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**MANAGING ROAD ASSETS IN THE CONTEXT OF
SUSTAINABLE DEVELOPMENT AND CLIMATE
CHANGE ADAPTATION**

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Abstract

The World Road Association (UK) Executive Committee has arranged for the preparation of this National Report for Strategic Direction Session D of the Mexico World Congress in 2011.

For transport, responsibility for certain high level and legislative issues (for example, vehicle safety) is retained by the UK Government and administered by the Department for Transport (DfT). However, most transport policy and operations are the responsibility of devolved administrations in Scotland, Wales and Northern Ireland. In England this responsibility remains with the UK Government in the form of DfT. Consequently, the road networks are managed by the following organisations:

- England: the Highways Agency (HA), an executive agency of DfT is responsible for the trunk road network, with the remaining network managed by local authorities;
- Scotland: Transport Scotland, the Scottish Government's transport agency, is responsible for the trunk road network with the remaining network managed by local authorities;
- Northern Ireland: the Roads Service, an executive agency of the Northern Ireland Department for Regional Development (DRD), is the sole authority for the public road network; and
- Wales: the Welsh Assembly Government is responsible for the trunk road network, with local authorities taking responsibility for local roads.

This National Report compiles information from all four organisations in order to achieve a broad and inclusive perspective on the challenges that they face in the coming years and their approaches to meeting those challenges.

This report specifically takes into account the approaches taken by each organisation in order to mitigate the effects of climate change and manage their roads assets in the context of sustainable development and climate change adaptation.

1. Introduction

In England the Highways Agency is responsible for the operation, maintenance, and improvement of England's strategic road network, which provides a vital service to industry, communities, and individuals. It is a key component of the country's overall transportation infrastructure, linking with local roads and other transportation modes, carrying a third of all traffic in England, and two thirds of all heavy freight traffic. As a result the Agency must ensure that the network continues to function in the face of a changing climate.

Northern Ireland's Roads Service is responsible for a motorway, trunk and local road network, comprising over 25,000 km of roads and associated highway assets.

Transport Scotland is responsible for the management, maintenance and improvement of Scotland's trunk road network. The trunk road network is comprised of route corridors that are considered to be of strategic importance to the economic strength and growth and social wellbeing of Scotland. The trunk road network is vital because it connects Scotland's cities, rural communities and the ports that serve Scotland's islands. It is important therefore that the Agency continues to manage the risks posed by climate

change, to minimise the impacts of costly disruptions and safeguard the continued smooth functioning of services and infrastructure.

In Wales the Welsh Assembly Government is responsible for approximately 1,700 km of motorway and trunk road with a current depreciated replacement cost of approximately £11.8bn.

2. QUALITY OF ROADS AND SUSTAINABLE DEVELOPMENT

2.1. Northern Ireland

Work is guided by high level strategies, such as the Regional Development Strategy and the Investment Strategy for Northern Ireland. There is a Regional Transport Plan and subsidiary sub-regional and local transport plans, along with extensive policy and procedures guidance, and good inventory, valuation and maintenance systems.

Sustainability in Major Works has been specifically addressed. NI's Roads Service incorporated a number of sustainability targets when developing the project specification of the Newry By-Pass PPP scheme. This Environmental plan was developed to identify assess and minimise any potential risks, with ecological and vegetation surveys being completed to ensure all the necessary steps were taken to protect the natural environment and wildlife.

To meet sustainability targets, an innovative low noise surfacing material was selected for the carriageway. Rivers and streams were protected from silt and run off, with noise, light and dust pollution kept to a minimum.

Where possible, materials were recycled or reused to keep the amount of waste to an absolute minimum. An illustration of which was where the contractor was required to excavate 1.2 million tonnes of rock at the Southern end of the scheme. The rock was reconstituted on site and used in the road base material as a cement bound material (CBM) resulting in the amount of imported hard fill being reduced to an absolute minimum.

2.2. Scotland

A central part of the Climate Change Action Plan was a review of sustainability practices in major transport infrastructure projects and network management and maintenance.

This Sustainability Review is the culmination of detailed work on behalf of Transport Scotland. The review has identified and supported many opportunities to increase the carbon and resource efficiency associated with Transport Scotland delivering its operational remit. This document presents the resulting observations and recommends a programme for continuous improvement.

The review has shown that the approaches to design management and procurement are key to enabling Transport Scotland's supply chain to respond with carbon- and resource-efficient solutions. These key elements are supported by others, such as the approaches to innovation, knowledge management, reporting, and employee development. A list of recommendations is given at the end of the document.

As well as recommendations on the Carbon Management System recommendations have been made in the areas of design, procurement and contract management, innovation and knowledge, reporting and monitoring and resource and employee development. These suggestions are as short, medium and long terms recommendations which will be implemented after discussion.

The sustainability review and the CMS development has been a catalyst for sustainability. Transport Scotland and its supply chain are involved in research on innovative approaches covering many aspects of infrastructure design, management, and operation. However, improvements could be made to the speed at which successful research and development is applied to day to day activities.

A set of best practice templates and examples have been produced. These support the process of making carbon and resource efficiency knowledge capture, transfer and dissemination more systematic within Transport Scotland. The templates include a simplified information capture template and two graphical style templates.

The first two best practice examples produced are:

- Crack and Seat – concrete road foundation in-situ re-use
- Sustainable Resource Management Framework – project control document to address the supply, management and use of resources

2.3. Wales

The Welsh Assembly Government has a duty under section 79 of the Government of Wales Act 2006 to make a scheme setting out how it intends to promote sustainable development in the exercise of its functions. The duty also requires Welsh Ministers to:

- Keep the sustainable development scheme under review and from time to time remake or revise it;
- Publish the sustainable development scheme;
- Publish each year a report of how the proposals set out in the sustainable development scheme were implemented; and
- Following the election of a new administration, publish a report containing an assessment of how effective the proposals set out in the Scheme have been in promoting sustainable development.

The Welsh Assembly Government's current sustainable development scheme, One Wales, One Planet was published in May 2009. Transport's contribution to the delivery of the sustainable vision for Wales is set out in the National Transport Plan published. For the motorway and trunk road network there is a recognition that it requires 'targeted and co-ordinated investment in order to improve journey time reliability and enhance road safety' and this must be carried out in a 'sustainable manner'.

In order to achieve this objective the network has been divided into 24 routes and a Route Management Strategy is being developed for each. The design of improvements and maintenance of each route as well as embracing global measures to deliver sustainability also takes into account the environment through which it passes (i.e. whether it's a national park, SSSI, cSAC etc) and the level of service required from it (e.g. the volume of traffic, whether it is a tourist or freight route etc.)

3. MANAGING ASSETS AND SUSTAINABLE DEVELOPMENT

3.1. Northern Ireland

Roads Service has carried out a Gap Analysis of the CSS Framework for Highway Asset Management, which shows that NI is well placed against most of the Framework recommendations. However, due to other priorities and resource issues, Roads Service has not yet assembled the various components into an inclusive Asset Management Plan.

In terms of sustainable development, Roads Service has a statutory duty to ensure that the principles of sustainability underpin all our decisions and actions. It follows a Sustainable Procurement Action Plan, to encourage innovation and making them more affordable and widely available. The Plan presents a package of actions to deliver the step change we need to ensure that clients and supply chains are focused on better design, low waste, higher recycled content, respect for biodiversity and delivery of our wider sustainable development goals.

A. Condition Assessment

Roads Service as a government agency operates a policy of continuous improvement, which encourages innovation and new ideas. One area where innovation has been to the fore is in the way network condition is now measured and incorporated in work planning processes. An accurate condition assessment is paramount, if these resources are to be targeted where they will be most effective.

Within the last few years, there has been an explosive growth in management systems and in the information technology used to assist in the planning of highway maintenance. Typically these systems take into account the amounts of deterioration, details of construction, geometry and traffic flows, together with defined engineering standards, to calculate appropriate treatments and related costs. An essential part of these, however, depends on some form of pavement assessment, which can either be founded on visual or mechanical measurements.

In Northern Ireland, routine monitoring of the highway network is now carried out (using a variety of methods) required to define its physical state and to predict its future deterioration to agreed levels of intervention. Network condition data is collected and recorded annually. Visual condition surveys, such as Coarse Visual Inspections (CVI,) form the backbone of the survey regime and are also used to determine where more detailed surveys are required. These visual condition assessments are augmented by the already well-proven machine based surveys such as the SCRIM and Deflectograph.

Visual assessments of road condition include some degree of subjectivity and treatments, like surface dressing, tend to obscure deep-seated deterioration and undervalue the total maintenance need. These factors, together with the impracticability of full coverage, have pointed towards automatic systems of road condition data collection.

A new machine called SCANNER has been developed. It incorporates the latest video and laser technology used to monitor conditions such as pavement cracking and provides faster, more consistent and accurate data economically. SCANNER can be applied to lower category roads that make up the bulk of the network in Northern Ireland.

The United Kingdom Pavement Management System (UKPMS) provides a consistent and unified basis for the storage of data arising from condition assessment surveys and permits comparisons to be made on treatment types, as well as in the allocation of funding for structural maintenance.

B. Materials

As well as new management techniques, new and innovative materials also help to extend the expected life of NI's roads. For example, surface dressing materials, which a few years ago had a recommended life of 7 years, can now be reasonably expected to last for up to 10 years.

Roads Service is also looking at modern asphalt materials and has been piloting thin surfacing at a number of sites on the road network. Stone Mastic Asphalt is one form of such material and has the following advantages over conventional materials. It has:

- reduced traffic noise
- reduced surface water spray
- less impact with regard to traffic management, as the laying equipment required is not as wide as that used for laying hot rolled asphalt.

3.2. Wales

The Welsh Assembly Government has an Asset Management Plan for its motorway and trunk road network, which it continually strives to improve in accordance with emerging best practice.

A. Condition Assessment

The Welsh Assembly Government carries out an annual programme of condition surveys across all asset types, in order to maintain network safety and determine optimum maintenance strategies. The survey programme includes SCANNER, the latest laser based technique for determining the surface condition of road pavements as well as the more traditional deflectograph to determine structural strength and SCRIM to establish the skid resistance of carriageways. The inspection of highway structures is carried out in accordance with the Design Manual for Roads and Bridges with principal inspection frequency being determined by structural form and risk of failure rather than the 6 year interval prescribed by standards in order to target resources and improve the Assembly's management of risk.

B. Annual Value Management (VM) Appraisal Process

The Welsh Assembly Government spends approximately £15-20M/ annum on the major maintenance of its road pavements. In order to achieve best value from this expenditure and minimize the use of the natural materials used in surfacing materials the Assembly carries out an annual Value Management Appraisal Process of maintenance schemes put forward by its maintaining agents. This involves an independent, third party, appraisal of the evidence, proposed method of implementation and potential benefits of each scheme. Whole life costings are used to demonstrate the optimum investment strategy benchmarked against 'do minimum' and 'do nothing' scenarios.

C. Materials

The use of the new generation of thin surfacing material is mandatory across the network in order to reduce noise. Aggregates are recycled whenever possible.

4. IMPACT OF CLIMATE CHANGE ON THE PERFORMANCE OF THE ROAD ASSETS

4.1. England

A. Highways Agency Action:

The Highways Agency's response to the challenge of climate change must involve both mitigation (taking action to reduce greenhouse gas emissions) and adaptation (changing behaviour so that it is more appropriate to the expected future climate). Its strategy is focused on adapting to climate change; and the Agency is delivering a separate carbon performance measure, recognising these two areas are highly interdependent.

B. Highways Agency Commitment:

The Highways Agency will assess the potential risks that climatic changes pose to the ongoing management, maintenance, improvement, and operation of the strategic road network. The Agency will factor anticipated climatic changes into the delivery of business and develop appropriate management and mitigation solutions to remove or reduce these risks.

C. Desired outcomes:

- Climate change considerations are factored into Highways Agency investment controls and business as usual, including design, construction, maintenance, and operations;
- Early consideration of climate change risks leading to greatly reduced costs over asset life;
- A move away from reliance on historical weather record as basis for standards and specifications;
- Residual climate change risks are assigned appropriate management action;
- The Highways Agency can demonstrate an effective approach to climate change risk management and fulfil reporting obligations.

D. Key Drivers:

Global scientific consensus is that the world's climate is changing. Stern (2007) highlights climate change as a serious and urgent issue and the need for action is widely acknowledged. Scientific evidence indicates that the rapidly changing climate is predominantly a result of increases in greenhouse gases caused by human activities. In recognition of this, Parliament passed the Climate Change Act in November 2008, which amongst other things, places a requirement on Government to report at least every five years on the risks to the UK of climate change, and to publish a programme setting out how these impacts will be addressed. The Act also introduces powers for Government to require public bodies and statutory undertakers to carry out their own risk assessments and make plans to address those risks.

As an Executive Agency of a Government Department, the Highways Agency is not legally required to report. However, in recognition of the importance of the Highways Agency's infrastructure and the risks of climate change to operations, they have volunteered to

report to the Secretary of State for the Environment, Food and Rural Affairs, to provide public assurance of progress on adaptation.

E. Predicted climate changes:

The key findings from the UK Climate Projections 09 (UKCP09) are:

- All areas of the UK get warmer and the warming is greater in summer than in winter
- There is little change in the amount of precipitation (rain, hail, snow etc) that falls annually, but it is likely that more of it will fall in the winter, with drier summers, for much of the UK
- Sea levels rise, and are greater in the south of the UK than the North

F. Climate Change Challenges:

Many of the Highways Agency’s activities are either directly affected or influenced by the climate. The Highways Agency needs to ensure it can continue to provide a robust strategic road network in a changing climate. Decisions have to be taken in the face of a range of uncertainties. These exist in climate change predictions, for example as a result of the uncertainty in climate models and in future greenhouse gas emissions. There is also uncertainty in the way that changes in climate will affect the activities of the Agency, the performance of its assets and the expectations and behaviours of customers and stakeholders. This uncertainty should not inhibit decision making, but does need to be understood and taken into account. The UKCP09 adoption of probability analysis within the climate change predictions however, greatly assists risk consideration and decision-making.

G. Climate Change Risks:

The table below (Table 1) provides examples of some of the high level climate change related risks that could impact upon the Highways Agency, and their associated consequences. The application of the HA Climate Change Adaptation Framework will allow the Agency to identify specific risks, and determine the most appropriate management options.

Table 1 - High-Level Climate-Related Risks

Highways Agency high-level climate-related risks to corporate objectives	
Risk	Examples
Reduced asset condition and safety	Assets deteriorate more quickly due to changes in average climatic conditions; assets are more badly damaged as a result of more extreme climatic events.
Reduced network availability and/or functionality	Need for restrictions on the network to maintain safety; increased need for roadworks.
Increased costs to maintain a safe, serviceable network	Construction/maintenance/repairs/renewal required more often; more extensive construction/maintenance/repairs/renewal required; new (more expensive) solutions required e.g. designs and materials/components/construction costs.
Increased safety risk to road workers	Increased risk to construction and maintenance workers and Traffic Officers as a result of climatic change e.g. if need to work on the network more often; if required to work on the network during extreme climatic events or if climate change requires them to perform more ‘risky’ activities.

Increased programme and quality risks due to required changes in construction activities	More onerous design requirements; new technical solutions required with higher uncertainty, affecting projects, programmes and/or quality.
Current Highways Agency internal operational procedures not appropriate	Effects of climate change require new ways of working - changed or new business processes, new skills/competences.
Increased business management costs	Need for more staff; more frequent (expensive) incidents to pay for; need for more research into ways of coping with climate change.

H. Business as usual:

The challenges of adapting to a changing climate cannot be considered in isolation. Climate change needs to be a routine consideration, factored into the Highways Agency's day to day decision making processes rather than a discrete risk to be managed independently. Although, many Highways Agency activities are affected by climate, few decisions can be made taking only climate considerations into account.

I. Highways Agency Adaptation Framework:

The Highways Agency is committed to understanding and assessing the risks posed to the strategic road network from a changing climate, and taking appropriate management action to mitigate these risks. In order to facilitate this, the Agency has developed a climate change adaptation framework which provides a consistent approach to assessing and understanding the risks posed to the strategic road network. The development of the adaptation framework has built upon detailed review of work by the Highways Agency, and organisations, including UKCIP (UK Climate Change Impacts Programme), IPCC (InterGovernmental Panel on Climate Change), and the Stern review. It has been guided by consultation with a stakeholder group comprising members from the Highways Agency, DEFRA, Met Office, and other government departments and interested groups.

J. Function of the framework:

The purpose of the adaptation framework is to enable the Highways Agency to systematically develop and implement its responses to the challenges of climate change in support of the delivery of its corporate objectives. The adaptation framework provides a platform for decision makers to examine their individual business areas, including standards, specifications, maintenance, and the development and operation of the Highways Agency network. It provides the process to identify the activities which will be affected by a changing climate, determine associated risks (and opportunities), and identify preferred options to address and manage them.

K. Highways Agency Adaptation Framework Model:

The Highways Agency's Adaptation Framework Model (HAAFMM) provides a seven stage process that identifies activities which will be affected by a changing climate; determines associated risks and opportunities; and identifies preferred options to address them.

L. Vulnerability Identification:

Over eighty Highways Agency activities, or vulnerabilities, have initially been identified which may be affected by climate change. A preliminary appraisal of the risks associated with these vulnerabilities has been undertaken which found that over 60% of them are expected to be materially affected by current predicted levels of climate change within their

relevant asset life or activity time horizon. The risk appraisal has also enabled vulnerabilities to be prioritised for attention, based upon several criteria including their potential to disrupt the operation of the strategic road network. The prioritisation provides a basis for establishing a forward programme of work to develop and implement adaptation action plans. Key areas for attention include internal business management processes, network resilience, investment appraisal, and various specific aspects of the design and maintenance of road pavement, structures and drainage.

Specific recommendations for implementation include the initiation of a “quick-wins” programme leading to the early application of adaptation actions where these are straightforward, low-cost and their benefits are clear, such as amending design standards for long-life assets to address predicted climatic changes.

4.2. Scotland

A. Responding to Climate Change:

The importance of mitigating carbon emissions and adapting to climate change is fundamental to the Scottish Government, as evidenced by the challenging target to reduce emissions by 80% (from 1990 levels) by 2050 set out in the Climate Change (Scotland) Act 2009. Transport Scotland’s own Corporate and Business Plans reflect this commitment and the Agency has been preparing its response to the challenges of climate change for some time. This work has included:

- the establishment of a Climate Change Steering Committee, chaired by Transport Scotland’s Chief Executive;
- the drafting of our first internal Climate Change Action Plan, building on a baseline review of existing good practice, and
- the undertaking of a Sustainability Review to understand in more detail how our strategic and delivery responsibilities can be undertaken in ways which reduce energy, materials, waste and carbon flows.

This work is being supported by the development of a Carbon Management System (CMS). We expect that in the next few years all Government agencies and departments will be required to provide annual reports of all their carbon emissions. The CMS is intended to provide a robust and reliable means of measuring, monitoring and reporting the carbon footprint of Transport Scotland.

B. Climate Change Steering Committee:

The Transport Scotland Climate Change Committee has been set up to oversee the development and delivery of a Transport Scotland-wide work programme that contributes to the Scottish Government’s climate change objectives by, encouraging more sustainable patterns of transport on the Scottish trunk road and rail networks; reducing the level of greenhouse gas emissions produced by construction activities on the Scottish trunk road and rail networks; reducing the level of greenhouse gas emissions produced by the operation of the Scottish trunk road and rail networks; and predicting and responding to the stresses that future climate changes will place on Scotland’s trunk road and rail networks. The committee also co-ordinate the Agency’s input into the development of relevant climate change policies at the European Union, United Kingdom and Scottish Government levels; ensures that the Agency’s policies and operational practices are consistent with the legal frameworks established at the European Union, United Kingdom and Scottish Government levels to tackle climate change and monitor and report on a bi-annual basis to the Transport Scotland Board on the Agency’s progress in meeting its

climate change targets (as set out in the Agency's Corporate Plan and annual Business Plans).

C. Climate Change Adaptation

The Scottish Government has published the Climate Change Adaptation Framework which will be a vital catalyst in building resilience and capacity to adapt to the changes. In releasing this Framework, the Scottish Government is taking a lead and challenging all sectors to take action and play their part in adapting to the future impacts of the changing climate. This recognises the considerable work that has already been made by Transport Scotland in roads including:

1. Gather more detailed information on the susceptibility of transport networks to the effects of climate change and impact of severe weather. This will guide contingency planning for the types of incidents which cause significant widespread disruption.
2. Assess future adaptation requirements for road and rail networks in light of the UK Climate Projections 2009.
3. Develop the role of Transport Emergency Planning and Consequence Management.
4. Taking forward the programme of design, research and policy initiatives that were identified in the Scottish Road Network Climate Change Study.
5. Implementation of the recommendations from the Landslides and Rock slope Risk Assessment Studies.
6. Implementation of the Strategy for the management of the impact of high winds on road networks

D. Scottish Road Network Climate Change Study:

Transport Scotland's 2005 Climate Change Study, and subsequent progress report published in 2008, considers the effect that climate change might have on the design and operation of roads and identifies where changes in current practice are required. There are 28 recommendations presented in the report, of which six are priority recommendations, 10 are recommendations for the short-term and a further 12 are long-term recommendations. In addition, recommendations have been categorised by type, namely:

- Design issues, where changes in the design of the road network are proposed
- Operational issues, where changes in the operation of the road network are proposed
- Research issues, where detailed recommendations are not possible at this time and further research is required
- Policy issues, where recommendations would have an impact on current policies.

Addressing these recommendations requires a range of technical and operational measures to be implemented. Whilst the majority of technical measures are relatively straightforward, e.g. increasing drainage capacity, the Agency recognises that some operational issues pose huge challenges, e.g. coping with more frequent and stronger winds.

Opportunities have been taken to embed responses, developed with climate change effects in mind, into the normal practice of roads authorities and those engaged in delivering services relating to the road network. It is considered that this will improve the level of service experienced by road users and, critically, will enhance road safety. In Scotland the full range of climate change effects will be felt. However, it is likely that the emphasis, at least in the next few years will be done in the areas of increased flooding and the effects of changes in rainfall amounts and patterns. In this area Scotland can take the lead whilst learning from others in the area of higher temperatures.

This study is currently being updated using the data sets published in the UK Climate Projections 2009 (UKCP09).

5. ROAD RESEARCH AND PROFESSIONAL TRAINING

5.1. Scotland

A. A Common Approach

Transport Scotland's view is that sustainability needs to be 'owned' by our staff, consultants and contractors. Changes in approach and attitude are as important as technical solutions as we aspire to meet the challenges of climate change, lead sustainability in the industry, and promote Transport Scotland as a recognised centre of excellence. We also see sustainability as a means to work more efficiently, reduce costs, and maximise returns on public spending for the road network.