 way traffic signals up to 300 metres in length on single carriageway road with speed limit of 40 mph or less	4	day		
100.0021	Removal of 2 way traffic signals up to 300 metres in length on single carriageway road with speed limit of 40 mph or less	1	Item		
	Information Boards				
100.0128	Information board to Diagram No. 100/IB1	2	no		
	Advance Notice of Roads Works				
100.0135	Provision and distribution of advance notice of road works to domestic and commercial properties affected by the works	60	no		
	Additional Operative on site for Traffic Management Duties (rate based on an 8 hour working day)				
100.0137	Additional Operative on site for Traffic Management Duties	1	no		
	Provision of Insurances				
	Compliance with Conditions of Contract requirements for Insurances.	1	item		
	Compliance with CDM Regulations				
	Compliance with current CDM (Construction, Design & Management) Regulations (2015) and the deliverables listed within the Pre-Construction Information Pack for completing the H&S File, including as-built drawings and details of services encountered	1	item		
	Compliance with Health and Safety Regulations				
	Compliance with the current Construction (Health, Safety and Welfare) Regulations (1992)	1	item		
	Temporary Accommodation				
	Erection of offices and messes for the Contractor.	1	item		
	Servicing of offices and messes for the Contractor.	1	item		
	Dismantling of offices and messes for the Contractor.	1	item		
	Erection of stores and workshops for the Contractor.	1	item		
	Servicing of stores and workshops for the Contractor.	1	item		
	Dismantling of stores and workshops for the Contractor.	1	item		
	Operatives for the Overseeing Organisation				
	Labourer for the Engineer (as per Appendix 1/8 and in accordance with Specification Clause 108), until completion of the works (provisional item).	1	op.day		
	Chainman for the Engineer (as per Appendix 1/8 and in accordance with Specification Clause 108), until completion of the works (provisional item).	1	op.day		
	Progress Photographs				
	Set of progress photographs, jpeg format	1	no		
	Additional progress photographs, jpeg format (provisional item)	1	no		
	Prevention of and Cleaning off Mud on Highways, as per Specification Appendix 1/17 and Clause 172AR				
	Establishment of measures for the Prevention of and Cleaning off Mud on Highways.	1	Item		
	Maintenance and implementation of measures for the Prevention of and Cleaning off Mud on Highways.	1	Item		

Removal of measures for the Prevention of and Cleaning off Mud on Highways.	1	Item			
Verification of Existing Services, Utilities, and Supplies					
Allow for obtaining information from Scottish Power, and its verification on site.	1	item			
Allow for obtaining information from NAC Street Lighting, and its verification on site (lighting cables and power supply cables).	1	item			
Allow for obtaining information from Scottish Gas, and its verification on site.	1	item			
Allow for obtaining information from British Telecom (BT), and its verification on site.	1	item			
Allow for obtaining information from Virgin Media, and its verification on site.	1	item			
Allow for obtaining information from Scottish Water, and its verification on site (mains / fresh water).	1	item			
Allow for obtaining information from Scottish Water, and its verification on site (storm; foul; and combined sewers)	1	item			
Allow for obtaining information from Stated Privately Owned Services and Supplies, and its verification on site.	1	item			
Testing Requested by the Engineer, over and above that included for in Appendix 1/5					
Delivery of test samples to an approved laboratory (provisional item).	1	no			
Testing of concrete cube samples for compressive strength (Note: A single sample includes 4 cubes, one tested at 7 days; two tested at 28 days; and one retained) (provisional item).	1	no			
Testing of bituminous mixture samples for binder content (provisional item).	1	no			
Testing of bituminous mixture samples, same samples as above, for grading (provisional item).	1	no			
Testing of granular stone samples for grading and fines content (provisional item).	1	no			
Testing of granular stone samples, same samples as above, for plasticity index (provisional item)	1	no			
Testing surface of granular stone formation (top of capping layer) or soil formation/sub-formation for Californian Bearing Ratio (CBR) to BS Test 16.	1	no			
Additional testing of bearing stratum to determine CBR values through plate testing	1	no			
Additional testing of bearing stratum to determine CBR values through DCP testing	1	no			
Ecological Mitigation					
Undertake Pre-Construction Invasive Species Survey	1	no			
Preparation of an Invasive Species Management Plan as detailed in the Preliminary Ecological Appraisal Report for Scheme 1C1 Glenriddet.	1	no			
Allow for the Mitigation of Japanese Knotweed by onsite management (burial) or off site management methods such as excavation and removal offsite. Any proposals will need to make allowances for excavation, contamination control, plant cleaning, 3rd party specialist advice, hazardous waste removal, arrangement of a waste management license or PPC permit, and compliance with SEPA regulations. See Figure 3b of the Preliminary Ecological Appraisal Report for Scheme 1C1 Glenriddet. (see note)	1	no			
Note					
(Japanese Knotweed noted in the Preliminary Ecological Appraisal Report - March 2020).					

	Series 200 : Site Clearance				
Item No.	Description	Quantity	Unit	Rate	Total
	Site Clearance				
200.0002	General Site Clearance as depicted on drawing IBH0653-1C1-1070, IBH0653-1C1-1071, IBH0653-1C1-1072	0,3	ha		
	Take Up or Down and Remove to Tip off Site				
200.0114	Take up or down and remove to tip off site precast concrete kerb	6,8	m		
	Tree Removal				
	Removal of existing trees as depicted on drawing 2424.7.01, including stump removal and disposal off site. Make good ground.	4	no		
	Take Up or Down and Set Aside for re-use				
	Take up or down and set aside for re-use bench, as denoted on drawing number IBH0652/1C1/1070.	1	no		
	Take up or down and set aside for re-use existing post and wire fencing, as denoted on drawing number IBH0652/1C1/1070.	65	m		
	Take up or down and set aside for re-use bin, as denoted on drawing number IBH0652/1C1/1072.	1	no		

	Series 300: Fencing			
Item No.	Description	Quantity	Unit	Rate
	Fencing, Gates and Stiles			
300.0011	Strained wire fencing 1250 mm high with timber posts with one strand of galvanised barbed wire with five strands of galvanised plain wire with woven wire sheep netting 800mm high.	59	m	

	Series 500: Drainage and Service Ducts			
Item No.	Description	Quantity	Unit	Rate
	Drains and Service Ducts			
500.0002	150 mm internal diameter drain on bed Type F in trench depth to invert not exceeding 2 metres average depth to invert 1 metre (MCDHW Drg No. F1)	12	m	
	Filter Drains			
500.0034	150 mm internal diameter filter drain in trench specified design Type H depth to invert not exceeding 2 metres average depth to invert 1 metre (MCDHW Drg No. F2)	182	m	
	Chambers and Gullies			
	Polypropylene "AquaCell 6LB600" silt trap with polypropylene cover and frame depth to invert exceeding 1 metre but not exceeding 2 metres	8	no	
	Supply and install pipe headwall detail as per detail on drawing IBH0652-1C1-1080	1	no	
	Renewal, Raising or Lowering of Covers and Gratings on Existing Chambers and Gullies			
500.0095	Raise or Lower the level of chamber cover and frame exceeding 0.25 square metre but not exceeding 0.50 square metre in area 150 mm or less in footway	1	no	

Series 600 : Earthworks

Item No.	Description	Quantity	Unit	Rate
	Excavation			
600.0002	Excavation of acceptable material Class 5A	170	m³	
600.0004	Excavation of acceptable material excluding Class 5A in cutting and other excavation	0	m³	
600.0008	Excavation of acceptable material excluding Class 5A in cutting and other excavation in footway	0	m³	
600.0012	Excavation of unacceptable material Class U1A in cutting and other excavation in footpath	198	m³	
600.0016	Excavation of unacceptable material Class U1A in cutting and other excavation in footway	62	m³	
	Extra over for hand digging in proximity to existing trees and their respective root networks	140	m²	
	Excavation in Hard Material			
600.0027	Extra over excavation for excavation in Hard Material in cutting and other excavation	42	m³	
	Deposition of Fill			
600.0028	Deposition of acceptable material in embankments and other areas of fill	535	m³	
600.0029	Deposition of acceptable material on sub-base material, base and capping	155	m³	
	Disposal of Material			
600.0031	Disposal of acceptable material Class 5A	0	m³	
600.0035	Disposal of unacceptable material Class U1A	317	m³	
	Imported Fill			
	Imported acceptable material Class 2A in embankments and other areas of fill	535	m³	
600.0042	Imported acceptable material Class 6F5 fill on sub-base material, base and capping	170	m³	
600.0045	Imported topsoil Class 5B	35	m³	
	Compaction of Fill			
600.0048	Compaction of acceptable material in embankments and other areas of fill	705	m³	
	Soft Spots and Other Voids			
600.0052	Excavation of soft spots and other voids below cuttings or under embankments	15	m³	
600.0054	Filling of soft spots and other voids below cuttings or under embankments with acceptable material	15	m³	
	Topsoiling and Storage of Topsoil			
600.0080	Topsoiling 150 mm thick to surfaces sloping at 10° or less to the horizontal	707	m²	
600.0082	Topsoiling 150 mm thick to surfaces sloping at more than 10° to the horizontal	657	m²	

Series 700: Pavements

Item No.	Description	Quantity	Unit
	Cold Milling (Planing)		
700.0096	Milling pavement not exceeding 50 mm depth	9	m²
	Reinstatement of Paved Areas		
700.0116	Reinstate paved area all Permanent Flexible Roads Type 4 (Specification for the Reinstatement of Openings in Roads 2015)	9	m²

	Series 1100 : Kerbs, Footways and Paved Areas			
Item No.	Description	Quantity	Unit	Rate
	Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems			
1100.0023	Precast concrete kerbs 125 mm x 255 mm half batter to bullnosed left hand transition laid straight or curved exceeding 12 metres radius	1,5	m	
1100.0025	Precast concrete kerbs 125 mm x 255 mm bullnosed to half batter right hand transition laid straight or curved exceeding 12 metres radius	1,5	m	
1100.0014	Precast concrete kerbs 125 mm x 150 mm bullnosed as Std Drg No 1100/KB3 laid straight or curved exceeding 12 metres radius	5	m	
1100.0019	Precast concrete kerbs 125 mm x 255 mm bullnosed as Std Drg No 1100/KB3 laid straight or curved exceeding 12 metres radius	6,8	m	
1100.0071	Precast concrete edging 50 mm x 150 mm flat top as Std Drg No 1100/KB4 laid straight or curved over 12 metres radius	878	m	
	Footways and Paved Areas			
1100.0221	Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips	1501	m²	
	Granular material Type 1 sub-base 300mm thick	450	m³	
	Footpath consisting of KBI Flexipave HD1750 40mm thick, laid on Infraweb Tree Root Protection System 75mm thick infilled with 4/20 clean stone. Make up to include ArborTex 300 Geotextile. Footway to be edged with timber board and stakes. Edging and stakes to be included in rate. Footway to be constructed as per detail in drawing IH0652-1C1-1080. Contractor to include for neccessary ground preparation in accordance with the manufacturers requirements. KBI flexipave to be installed by a KBI approved contractor	140	m²	
	Sharp sand	10	m³	
	4/20mm clean angular stone to BS EN 13242/EN 12620	12	m³	
	Granular material Type 3 sub-base	15	m³	
	Paving Flags,Slabs and Blocks			
	400 mm x 400 mm x 50 mm precast concrete buff blister paving in Footway on ST2 concrete bedding 100 mm thick and 65 mm thick granular sub-base	3,2	m²	
	400 mm x 400 mm x 50 mm precast concrete buff ladder paving in Footway on ST2 concrete bedding 100 mm thick and 65 mm thick granular sub-base	1,3	m²	

	Series 1200: Traffic Signs and Road Markings			
Item No.	Description	Quantity	Unit	Rate
	Traffic Sign Posts			
1200.0001	Supply and install galvanized tubular steel post 76 mm external diameter, including cap and baseplate with concrete foundation up to 0.5 cubic metres.	9	no	
	Traffic Signs			
1200.0012	Permanent retroreflective traffic sign, sign face not exceeding 0.25 square metres in area	5	no	
1200.0014	Permanent retroreflective traffic sign, sign face exceeding 0.50 square metres but not exceeding 0.75 square metres in area	4	no	
	Street Furniture			
	Remove from store and install metal bench to edge of path.	1	no	
	Remove from store and relocate bin.	1	no	
	Supply new 2m steel bench and install to edge of path, with foundation as detailed in drawing IBH0653/DC1/1080. Mounting detail to be as per bench manufacturers specification	2	no	
	Road Studs			
	Bi-directional solar powered road studs, as per 'SolarLite F Series Flush Road Studs supplied by Clearview Intelligence (or similar approved)', with white reflectors. For further details refer to the 'Solarlite F-Series Flush Stud Standard Detail' shown on Drawing No's IBH0652-1C1-1080. Include for installing and securing the studs in accordance with the manufacturers recommendations, using Triflex two part expoxy resin. The proposed stud locations are outlined on Drawing Nos IBH0652-1C1-1020, IBH0652-1C1-1021 and IBH0652-1C1-1022.	89	no	
	KBI Flexiglow inserts supplied by KBI and installed by KBI approved Contractor. For further details refer to the Appendix containing KBI Product data. Inserts to be positioned at 5m staggered intervals	15	no	
Carry Total for Series forward to General Summary				

	Series 1700: Structural Concrete				
Item No.	Description	Quantity	Unit	Rate	Total
	In Situ Concrete				
	In situ concrete mix C16/20, for foundation slabs for benches and bins as per detail on Drawing IBH0652-1C1-1080	2,0	m^3		

	Series 2700 : Accomodation Works, Works for Statutory Undertakers, Provional Sums and Prime Cost Items				
Item No.	Description	Quantity	Unit	Rate	Total
	Accommodation Works, Works for Statutory Undertakers, Provisional Sums and Prime Cost Items				
NC	Allow the provisional sum of £5,000 for relocation of B.T apparatus to be executed by the main contractor		Sum		
	Add for all labours		Sum		
	Add for all other charges and profits		%		

	Series 3000: Landscape and Ecology				
Item No.	Description	Quantity	Unit	Rate	Total
	Ground Preparation and Cultivation				
3000.0003	Final preparation of soils to surfaces sloping at 10° or less to the horizontal	707	m²		
3000.0006	Final preparation of soils to surfaces sloping at 10° or more to the horizontal	657	m²		
	Grass Seeding and Turfing				
3000.0009	Grass seeding by conventional sowing to surfaces sloping at 10° or less to the horizontal with Type 1 Seed Mixture as per Appendix 30/5 of the RPS Highway Works Specification	707	m²		
3000.0012	Grass seeding by conventional sowing to surfaces sloping at 10° or more to the horizontal with Type 2 Seed Mixture as per Appendix 30/5 of the RPS Highway Works Specification	657	m²		
	Tree Planting				
3000,0027	Standard (Semi Mature) Trees Excavate pits for species as listed in Table 1, Drawing 2424.5.02 Planting Plan and Detail A.	4	No.		
	Semi Mature Trees **Supply, plant and protect the following plant materials in accordance with the landscape specification**				
3000,0028	Quercus robur: 4x transplanted, 20 – 25cm girth; minimum 4.5m overall height, minimum 2.0m clear stem, rootballed	4	No.		
	Tree Staking				
3000,0029	Double Tree staking of Semi mature Trees as per the Landscape Specification, Establishment & Maintenance Plan & Detail A drawing 2424.5.02 Planting Plan.	4	No.		
	General: Establishment & Maintenance (24 months from completion of all landscape works) as per Q30 and Q31 of the Landscape Specification				
3000,0030	Maintain specimen trees in a weed free condition with approved herbicide. Approved herbicide to be applied by hand in accordance with the manufacturers recommendations during favourable weather conditions for spraying & in accordance with Landscape Specification, Establishment & Maintenance Plan.	24	Visits		
3000,0031	Include cost for adjustments to tree ties, supports, tubes, stakes as required, replacement of stakes and ties broken or loosened by wind.	24	Visits		
3000,0032	Formative pruning	24	Visits		
3000,0033	Application of 150g of slow release fertiliser to specimen trees	4	Visits		
	Watering				
3000,0034	Include for watering of all Standard (Semi Mature) trees using water tanker as necessitated by dry weather 15 to 20 litres per tree.	24	Visits		

Fairlie's Bill of Quantities

GENERAL SUMMARY FOR COASTAL PATHWAY

Series 100:	Preliminaries	£ -
Series 200:	Site clearance	£ -
Series 300:	Fencing	£ -
Series 500:	Drainage	£ -
Series 600:	Earthworks	£ -
Series 700:	Pavements	£ -
Series 1100:	Kerbs, footways and paved areas	£ -
Series 1700:	Structural Concrete	£ -
Series 1800:	Structural Steelwork	£ -
Series 2600:	Miscellaneous	£ -
	Total for Coastal Pathway	£ -

SERIES 100: PRELIMINARIES

Ref	Description	Qty	Unit	Cost	Total
	Temporary Accommodation				
100,01	Temporary Accommodation includes welfare facilities, offices, stores, workshops, and other facilities as may be required on site by the Contractor.	1	Item		£ -
100,02	Erection of contractor's welfare facilities	1	Item		£ -
100,03	Servicing of contractor's welfare facilities	1	Item		£ -
100,04	Dismantling of contractor's welfare facilities	1	Item		£ -
	Information Boards				
100,05	Information boards in number not exceeding 5	5	Item		£ -
100,06	Pedestrian Diversion	2	Item		£ -
SERIES 100: PRELIMINARIES TOTAL CARRIED FORWARD TO GENERAL SUMMARY					**£ -**

SERIES 200: SITE CLEARANCE

Ref	Description	Qty	Unit	Cost	Total
	General Site Clearance				
200,01	Clear vegetation along the slipway and jet wash the surface as shown in drawings 60283360-PH3-C-001, 60283360-PH3-C-003 and 60283360-PH3-C-004.	0,04	ha		£ -
200,02	Clearance of rubbish, seaweed, debris etc. from site area	0,216	m^2		£ -

SERIES 300: FENCING

Ref	Description	Qty	Unit	Cost	Total
	Fencing, Gates, and Stiles				
300,01	Heras fencing (required for duration of works)	300	m		£ -
SERIES 200: SITE CLEARANCE TOTAL CARRIED FORWARD TO GENERAL SUMMARY					£ -

SERIES 500: DRAINAGE

Ref	Description	Qty	Unit	Cost	Total
	General Drainage				
500,01	DN300 PVC Pipe	3	m		£ -
SERIES 200: SITE CLEARANCE TOTAL CARRIED FORWARD TO GENERAL SUMMARY					£ -

SERIES 600: EARTHWORKS

Ref	Description	Qty	Unit	Cost	Total
	Removal of existing material				
600,01	Breakout and removal of existing concrete path	54	m^3		£ -
600,02	Removal of beach material to expose rock	43	m^3		£ -
	Excavation for Foundations				
600,03	Breakout existing rock outcrop to form horizontal interface	47	m^3		£ -

	Edge Protection				
600,04	Imported Rock – Use BS EN 13383-1 Standard Light Grading 60-300kg LMA 60-300	95	m^3		£ -
SERIES 600: EARTHWORKS TOTAL CARRIED FORWARD TO GENERAL SUMMARY					£ -

SERIES 700: PAVEMENTS

Ref	Description	Qty	Unit	Cost	Total
	Sub-Base				
700,01	Type 1 Unbound Mixture Sub-Base as shown in drawing series 60283360-PH3-C-102 to 60283360-PH3-C-111 inclusive	88	m^3		£ -
700,02	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.	54	Item		£ -
700,03	Resurfacing using Fosroc Paveroc repair mortar. See drawing 60283360-PH3-C-112.	173	m^2		£ -
SERIES 700: ROAD PAVEMENTS GENERAL TOTAL CARRIED FORWARD TO GENERAL SUMMARY					£ -

SERIES 1100: KERBS, FOOTWAYS AND PAVED AREAS

Ref	Description	Qty	Unit	Cost	Total
	Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage				
1100,01	125 x 150 Bullnosed Kerb	19	m		£ -
1100,02	Channel Drain (ACO M100D)	6	m		£ -
	Additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems				
1100,03	Concrete bedding to kerbs	2	m^3		£ -
1100,04	Concrete bedding for channel drains	1	m^3		£ -
1100,05	Concrete surround for DN300 PVC carrier drain	1	m^3		£ -
1100,06	75mm thick concrete blinding underneath sea wall	14	m^3		£ -
1100,06	Mass concrete steps	0,5	m^3		£ -
SERIES 1100: KERBS, FOOTWAYS AND PAVED AREAS TOTAL CARRIED FORWARD TO GENERAL SUMMARY					**£ -**

SERIES 1700: STRUCTURAL CONCRETE

Ref	Description	Qty	Unit	Cost	Total
	In-Situ Concrete				
1700,01	Insitu concrete mix C40/50	220	m^3		£ -
1700,02	Premixed pourable grout (for infilling voids)	5	m^3		£ -
1700,03	Formwork for vertical surfaces of In-Situ Concrete				
	Height 0 – 500mm	200	m		£ -
	Height 500 – 1000mm	310	m		£ -
	Height 1000 – 1500mm	120	m		£ -
	Steel Reinforcement for Structures				
1700,04	A393 steel reinforcement	456	m^2		£ -
1700,05	16mm diameter vertical dowel bars. Length = 475mm	432	nr.		£ -
1700,06	20mm diameter vertical dowel bars. Length = 775mm	104	nr.		£ -
1700,07	20mm diameter horizontal bars (expansion joints). Length = 500mm	309	nr.		£ -
1700,08	Cementitious Grout around dowel bars	1,5	m^3		£ -
1700,09	Transverse and Longitudinal H12 Reinforcement	10	t		£ -
	Expansion Joints				
1700,10	Expansion Joints in RC wall: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.	10	nr.		£ -
SERIES 1700: STRUCTURAL CONCRETE TOTAL CARRIED FORWARD TO GENERAL SUMMARY					£ -

SERIES 1800: STRUCTURAL STEELWORK

Ref	Description	Qty	Unit	Cost	Total
	Handrails				
1800,01	Harbour 2 Rail Post and Rail handrail from Marshalls or equivalent approved, surface mounted to manufacturer's recommendations.	10	m		£ -
1800,02	Harbour 2 Rail Post and Rail handrail from Marshalls or equivalent approved, side mounted to manufacturer's recommendations	2	m		£ -
	Mooring Rings				
1800,01	130mm diameter 20mm thick galvanised mooring ring with 16mm thick galvanised base plate	1	nr.		£ -
1800,02	M16 HIT-V-F (8.8) + HIT-HY 200 with minimum embedment depth of 300mm	4	nr.		£ -
SERIES 1800: STRUCTURAL STEELWORK TOTAL CARRIED FORWARD TO GENERAL SUMMARY					**£ -**

Appendix B: Carbon's emission reports of the assessed projects

Hawick

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A5	Asphalt waste ?	92	ton	433	0	433		Construction waste	Disposal of tarmac surfacing				Other waste		Asphalt waste					
A1-A3a	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	0,12	m3	32	0	32	0	Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A1-A3a	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	2,66	m3	720	0	720	0	Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A1-A3a	Reinforcement steel (rebar), generic, 97% recycled content (... ?	5,7	kg	3	0	3	0	Construction works	Assumed 2.0% reinforcement ratio per weight of concrete		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A1-A3a	Bollard, stainless steel ?	10	unit	921	0	921	0	Construction works	Supply and install new bollards		As building		Stainless steel	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Bollard, stainless steel			P4		
A1-A3a	Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI),... ?	51	m2	910	0	909	0	Construction works	Supply and install new concrete slab over existing drain		As building		Concrete slabs (hollow and solid)	One Click LCA	Hollow core concrete slabs, generic			P2		
A1-A3a	Reinforcement steel (rebar), generic, 97% recycled content (... ?	100,4	kg	50	0	49	0	Construction works			As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A4-full	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	0,12	m3	2	0	2		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A4-full	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	2,66	m3	50	0	50		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A4-full	Reinforcement steel (rebar), generic, 97% recycled content (... ?	5,7	kg	0	0	0		Construction works	Assumed 2.0% reinforcement ratio per weight of concrete		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A4-full	Bollard, stainless steel ?	10	unit	1	0	1		Construction works	Supply and install new bollards		As building		Stainless steel	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Bollard, stainless steel			P4		
A4-full	Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI),... ?	51	m2	11	0	11		Construction works	Supply and install new concrete slab over existing drain		As building		Concrete slabs (hollow and solid)	One Click LCA	Hollow core concrete slabs, generic			P2		
A4-full	Reinforcement steel (rebar), generic, 97% recycled content (... ?	100,4	kg	0	0	0		Construction works			As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A5	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	0,12	m3	1	0	1		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A5	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	2,66	m3	31	0	31		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
A5	Reinforcement steel (rebar), generic, 97% recycled content (... ?	5,7	kg	0	0	0		Construction works	Assumed 2.0% reinforcement ratio per weight of concrete		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A5	Bollard, stainless steel ?	10	unit	23	0	23		Construction works	Supply and install new bollards		As building		Stainless steel	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Bollard, stainless steel			P4		
A5	Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI),... ?	51	m2	0	0	0		Construction works	Supply and install new concrete slab over existing drain		As building		Concrete slabs (hollow and solid)	One Click LCA	Hollow core concrete slabs, generic			P2		
A5	Reinforcement steel (rebar), generic, 97% recycled content (... ?	100,4	kg	2	0	2		Construction works			As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
C1-C4	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	0,12	m3	1	0	1		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
C1-C4	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	2,66	m3	21	0	21		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
C1-C4	Reinforcement steel (rebar), generic, 97% recycled content (... ?	5,7	kg	0	0	0		Construction works	Assumed 2.0% reinforcement ratio per weight of concrete		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
C1-C4	Bollard, stainless steel ?	10	unit	10	0	10		Construction works	Supply and install new bollards		As building		Stainless steel	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Bollard, stainless steel			P4		
C1-C4	Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI),... ?	51	m2	23	0	23		Construction works	Supply and install new concrete slab over existing drain		As building		Concrete slabs (hollow and solid)	One Click LCA	Hollow core concrete slabs, generic			P2		
C1-C4	Reinforcement steel (rebar), generic, 97% recycled content (... ?	100,4	kg	4	0	4		Construction works			As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
D	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	0,12	m3	−7	0	−7		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
D	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5... ?	2,66	m3	−150	0	−150		Construction works			As building		Ready-mix concrete for external walls and floors	One Click LCA	Ready-mix concrete, normal-strength, generic			P2		
D	Reinforcement steel (rebar), generic, 97% recycled content (... ?	5,7	kg	0	0	0		Construction works	Assumed 2.0% reinforcement ratio per weight of concrete		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
D	Bollard, stainless steel ?	10	unit	−451	0	−451		Construction works	Supply and install new bollards		As building		Stainless steel	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Bollard, stainless steel			P4		
D	Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI),... ?	51	m2	−312	0	−312		Construction works	Supply and install new concrete slab over existing drain		As building		Concrete slabs (hollow and solid)	One Click LCA	Hollow core concrete slabs, generic			P2		
D	Reinforcement steel (rebar), generic, 97% recycled content (... ?	100,4	kg	−7	0	−7		Construction works			As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
				2 636	**0**	**2 634**		**Construction works**												
A0	KKH 08, excavator, tracked ?	8	h	104	0	104	0	Pre-Construction Work					Machine operation	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	KKH 08, excavator, tracked					
				104		**104**		**Pre-Construction Work**												
A4-full	Asphalt, average, -10 to 40 degC (Tarmac CRH) ?	200	m2	146	0	146		Removed masses	Break out existing tarmac surfacing		30		Asphalt	EPD Asphalt, Tarmac CRH 2016	Asphalt, average			P3		
A4-full	Asphalt, generic, compacted, 5/95% bitumen-aggregate ratio, ... ?	4 320	kg	19	0	19		Removed masses	2 cm		30		Asphalt	One Click LCA	Asphalt, generic, compacted			P3		
A4-full	Macadam (8…16 mm), wet bulk density, 2000 kg/m3 ?	7 200	kg	32	0	32		Removed masses	4 cm		As building		Sand, soil and gravel	LCA inventory for gravel production	Macadam (8…16 mm), wet bulk density			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	21 600	kg	95	0	95		Removed masses	15 cm		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	500	m3	1 522	0	1 522		Masses that can be reused in the project	Strip existing topsoil and dispose on site (prov qty)		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A1-A3a	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	4,68	m2	58	0	58	0	Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A1-A3a	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	121	0	121	0	Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
A1-A3a	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	7 457	2	7 228	0	Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A1-A3a	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	4 051	1	3 999	0	Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A1-A3a	Anti-skid silica aggregates coating, 2700 kg/m3, film thickn... ?	176	kg	63	0	63	0	Pavings and surfaces			10		Paints, coatings and lacquers	EPD Jotafloor Non Slip Aggregate, Jotun U.A.E. Ltd. (L.L.C.)	Anti-skid silica aggregates coating		10,20,30,40	P7		
A1-A3a	Granular fill, UK average (IStructE) ?	208	m3	3 727	0	3 727	0	Pavings and surfaces	Supply and install Type 1 sub-base 150mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A1-A3a	Precast concrete kerb or edging unit from pigmented wet pres... ?	794	m	6 019	2	5 971	0	Pavings and surfaces	Precast Concrete Edgings+kerbs		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Pigmented Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from pigmented wet pressed process			P2		
A4-full	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	4,68	m2	3	0	3		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A4-full	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	0	0	0		Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
A4-full	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	492	0	492		Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A4-full	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	301	0	301		Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A4-full	Anti-skid silica aggregates coating, 2700 kg/m3, film thickn... ?	176	kg	2	0	2		Pavings and surfaces			10		Paints, coatings and lacquers	EPD Jotafloor Non Slip Aggregate, Jotun U.A.E. Ltd. (L.L.C.)	Anti-skid silica aggregates coating		10,20,30,40	P7		
A4-full	Granular fill, UK average (IStructE) ?	208	m3	1 418	0	1 418		Pavings and surfaces	Supply and install Type 1 sub-base 150mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Precast concrete kerb or edging unit from pigmented wet pres... ?	794	m	91	0	91		Pavings and surfaces	Precast Concrete Edgings+kerbs		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Pigmented Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from pigmented wet pressed process			P2		
A5	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	4,68	m2	3	0	3		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A5	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	12	0	12		Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
A5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	0	0	0		Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	0	0	0		Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A5	Anti-skid silica aggregates coating, 2700 kg/m3, film thickn... ?	176	kg	7	0	7		Pavings and surfaces			10		Paints, coatings and lacquers	EPD Jotafloor Non Slip Aggregate, Jotun U.A.E. Ltd. (L.L.C.)	Anti-skid silica aggregates coating		10,20,30,40	P7		
A5	Granular fill, UK average (IStructE) ?	208	m3	0	0	0		Pavings and surfaces	Supply and install Type 1 sub-base 150mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Precast concrete kerb or edging unit from pigmented wet pres... ?	794	m	0	0	0		Pavings and surfaces	Precast Concrete Edgings+kerbs		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Pigmented Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from pigmented wet pressed process			P2		
B4-B5	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	121	0	121		Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
B4-B5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	8 471	2	8 241		Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
B4-B5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	4 671	1	4 620		Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
B4-B5	Anti-skid silica aggregates coating, 2700 kg/m3, film thickn... ?	176	kg	262	0	262		Pavings and surfaces			10		Paints, coatings and lacquers	EPD Jotafloor Non Slip Aggregate, Jotun U.A.E. Ltd. (L.L.C.)	Anti-skid silica aggregates coating		10,20,30,40	P7		
C1-C4	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	4,68	m2	4	0	4		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
C1-C4	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	0	0	0		Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
C1-C4	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	522	0	522		Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
C1-C4	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	319	0	319		Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
C1-C4	Anti-skid silica aggregates coating, 2700 kg/m3, film thickn... ?	176	kg	1	0	1		Pavings and surfaces			10		Paints, coatings and lacquers	EPD Jotafloor Non Slip Aggregate, Jotun U.A.E. Ltd. (L.L.C.)	Anti-skid silica aggregates coating		10,20,30,40	P7		
C1-C4	Precast concrete kerb or edging unit from pigmented wet pres... ?	794	m	187	0	187		Pavings and surfaces	Precast Concrete Edgings+kerbs		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Pigmented Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from pigmented wet pressed process			P2		
D	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	4,68	m2	−5	0	−5		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
D	Ceramic/sandstone tile, 9 mm, 18 kg/m2 (KBOB) ?	8	m2	−1	0	−1		Pavings and surfaces	Sandstone Setts		30		Wall and floor tiles	KBOB	Ceramic/sandstone tile		30	P2		
D	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	69,4	m3	−1 270	−1	−1 270		Pavings and surfaces	BASE BINDER - 50mm AC20 Dense Bin 100/150		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
D	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	99	ton	−777	−1	−777		Pavings and surfaces	30mm AC6 Dense Surf 100/150		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
D	Precast concrete kerb or edging unit from pigmented wet pres... ?	794	m	−2 521	−2	−2 521		Pavings and surfaces	Precast Concrete Edgings+kerbs		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Pigmented Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from pigmented wet pressed process			P2		
				21 495	**5**	**21 166**		**Pavings and surfaces**												
A5	Traffic sign, large triangle, 1350 mm, aluminum ?	3	unit	56	0	56		Site and process materials	Allowance for new traffic signs		As building		Aluminium	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Traffic sign, large triangle, 1350 mm, aluminum			P4		
A1-A3a	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	40	0	40	0	Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
A4-full	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	0	0	0		Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
A5	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	0	0	0		Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
B4-B5	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	41	0	41		Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
C1-C4	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	1	0	1		Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
D	Electrical conduits, 0.083 kg/m, B34016, B34020, B34025, B34... ?	150	m	−49	0	−49		Systems	New ductwork for street lights		25		Other building technology systems	PEP	Electrical conduits		25	P8		
				40		**40**		**Systems**												

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Eddleston

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A5	Construction waste to landfill ?	550	ton	24 841	0	24 841		Construction waste	Disposal off site of acceptable material excluding Class 5A				Other waste		Construction waste to landfill					
A5	Soil waste ?	4 300	ton	40 219	0	40 219		Construction waste	Disposal off site of acceptable material Class 5A				Mineral waste		Soil waste					
A1-A3a	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	10	m3	110	0	110	0	Construction works	Type B Filter Material for soakaway		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A1-A3a	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	2 876	0	2 875	0	Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
A1-A3a	PVC plastic pipe, 0% recycled content ?	56,8	kg	126	0	126	0	Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
A1-A3a	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	64,5	kg	181	0	181	0	Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A1-A3a	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	125,5	kg	232	0	232	0	Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
A1-A3a	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	5 630,85	kg	15 843	0	15 838	0	Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A1-A3a	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	10 956,15	kg	20 221	0	20 212	0	Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
A4-full	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	10	m3	51	0	51		Construction works	Type B Filter Material for soakaway		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A4-full	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	5	0	5		Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
A4-full	PVC plastic pipe, 0% recycled content ?	56,8	kg	0	0	0		Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
A4-full	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	64,5	kg	0	0	0		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A4-full	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	125,5	kg	1	0	1		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
A4-full	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	5 630,85	kg	24	0	24		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A4-full	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	10 956,15	kg	46	0	46		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
A5	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	10	m3	0	0	0		Construction works	Type B Filter Material for soakaway		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A5	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	0	0	0		Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
A5	PVC plastic pipe, 0% recycled content ?	56,8	kg	18	0	18		Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
A5	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	64,5	kg	14	0	14		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A5	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	125,5	kg	17	0	17		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
A5	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	5 630,85	kg	1 190	0	1 190		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A5	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	10 956,15	kg	1 520	0	1 519		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
B4-B5	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	2 925	0	2 924		Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
B4-B5	PVC plastic pipe, 0% recycled content ?	56,8	kg	244	0	243		Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
C1-C4	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	44	0	44		Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
C1-C4	PVC plastic pipe, 0% recycled content ?	56,8	kg	118	0	118		Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
C1-C4	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	64,5	kg	3	0	3		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
C1-C4	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	125,5	kg	5	0	5		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
C1-C4	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	5 630,85	kg	228	0	228		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
C1-C4	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	10 956,15	kg	443	0	443		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
D	Steel sliding gate, fire resistant, 3 m x 3 m, 551.88 kg, 61... ?	17	m2	−4 137	−3	−4 137		Construction works	Steel tubular frame single field gate (12 units)		30		Metal and industrial doors	EPD Turen und Tore Turen, Tore und Klappen aus Stahl des System Schroders Franzen Brandschutzture	Steel sliding gate, fire resistant		30	P8		
D	PVC plastic pipe, 0% recycled content ?	56,8	kg	−161	0	−152		Construction works	Allowance for 150mm diameter PVC pipe with Type Z surround, depth to invert not exceeding 2 metres		30		Plastic profiles and products	One Click LCA	PVC plastic pipe		30	P7		
D	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	64,5	kg	−153	0	−153		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
D	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	125,5	kg	−208	0	−208		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
D	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	5 630,85	kg	−13 345	−9	−13 345		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
D	Hot-dip galvanized structural steel, 7850 kg/m3 (bauforumsta... ?	10 956,15	kg	−18 176	−13	−18 176		Construction works	Allowance for 1.4m high post and wire fence.		As building		Hot-dip galvanized/zinc coated steel	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel			P4		
				39 589		**39 573**		**Construction works**												
A1-A3b	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	3 090	ton	9 950	3	9 857	0	Masses sourced for the project	Topsoiling 150mm thick in new verges to surfaces sloping at 10 degrees or less to the horizontal		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A1-A3b	Granular fill, UK average (IStructE) ?	6 820	m3	122 214	0	122 214	0	Masses sourced for the project	Imported acceptable material Class 1 in embankments and other areas of fill		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	3 090	ton	9 404	0	9 404		Masses sourced for the project	Topsoiling 150mm thick in new verges to surfaces sloping at 10 degrees or less to the horizontal		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A4-full	Granular fill, UK average (IStructE) ?	6 820	m3	46 491	2	46 491		Masses sourced for the project	Imported acceptable material Class 1 in embankments and other areas of fill		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
				132 164	**3**	**132 072**		**Masses sourced for the project**												
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	460	kg	18	0	18	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
A0	Soil compaction with soil roller	6 820	ton	382 602	33	382 602	0	Pre-Construction					Machine operation	One Click LCA	Soil compaction					

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
	compactor, per m2, P=80 kW,... ?							Work							with soil roller compactor, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	9 716,4	kg	371	0	371	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	64 000	m2	6 223	1	6 223	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				389 214	**34**	**389 214**		**Pre-Construction Work**												
A4-full	Cement floor screed (concrete screed), 2200 kg/m3 ?	100	m3	350	0	350		Removed masses	Extra over excavation for excavation in Hard Material in cutting and other excavation (assume 2% of all excavated material)		As building		Cement	India Construction Materials Database November 2017	Cement floor screed (concrete screed)			P2		
A4-full	Asphalt, generic, compacted, 5/95% bitumen-aggregate ratio, ... ?	250	m3	1 788	0	1 788		Removed masses	Excavation of acceptable material excluding Class 5A (assume 5% of all excavated material)		30		Asphalt	One Click LCA	Asphalt, generic, compacted			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	4 750	m3	23 128	1	23 128		Removed masses	Excavation of acceptable material Class 5A		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Water-borne interior paints, 1.36 kg/L, average coverage 8-1... ?	0,54	kg	0	0	0		Masses that can be reused in the project	For inner wall, average spread rate 10.15 m2/l		10		Paints, coatings and lacquers	EPD RTS EPD, Water-borne interior paints	Water-borne interior paints			P7		
A4-full	Masonry mortar/facing wall mortar/mortar with special proper... ?	0,65	m2	0	0	0		Masses that can be reused in the project			As building		Mortar (masonry/bricklaying)	Oekobau.dat 2017-I, EPD Mineralische Werkmörtel: Mauermörtel - Vormauermörtel/Mörtel mit besonderen Eigenschaften Industrieverband WerkMörtel e.V. (IWM)	Masonry mortar/facing wall mortar/mortar with special properties			P2		
A4-full	Red brick, average production, UK, 215 mm x 102.5 mm x 65 mm... ?	3,35	m2	1	0	1		Masses that can be reused in the project	60 bricks (65 mm x 215 mm x 102 mm) per m2		As building		Brick, common clay brick	EPD BDA Generic Brick, The Brick Development Association	Red brick, average production, UK			P33		
A4-full	Plastic vapour control layer, 0.2 mm (Tommen Gram) ?	4	m2	0	0	0		Masses that can be reused in the project			30		Plastic membranes	Gram Dampsperre, Tommen Gram Folie AS (2015)	Plastic vapour control layer			P7		
A4-full	Plastic vapour control layer, 0.2 mm (Tommen Gram) ?	4	m2	0	0	0		Masses that can be reused in the project			30		Plastic membranes	Gram Dampsperre, Tommen Gram Folie AS (2015)	Plastic vapour control layer			P7		
A4-full	Plywood, generic, 4-50 mm (0.16-1.97 in), 620 kg/m3 (38.7 lb... ?	4	m2	0	0	0		Masses that can be reused in the project			As building		Plywood	One Click LCA	Plywood, generic			P5		
A4-full	Stone wool insulation panels, unfaced, generic, L = 0.037 W/... ?	4	m2	0	0	0		Masses that can be reused in the project			As building		Stone wool insulation	One Click LCA	Stone wool insulation panels, unfaced, generic			P3		
A4-full	Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98... ?	4	m2	0	0	0		Masses that can be reused in the project			As building		Regular gypsum board	One Click LCA	Gypsum plaster board, regular, generic			P232		
A4-full	Gypsum plaster, 1100 kg/m3 (Bundesverband der Gipsindustrie) ?	4	m2	0	0	0		Masses that can be reused in the project			30		Gypsum plaster (interior applications)	Oekobau.dat 2017-I, EPD GIPSPUTZ Bundesverband der Gipsindustrie e.V.	Gypsum plaster			P232		
A4-full	Mortar, 2000 kg/m3, EN15804+A2, ref. year 2021 ?	150	kg	0	0	0		Masses that can be reused in the project	Assumed 10 mm joint and 0.02 m3 of dry mortar per m2 of brick wall		As building		Mortar (masonry/bricklaying)	ÖKOBAUDAT 2021-II (25.06.2021)	Mortar			P2		
A4-full	Clay brick (One Click LCA) ?	560	kg	1	0	1		Masses that can be reused in the project	Assumed 54 bricks per m2 of brick wall, adjusted for thickness of 110 mm		As building		Brick, common clay brick	One Click LCA	Clay brick			P33		
A1-A3a	Road marking tape, 2.98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	50 100	88	0	0	Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		
A1-A3a	Tack coat, generic, 0.271 l/m2 spray on application (0.06 ga... ?	24	m2	43	0	43	0	Pavings and surfaces	Tack coat		20		Bitumen and other roofing	One Click LCA	Tack coat, generic		20,40	P34		
A1-A3a	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	1 706	0	1 689	0	Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness,		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.											
A1-A3a	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	6 576	2	6 374	0	Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A1-A3a	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	13 182	3	12 709	0	Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A1-A3a	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	40 709	9	39 248	0	Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A1-A3a	Granular fill, UK average (IStructE) ?	580	ton	4 640	0	4 640	0	Pavings and surfaces	Completion of formation on material other than Class 1C, 6B or rock in cuttings		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A1-A3a	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	33 301	6	32 965	0	Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A1-A3a	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	89 215	22	86 465	0	Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A1-A3a	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	153 281	35	147 782	0	Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A1-A3a	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	96 349	18	95 378	0	Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A4-full	Road marking tape, 2,98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	0	0	0		Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).											
A4-full	Tack coat, generic, 0.271 l/m2 spray on application (0.06 ga... ?	24	m2	0	0	0		Pavings and surfaces	Tack coat		20		Bitumen and other roofing	One Click LCA	Tack coat, generic		20,40	P34		
A4-full	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	124	0	124		Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	434	0	434		Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	1 013	0	1 013		Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	3 127	0	3 127		Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A4-full	Granular fill, UK average (IStructE) ?	580	ton	1 765	0	1 765		Pavings and surfaces	Completion of formation on material other than Class 1C, 6B or rock in cuttings		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	2 423	0	2 423		Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	5 887	0	5 887		Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	11 774	0	11 774		Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A4-full	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	7 012	0	7 012		Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		

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									surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).											
A5	Road marking tape, 2.98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	3 763	7	6		Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		
A5	Tack coat, generic, 0.271 l/m2 spray on application (0.06 ga... ?	24	m2	4	0	4		Pavings and surfaces	Tack coat		20		Bitumen and other roofing	One Click LCA	Tack coat, generic		20,40	P34		
A5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	0	0	0		Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	0	0	0		Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
A5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	0	0	0		Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	0	0	0		Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A5	Granular fill, UK average (IStructE) ?	580	ton	0	0	0		Pavings and surfaces	Completion of formation on material other than Class 1C, 6B or rock in cuttings		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	0	0	0		Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	0	0	0		Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness											
A5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	0	0	0		Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	0	0	0		Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
B4-B5	Road marking tape, 2,98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	50 177	88	78		Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		
B4-B5	Tack coat, generic, 0.271 l/m2 spray on application (0.06 ga... ?	24	m2	87	0	87		Pavings and surfaces	Tack coat		20		Bitumen and other roofing	One Click LCA	Tack coat, generic		20,40	P34		
B4-B5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	1 962	0	1 945		Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
B4-B5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	7 470	2	7 267		Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
B4-B5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	15 267	3	14 795		Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
B4-B5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	47 150	10	45 689		Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
B4-B5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	38 292	7	37 957		Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness											
B4-B5	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	101 341	23	98 591		Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
B4-B5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	177 533	37	172 034		Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
B4-B5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	110 791	19	109 821		Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
C1-C4	Road marking tape, 2.98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	77	0	77		Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		
C1-C4	Tack coat, generic, 0.271 l/m2 spray on application (0.06 ga... ?	24	m2	1	0	1		Pavings and surfaces	Tack coat		20		Bitumen and other roofing	One Click LCA	Tack coat, generic		20,40	P34		
C1-C4	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	132	0	132		Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
C1-C4	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	460	0	460		Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
C1-C4	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	1 073	0	1 073		Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.											
C1-C4	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	3 314	0	3 314		Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
C1-C4	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	2 568	0	2 568		Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
C1-C4	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	6 239	1	6 239		Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
C1-C4	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	12 478	2	12 478		Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
C1-C4	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	7 431	1	7 431		Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
D	Road marking tape, 2,98 kg/m2, 3M™ Stamark™ High Performance... ?	12,56	m2	−106	0	−100		Pavings and surfaces	13 Triangle in white thermoplastic screed with applied solid glass beads 1875mm long to Traffic Signs Regulations and General Directions Diagram No. 1023B+33m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide with 4m line and 2m gap (TSRGD Ref. 1004)+34m of Intermittent line in white thermoplastic screed with applied solid glass beads 100mm wide in with 300mm line and 150mm gap (TSRGD Ref. 1003B and 1009B).		30		Plastic profiles and products	EPD S-P-02166 3M™ Stamark™ High Performance Tape Series 380ESD IMP White	Road marking tape		30	P7		
D	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	40,8	ton	−320	0	−320		Pavings and surfaces	DIVIDED 2-SURFACE-Construction Type P2: Footway comprising Type 1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
D	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	61,2	m3	−1 120	−1	−1 120		Pavings and surfaces	DIVIDED 2-BASE BINDER-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.											
D	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	142,8	m3	−2 612	−2	−2 612		Pavings and surfaces	DIVIDED 2-SUB BASE-Construction Type P2: Footway comprising Type1 Unbound sub-base 210mm thickness, Asphalt Concrete Binder Course 90mm thickness, and Hot Rolled Asphalt Surface Course 25mm thickness.		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
D	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	441	m3	−8 068	−6	−8 068		Pavings and surfaces	Additional Type 1 sub-base material to form path shoulders (300mm wide)		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
D	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	796,32	ton	−6 252	−4	−6 252		Pavings and surfaces	DIVIDED 1-SURFACE-Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
D	Asphalt pavement (asphalt concrete) binder course, hot mix, ... ?	830,25	m3	−15 189	−11	−15 189		Pavings and surfaces	DIVIDED 1-BASE BINDER - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) binder course, hot mix		30	P3		
D	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	1 660,5	m3	−30 377	−21	−30 377		Pavings and surfaces	DIVIDED 1-SUB BASE - Footway comprising Type 1 unbound sub-base 100mm thickness, Asphalt concrete binder course 50mm thickness, and Hot Rolled Asphalt surface course 20mm thickness		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
D	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	2 304	ton	−18 090	−13	−18 090		Pavings and surfaces	Hot rolled asphalt (HRA 30/14F surf 40/60) with 14mm aggregate surface course 40mm thick with 20mm black coloured coated chippings in carriageway, hard shoulder and hard strip (300mm wide strip adjacent to new kerbing).		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
				489 100	**184**	**427 294**		**Pavings and surfaces**												
A5	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,88	m2	38	0	38		Site and process materials			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A5	Precast concrete paving (Blocks, Slabs, Channels and Kerbs) ?	4,2	ton	563	0	563		Site and process materials	Precast concrete dropped bullnosed kerbs 125mm x 175mm, laid straight or curved to any radius.		As building		Other precast concrete products	ICE database August 2019, V3.0	Precast concrete paving (Blocks, Slabs, Channels and Kerbs)			P2		
A5	Traffic sign, normal, diameter 640 mm, aluminum ?	46	unit	334	0	334		Site and process materials	Permanent retroflective traffic sign as non-lit sign unit not exceeding 0.25m2 in area on one 76mm diameter tubular steel post.		As building		Aluminium	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Traffic sign, normal, diameter 640 mm, aluminum			P4		
A5	Traffic sign, small, 400 x 400 mm, aluminum ?	52	unit	200	0	200		Site and process materials	Permanent retroflective traffic sign as non-lit sign unit not exceeding 0.25m2 in area on any size existing lighting column or post.		As building		Aluminium	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Traffic sign, small, 400 x 400 mm, aluminum			P4		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A5	Precast concrete paving (Blocks, Slabs, Channels and Kerbs) ?	1 454	ton	194 779	0	194 779		Site and process materials	Precast concrete transition kerbs 255x125mm, laid straight or curved to any radius		As building		Other precast concrete products	ICE database August 2019, V3.0	Precast concrete paving (Blocks, Slabs, Channels and Kerbs)			P2		
A5	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	2 000	m3	12 526	2	12 466		Site and process materials	Ground Preparation and Cultivation - Final preparation of soils		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		

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Glenriddet

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
B7	Water, 1000 kg/m3 ?	4	m3	200	0	200		Water use, per year	Include for watering of all Standard (Semi Mature) trees using water tanker as necessitated by dry weather 15 to 20 litres per tree.				Water	EPiC	Water			P8		
				200		**200**		**Water use, per year**												
A5	Chainsaw for domestic use, petrol driven, operation per hour... ?	8	h	6	0	6		Machine hours	Removal of existing trees as depicted on drawing 2424.7.01, including stump removal and disposal off site. Make good ground.				Machine operation	LCA for machine operation, One Click LCA, Lipasto.fi	Chainsaw for domestic use, petrol driven, operation per hour					
A5	Compactors, diesel-driven, operation per hour, average power... ?	8	h	107	0	107		Machine hours	Compaction of acceptable material in embankments and other areas of fill				Machine operation	LCA for machine operation, One Click LCA, Lipasto.fi	Compactors, diesel-driven, operation per hour					
A5	Soil waste ?	570	ton	5 331	0	5 331		Construction waste	Disposal of unacceptable material Class U1A				Mineral waste		Soil waste					
A1-A3b	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	15	m3	165	0	165	0	Masses sourced for the project	Filling of soft spots and other voids below cuttings or under embankments with acceptable material		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A1-A3b	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	35	m3	113	0	112	0	Masses sourced for the project	Imported topsoil Class 5B		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A1-A3b	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	205	m3	660	0	654	0	Masses sourced for the project	Topsoiling 150 mm thick to surfaces sloping at 10° or less to the horizontal + Topsoiling 150 mm thick to surfaces sloping at more than 10° to the horizontal		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A1-A3b	Sand, compacted dry density, 1682 kg/m3 ?	705	m3	2 751	0	2 751	0	Masses sourced for the project	Imported acceptable material Class 2A in embankments and other areas of fill + Imported acceptable material Class 6F5 fill on sub-base material, base and capping		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand, compacted dry density			P3		
A4-full	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	15	m3	77	0	77		Masses sourced for the project	Filling of soft spots and other voids below cuttings or under embankments with acceptable material		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A4-full	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	35	m3	107	0	107		Masses sourced for the project	Imported topsoil Class 5B		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A4-full	Topsoil, 1000 kg/m3 (Den Ouden Group) ?	205	m3	624	0	624		Masses sourced for the project	Topsoiling 150 mm thick to surfaces sloping at 10° or less to the horizontal + Topsoiling 150 mm thick to surfaces sloping at more than 10° to the horizontal		As building		Sand, soil and gravel	EPD Teelaarde (Kelpen-Oler)	Topsoil			P3		
A4-full	Sand, compacted dry density, 1682 kg/m3 ?	705	m3	3 609	0	3 609		Masses sourced for the project	Imported acceptable material Class 2A in embankments and other areas of fill + Imported acceptable material Class 6F5 fill on sub-base material, base and capping		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand, compacted dry density			P3		
				3 689	**0**	**3 682**		**Masses sourced for the project**												
A0	Milling machine, asphalt ?	0,3	h	45	0	45	0	Pre-Construction Work					Machine operation	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Milling machine, asphalt					
A0	KKH 08, excavator, tracked ?	8	h	104	0	104	0	Pre-Construction Work					Machine operation	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	KKH 08, excavator, tracked					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 000	m2	811	0	811	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				1 065	**0**	**1 065**		**Pre-Construction Work**												
A4-full	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	15	m3	77	0	77		Removed masses	Excavation of soft spots and other voids below cuttings or under embankments		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	42	m3	205	0	205		Removed masses	Extra over excavation for excavation in Hard Material in cutting and other excavation		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	155	m3	755	0	755		Removed masses	Deposition of acceptable material on sub-base material, base and capping		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	170	m3	828	0	828		Removed masses	Excavation of acceptable material Class 5A		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Asphalt, generic, compacted, 5/95% bitumen-aggregate ratio, ... ?	12 480	kg	55	0	55		Removed masses	2 cm		30		Asphalt	One Click LCA	Asphalt, generic, compacted			P3		
A4-full	Macadam (8…16 mm), wet bulk density, 2000 kg/m3 ?	20 800	kg	91	0	91		Removed masses	4 cm		As building		Sand, soil and gravel	LCA inventory for gravel production	Macadam (8…16 mm), wet bulk density			P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A4-full	Asphalt, generic, compacted, 5/95% bitumen-aggregate ratio, ... ?	25 680	kg	113	0	113		Removed masses	2 cm		30		Asphalt	One Click LCA	Asphalt, generic, compacted			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	41 600	kg	183	0	183		Removed masses	10 cm		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A4-full	Macadam (8…16 mm), wet bulk density, 2000 kg/m3 ?	42 800	kg	188	0	188		Removed masses	4 cm		As building		Sand, soil and gravel	LCA inventory for gravel production	Macadam (8…16 mm), wet bulk density			P3		
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	85 600	kg	376	0	376		Removed masses	10 cm		As building		Sand, soil and gravel	One Click LCA	Aggregate (crushed gravel), generic, dry bulk density			P3		
A1-A3a	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,16	m2	27	0	27	0	Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A1-A3a	Quarry stone, 1800 kg/m3 ?	12	m3	71	0	71	0	Pavings and surfaces	4/20mm clean angular stone to BS EN 13242/EN 12620		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Quarry stone			P3		
A1-A3a	Granular fill, UK average (IStructE) ?	15	m3	269	0	269	0	Pavings and surfaces	Granular material Type 3 sub-base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A1-A3a	Sand (One Click LCA) ?	16	ton	234	0	233	0	Pavings and surfaces	Sharp sand		As building		Sand, soil and gravel	One Click LCA	Sand			P3		
A1-A3a	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	2 059	0	2 038	0	Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A1-A3a	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	7 574	2	7 302	0	Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A1-A3a	Granular fill, UK average (IStructE) ?	150	m3	2 688	0	2 688	0	Pavings and surfaces	Granular material Type 1 sub-base 300mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,16	m2	1	0	1		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A4-full	Quarry stone, 1800 kg/m3 ?	12	m3	66	0	66		Pavings and surfaces	4/20mm clean angular stone to BS EN 13242/EN 12620		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Quarry stone			P3		
A4-full	Granular fill, UK average (IStructE) ?	15	m3	102	0	102		Pavings and surfaces	Granular material Type 3 sub-base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Sand (One Click LCA) ?	16	ton	49	0	49		Pavings and surfaces	Sharp sand		As building		Sand, soil and gravel	One Click LCA	Sand			P3		
A4-full	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	150	0	150		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A4-full	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	582	0	582		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A4-full	Granular fill, UK average (IStructE) ?	150	m3	1 023	0	1 023		Pavings and surfaces	Granular material Type 1 sub-base 300mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,16	m2	1	0	1		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
A5	Quarry stone, 1800 kg/m3 ?	12	m3	0	0	0		Pavings and surfaces	4/20mm clean angular stone to BS EN 13242/EN 12620		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Quarry stone			P3		
A5	Granular fill, UK average (IStructE) ?	15	m3	0	0	0		Pavings and surfaces	Granular material Type 3 sub-base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Sand (One Click LCA) ?	16	ton	0	0	0		Pavings and surfaces	Sharp sand		As building		Sand, soil and gravel	One Click LCA	Sand			P3		
A5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	0	0	0		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
A5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	0	0	0		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
A5	Granular fill, UK average (IStructE) ?	150	m3	0	0	0		Pavings and surfaces	Granular material Type 1 sub-base 300mm thick		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
B4-B5	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	2 367	0	2 347		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
B4-B5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	8 772	2	8 501		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
C1-C4	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,16	m2	2	0	2		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
C1-C4	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	159	0	159		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
C1-C4	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	617	0	617		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
D	Rectangular paving stone, Finnish average, 2700 kg/m3 (KIVI ... ?	2,16	m2	−2	0	−2		Pavings and surfaces			As building		Natural stone	EPD Noppa- ja nupukivi	Rectangular paving stone, Finnish average			P1		
D	Hot rolled asphalt, hot mix, 14 mm nominal aggregate size (O... ?	49,23	ton	−387	0	−387		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Hot rolled asphalt, hot mix		30	P3		
D	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	82,05	m3	−1 501	−1	−1 501		Pavings and surfaces	DIVIDED IN 2 PARTS - Footpath comprising dense asphalt concrete binder course with 20 mm aggregate 50 mm thick and hot rolled asphalt 15/10 F surface course 30 mm thick with 6 mm limestone chips		30		Asphalt	One Click LCA	Asphalt pavement (asphalt concrete) base course, hot mix		30	P3		
				12 921	**2**	**12 628**		**Pavings and surfaces**												
A5	Pine wood, treated for external application (Protec) ?	0,3	m3	81	0	81		Site and process materials			As building		Treated or coated timber	Declaracion Ambiental de Producto: MADERA TRATADA PARA EXTERIORES	Pine wood, treated for external application			P5		
A5	Outdoor bench from solid wood and steel, 94.4 kg/unit, BLOC ... ?	2	unit	568	0	568		Site and process materials	Supply new 2m steel bench and install to edge of path, with foundation as detailed in drawing IBH0653/DC1/1080. Mounting detail to be as per bench manufacturers specification		12		Furniture	EPD Bloc seat with armrest	Outdoor bench from solid wood and steel			P8		
A5	Ready-mix concrete, in-situ, UK average, C16/20 (IStructE) ?	2	m3	591	0	591		Site and process materials	In situ concrete mix C16/20, for foundation slabs for benches and bins as per detail on Drawing IBH0652-1C1-1080		As building		Ready-mix concrete for lightweight applications (domestic and auxiliary)	The Structural Carbon Tool, v2.0	Ready-mix concrete, in-situ, UK average			P2		
A5	Traffic sign post (Zn) diameter 60 mm, height 4 m ?	9	unit	438	0	438		Site and process materials	Supply and install galvanized tubular steel post 76 mm external diameter, including cap and baseplate with concrete foundation up to 0.5 cubic metres.		As building		Other steel/iron	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Traffic sign post (Zn) diameter 60 mm, height 4 m			P4		
A5	Traffic sign, normal, 600 x 600 mm, aluminum ?	9	unit	78	0	78		Site and process materials	Permanent retroreflective traffic sign, sign face exceeding 0.50 square metres but not exceeding 0.75 square metres in area		As building		Aluminium	infraCO2, 01.00.000, 2022-12-08T01:01:11.801Z	Traffic sign, normal, 600 x 600 mm, aluminum			P4		
A5	Hot dip galvanized steel, 0.73 mm, 5.72 kg/m2, EN15804+A1, r... ?	76,11	kg	234	0	234		Site and process materials			As building		Hot-dip galvanized/zinc coated steel	ÖKOBAUDAT 2021-II (25.06.2021)	Hot dip galvanized steel			P4		
A5	Polypropylene (PP) pipe for drainage and sewerage networks, ... ?	194	m	3 712	2	3 459		Site and process materials	150 mm internal diameter drain on bed Type F in trench depth to invert not exceeding 2 metres average depth to invert 1 metre (MCDHW Drg No. F1)		60		Pipes (water, heating, sewage)	One Click LCA	Polypropylene (PP) pipe for drainage and sewerage networks			P8		
A5	Precast concrete kerb or edging unit from premium wet presse... ?	893	m	9 148	3	9 059		Site and process materials	Precast concrete kerbs 125 mm x 255 mm bullnosed as Std Drg No 1100/KB3 laid straight or curved exceeding 12 metres radius		As building		Other precast concrete products	EPD Concrete Kerb & Edging - Premium Wet Pressed Marshalls Plc	Precast concrete kerb or edging unit from premium wet pressed process			P2		
A5	Modular access chamber system from polypropylene (PP), STAKK... ?	3 600	kg	1 806	7	6		Site and process materials	Polypropylene AquaCell 6LB600 silt trap with polypropylene cover and frame depth to invert exceeding 1 metre but not		30		Plastic profiles and products	EPD STAKKAbox™ Modula from Cubis Systems	Modular access chamber system from polypropylene (PP)			P7		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
									exceeding 2 metres - 8 pieces											
B1	Oak, willow, Quercus phellos (Hardwood) ?	8	unit	0	0		12 204	Vegetation and landscaping scenarios	Quercus robur: 4x transplanted, 20 – 25cm girth; minimum 4.5m overall height, minimum 2.0m clear stem, rootballed + Standard (Semi Mature) Trees Excavate pits for species as listed in Table 1, Drawing 2424.5.02 Planting Plan and Detail A.				Vegetation	Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings - U.S. Department of Energy	Oak, willow					
							12 204	**Vegetation and landscaping scenarios**												

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Fairlie

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A1-A3b	Crushed rock / gravel mix (50-50 %), dry bulk density, 1680 ... ?	95	m3	1 045	0	1 045	0	Masses sourced for the project	Imported Rock – Use BS EN 13383-1 Standard Light Grading 60-300kg LMA 60-300		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock / gravel mix (50-50 %), dry bulk density			P3		
A4-full	Crushed rock / gravel mix (50-50 %), dry bulk density, 1680 ... ?	95	m3	701	0	701		Masses sourced for the project	Imported Rock – Use BS EN 13383-1 Standard Light Grading 60-300kg LMA 60-300		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock / gravel mix (50-50 %), dry bulk density			P3		
				1 045		**1 045**		**Masses sourced for the project**												
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	400	m2	15	0	15	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				15	**0**	**15**		**Pre-Construction Work**												
A4-full	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	43	m3	293	0	293		Removed masses	Removal of beach material to expose rock		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density			P3		
A4-full	Asphalt concrete for heavy load bearing applications, hot mi... ?	44,52	m3	480	0	480		Removed masses			30		Asphalt	EPD AB16 RC50%, AB16 RC50% BitumenMix 2%, ABK31 RC50% BitumenMix 2%	Asphalt concrete for heavy load bearing applications, hot mix			P3		
A4-full	Crushed rock (0…100 mm), dry bulk density, 1680 kg/m3 ?	47	m3	347	0	347		Removed masses	Breakout existing rock outcrop to form horizontal interface		As building		Sand, soil and gravel	LCA of crushed stone, OneClickLCA 2016	Crushed rock (0…100 mm), dry bulk density			P3		
A1-A3a	Acrylic sealant, fire resistant, Protecta FR Akryl (Polyseam... ?	32	kg	57	0	0	0	Pavings and surfaces	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.		20		Sealants (silicone and others)	EPD Protecta FR Akryl (plastpatron)	Acrylic sealant, fire resistant		20,40	P7		
A1-A3a	Granular fill, UK average (IStructE) ?	88	m3	1 577	0	1 577	0	Pavings and surfaces	Type 1 Unbound Mixture Sub-Base as shown in drawing series 60283360-PH3-C-102 to 60283360-PH3-C-111 inclusive		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A1-A3a	Concrete repair materials, dry mix (Group 1), Renderoc DS, R... ?	346	kg	114	0	107	0	Pavings and surfaces	Resurfacing using Fosroc Paveroc repair mortar. See drawing 60283360-PH3-C-112.		As building		Concrete admixtures	EPD Average EPD for Concrete Repair Products (Group 1) FOSROC INTERNATIONAL LIMITED	Concrete repair materials, dry mix (Group 1)			P7		
A4-full	Acrylic sealant, fire resistant, Protecta FR Akryl (Polyseam... ?	32	kg	0	0	0		Pavings and surfaces	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.		20		Sealants (silicone and others)	EPD Protecta FR Akryl (plastpatron)	Acrylic sealant, fire resistant		20,40	P7		
A4-full	Granular fill, UK average (IStructE) ?	88	m3	600	0	600		Pavings and surfaces	Type 1 Unbound Mixture Sub-Base as shown in drawing series 60283360-PH3-C-102 to 60283360-PH3-C-111 inclusive		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Concrete repair materials, dry mix (Group 1), Renderoc DS, R... ?	346	kg	2	0	2		Pavings and surfaces	Resurfacing using Fosroc Paveroc repair mortar. See drawing 60283360-PH3-C-112.		As building		Concrete admixtures	EPD Average EPD for Concrete Repair Products (Group 1) FOSROC INTERNATIONAL LIMITED	Concrete repair materials, dry mix (Group 1)			P7		
A5	Acrylic sealant, fire resistant, Protecta FR Akryl (Polyseam... ?	32	kg	6	0	0		Pavings and surfaces	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.		20		Sealants (silicone and others)	EPD Protecta FR Akryl (plastpatron)	Acrylic sealant, fire resistant		20,40	P7		
A5	Granular fill, UK average (IStructE) ?	88	m3	0	0	0		Pavings and surfaces	Type 1 Unbound Mixture Sub-Base as shown in drawing series 60283360-PH3-C-102 to 60283360-PH3-C-111 inclusive		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Concrete repair materials, dry mix (Group 1), Renderoc DS, R... ?	346	kg	0	0	0		Pavings and surfaces	Resurfacing using Fosroc Paveroc repair mortar. See drawing 60283360-PH3-C-112.		As building		Concrete admixtures	EPD Average EPD for Concrete Repair Products (Group 1) FOSROC INTERNATIONAL LIMITED	Concrete repair materials, dry mix (Group 1)			P7		
B4-B5	Acrylic sealant, fire resistant, Protecta FR Akryl (Polyseam... ?	32	kg	115	0	1		Pavings and surfaces	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.		20		Sealants (silicone and others)	EPD Protecta FR Akryl (plastpatron)	Acrylic sealant, fire resistant		20,40	P7		
C1-C4	Acrylic sealant, fire resistant, Protecta FR Akryl (Polyseam... ?	32	kg	0	0	0		Pavings and surfaces	Expansion Joints between slabs: Sealant and joint material (excluding dowels). See drawing 60283360-PH3-C-112.		20		Sealants (silicone and others)	EPD Protecta FR Akryl (plastpatron)	Acrylic sealant, fire resistant		20,40	P7		
				1 748	**0**	**1 684**		**Pavings and surfaces**												
A5	HS2 baseline - Cement grout, Cementitious modified mineral m... ?	1,5	m3	2 504	0	2 504		Site and process materials	Cementitious Grout around dowel bars		As building		Mortar (masonry/bricklaying)	EPD Modified mineral mortars, group 3 FEICA - Association of the European Adhesive and Sealant Industry	HS2 baseline - Cement grout			P2		
A5	Polyvinyl chloride (PVC) pipe for drainage and sewerage netw... ?	3	m	243	0	232		Site and process materials	DN300 PVC Pipe		60		Pipes (water, heating, sewage)	One Click LCA	Polyvinyl chloride (PVC) pipe for drainage and sewerage networks			P8		
A5	HS2 baseline - Cement grout, Cementitious modified mineral m... ?	5	m3	8 345	0	8 345		Site and process materials	Premixed pourable grout (for infilling voids)		As building		Mortar (masonry/bricklaying)	EPD Modified mineral mortars, group 3 FEICA - Association of the European Adhesive and Sealant Industry	HS2 baseline - Cement grout			P2		
A5	Precast drainage channels, 38 kg/m, Birco 100, 150 & 200, Dr... ?	6	m	66	0	65		Site and process materials	Channel Drain (ACO M100D)		As building		Other precast concrete products	EPD Concrete Drainage Channels Marshalls Plc	Precast drainage channels			P2		
A5	Steel and aluminium integrated handrails, 13.77 kg/m, HRB-10... ?	12	m	235	0	235		Site and process materials	Harbour 2 Rail Post and Rail handrail from Marshalls or equivalent approved, surface mounted to manufacturer's recommendations+Harbour 2 Rail Post and Rail handrail from Marshalls or equivalent approved, side mounted to manufacturer's recommendations		As building		Aluminium	EPD HRB Integrated Handrails	Steel and aluminium integrated handrails			P4		
A5	Ready-mix concrete, in-situ, UK average, C40/50 (IStructE) ?	18,5	m3	6 622	0	6 622		Site and process materials	Concrete bedding to kerbs+Concrete bedding for channel drains+Concrete surround for DN300 PVC carrier drain+Mass concrete steps+75mm thick concrete blinding underneath sea wall		As building		Ready-mix concrete for structures (beams, columns, piling)	The Structural Carbon Tool, v2.0	Ready-mix concrete, in-situ, UK average			P2		

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A5	Reinforcement steel products - cut and bent meshes, 7800 kg/... ?	198,35	kg	146	0	146		Site and process materials	20mm diameter vertical dowel bars. Length = 775mm		As building		Reinforcement for concrete (rebar)	EPD Fabricated steel reinforcement products (cut and bent mesh)	Reinforcement steel products - cut and bent meshes			P4		
A5	Ready-mix concrete, in-situ, UK average, C40/50 (IStructE) ?	220	m3	78 748	0	78 748		Site and process materials	Insitu concrete mix C40/50		As building		Ready-mix concrete for structures (beams, columns, piling)	The Structural Carbon Tool, v2.0	Ready-mix concrete, in-situ, UK average			P2		
A5	Reinforcement steel (rebar), 10-40mm (BRC) ?	323	kg	233	0	233		Site and process materials	16mm diameter vertical dowel bars. Length = 475mm		As building		Reinforcement for concrete (rebar)	Environmental product declaration (EPD) report of fabricated steel products produced in the UK by Eco-Reinforcement members	Reinforcement steel (rebar)			P4		
A5	Reinforcement steel products - cut and bent meshes, 7800 kg/... ?	380,77	kg	280	0	280		Site and process materials	20mm diameter vertical dowel bars. Length = 775mm		As building		Reinforcement for concrete (rebar)	EPD Fabricated steel reinforcement products (cut and bent mesh)	Reinforcement steel products - cut and bent meshes			P4		
A5	Concrete flags, blocks and kerbs, 200x100x60mm, 134,9 kg/m2,... ?	856	kg	112	0	25		Site and process materials	125 x 150 Bull nosed Kerb		As building		Other precast concrete products	EPD Omega 200x100x60mm	Concrete flags, blocks and kerbs			P2		
A5	Reinforcement steel (rebar), generic, 0% recycled content (o... ?	2 807,36	kg	8 525	0	8 525		Site and process materials	A393 steel reinforcement		As building		Reinforcement for concrete (rebar)	One Click LCA	Reinforcement steel (rebar), generic			P4		
A5	Formwork concrete elements for floor slabs, 127 kg/m2, Gamme... ?	12 600	kg	1 121	0	1 121		Site and process materials	Formwork for vertical surfaces of In-Situ Concrete		As building		Concrete slabs (hollow and solid)	FDES	Formwork concrete elements for floor slabs			P2		
B1	Willow, black, Salix nigra (Hardwood) ?	20	unit	0	0		55 215	Vegetation and landscaping scenarios					Vegetation	Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings - U.S. Department of Energy	Willow, black					
							55 215	Vegetation and landscaping scenarios												

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Appendix C: Carbon's emission reports of the standard path with pavement alternatives

Carbon report - Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile			P7		
				969	**1**	**925**		**Construction works**												
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compaction with asphalt roller compactor, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				295	**0**	**295**		**Pre-Construction Work**												
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density			P3		
A1-A3a	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	17 677	3	17 451	0	Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	1 315	0	1 315		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	0	0	0		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
B4-B5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	20 385	4	20 159		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
C1-C4	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	1 393	0	1 393		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
D	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	−3 392	−2	−3 392		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix			P3		
				26 547	**3**	**26 322**		**Pavings and surfaces**												

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Carbon report - Warm asphalt Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
				969	**1**	**925**		**Construction works**							
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compaction with asphalt roller compactor, per m2
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2
				295	**0**	**295**		**Pre-Construction Work**							
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density
A1-A3a	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	17 677	3	17 451	0	Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
A1-A3a	Granular fill, UK average	495	m3	8 870	0	8 870	0	Pavings and surfaces	Well-graded type 1		As building		Sand, soil and gravel	The Structural	Granular fill, UK average

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
	(IStructE) ?								granular fill 150mm					Carbon Tool, v2.0	
A4-full	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	1 315	0	1 315		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	0	0	0		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
B4-B5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	20 385	4	20 159		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
C1-C4	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	1 393	0	1 393		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
D	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	−3 392	−2	−3 392		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix
				26 547	**3**	**26 322**		**Pavings and surfaces**							

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Carbon report - OPEN GRADED ASPHALT - Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
				969	**1**	**925**		**Construction works**							
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compacti with asph roller compacto per m2
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clear per m2
				295	**0**	**295**		**Pre-Construction Work**							
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacte dry densi
A1-A3a	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	120	m3	11 077	3	10 680	0	Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt concrete) base cou hot mix

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A1-A3a	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	6 271	0	6 266	900	Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
A4-full	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	120	m3	851	0	851		Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt concrete) base cou hot mix
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A4-full	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	1 053	0	1 053		Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
A5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	120	m3	0	0	0		Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt concrete) base cou hot mix
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A5	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	0	0	0		Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
B4-B5	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	120	m3	12 830	3	12 432		Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt concrete) base cou hot mix
B4-B5	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	16 197	0	16 187		Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
C1-C4	Asphalt pavement (asphalt concrete) base course, hot mix, 23... ?	120	m3	902	0	902		Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt concrete) base cou hot mix
C1-C4	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	774	0	774		Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
D	Asphalt pavement (asphalt	120	m3	−2 195	−2	−2 195		Pavings and surfaces			30		Asphalt	One Click LCA	Asphalt pavemen (asphalt

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
	concrete) base course, hot mix, 23... ?														concrete) base cou hot mix
D	Asphalt bound gravel, with penetration bitumen, Fixed plant,... ?	240 000	kg	−2 827	−2	−2 827		Pavings and surfaces			20		Asphalt	EPD Asfaltsprodukter tillverkade i fasta verk - AG, ABb, ABT, ABS	Asphalt bound gr with penetrati bitumen
				26 218	**3**	**25 816**	**900**	**Pavings and surfaces**							

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Carbon report - PERMEABLE BLOCKS - Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
				969	**1**	**925**		**Construction works**							
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2
				126	**0**	**126**		**Pre-Construction Work**							
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density
A1-A3a	Paving blocks, 2344 kg/m3, Plaza Paving: Flags; Standard + P... ?	421,9	ton	41	0	17	0	Pavings and surfaces			As building		Other precast concrete products	EPD Plaza Paving: Flags; Standard + Permeable Block Paving.	Paving blocks
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A1-A3a	Sand (0…8 mm), loose dry density,	3 000	m2	325	0	325	0	Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
	1555 kg/m3 ?														
A4-full	Paving blocks, 2344 kg/m3, Plaza Paving: Flags; Standard + P... ?	421,9	ton	672	0	672		Pavings and surfaces			As building		Other precast concrete products	EPD Plaza Paving: Flags; Standard + Permeable Block Paving.	Paving blocks
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A4-full	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	3 000	m2	426	0	426		Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density
A5	Paving blocks, 2344 kg/m3, Plaza Paving: Flags; Standard + P... ?	421,9	ton	0	0	0		Pavings and surfaces			As building		Other precast concrete products	EPD Plaza Paving: Flags; Standard + Permeable Block Paving.	Paving blocks
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A5	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	3 000	m2	0	0	0		Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density
C1-C4	Paving blocks, 2344 kg/m3, Plaza Paving: Flags; Standard + P... ?	421,9	ton	1 380	0	1 380		Pavings and surfaces			As building		Other precast concrete products	EPD Plaza Paving: Flags; Standard + Permeable Block Paving.	Paving blocks
D	Paving blocks, 2344 kg/m3, Plaza Paving: Flags; Standard + P... ?	421,9	ton	−18 603	−13	−18 603		Pavings and surfaces			As building		Other precast concrete products	EPD Plaza Paving: Flags; Standard + Permeable Block Paving.	Paving blocks
				9 236	**0**	**9 213**		**Pavings and surfaces**							

Carbon report - CLAY PAVER Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropy geotextile
				969	**1**	**925**		**Construction works**							
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clear per m2
				126	**0**	**126**		**Pre-Construction Work**							
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacte dry densi
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A1-A3a	Sand, compacted dry density, 1682 kg/m3 ?	151 380	kg	351	0	351	0	Pavings and surfaces	3 cm		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand, compacte dry densi
A1-A3a	Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (... ?	306 000	kg	76 460	0	76 427	0	Pavings and surfaces	6 cm		As building		Brick, common clay brick	Oekobau.dat 2017-I, EPD Vormauerziegel, Pflasterziegel und Riemchen Bauen mit Backstein	Facing br clay pave and brick slips

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
														Zweischalige Wand Marketing e. V.	
A1-A3a	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	960 000	kg	2 409	0	2 402	0	Pavings and surfaces	20 cm		As building		Sand, soil and gravel	One Click LCA	Aggregat (crushed gravel), generic, bulk dens
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A4-full	Sand, compacted dry density, 1682 kg/m3 ?	151 380	kg	461	0	461		Pavings and surfaces	3 cm		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand, compacte dry densi
A4-full	Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (... ?	306 000	kg	487	0	487		Pavings and surfaces	6 cm		As building		Brick, common clay brick	Oekobau.dat 2017-I, EPD Vormauerziegel, Pflasterziegel und Riemchen Bauen mit Backstein Zweischalige Wand Marketing e. V.	Facing br clay pave and brick slips
A4-full	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	960 000	kg	2 921	0	2 921		Pavings and surfaces	20 cm		As building		Sand, soil and gravel	One Click LCA	Aggregat (crushed gravel), generic, bulk dens
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces			As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular UK avera
A5	Sand, compacted dry density, 1682 kg/m3 ?	151 380	kg	0	0	0		Pavings and surfaces	3 cm		As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand, compacte dry densi
A5	Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (... ?	306 000	kg	3 847	0	3 846		Pavings and surfaces	6 cm		As building		Brick, common clay brick	Oekobau.dat 2017-I, EPD Vormauerziegel, Pflasterziegel und Riemchen Bauen mit Backstein Zweischalige Wand Marketing e. V.	Facing br clay pave and brick slips
A5	Aggregate (crushed gravel), generic, dry bulk density, 1600 ... ?	960 000	kg	0	0	0		Pavings and surfaces	20 cm		As building		Sand, soil and gravel	One Click LCA	Aggregat (crushed gravel), generic, bulk dens
C1-C4	Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (... ?	306 000	kg	1 001	0	1 001		Pavings and surfaces	6 cm		As building		Brick, common clay brick	Oekobau.dat 2017-I, EPD Vormauerziegel, Pflasterziegel und Riemchen Bauen mit Backstein Zweischalige Wand Marketing e. V.	Facing br clay pave and brick slips
D	Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (... ?	306 000	kg	−1 261	−1	−1 261		Pavings and surfaces	6 cm		As building		Brick, common clay brick	Oekobau.dat 2017-I, EPD Vormauerziegel, Pflasterziegel und Riemchen Bauen mit Backstein Zweischalige	Facing br clay pave and brick slips

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
														Wand Marketing e. V.	
				88 091		**88 050**		**Pavings and surfaces**							

Carbon report - CONCRETE FLAGS - Standard 1km path

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile
				969	**1**	**925**		**Construction works**							
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2
				126	**0**	**126**		**Pre-Construction Work**							
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density
A1-A3a	Concrete flag paving unit from premium wet pressed process, ... ?	150	m3	2 145	1	2 130	0	Pavings and surfaces	Concrete Flags 50mm		As building		Other precast concrete products	EPD Concrete Flag Paving - Premium Wet Pressed Marshalls Plc	Concrete flag paving unit from premium wet pressed process
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A1-A3a	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	3 000	m2	271	0	271	0	Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name
A4-full	Concrete flag paving unit from premium wet pressed process, ... ?	150	m3	28	0	28		Pavings and surfaces	Concrete Flags 50mm		As building		Other precast concrete products	EPD Concrete Flag Paving - Premium Wet Pressed Marshalls Plc	Concrete flag paving unit from premium wet pressed process
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A4-full	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	3 000	m2	355	0	355		Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density
A5	Concrete flag paving unit from premium wet pressed process, ... ?	150	m3	0	0	0		Pavings and surfaces	Concrete Flags 50mm		As building		Other precast concrete products	EPD Concrete Flag Paving - Premium Wet Pressed Marshalls Plc	Concrete flag paving unit from premium wet pressed process
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Base		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average
A5	Sand (0…8 mm), loose dry density, 1555 kg/m3 ?	3 000	m2	0	0	0		Pavings and surfaces			As building		Sand, soil and gravel	LCA inventory for sand quarry operation	Sand (0…8 mm), loose dry density
C1-C4	Concrete flag paving unit from premium wet pressed process, ... ?	150	m3	58	0	58		Pavings and surfaces	Concrete Flags 50mm		As building		Other precast concrete products	EPD Concrete Flag Paving - Premium Wet Pressed Marshalls Plc	Concrete flag paving unit from premium wet pressed process
D	Concrete flag paving unit from premium wet pressed process, ... ?	150	m3	−780	−1	−780		Pavings and surfaces	Concrete Flags 50mm		As building		Other precast concrete products	EPD Concrete Flag Paving - Premium Wet Pressed Marshalls Plc	Concrete flag paving unit from premium wet pressed process
				11 286	**1**	**11 271**		**Pavings and surfaces**							

Appendix D: Carbon's emission reports of the standard path with recycled materials and different distances

Case 1 – No asphalt recycled content, 15km distance

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
				969	**1**	**925**		**Construction works**												
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compaction with asphalt roller compactor, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				295	**0**	**295**		**Pre-Construction Work**												
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density			P3		
A1-A3a	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	17 677	3	17 451	0	Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	474	0	474		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	0	0	0		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Well-graded type 1 granular fill 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
B4-B5	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	19 544	3	19 319		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
C1-C4	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	1 393	0	1 393		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
D	Asphalt concrete surface course, hot mix, 10 mm nominal aggr... ?	432	ton	−3 392	−2	−3 392		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	One Click LCA	Asphalt concrete surface course, hot mix		30	P3		
				26 547	**3**	**26 322**		**Pavings and surfaces**												

Case 2 – 15% asphalt recycled content, 60km distance

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
				969	**1**	**925**		**Construction works**												
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compaction with asphalt roller compactor, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				295	**0**	**295**		**Pre-Construction Work**												
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density			P3		
A1-A3a	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	10 251	16	0	0	Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	1 896	0	1 896		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	0	0	0		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
B4-B5	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	13 540	16	3 289		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
C1-C4	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	1 393	0	1 393		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
D	Asphalt mixtures for paving, warm mix, 15% RAP (actual annua... ?	432	ton	−2 883	−2	−2 883		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Borlänge asphalt plant – Gustafs	Asphalt mixtures for paving, warm mix		30	P3		
				19 121	**16**	**8 870**		**Pavings and surfaces**												

Case 3 – 37% asphalt recycled content, 120km distance

Infrastructure carbon, EN 17472

Section	Resource	User input	Unit	Global Warming Potential fossil-A2 kg CO_2e	Global Warming Potential, LULUC kg CO_2e	Global warming kg CO_2e	Biogenic carbon storage kg CO_2e bio	Question	Comment	Cost item	Service life	Construction	Resource type	Datasource	Name	Transformation process	Years of replacement	uniClass	class	Imported label
A1-A3a	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	969	1	925	0	Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A4-full	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1	0	1		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
A5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	172	0	168		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
B4-B5	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	1 721	1	1 677		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
C1-C4	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	751	0	751		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
D	Woven polypropylene geotextile, 0.11 kg/m2 (One Click LCA) ?	3 300	m2	−1 208	0	−1 141		Construction works	Geotextile		30		Plastic membranes	One Click LCA	Woven polypropylene geotextile		30	P7		
				969	**1**	**925**		**Construction works**												
A0	Asphalt compaction with asphalt roller compactor, per m2, P=... ?	3 000	m2	170	0	170	0	Pre-Construction Work					Machine operation	One Click LCA	Asphalt compaction with asphalt roller compactor, per m2					
A0	Site clearing, per m2, with medium power bulldozer (60-330 k... ?	3 300	m2	126	0	126	0	Pre-Construction Work					Machine operation	One Click LCA	Site clearing, per m2					
				295	**0**	**295**		**Pre-Construction Work**												
A4-full	Soil, compacted dry density, 1650 kg/m3 ?	300	m3	1 506	0	1 506		Removed masses	Excavated and removed masses (1m from each side of the path)		As building		Sand, soil and gravel	LCA for site construction products, OneClickLCA 2012	Soil, compacted dry density			P3		
A1-A3a	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	7 227	10	0	0	Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
A1-A3a	Granular fill, UK average (IStructE) ?	495	m3	8 870	0	8 870	0	Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A4-full	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	3 792	0	3 792		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
A4-full	Granular fill, UK average (IStructE) ?	495	m3	3 374	0	3 374		Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
A5	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	0	0	0		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
A5	Granular fill, UK average (IStructE) ?	495	m3	0	0	0		Pavings and surfaces	Sub Base 150mm		As building		Sand, soil and gravel	The Structural Carbon Tool, v2.0	Granular fill, UK average			P3		
B4-B5	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	12 412	10	5 186		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
C1-C4	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	1 393	0	1 393		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
D	Asphalt mixtures for paving, warm mix, 37% RAP (actual annua... ?	432	ton	−2 137	−2	−2 137		Pavings and surfaces	Base/Surface 60mm 2400kg/m3		30		Asphalt	EPD for asphalt mixtures from Halmstad asphalt plant – Biskopstorp	Asphalt mixtures for paving, warm mix		30	P3		
				16 097	**10**	**8 870**		**Pavings and surfaces**												