JACOBS ARUP

A report on behalf of Transport Scotland and in association with Natural Capital

Forth Replacement Crossing

Sustainability Appraisal and Carbon Management Report

Appendix 7:

Sustainable Design Innovations

November 2009

TRANSPORT SCOTLAND

natural CAPITAL

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Appendix 7: Sustainable Design Innovations

Design Ideas and Innovations that Deliver Sustainability Benefits Whilst Meeting Scottish Government Strategic Objectives, FRC Sustainable Development Policy Objectives and Sustainability Appraisal Framework Objectives

Scottish Government Strategic Objectives	Wealthier	Healthier	Greener	
FRC Sustainable Development Policy – Objectives	Economic	Social	Environmental Resources	
Sustainability Appraisal Framework Objectives	Delivers Objectives: 1, 2, 3, 4	Delivers Objectives: 2, 3, 6, 7, 8, 9, 10	Delivers Objectives: 5, 11, 12, 13, 14, 15, 16, 17	
Design Ideas/Innovations Incorporated into Stage 3 Design				
Wind shielding on Main Crossing will improve reliability	• Improvements in reliability can cut congestion, improve journey times to work etc • More efficient use of crossing • Fuel efficiency	• Safer crossing • More reliable journey times • Less congestion	• Greater efficiency leads to lower vehicle emissions • Demonstrates a degree of adaptation to climate change (increased incidents of high wind) • Fuel efficiency helps to cut the depletion of finite resources and emissions of carbon	
Both carriageways on the main crossing will have widened hard shoulders	• Removes delays due to blockages caused by breakdowns and maintenance activities, thus improving reliability	• Safer crossing • More reliable journey times • Less congestion	• Less congestion should result in lower vehicle emissions • Less congestion means less carbon emissions and greater fuel efficiency	
Hard shoulder provision on the scheme. The proposed scheme will incorporate hard shoulders on the majority of the scheme	• Improvements in reliability can cut congestion, improve journey times to work etc	• Safer crossing • More reliable journey times • Less congestion	• Less congestion should result in lower vehicle emissions	
Dedicated public transport corridor will provide a means of ensuring that public transport services can run more reliably	• Reliable public transport facilities ensure less disruption to the smooth running of the economy in terms of movement of capital and labour	• More reliable journey times • Improved access to public transport services	• Reduced CO_2 emissions and fossil fuel consumption • Improved public transport facilities should help to get cars off the road which in turn will reduce CO_2 emissions	
Intelligent Transport Systems (ITS) will help to regulate flow of traffic	• Improvements in traffic movement leads to greater fuel efficiency • More reliable journey times to work	• Less congestion and safer roads • More reliable journey times • Less congestion leads to less pollution	• More efficiency leads to lower emissions and less pollution	• Improved traffic movement relieves congestion and lowers carbon emissions • Less congestion means greater fuel efficiency and less depletion of resources
New and improved car/bus interchanges to facilitate use of public transport	• More efficient use of transport should help to cut fuel consumption and costs	• More choices in public transport • Could help reduce car numbers increasing safety	• Cuts CO_2 emissions • Could lead to improved air quality • Possible noise reductions	• Modal switch should help to get cars off the road which in turn will reduce CO_2 emissions • Helps reduce depletion of fossil fuels

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Preparation of Sustainable Resource Management Strategy	• Aims to ensure in a non discriminatory manner that materials are sourced locally where feasible, thereby contributing to the local economy	• Sourcing materials locally supports local employment opportunities. • Responsible sourcing of materials ensures products have been produced to high ethical standards.	• Reduced CO2 emissions • Ensures environmental impacts are considered during procurement process (e.g. sourcing timber from certified sustainable sources)	• The strategy aims to ensure all materials are sourced responsibly, from low-carbon sources where feasible • Sourcing materials locally where feasible, thereby reducing carbon emissions associated with transport
Where existing footpaths/cycleways are disrupted, routes will be maintained with improvements where practicable		• Maintains access along routes and improve accessibility within the scheme catchment		
New footpaths to link in with existing path network		• Improves accessibility within the scheme catchment		
Pedestrian/cycle crossing points to be provided at Ferrytoll and Queensferry Junctions		• Improves accessibility and perceived safety within the scheme catchment		
Controlled crossing to be provided at the northern end of Forth Road Bridge		• Improves access from east to west across the A90		
Access ramp from B981 to A90 and Forth Road Bridge suitable for disabled users		• Maintains access and improves accessibility for all users		
Design Ideas/Innovations to be Considered at Tender Design Stage				
Specification of carriageway surfacing to the cable-stay bridge (orthotropic deck option) to reduce the frequency at which resurfacing is required	• More reliable journey times to work	• More reliable journey times • Less congestion		
Sourcing timber products from certified sustainable sources (e.g. FSC)	• Demonstrates commitment to sustainable resource use	• Ensures timber products are sourced in a responsible and ethical manner	• Contributes towards the sustainable management of forest resources	• Ensure timber is sourced from forests that are sustainably managed and this has benefits in terms of carbon sequestration

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Use of recycled materials in Highways design (including kerbs and plastic pipes)	• Less material use means greater material efficiency • Greater efficiency can cut costs and improve life cycle costs	• Recycling can lead to less impacts from primary manufacturing • Less impacts means less pollution and less impacts on environment	• Recycling can lead to less impacts from primary manufacturing • Less impacts means less pollution and less impacts on environment	• Recycling can lead to less impacts from primary manufacturing • Less energy intensity would lead to lower carbon footprint
Use of recycled aggregate instead of quarried aggregate	• Reduces consumption of non-renewable finite resources	• Reduces impact of quarrying on communities	• Reduces impacts of quarrying on the environment	• Cuts CO2 emissions as recycled aggregate has a lower embodied carbon content than quarried aggregate
Sustainable sourcing of steel	• Consider sources that use less energy and fossil fuels in the steel making process • Consider sources that include higher percentage of secondary material – with economic benefits	• Consider sources with strong corporate social responsibility agenda • More modern manufacturing processes are better for environment and better for local communities	• Reduces impacts of steel production on the environment	• Consider which suppliers of steel produce the lowest embodied carbon product • Consider carbon emissions associated with transport of steel to site
Use of pre-cast technologies to minimise material use	• Less material use means greater material efficiency • Greater efficiency can cut costs	• Less material could lead to less transportation and less nuisance effects	• Less material could lead to less transportation and less nuisance effects (noise and emissions) • Less use of raw materials leads to less pressure on the environment	• Less material use leads to a lower carbon footprint
Use of lightweight fills for abutments/wingwalls	• Less material use means greater material efficiency • Greater efficiency can cut costs	• Less material could lead to less transportation and less nuisance effects	• Less material could lead to less transportation and less nuisance effects (noise and emissions) • Less use of raw materials leads to less pressure on the environment	• Less material use leads to a lower carbon footprint
Energy-efficient ITS and lighting systems	• Ensures efficient use of energy resources • Cost savings associated with reduced energy consumption	• Better for environment and therefore better for quality of life	• Reduces impacts associated with consumption of fossil fuels	• Reduce energy consumption and associated emissions of CO_2

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To accept non-toxic products for concrete impregnation		• Better for environment so better for quality of life	• Reduce impacts on environment associated with conventional concrete impregnation products	
Stainless steel reinforcement in areas of high exposure (piers / parapet edge beams) to reduce future maintenance	• Improved durability and reduced future maintenance costs • Reduce whole life project costs	• Less environmental impact contributes to improved quality of life	• Reducing future maintenance reduces knock-on impacts on environment	
Greater use of voided concrete construction to reduce materials (Cobiaxdeck, voided abutments)	• Increased resource efficiency	• Less pressure on environment leads to improved quality of life	• Reduces CO2 emissions • Less use of raw materials leads to less pressure on the environment	• Reduced embodied carbon
Precast Technologies – Precast foundations, columns crossheads, beams and deck	• Increased resource efficiency	• Less pressure on environment leads to improved quality of life	• Reduces CO2 emissions • Less use of raw materials leads to less pressure on the environment	• Reduced material use, energy use and embodied carbon
Compressive membrane action to reduce reinforcement in deck slabs	• Increased resource efficiency	• Less pressure on environment leads to improved quality of life	• Reduces CO2 emissions • Less use of raw materials leads to less pressure on the environment	• Reduced material use, energy use and embodied carbon
Use of non-chemical de-icing or non-salt de-icing products		• Less environmental impact contributes to improved quality of life	• Reduced impact on local environment, particularly water environment	
Flexi-arch for culverts and/or pipeline structures	• To minimise whole life costs • Increased resource efficiency	• Less environmental impact contributes to improved quality of life	• Reduced impact on local environment, particularly water environment	• Increased resource efficiency • Reduced material use, energy use and embodied carbon
Design Ideas/Innovations that are Examples of Current Best Practice				
Community engagement and public consultation		• Ensures all relevant stakeholders included in consultation process • Information made available at appropriate stages in the project • Feedback considered during design development process		

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Improvements to local accessibility and provision for non-motorised users	• Improved walk/cycle access to public transport services facilitates improved general accessibility to key life opportunities.	• Significant reduction in traffic at one location (south of South Queensferry), resulting in a safer and more pleasant journey • Minor reduction to traffic flows at seven other crossing points • Improved walking and cycling provision	• Reduced fossil fuel consumption and CO2 emissions	• Modal switch toward active and sustainable forms of transport should help to get cars off the road which in turn will reduce CO_2 emissions
Ensuring the scheme accommodates the needs of disabled people (DDA 2005)	• Meeting the needs of all means equal access for all to jobs and essential services with economic benefits	• Meets equality standards and accommodates the needs of all		
Maintaining quality of open space		• Ensures amenity value of open space is maintained • Ensures accessibility to open space is maintained	• Can help to maintain green infrastructure and benefit local biodiversity	
Promote local training and skills to develop relevant construction skills	• This will enable local people and disadvantaged groups or individuals to benefit from job opportunities during construction and contribute towards a prosperous local economy	• Promote local employment • Reduce social deprivation		
Optimisation of cut and fill balance to minimise the need to import, or export, fill from site	• Less import/export means greater resource efficiency • Greater resource efficiency can cut costs	• Less local transportation would lead to less traffic and less pollution effects on local communities • Less traffic movements means less noise and disturbance • Less traffic movements could lead to safer roads	• Less local transportation would lead to less traffic and less pollution emissions (Co_2 and NO_x) • Less traffic movements means less noise and disturbance	• Less import/export means less transportation with less emissions of CO_2
Efficient design of structural elements	• Ensures efficient and economical design		• Reduces impact of resource consumption on the environment	• Minimise material use and therefore reduce embodied energy and carbon
Retain and re-use existing land-based structures where possible	• Ensures efficient and economical design		• Reduces impact of resource consumption on the environment	• Minimise material use and therefore reduce embodied energy and carbon

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Pass majority of runoff through SUDS		• Helps to remove some pollution and therefore improves quality of local environment for people	• Effective means of dealing with pollution of surface water • With careful design could lead to increases in biodiversity	• Shows some adaptation to possible effects of climate change (increased rain and storm events)
Limit number of watercourse crossing and re-alignments by making use of existing infrastructure			• Can protect and enhance the natural heritage including local biodiversity • Can protect water quality, geomorphology and ecology	
CDM adopted throughout design		• Provide a safe design for both road users and non-motorised users		
Design of structures to be in accordance with DMRB, MCDHW, British Standards and all other applicable codes of practice and guidance	• To minimise whole life costs	• Provide a safe design for both road users and non-motorised users		
The design of the structures to achieve an acceptable level of aesthetics		• Contributes towards protecting the landscape, historic environment and cultural heritage	• Contributes towards protecting the landscape, historic environment and cultural heritage	