



Sustainable Construction, Maintenance and Operations

Task Element 2 – Summary of Sustainable Construction Review

By

C4S at TRL Limited and Halcrow

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Executive summary

This document is a summary of 'state of the art' review on sustainable construction undertaken through the Being Responsible Owner (BRO) portfolio on Sustainable Construction, Maintenance and Operations. This review has identified relevant International, European and UK Strategies, Policies, Legislation and best practice in relation to all aspects of sustainable construction and sustainable road construction. This review aimed to identify gaps in the Highways Agency (HA)'s current strategies, policy and guidance to inform HA policy and strategy makers, those charged with implementing all aspects of the Sustainable Development Action Plan (SDAP) and those responsible for procurement. Report includes recommendations as to how the HA might bridge these gaps.

A state of art review has been concluded to identify and document legislative and strategic drivers applicable to sustainable construction and sustainable road construction in particular at an international, European and UK level. This review has also identified best practice in terms of legislation, legislation and policy implementation and has also identified sustainable road construction techniques.

An assessment of internal HA sustainability documents has been conducted to ascertain where gaps exist within its policies and strategies in relation to delivering current and future strategic, legislative and policy requirements and obligations. In-order to inform this gap analysis, a high level comparison has been made of relevant legislative and strategic drivers in relation to documentation and operations of the Highways Agency. Gaps exist within the HA's policy and strategies in terms of resource and natural resource management, waste management, energy usage, procurement, climate change and adapting to climate change and also sustainable communities and the people agenda as a whole. The significance of these subject areas in terms of current and future obligations has been highlighted to demonstrate their importance to the HA. Overall, it has been concluded that gaps exist within the HA in term of ensuring and demonstrating environmental compliance. Gaps exist also when introducing processes to implement change to deliver sustainable assets whether it is at a strategic or legislative level.

The state of art review has highlighted an ever increasing number of current and future strategic drivers and legislative drivers which are intended to address every aspect of sustainability, the intention being for sustainability to be fully integrated within all aspects of construction. Of course, these drivers identify statutory and non-statutory targets which must or should be reached in-order to achieve the Governments overall aims on sustainable development, and the Highways Agency has its role to play within this.

1 Introduction

What is sustainable construction?

"Sustainable construction is the application of the principles of sustainable development to the construction sector" (AggRegain 2007).

Sustainable construction is one of many subsets of sustainable development and refers to the creation, construction, maintenance and operation of infrastructure and buildings which helps shape communities in a way that sustains the environment, generates long term wealth and enhances the quality of life. Sustainable construction also extends to subjects on the periphery of sustainability but which are directly applicable and contribute to the overall aims of sustainable development such as procurement, design and innovation.

Why is sustainable construction important and why is it important to the Highways Agency?

In order to achieve the Governments policies and principles in relation to sustainable development, the construction industry must embrace and implement the principles of sustainability, we have to therefore change the way in which we build, operate and maintain infrastructure.

Embracing sustainable construction along with current and future strategic and legislative targets and requirements in relation to each aspect of sustainability, will assist the HA to meet its own sustainability aims and objectives. The Highways Agency will also be able to demonstrate its contribution towards the Governments principles and policies in relation to overall sustainable development and demonstrate environmental compliance to the regulators.

In comparison to other industry sectors, the construction industry is vast. Its input into the UK economy every year is in the region of £100 billion which accounts for 8% of the UK's GDP and it employs some 2.1 million people. However, the buildings and structures for which the construction industry is responsible for constructing are directly responsible for almost half of all UK carbon emissions, half the UK's total water consumption, produce one third of all landfilled waste and use 13% of materials resources. This therefore demonstrates the enormous role the construction industry has as a whole, including the Highways Agency, in relation to introducing and developing the principles of sustainability across the sector and through working with its service providers. Organisations within the public sector are responsible for procuring 40% of non-domestic construction and therefore have a role to play in relation to influencing the mainstream integration of sustainability within the built environment.

The Highways Agency SDAP has identified where they consider its business impacts against the UK sustainability priorities. Material and resource use

features heavily in these impacts. Road construction, maintenance and operational activities consume large quantities of resources. Between 20,000 and 60,000 tonnes of aggregate is used to construct just one mile of motorway. Over 90% of non-energy minerals extracted in Great Britain are used to supply the construction industry. The construction industry and road sector are therefore large consumers of natural resources and as such have a role to play in reducing resource use and increasing the re-use and recycling of materials.

2 Sustainable Construction – International, EU and UK Perspectives

This section shows how certain countries have chosen to deliver aspects of sustainable construction and highlights best practice. Sustainable construction has been reviewed by means of internet searches, literature reviews and through various contacts within both TRL and Halcrow.

2.1 International

Sustainable construction legislation, policies and construction methods have been reviewed in New Zealand, Australia, Japan, South Africa, China, Hong Kong and the USA. These countries were chosen to reflect a cross-section of the world and because of their close similarities with the UK. This study has included identification and a review of relevant legislative and strategic drivers. No international legislative or strategic drivers were identified which impact on UK sustainable construction or sustainable road construction directly, however, international best practice was identified and examples are shown below.

Japan has gone further compared to the UK and has chosen to legislate sustainable consumption as opposed to merely imposing a strategy to facilitate sustainable resource and waste management. The Japanese Law for the Promotion of Effective Utilization of Resources (2000) aims to establish a sound material-cycle economic system, which requires the 3Rs (reduce, reuse and recycle) to be implemented at the design stage and right through to the collection and recycling of used products. Japan has a rather novel research programme into materials for use in pavement construction. Alongside materials which have been trialled and tested in the UK such as glass and tyres, the Japanese have been trialling lumber chips, shells, tiles, earthen wares (pottery) and porcelain.

New Zealand has a joined up holistic approach to its environmental legislation and recognises public engagement as being fundamental to achieving sustainability goals. New Zealand's Resource Management Act (RMA) 1991 sets out how the country should manage its whole environment and encourages citizens to plan for their own future. The RMA is focused towards managing the effects that man's activities have on the environment thereby ensuring the environment doesn't suffer as a result.

2.2 European

Sustainable construction has been reviewed in 29 countries across Europe. This has included the identification and review of relevant legislative and strategic drivers, and best practice. Of those countries reviewed, the Netherlands has the most advanced and holistic approach to legislation which encourages and promotes the use of secondary and recycled materials, this is detailed below.

In the Netherlands, the government's policy on the use of recycled materials is advanced. The Dutch policy on economic growth and the environment is based on the principle that economic growth should occur only if pollution declines at the same time. It's a long term process that must involve all elements of society. For the Dutch sustainable development involves three main policies from an environmental perspective: the Waste Materials Policy, the Soil Protection Policy, and the Surface Mineral Policy. The Waste Materials Policy is based on the hierarchy of waste prevention, recycling, burning, and landfill. Many of the policy objectives within these policies are supported by legislation. Among the provisions of the Soil Protection Policy is the concept of permitting a marginal amount of contaminants in the soil when using secondary materials. The objectives of the Surface Mineral Policy are to encourage the conservation of raw materials, stimulate the use of secondary materials, support the use of renewable raw materials, and ensure that adequate supplies of raw materials are available for construction.

2.3 UK

In the UK there are several strategic and legislative drivers which act as vehicles for delivering the principles, policies and targets of sustainable development. However, until 2007 and the release of the Government's draft Sustainable Construction Strategy, there was no single strategy or piece of legislation which took a holistic approach to the implementation and integration of sustainable development within the construction context. Many organisations within the UK's construction industry have however facilitated the inclusion of sustainability within their operations through their corporate and social responsibility.

3 The Road Construction Context – International, EU and UK Perspectives

This section shows how certain countries have chosen to deliver aspects of sustainable road construction and highlights best practice.

3.1 International

Sustainable construction in the context of road construction, maintenance and operations has been reviewed in New Zealand, Australia, Japan, South Africa, China, Hong Kong and the USA. The information has been obtained as a result of internet searches, literature reviews and personal contacts in the various countries. New Zealand has been identified as having a holistic and integrated approach to sustainable transport.

The New Zealand Transport Strategy (NZTS) vision is that “By 2010 New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system”. In 2008 the Government will publish an update of the NZTS which will:

- provide direction for the transport sector;
- translate that direction into high level targets;
- provide clearer guideline for decision making;
- Contain an action plan.

New Zealand takes a holistic and integrated approach to sustainability in relation to their transport strategies. The principles of the current NZTS are:

Sustainability: Ensuring that current and future transport is underpinned by the principles of sustainability and integration, transport policy will need to focus on improving the transport system in ways that enhance economic, social and environmental well-being, and that promote resilience and flexibility.

Integration: Transport policy will help create an efficient and integrated mix of transport modes. To facilitate integration, co-operation and collaboration between stakeholders will need to be encouraged.

Safety: Ensuring that transport is underpinned by the principles of safety and responsiveness, policy will need to ensure high standards of health, safety and personal security for all people, including users, workers, and operators.

Responsiveness: Recognising the diverse needs of urban and rural communities. Those who use transport, and those who are affected by it, will need to be encouraged to participate in transport policy development.

Case Study: Long-term pavement performance in New Zealand
In 2000, New Zealand embarked on a Long-Term Pavement Performance (LTTP) programme with the establishment of the 63 LTTP sites on the State Highway network. These sections were chosen across New Zealand based on a design matrix that allowed for expected ranges of climatic and soil conditions, traffic volumes, the strength of the pavements and its age / condition to be considered. The programme will enable engineers to refine and tailor their maintenance techniques and road designs to suit the various climates found within the country.

3.2 European

Sustainable construction in the context of road construction, maintenance and operation has been reviewed in 29 European Countries. The information has been obtained as a result of internet searches and literature reviews. Of those countries reviewed, Denmark was identified as having a strong history of the use of secondary recycled materials in road construction, this is detailed below.

Denmark has a strong record for the use of recycled materials in road construction largely due to the government supporting regulation on waste management and its driving role in promoting recycling. The Danish government supports road contractors, producers of waste materials, and suppliers to work together to encourage the use of recycled materials. The government's general policy is that recycling should be done at the highest level that is technically and economically feasible. The Danish approach whereby the Government are leading from the front and by example often encourages such activities to be regarded as best practice within the relevant section of population. Danish waste legislation actively encourages the use of secondary and recycled materials in road building. In the UK, waste legislation is often seen as a hindrance to recycling activities due to its rigid nature and often impracticable implementation.

3.3 UK

Sustainable construction in the context of road construction, maintenance and operation has been reviewed in the UK by means of internet searches, literature reviews and through various contacts both within TRL and Halcrow.

With the possible exception of the DfT's strategy 'Towards a Sustainable Transport System – Supporting economic growth in a low carbon world' there are no strategies which expressly detail the application of sustainable construction within the road construction context. This DfT document is not focussed on vehicular traffic and has a strong focus toward highways users and health and safety. Notwithstanding the before mentioned, one such piece of guidance exists which should be mentioned as it is an example of best practice. Sustainable Highways (Draft May 2007 – produced by TRL) has been produced to provide relevant succinct guidance to Local Authority highway

and materials engineers giving a range of techniques and sustainable materials which should be used for footway and highway maintenance and also for new construction. The document divides construction and highway maintenance of highways works into six applications; surfacing, pavement reconstruction, edging, footways and cycle tracks, capping and sub-base and earthworks. For each of these applications a number of actions have been identified which are grouped under milestones. These actions include the use of different materials and associated maintenance techniques and also the reuse of waste.

Waste and Resources Action Programme (WRAP)

WRAP have developed a number of best practice guidance documents with regards to the construction and maintenance of roads using recycled/secondary materials. These documents include site waste management guidance documents for site/environmental managers, site foremen, and site labourers (WRAP, 2008a). Additionally, guidance documents relating to achieving good practice in waste management and minimisation have been developed (WRAP, 2008b).

In addition to the documents mentioned above, WRAP has developed an Opportunities Module on their dedicated Aggregates website, AggRegain. This Module aims to indicate where recycled and secondary aggregates can be used in construction applications (WRAP, 2007) including concrete roads, bituminous road construction, hydraulically bound road construction and deep foundations.

The Case Study section within the AggRegain website displays a number of best practice studies in relation to road infrastructure (WRAP, 2007b). These include the following:

- A38: Ex-situ recycling of a trunk road in South Devon;
- Recycled Asphalt in Footway Works on B3047 at Martyr Worthy;
- Recycling in highway construction and maintenance enabled by partnering in Staffordshire;
- Ferrosilicate slag from zinc production as aggregates bound in bituminous mixes; and,
- Use of recycled aggregates and in-situ stabilisation on the A120 Stansted to Braintree Bypass.

4 Highways Agency's Own initiatives (policies and strategies)

In December 2003, the HA released 'Building Better Roads: Towards Sustainable Construction', this document highlighted and explained what the HA are doing in-order to promote sustainability through the construction and maintenance of the strategic road network in England. The document demonstrated why the HA wanted to develop a more sustainable approach to its activities and how it was looking to improve its performance, and how it is improving in the following key areas; management of natural resources, reducing energy consumption, reducing emissions, landscape, townscape and heritage, biodiversity, respect for people and partnerships to better business.

Since the publication of 'Building Better Roads', the HA has clearly made progress towards the integration of sustainability throughout its operations. The introduction of the Sustainable Development Action Plan (SDAP) in June 2007 was released in response to "Securing the Future" and mirrors the Governments sustainable development priorities and guiding principles. Within the SDAP the HA has identified where it believes its business actions impact against the UK sustainability priorities. It is the SDAP which sets out the actions for how the HA Business Plan targets can be delivered in a more sustainable manner. This first SDAP is also a tool which is aimed at engaging and involving HA staff and partners throughout the supply chain.

The HA's Business Plan for 2007-2008 'Helping you with your journey', not only details how HA intends to help its customers with their journeys during this period, it gives an indication of the HA's longer term priorities. Within the introduction to the plan is a section which discusses sustainable development and details how through the SDAP, the HA will be able to develop and implement sustainable ways of working across all its business activities. The business plan is very much, along with supplementary documents, the vehicle for which the HA delivers sustainability to its business activities. Annex C of the 2007-2008 business plan contains the HA's KPI (key Performance Indicators) for this period. A section of these KPI's is dedicated to 'respecting the environment', this section does not however align with the areas where the HA itself has identified its activities impact against sustainability as identified within the SDAP but provides high level targets for 2007-2008 in relation to air quality, biodiversity, landscape, noise, water quality and overall environmental performance. However, it is clearly apparent that there is a lack of focus on material use and waste generation.

'Towards a balance with nature 1999' remains the HA's Environment Strategic Plan. This plan covers areas of Maintenance, Operation and Improvement within the delivery areas of the Governments criteria of safety, environment, economy, accessibility and integration. The plan identifies 10 areas for action and for each area there is an objective and actions which may help achieve these objectives. For instance, within waste management, the objective is to 'develop techniques which will ensure that trunk roads are managed in the most sustainable manner, by conserving existing resource and by generating less waste and by removing barriers which exist surrounding the use of

secondary and waste materials'. No compliance or performance targets are given within this document to help monitor progress of this aim.

Volumes 10 and 11 of DMRB give advice on Environment Design and Management and Environment Assessment. The methodology is intended to provide a consistent system for defining and achieving environment objectives, which may be policy or route, or route specific objectives. All volumes of DMRB are supplemented by subject specific IANs (interim advice notes).

Volume 7 of the Design Manual for Roads and for Bridges (DMRB) is to provide an instruction manual with regard to pavement assessment and maintenance. Of great importance is Part 2 of Volume 7 which provides specific guidance in relation to the use and conservation of secondary and recycled materials. It gives specific guidance in relation to the secondary and recycled materials which are currently permitted for use in the Specification (Manual Contract Documents for Highways Works). The Specification for Highway Works (MCHW1) supports the use of vast range of waste, reclaimed and recycled materials within the construction and maintenance of roads whilst ensuring the materials are fit for purpose.

The HAs 1999 report 'Greening Operations' is a policy statement and action plan which sets out how the HA can contribute to greening its operations which are not network based such as facilities management, office servers and procurement.

Both the Routine and Winter Service Code and the Highways Agency Network Management Manual touch on areas of sustainability in a cursory manner. These subjects include biodiversity, flooding (links to climate change and SUDS), the use of environmental barriers (for noise reduction and visual effect), waste within the context of street cleansing residues (sweepings, litter, refuse etc) and pollution prevention within the context of pollution prevention and Environmental Protection Act 1990.

The HA also have the following documents which look to address areas normally considered within the context of sustainability;

- The HA Disability Equality and Duty Action Plan 2006-2009 – This sets out the HAs commitment to its customers in terms of putting them first and ensuring its own workforce is representative of its customer base.
- The role of HA in Local Air Quality Management (LAQM) 2003 – This document has three main purposes; it introduces the HA and sets out the process and contracts; it describes how the HA can work in partnership with LAs with an aim of producing AQS; and it introduces how emissions and concentrations can be addressed by proposals.

4.1 Highways Agency's own Implementation and best practices

The Highways Agency has commissioned a number of research projects and studies in relation to numerous sustainability aspects of road construction, maintenance and operations. An example is given below in relation to identifying and reducing CO₂ emissions.

Carbon calculation of the construction, maintenance and operation of the Scottish trunk road network

C4S at TRL staff have worked with the Scottish Executive to quantify the carbon sequestration potential of its roadside estate and advise on possible management practices to maximise the offset potential. In order to determine the potential, C4S at TRL undertook a study to determine the extent of carbon emissions resulting from the construction, maintenance and operation of the Scottish trunk road network. The report then went on to establish the potential to offset these emissions using the soft estate associated with the network. C4S at TRL also developed a tool to allow the estimation of an emissions module for linking with traffic micro-simulation models, including CO₂ and carbon.

The Quality Protocol for the Production of aggregates from inert waste

This document was published by WRAP and has been produced in collaboration between the Quarry Production Association, Highways Agency and WRAP. The document puts in place a formalised quality procedure for the production of aggregates from recovered inert materials. The document itself has two purposes;

- It helps to identify the point as which inert waste has been recovered for use as aggregate and therefore is no longer classified as waste, and;
- To provide assurances that recovered aggregates conform to the same standards and are therefore fit for purpose.

5 HA Service providers initiatives (policies and strategies)

For the state of art review the sustainability policies of strategies of Tarmac, A-One Integrated Highway Services, Carillion, Atkins, Costain Group PLC, Alfred McAlpine and Balfour Beatty have been reviewed. The integration and implementation of sustainability within these organisations varies enormously. The headlines in terms of best practice from these companies are given below.

5.1 Tarmac

The latest achievements of Tarmac are detailed in 'Constructive Thinking, Report to Society 2006'. This document not only details how Tarmac are performing to date against their key areas of safety, health, environment and the community but also sets out future environment performance targets which include; reducing energy consumption by 15%, reduce waste sent to landfill by 5% by 2010, introduce site-specific BAPs at all active mineral extraction sites, reduce portal water consumption and introduce defined policies in relation to investment and diversity in the workplace.

5.2 A-one Integrated Highway Services

Responsible for Area 14 and has a series of annual and monthly APIs (Area Performance Indicators) which are broken down into 15 performance areas. There is a very strong focus on waste reduction and recycling within A-one as well as comprehensive waste data gathering. The overall average waste recycling figure across the 19 recorded waste streams was 76% which far exceeded the 50% target given in the API.

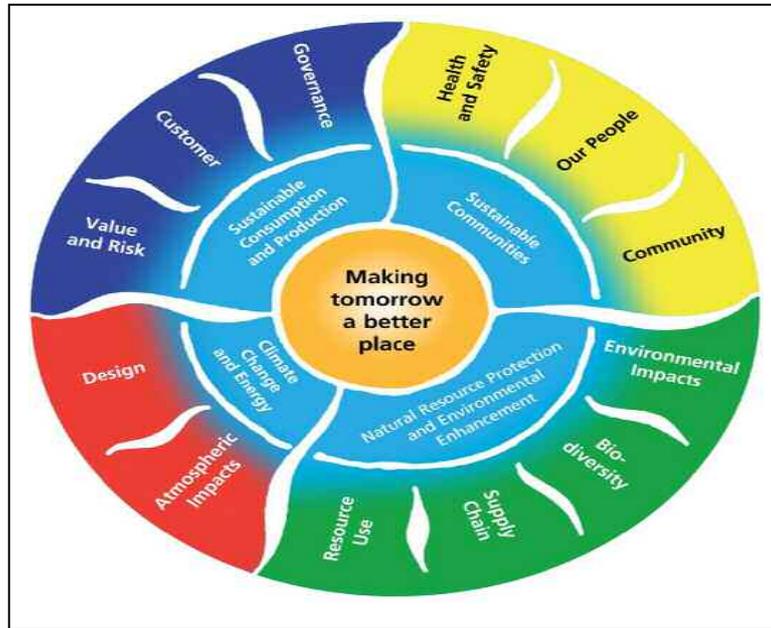
5.3 Carillion

Like most companies, Carillion deals with sustainability through CSR (Corporate Social Responsibility). Sustainability is built into all aspects of Carillion's business activities. Carillion's sustainability strategy is aligned to the Governments sustainable development principles and policies and within each of the four core priority areas, Carillion have 12 impacts areas which each has its own developed policies for implementation, measuring progress and targets. In 2000 Carillion launched its 'Sun Diagram'¹ which is shown below in figure 1 and which formally aligns its sustainability strategy to its operations including business processes, decision-making and KPIs. The Sun Diagram not only engrains sustainability within Carillion as a whole but it also ensures the company take a holistic approach to sustainability.

1

http://www.carillionplc.com/sustain_2005/assets/documents/new_sun_diagram_2006.pdf

Figure 1: Carillion Sun Diagram



5.4 Balfour Beatty

Sustainability appears incorporated in all aspect of their business. The way in which Balfour Beatty presents its sustainability objectives and aims is clear, concise and it is readily apparent how the performance targets are formulated and achieved. The company splits its corporate responsibility into 5 areas; safety, health, environment, people and communities. The company has set clearly prescribed numerical targets in each of these fives areas which include, reducing accidents, undertaking occupational health screening, reducing its contribution to global warning, increasing the number of full time employees, investing in workforce training and raising money for charity.

6 Implementation and best practice

As part of the state of art review, sustainability best practice and implementation has been identified and reviewed within Tarmac, A-One Integrated Highway Services, Carillion, Atkins, Costain Group PLC, Alfred McAlpine and Balfour Beatty. Examples of best practice and implementation are given below.

Cement Manufacture – Fossil Fuel Replacement (Source: Tarmac)

In accordance with the Environment Agency's Substitute Fuels Protocol, Tarmac has been trialling the use of waste tyres as an alternative fuel feed to traditional fossil fuels at its Tunstead Cement Plant. With the possibility of replacing 25% of its normal fossil fuel feed with waste tyres this type of operations has the potential to offer many benefits from providing a recovery route for the problematic tyre waste stream and job creation.

Oxford John Radcliffe Hospital (Source: Carillion)

In 2006 Carillion completed the construction of the John Radcliffe Hospital, Oxford.

Highlights of this project include the following:

- More than 90% of waste has been diverted from landfill
- Introduction of a green transport plan for site workers – car sharing schemes have reduced carbon dioxide emissions by at least one fifth
- 60% of the flooring selected for the project is linoleum that was manufactured from renewable raw materials and is biodegradable. This will enhance replacement life cycles from the typical 10-15 years for vinyl to 25 years.
- Ceiling tiles have been selected, consisting of about 30% post-industrial waste that does not require metal fixing clips. This saved approximately £60k and maintenance will be easier for the estates team.
- A close working relationship was formed with the paint supplier who agreed to supply paint in 10 litre metal cans. This eliminated the need for Polyethylene Terephthalate (PET) plastic cans, which cannot be recycled after paint contamination. All metal tins were therefore recycled.
- In addition to this, the project team worked with the local community and sponsored the local wildlife group.

The Porth Relief Road, Wales (Figure 2) (Source: Costain)

This project involved the construction of a 90m span bowstring Rheola Bridge in Porth town centre, 8 kms of new and improved carriageway, 10 other bridges, 15 retaining walls and 16 culverted watercourses. The aims of the project were to improve the quality of life for the residents of 2,500 homes through increased accessibility, contribute towards economic regeneration and to improve routes for pedestrians and cyclists.

Highlights of this scheme:

- Around 96% of waste by volume was reused or recycled; overall the project avoided the disposal of 100,000m³ off site and the associated 10,000 truck movements which would have been required to remove the material.
- 46 local 'economically inactive' people were recruited and trained for long term employment. The original target was only 30 people.
- The project was delivered with a 33% cost saving on the target price
- Early Contractor Involvement (ECI) and the use of the New Engineering Contract was central to procurement and to the success of the project
- The scheme highlighted the need and importance for early consultation with stakeholders and community engagement.

Figure 1: Porth Relief Road as seen from Rheola Bridge



Sustainable Development Research Network

<http://www.sd-research.org.uk/>

The Sustainable Development Research Network (SDRN) aims to contribute to sustainable development in the UK by encouraging the better use of evidence and research in policy-making. It is an initiative funded by DEFRA and the Department for Transport, and is coordinated by the Policy Studies Institute in London.

SDRN's specific objectives are to:

- Facilitate the provision of research and evidence to policymakers
- Engage government policymakers, scientists and members of the research community
- Promote sustainable development in the research and academic communities
- Work with funding bodies to encourage relevant research
- Advise the Defra Sustainable Development Unit on SD research issues

The SDRN have four "Research into Practice" workstreams, one of which focuses on Sustainable Transport. This work stream aims to explore the problems associated with transport including:

- Air quality and emissions, Social, economic and environmental impacts, Noise, Congestion, Social cohesion, and Community severance and accessibility.

Another of these work streams focuses upon Engineering and Sustainable Development. This work stream will work with the Royal Academy of Engineering Academy and the professional engineering institutions to explore how engineers and, natural and social scientists can work together to put sustainable development into practice.

7 What are gaps in HA policies and strategies

Overall there is a notable absence of policies and strategies in relation to the delivery of sustainability within the HA. The source of the HAs sustainability objectives is convoluted. Although the SDAP helps to bring these objective together it does not the related performance targets which are found elsewhere, for instance within the business plan.

Fundamentally the state of art review of the HAs current strategies and polices has revealed a number of gaps which are discussed below. The review also shows that the HA have set objectives and targets such as those contained in the SDAP and Business Plan, but there is little guidance or policy in relation to how these targets will be achieved and what's expected of the business to deliver these targets.

The following gaps have been identified within current HA strategies. Reasons why the HA may find these gaps of importance are also detailed;

7.1 Resource Use & Natural Resource Protection

The HA has no policy or strategy in relation to resource use. Constructing, maintaining and operating roads require a lot of resources for instance energy, water, aggregate, and asphalt. There are also issues directly relevant to resource use such as transport movement, ever depleting supplies aggregate and CO2 emissions. The HA needs to look at resource use across its business in line with sustainable consumption and more importantly take direction from current and future strategic drivers such as, but not limited to, the Strategy for Sustainable Construction, Waste Management Strategy for England 2007, Aggregates Levy changes, the Energy White Paper (the need to cut CO2 emissions by some 60% by 2050), and the Water Strategy. Resource use should be considered in direct partnership with waste management.

7.2 Waste Management

The HA has no policy or strategy in relation to waste management. Construction activities produce a lot of waste in comparison to other sectors, for instance 10-15% of materials going onto construction sites become waste before they are even used. Waste and Resource management go hand in hand, however in terms of strategy should be considered separately because any waste management strategy should include a large element of regulatory and legislative compliance. Both the Strategy for Sustainable Construction and also the Waste Strategy 2007 are placing enormous emphasis on the construction industry to manage its waste in a more sustainable way, such proposed targets include: by 2012 a 50% reduction of construction, demolition and excavation waste to landfill compared to 2005, by 2015 zero net waste from at construction site level and by 2020 zero waste to landfill.

7.2.1 Procurement

Imposing contractual clauses at the procurement stage can ensure sustainability is integral and delivered to a business. Procuring items and services which are from sustainable sources or service providers would significantly contribute to the HAs sustainability objectives.

7.2.2 Soil

Soils are fundamental to many aspects of society for instance supporting agriculture and forestry, protecting cultural heritage, supporting biodiversity and as a platform for construction. Soil is very much a hot topic and in Spring 2008 DEFRA is expected to release their new Soil Strategy which will complement the 2005 strategy for soils in the built environment. Soil is likely, in the near future, to pose a challenge to the HA, the construction industry as a whole and the Government to protect soils through legislative and regulatory frameworks as an irreplaceable resource.

7.2.3 Climate Change & Adapting the network to Climate Change

Climate Change is all around us and its longevity is unsure; however, it's on the political agenda around the world. The UK Government is currently consulting on the Climate Change Bill. This Bill will commit the UK to increasingly stringent carbon budgets. Specific targets are already suggested within the draft Sustainable Construction Strategy of 2007 and relate directly in some instances to Government Department operations. Government departments are therefore likely to have to lead from the front and set the example in relation to climate change and other aspects of sustainability.

7.2.4 Sustainable Communities

In terms of the people agenda, there is little HA policy or strategy with the exception of the Highways Agency Disability Equality and Duty Action Plan 2006-2009. However this document is very much focused towards ensuring the requirements for public body in relation to the Disability Discrimination Act 2005 are met and it is very much focussed on the issues surrounding mobility and disability. Securing the future has brought together policy makers and stakeholders to explore the concept of 'wellbeing' in relation to sustainability.

Although gaps have been identified in relation to the delivery of specific subjects across the HA's business, it should be recognised that these subjects cannot be delivered in isolation to each other and that a wide reaching holistic view of areas of sustainability should be embedded within all strategies and policies.

7.3 What are the gaps in construction, maintenance and operations in terms of incorporating sustainable construction

This section of the report identifies reasons why sustainability has not or is not being incorporated within the HA's operations.

First and foremost are the gaps identified above in terms of having in place suitable strategies, policies and guidance which provides direction and the practical detail of how HA intends to implement sustainability within its business. Without this direction it is difficult to obtain the support needed to deliver the aims, objectives and targets throughout the business. Having in place such strategic documents will also facilitate buy in from within the HA to deliver the sustainability agenda.

Although targets exist within specific subject areas at a strategic or legislative level such as those in relation to biodiversity, until July 2007 and the publishing of the draft strategy for Sustainable Construction, no targets existed for sustainability issues within construction. Without such targets and hence certainty in terms of what is expected of the construction industry, only the most corporately responsible companies have made significant headway in terms of integrating sustainability within their business. The Government through its Sustainable Construction Strategy is looking to put in place sustainability targets in the context of construction significant progress is likely to be achieved. However, it should be noted that targets also exist outside the Sustainable Construction Strategy such as the Waste Strategy for England 2007 which now contains target figures for construction waste. It should be noted that this gap in relation to operational implementation is not unique to the HA.

This report has highlighted the increasing number of strategic drivers and legislative drivers which are intended to address every aspect of sustainability. The intention is for the sustainability agenda to be fully included within all aspects of construction. Of course, these drivers identify statutory and non-statutory targets which must or should be reached in-order to achieve the Governments overall aims on sustainability development. The Highways Agency has its role to play within this which it recognises. It has been identified that a gap exists within the Highways Agency in terms of ensuring environmental compliance whether it be at a strategic or legislative level. Since the publication of 'Building Better Roads: Towards Sustainable Construction' the Highways Agency has produced no such further publications to highlight their continued progression in relation to their operations and sustainable development. In-order to assess the implications of this gap, the requirements placed on the Highways Agency from strategy and legislation should be established and then assessed against all Highways Agency activities. This would demonstrate whether the Agency is non-compliant, on target or exceeding what is required in terms of sustainability. Such a study would need to include the identification and likely impact of future legislative and strategic drivers on the Highways Agency and its activities.

In terms of waste management, there are a number of historic issues which make waste management a challenging subject area for the HA to tackle and hence the need for an internal strategy. Historically waste data pertaining to construction and demolition waste (including excavated waste) has been one of the best kept secrets. This is for a number of reasons, fundamentally because commercial businesses use commercial waste companies and hence there is no centralised data capture other than when the Environment Agency periodically carries out waste arising surveys. Unlike municipal waste which has statutory recycling and reuse targets for local authorities. There have also been no predetermined recycling or re-use targets for construction and demolition waste. This lack of data for construction and demolition waste is further exacerbated by the fact that a large proportion of construction and demolition waste goes to exempt waste sites that on the whole, have no statutory duty to report waste in-take to the Environment Agency. These issues along with a common perception amongst the construction industry that aggregate is cheap and hence historically resource use has not been measured or been seen as an issue. To establish a baseline on which to device meaningful and achievable waste management targets for construction and demolition waste is a challenge. Notwithstanding the before mentioned, the HA do not have a Waste Management Strategy.

8 Recommendations & future research and development needs

This section builds upon the gaps identified above and looks to show how through research and development or by making recommendations, the gaps can be bridged and issues addressed.

- It is recommended that HA adopts the following definition of Sustainable Construction; "Sustainable construction is the application of the principles of sustainable development to the construction sector". This definition should be put at the heart of all future decision making and policy writing.
- It is recommended that the HA revisit its SDAP with a view to rationalising its aims, objectives and performance targets. The source of the HAs sustainability objectives is convoluted, although the SDAP helps to bring these objective together but not the related performance targets which are found elsewhere, for instance within the business plan. For traceability and ease of use, the SDAP should also contain a spider diagram which shows how the SDAP is cascaded through all HA operations and what polices and strategies are available for delivering the actions and sustainability as a whole. Including this enhancement to the proposed revised SDAP will help to engage HA staff and service providers by ensuring they are aware of the HAs priorities, what the HA want to achieve and what is expected from them. However, as this is the HAs first SDAP, although not the first time the HA has looked to address some of the issues such as biodiversity, many of the objectives and accompanying targets are therefore in the conceptual stage and are without a delivery vehicle, whether a subject specific plan or guidance, to deliver these targets.
- It is recommended that the HA conduct a study which identifies all relevant strategic and legislative statutory and non-statutory targets in relation to all environmental issues. The targets should then be assessed against the HA's current performance. This will assess the implications of strategic and legislative targets on the HA activities and will established whether the HA are non-compliant, on course and progressing towards or far exceeding what is required of them in terms of environmental performance and sustainable construction targets. Such a study should include the identification and likely impact of future legislative and strategic drivers on the Highways Agency and its activities.
- The state of art review revealed that the HA have numerous gaps in relation to strategies and policies which act as vehicles to deliver HAs sustainability objectives. It is recommended that the HA develop and implement policies, strategies and guidance in the following areas; resource use and natural resource protection, waste management, procurement, soil, climate change and adapting the network to climate change and sustainable communities.

- It is recommended that the HA carry out a cradle to grave audit of all waste streams which arise as a result of construction and maintenance operations. This data should be used to form the basis of a demonstration project which should aim to generate figures for the average amount of aggregate (may also include water, energy usage) use and waste produced per mile of motorway, specific road type, or maintenance operation. These figures can then be used for the purposes of the three further recommendations made below. This method of data gathering could then be applied to non-network activities of the HA such as office facilities management.
- Introduce contractual clauses and KPI's which stipulate the maximum waste arising permitted for common road construction and maintenance activities.
- Introduce contractual clauses which look to control the percentage use of recycled and secondary materials within all new builds and maintenance operations. The Governments target of waste neutrality is entirely dependant on the re-use and recycling of waste and the use of more recovered materials.
- In terms of resource management, contractual clauses should be added which require the measurement and involvement of materials and resource efficiency for projects. This is especially important for public organisations and this may encourage the private sector to sign up to such commitments.
- Carry out a comprehensive cost benefit analysis showing the economic differences associated with using secondary or recycled aggregate versus virgin materials. This cost benefit analysis should include full waste recycling and any transportation costs. For the virgin materials, costs should include all quarrying costs and transportation costs. The Specification for Highways makes using waste materials as aggregate replacements a reality subject to suitability; however, not all roads are constructed using waste materials. Pursuing a cost benefit analysis to show the financial savings and environment benefits of using waste materials as opposed to virgin materials may be a way of 'selling' this concept to the HA service providers.

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