Joint Research Centre
Institute for Prospective Technological Studies

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The European Commission’s in-house science service

Serving society
Stimulating innovation
Supporting legislation
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP criteria process description
• **IE** – Petten, The Netherlands
  • Institute for Energy

• **IRMM** – Geel, Belgium
  • Institute for Reference Materials and Measurements

• **ITU** – Karlsruhe, Germany
  Institute for Transuranium Elements

• **IES/ IHCP/ IPSC** – Ispra, Italy
  Institute for Environment and Sustainability

• **IPTS** – Sevilla, Spain
  • Institute for Prospective Technological Studies

Institute for the Protection and Security of the Citizen
Provide support to EU policy making process by developing **science based responses to policy challenges** that have both a socio-economic and a technological dimension.
Activities in support of Product Policy

IPTS supports the development and implementation of environmental product policies, amongst them the EU Ecolabel Regulation, the Green Public Procurement Communication, the Energy Related Products Directive and the Energy Labelling Directive.

This includes the techno-economic research as well as the operational management particularly of the stakeholder consultation.
GPP criteria process development

Product Group Identification (GPP AG)

1. Preparatory work
2. Preliminary Report
3. Technical report (draft criteria areas and guidance on procurement)

1st AHWG
12.03.2014

Translate criteria areas into criteria

Technical report (draft criteria and guidance on procurement)

2nd AHWG
28.01.2015

Final Draft Criteria

Today
# Agenda

<table>
<thead>
<tr>
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<th>Topic</th>
<th>Time</th>
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<tr>
<td>1</td>
<td>Opening and welcome. GPP criteria process description</td>
<td>09:30-09:45</td>
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<tr>
<td>2</td>
<td>Project overview and scope proposal</td>
<td>09:45-10:00</td>
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<td>3</td>
<td>Criteria proposal on pavement-vehicle interaction</td>
<td>10:00-10:45</td>
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<td>4</td>
<td>Criteria proposal on resource efficient construction. LCA performance requirements</td>
<td>10:45-11:30</td>
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<td><em>Coffee break</em></td>
<td>11:30-11:45</td>
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<td>5</td>
<td>Criteria proposal on resource efficient construction. Recycled content, materials transportation, asphalt</td>
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<td><em>Lunch</em></td>
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<td>6</td>
<td>Criteria proposal on resource efficient construction. Excavated materials and soil management</td>
<td>14:00-14:30</td>
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<td>7</td>
<td>Criteria proposal on noise emissions</td>
<td>14:30-15:30</td>
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<td>8</td>
<td>Criteria proposal on water and habitat preservation</td>
<td>15:30-16:30</td>
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<td></td>
<td><em>Coffee break</em></td>
<td>16:30-16:45</td>
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<td>9</td>
<td>Criteria proposal on congestion</td>
<td>16:45-17:00</td>
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<td>10</td>
<td>Criteria proposal on maintenance and rehabilitation strategies</td>
<td>17:00-17:30</td>
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<td>11</td>
<td>Developing guidance for the procurement of road construction</td>
<td>17:30-17:45</td>
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<td>12</td>
<td>Conclusions, next steps and closure of the meeting</td>
<td>17:45-18:00</td>
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Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

Project overview and scope proposal
Project overview


1st AHWG: **12.03.2014**


**EU GPP Advisory Group** (MSs + five stakeholders: Industry, NGOs, local/regional government)

Stakeholders +

**121 Registered stakeholders** (Public Authorities, Research centres and universities, Industry, NGOs)
Definition

Road "Line of communication (travelled way) open to public traffic, primarily for the use of road motor vehicles, using a stabilized base other than rails or air strips" (Eurostat, 2009)

Road construction "the preparation and building of a road using materials, including aggregate, bituminous and hydraulic binders and additives that are used for the sub-base, road-base and surfacing layers of the road" (previous GPP criteria)

Classification of roads

<table>
<thead>
<tr>
<th>Eurostat</th>
<th>IRF</th>
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<tbody>
<tr>
<td>Motorway / freeway</td>
<td>Motorways</td>
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<tr>
<td>Express road</td>
<td>Highways, main or national roads</td>
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<tr>
<td>Road outside a built-up area</td>
<td>Secondary or regional roads</td>
</tr>
<tr>
<td>Road inside a built-up area: urban road</td>
<td>Other roads - Rural</td>
</tr>
<tr>
<td></td>
<td>Other roads - Urban</td>
</tr>
</tbody>
</table>

Market analysis
Road maintenance (Weninger-Vycudil, 2009 - ERA-NET PO3 project)

Routine maintenance: small measures to repair local deterioration (cracks, potholes...) and operational activities (e.g. winter maintenance...). The objective of these measures is to keep the road (pavement and the other sub-assets) in a defined (minimum) condition level and to avoid progressive deterioration.....

Periodic maintenance: measures with a long lasting improving effect to the condition of the sub-asset or component... They are planned as soon as the condition of the component falls below a given warning level and they have to be conducted according to a priority rating (e.g. LCC-analysis) ....

Upgrade and extension: measures which upgrade the existing sub-asset or component or extend the infrastructure to a higher level than the original new condition.... Normally only the part of the works which is attributed to the basic improvement (rehabilitation) is paid from the maintenance budget

Rehabilitation: works undertaken to extend the service life of an existing facility. This includes placement of an overlay and/or other work necessary to return an existing roadway, including shoulders, to a condition of structural or functional adequacy, for the specified service life. This might include the partial or complete removal and replacement of portions of the pavement (Caltrans, 2013)
Categorization of roads

**Pavement condition**

**Rigid pavements layer system**
- Reinforcing materials
- Concrete slab
- Sub-base (bound or unbound aggregate)
- Sub-grade (soil)
- Surface course (bituminous bound)

**Flexible pavement layer system**
- Surface course + binder course (bituminous bound)
- Base course (bituminous bound)
- Road base (bound or unbound aggregate)
- Sub-base (bound or unbound aggregate)
- Sub-grade (soil)

**Semi-rigid pavement layer system**
- Surface course + binder course (bituminous bound)
- Base course (hydraulically bound)
- Road base (bound or unbound aggregate)
- Sub-base (bound or unbound aggregate)
- Sub-grade (soil)
Scope proposal
Phases considered

- **Materials production including raw materials extraction** (including upstream supply chain, transportation, off-site equipment, use of by-products and recycled/reused/recovered materials)

- **Construction** (including clearance, earthworks, ground works & stabilisation, on-site equipment, pavement and drainage systems construction, congestion, noise)

- **Use** (including the daily traffic and thus vehicle fuel consumption during the road service life). Allocation with structural characteristics and surface texture

- **Maintenance (and operation)** (including routine and periodic maintenance and rehabilitation, lighting and road ancillary elements, congestion, noise)

- **End-of-life (EoL)** Surface courses removed during maintenance or decommissioning
Exclusion from the scope

- **Traffic signs**, because of minor importance (Stripple, 2001; SUSCON, 2006; Loijos et al., 2013)
  
  ⇒ approximate influence of the traffic signs below 1% of materials production, construction and maintenance

- **Foundations** or **lighting of traffic signs**: small amounts of energy compared to the energy consumption through the full life cycle (Stripple, 2001; Mroueh et al., 2001)

- **Road markings** (included in GPP criteria for paints and varnishes)

- **Street lighting and traffic signals** (dedicated GPP criteria)

- **Information systems**

- **Other types of road furniture** (pedestrian walkways, bollards, overhead gantries and central reservations)
Criteria overview

**Project process**

- **Preparation**
  - Assessment of need
  - Appraisal
  - Strategic briefing
  - Project briefing
  - Concept design

- **Design**
  - A. Selection criteria
  - B. Detailed design
  - Construction procurement

- **Construction**
  - C. Construction
  - Completion

- **Use**
  - Handover
  - D. Use

- **End of Life**
  - E. Maintenance & operation
  - F. EoL / decommissioning

**Procurement phase**

**Client led procurement of:**
- Consultants - design cost, engineering, quantity surveyors, other specialists
- Design team
- Main contractors (for DB, DBO, PPP contracts)
  - DB design and build
  - DBO design build operation
  - PPP public private partnerships

**Client led procurement traditional contractor(s):**
**Main contractor(s)**
- **Main contractors led procurement** (subcontractors, materials, temporary labour, plant and equipment)
  - **Sub-contractor(s) led procurement** (further subcontractors, materials, plant and equipment, trades)
  - **Trades procurement** (materials, plant and equipment, labour)

**Client or contract led procurement**
- Operator management services
- Maintenance services

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*Joint Research Centre*
Criteria overview
GPP criteria grouped by criteria areas (order in this presentation)

<table>
<thead>
<tr>
<th>Title of the criterion</th>
<th>Proc. phase</th>
<th>Criterion classif.</th>
<th>Criteria type</th>
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<td>Competencies of the project manager and the design team</td>
<td>A.</td>
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<td><strong>Durability</strong></td>
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# GPP criteria grouped by procurement phases

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<th>Core criteria</th>
<th>Comprehensive criteria</th>
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<td><strong>A. Selection of the design team and contractors</strong></td>
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<td>A1. Competencies of the project manager and design team</td>
<td>A1. Competencies of the project manager and design team</td>
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<tr>
<td>A2. Competencies of the main construction contractor</td>
<td>A2. Competencies of the main construction contractor</td>
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<td><strong>B. Detailed design and performance requirements</strong></td>
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<td><strong>TECHNICAL SPECIFICATIONS</strong></td>
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<td>B2. Low temperature asphalt</td>
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<td>B3. Excavated materials and soil management plan</td>
<td>B3. Excavated materials and soil management plan</td>
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<td>B4. Performance requirements for water pollution control components in drainage systems</td>
<td>B4. Performance requirements for water pollution control components in drainage systems</td>
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<td>B5. Performance requirements for storm-water retention capacity in drainage systems</td>
<td>B5. Performance requirements for storm-water retention capacity in drainage systems</td>
</tr>
<tr>
<td>B8. Noise barrier design and material properties</td>
<td>B8. Noise barrier design and material properties</td>
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<tr>
<td>B10. Traffic congestion mitigation plan</td>
<td>B10. Traffic congestion mitigation plan</td>
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<td>B11. Performance requirements for durability of pavement and rehabilitation</td>
<td>B11. Performance requirements for durability of pavement and rehabilitation</td>
</tr>
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<td>B12. Maintenance and rehabilitation (M&amp;R) plan</td>
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<td>B13. Performance requirements on traffic fuel consump. due to rolling resist.</td>
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<td>B16. Performance requirements for CO2e emission from materials transportation</td>
<td>B16. Performance requirements for CO2e emission from materials transportation</td>
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<td>B17. Requirements for water pollution control &quot;soft engineered&quot; components in drainage systems</td>
<td>B17. Requirements for water pollution control &quot;soft engineered&quot; components in drainage systems</td>
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<td>B18. Requirements for storm-water retention capacity in drainage systems that incorporate &quot;soft engineered&quot; components</td>
<td>B18. Requirements for storm-water retention capacity in drainage systems that incorporate &quot;soft engineered&quot; components</td>
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<td>B19. Performance requirements for wildlife corridors across the road</td>
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### C. Construction

<table>
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<th>CONTRACT PERFORMANCE CLAUSE</th>
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<td>C2. Commissioning of the road construction</td>
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<td>C3. Quality of the completed road - monitoring of the performance parameters</td>
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<td>C4. Incorporation of recycled content</td>
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<td>C5. Monitoring of the low temperature asphalt</td>
<td>C5. Monitoring of the low temperature asphalt</td>
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<td>C6. Commissioning of the excavated materials and soil management plan</td>
<td>C6. Commissioning of the excavated materials and soil management plan</td>
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<tr>
<td>C7. Inspection of water pollution control components in drainage systems</td>
<td>C7. Inspection of water pollution control components in drainage systems</td>
</tr>
<tr>
<td>C8. Construction of water pollution control &quot;soft engineered&quot; components in drainage systems</td>
<td>C8. Construction of water pollution control &quot;soft engineered&quot; components in drainage systems</td>
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<tr>
<td>C9. Inspection of storm-water retention capacity in drainage systems</td>
<td>C9. Inspection of storm-water retention capacity in drainage systems</td>
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<td>C10. Inspection of storm-water retention capacity in drainage systems that incorporate &quot;soft engineered&quot; components</td>
<td>C10. Inspection of storm-water retention capacity in drainage systems that incorporate &quot;soft engineered&quot; components</td>
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<td>C11. Inspection of wildlife corridors across the road and other measures</td>
<td>C11. Inspection of wildlife corridors across the road and other measures</td>
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<td>C15. Commissioning of the traffic congestion mitigation plan</td>
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### D. Use

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<td>D1. Commissioning of the maintenance and rehabilitation (M&amp;R) plan</td>
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### E. Maintenance and operation

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<td>E1. Tar-containing asphalt</td>
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<td>E2. Demolition waste audit and management plan</td>
<td>E2. Demolition waste audit and management plan</td>
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### F. End of life

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<td>F1. Demolition waste audit and management plan</td>
<td>F1. Demolition waste audit and management plan</td>
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Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on pavement-vehicle interaction
Pavement-vehicle interaction

Rationale

- Traffic during the use phase dominates the life cycle impacts of a road with expected high traffic volume. The authors referred to studies indicating that a 10% reduction in the rolling resistance can lead to 1-2% improvement in fuel economy (Wang et al., 2012a)

- Results → very sensitive to traffic flow

- Rolling resistance is a function of many performance parameters, mainly macrotexture, unevenness and stiffness

- The relation of fuel consumption (Fc) and the change of MPD and IRI was investigated

- The results show that RR is very well correlated to MPD, while the effect of IRI is less apparent.

- Deflection represents 1 – 2% of RR
FUEL CONSUMPTION Fc with (_red) and without an IRI speed effect

- MIRIAM and MIRAVEC projects:
  - IRI is not so relevant to save fuel consumption of cars and heavy trucks (potential savings for heavy trucks + trailers) due to speed effect
  - Reduction of IRI by 0.5 and MPD by 0.5 is expected to change total Fc by (Hammarström, 2012):
    - 0.0% for just IRI
    - -1.1% for just MPD
    - -1.1% for both IRI and MPD.

Rise and fall (RF), curvature (ADC), macrotexture (MPD), unevenness (IRI) and rutting (RUT)

Carlson, Hammarström, Eriksson, 2013
An improvement on MPD to decrease the rolling resistance of the road surface can conflict with safety conditions, particularly with skid resistance. Any criterion on MPD shall therefore be framed within the safety requirements for the road surface.

(Haider et al, 2012)
### Interdependency matrix of surface parameters (Tyrosafe project)

Set of parameters used for optimising road surfacing performance:
- low aggregate size
- polishing resistance
- aggregates high angularity
- aggregates cubic shape
- binder viscosity
- a concave surface texture

---

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Skid Resistance</th>
<th>Rolling Resistance</th>
<th>Noise Emission</th>
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<tr>
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</tr>
<tr>
<td>angularity of aggregates</td>
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<td>+</td>
<td></td>
</tr>
<tr>
<td>polishing resistance (Polished Stone Value (PSV)/coarse aggregates)</td>
<td>↑</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>polishing resistance (PWS/fine aggregates)</td>
<td>↑</td>
<td>+</td>
<td></td>
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<tr>
<td>hardness</td>
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<td>aggregate composition and Structure (percent of hard fraction by visual examination and petrographic analysis)</td>
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<td></td>
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<tr>
<td>abrasion/wear resistance (Micro Deval)</td>
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<tr>
<td>maximum aggregate size</td>
<td>↓</td>
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</tr>
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<td>binder content</td>
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</tr>
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<td>binder type (viscosity)</td>
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<td>void content (mix design)</td>
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<table>
<thead>
<tr>
<th>Parameters</th>
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<th>Noise Emission</th>
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<tr>
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<tr>
<td>chippings – PSV/PWS</td>
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<td>degree of compaction</td>
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<table>
<thead>
<tr>
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<tr>
<td>angularity of aggregates</td>
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<tr>
<td>polishing resistance (Polished Stone Value (PSV)/coarse aggregates)</td>
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<tr>
<td>hardness</td>
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<td>aggregate composition and structure (percent of hard fraction by visual examination and petrographic analysis)</td>
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<td></td>
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</tr>
<tr>
<td>abrasion/wear resistance (Micro Deval)</td>
<td>↓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Sharnigg, 2010
Cost 354 "Selection and assessment of individual performance indicators" (COST, 2008)

- Range of 0.75 to 1.5 mm of MPD seems → 'very good' in terms of skid resistance for motorways and other primary roads.
- 0.64 mm is the 'warning limit' in the Czech Republic
- 0.54 mm triggers maintenance measures

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>NAME</th>
<th>Performance indicator</th>
<th>THRESHOLD</th>
<th>WARNING</th>
<th>ACCEPTANCE</th>
<th>TARGET</th>
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</thead>
<tbody>
<tr>
<td>CZECH REPUBLIC 1</td>
<td>Texture depth MPD</td>
<td>MPD</td>
<td>0,54</td>
<td>0,64</td>
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<tr>
<td>CZECH REPUBLIC 2</td>
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<td>MPD</td>
<td>0,44</td>
<td>0,54</td>
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<td>FRANCE 1</td>
<td>Sand patch value MPD</td>
<td>MPD</td>
<td>40</td>
<td>60</td>
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</tr>
</tbody>
</table>

MPD thresholds in Sweden (under consideration)

<table>
<thead>
<tr>
<th>MDP interval</th>
<th>90 - 110 km/h Motorways and other primary roads</th>
<th>70 km/h Secondary roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 0,3</td>
<td>Not suitable/very poor</td>
<td>Not suitable/very poor</td>
</tr>
<tr>
<td>0,31 - 0,5</td>
<td>Not suitable/very poor</td>
<td>Bad/poor</td>
</tr>
<tr>
<td>0,51 - 0,7</td>
<td>Bad/poor</td>
<td>Ok/very good</td>
</tr>
<tr>
<td>0,71 - 1,0</td>
<td>Ok/very good</td>
<td>Acceptable/good</td>
</tr>
<tr>
<td>1,01 - 1,50</td>
<td>Ok/very good</td>
<td>Bad/poor</td>
</tr>
<tr>
<td>1,51 - 2,00</td>
<td>Acceptable/good</td>
<td>Bad/poor</td>
</tr>
<tr>
<td>2,01 -</td>
<td>Bad/poor</td>
<td>Not suitable/very poor</td>
</tr>
</tbody>
</table>
Evolution of MPD over time

MPD is generally prone to decrease with the road aging due to polishing effect of traffic

Measurement campaign in the Netherlands (2013): ageing effects more apparent in DAC

Effect of polishing is determining to define a criterion on low MPD → demand more frequent maintenance actions

A holistic approach based on LCA and LCCA should be applied (MIRAVEC D4: VTI report, UCPRC report)

MIRAVEC WP3 ⇒ Excel tool for estimating fuel consumption associated with a specific route and evaluate the effects of various changes to the road infrastructure
Assessment and verification issue

- Incorporation of MPD as GPP criterion \(\Rightarrow\) deviations of MPD from the designed valued in the construction phase
- Texture is depending on the mix design (aggregates, bitumen content)

- Measurement campaign in Netherlands:
  - MPD deviation among roads with same surface texture can be large per pavement type, but the average MPD value per pavement type is significantly different from the others
  - Rolling resistance parameter instead or MPD?
  - Standard test methods
Pavement-vehicle interaction
Criteria proposal

B13. Performance requirements on traffic fuel consumption due to rolling resistance
For those motorways and highways, main roads or national roads designed to bear high AADT at steady speed, points will be awarded to those offers that commit

OPTION 1: to a lower MPD of the road surface.
OPTION 2: to a road surface which will reduce traffic fuel consumption. The contracting authority will provide the tenderers with the Excel tool including the planning data.

The tenderer shall include the design parameters influencing the fuel consumption declaring those values together with their error margins.

The MPD shall ensure the compliance with the skid resistance required by national, regional and/or local legislation.
The MPD declared shall be guaranteed along the lifetime of the road, therefore, the maintenance plan shall include the monitoring of MPD on a regular basis (at least every 5 years) and the maintenance works to be implemented.
Verification

**OPTION 1 – 2:**
The design team, DB tenderer or DBO tenderer shall provide the detailed design including the performance parameters declared together with test results on a representative test sample of the surface, according to the standard ISO 13473-1. Tests shall be carried out by an independent laboratory.

**Only in OPTION 2:**
The design team, DB tenderer or DBO tenderer shall evaluate the fuel consumption by means of the MIRAVEC tool or, where existing, other assessment tools including:

- **Fuel consumption model** for free flow traffic based on:
  - Vehicle characteristics
  - Rolling resistance, Air resistance, Average degree of curvature, Rise and fall/gradient, Velocity
- **Rolling resistance** dependent on ambient temperature, IRI, MPD
- **Vehicle velocity**, based on posted speed, vehicle type, traffic volume, gradient, IRI and rutting present
- **Idle time**
C3. Quality of the completed road - monitoring of the performance parameters

The main construction contractor or DBO contractor shall monitor the agreed rolling resistance performance parameters affecting the traffic fuel consumption after the construction before the road opening and 6 months after the opening (in-service road), and provide the test results of the monitoring.
Questions to stakeholders

- Is it possible to anticipate in a tender the MPD of the pavement? Which is the range of deviation expected?

- Constraints of verification?

- Is it suitable the use of MIRAVEC Excel tool?
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on resource efficient construction
Resource efficient construction

The embodied impacts of construction materials production and transportation are the second most significant environmental impacts for high traffic roads (the most important for low traffic roads).

The main materials in road construction are asphalt, concrete and aggregates. Main potential environmental savings with:

- WMA, HWMA, CMA in substitution of HMA
- Reused/recycled/recovered materials and by-products
  - Reclaimed asphalt pavement RAP
  - SCM supplementary cementitious materials, such as BFS, fly ash
  - Recycled aggregates from C&DW
  - Recycled concrete
  - Manufactured aggregates such as iron and steel slag, coal combustion ashes, MSWI bottom ash, reclaimed rubber from tyres
  - Excavated materials and soils

- Assessment of Scenarios and Options towards a Resource Efficient Europe 2030
- Preliminary report
Holistic performance approach

Stakeholders feedbacks:

• Disagreement on **detailed criteria** on different construction materials. Need of flexible criteria

• Need of an **holistic performance based approach** (evaluation of environmental performance for the whole infrastructure by means of a LCA/LCC)

• Support to the **use of recycled materials and by-products**, but **not for each material** (holistic and non-prescriptive approach)

New proposal:

⇒ a **LCA performance approach**

⇒ a **recycled content criterion for the total weight of all construction materials**
LCA performance requirements of the main road elements

Rationale

Characterising the different systems used by existing schemes for road and civil works

- **CEN 350** Sustainability of construction works
  - **EN 15804 + EN15978** standards on buildings
  - **WG6** is developing standards on civil engineering works (timeline?)

- **EPD schemes** for road construction materials – **1 PCR** for road

- **Environmental performance assessment schemes for civil works**
  - Existing multi-criteria rating systems: **Invest**, **Greenroads** and **CEEQUAL**
  - **BREEAM-NL – Ecolxbel FP7 project** methodology under development
  - Several **LCA tools** available
## Tools for road construction and materials

### Specific materials

<table>
<thead>
<tr>
<th>Scheme</th>
<th>asPECT&lt;sup&gt;12&lt;/sup&gt;</th>
<th>Aggregain</th>
<th>Changer</th>
<th>CO2ladder</th>
<th>Dubocalc&lt;sup&gt;13&lt;/sup&gt;</th>
<th>ROAD-RES&lt;sup&gt;14&lt;/sup&gt;</th>
<th>Klimatkalkyl&lt;sup&gt;15&lt;/sup&gt;</th>
<th>Seve</th>
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<tbody>
<tr>
<td>Assessment method</td>
<td>HA, MPA, RBA and TRL (UK)</td>
<td>TRL and funded by WRAP (UK)</td>
<td>IRF</td>
<td>Rijkwaterstaat (NL)</td>
<td>Rijkwaterstaat (NL)</td>
<td>DTU (DK)</td>
<td>STA (SE)</td>
<td>Usirf (FR)</td>
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<td>Construction</td>
<td>Maintenance</td>
<td>End of life</td>
<td>Construction</td>
<td>Maintenance</td>
<td>and operation</td>
<td>End of life</td>
<td>Construction</td>
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<td>Global warming (GWP)</td>
<td>Global warming (GWP)</td>
<td>Global warming (GWP)</td>
<td>Global warming (GWP)</td>
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<td>Ozone Depletion potential (ODP)</td>
<td>Photochemical oxidant creation potential (POCP)</td>
<td>Human Toxicity Potential (HTP)</td>
<td>Freshwater Aquatic Ecotoxicity (FAETP)</td>
<td>Ecotoxicity sediments Terrestrial Ecotoxicity Potential (TEETP)</td>
<td>Over fertilization Depletion of renewable materials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Human Toxicity Potential (HTP)</td>
<td>Freshwater Aquatic Ecotoxicity (FAETP)</td>
<td>Ecotoxicity sediments Terrestrial Ecotoxicity Potential (TEETP)</td>
<td>Over fertilization Depletion of renewable materials</td>
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<td></td>
<td>Terrestrial Ecotoxicity Potential (TEETP)</td>
<td>Ecotoxicity sediments Terrestrial Ecotoxicity Potential (TEETP)</td>
<td>Ecotoxicity sediments Terrestrial Ecotoxicity Potential (TEETP)</td>
<td>Over fertilization Depletion of renewable materials</td>
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<tr>
<td></td>
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<td>Photochemical oxidant creation potential (POCP)</td>
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### LCA tools

<table>
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<tbody>
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</tr>
<tr>
<td>Energy consumption (MJ)</td>
</tr>
<tr>
<td>Eutrophication (EP)</td>
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<td>Acidification (AP)</td>
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<td>Photochemical oxidant creation potential (POCP)</td>
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<td>Human Toxicity Potential (HTP)</td>
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<td>Ecotoxicity sediments Terrestrial Ecotoxicity Potential (TEETP)</td>
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<td>Over fertilization Depletion of renewable materials</td>
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### Tools in EU projects

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<thead>
<tr>
<th>Scheme</th>
<th>CEREAL ERA Net II program</th>
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<th>LICCR ERA Net program</th>
<th>MIRAVEC ERA Net program</th>
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<tbody>
<tr>
<td>Assessment method</td>
<td>DHV (NL), KOAC-NPC (NL), DRD (DK)</td>
<td>Waterford County Council (IE) and other partners from CZ, FI, FR, PT, SE and UK</td>
<td>KTH, NTNU, Birgisdottir, Wageningen University, Ecoloop</td>
<td>AIT, TRL, VTI, ZAG, CDV, FEHRL</td>
</tr>
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<td>Reference standard</td>
<td>ISO 14040-14064, EN 15804, CESSM3 Carbon</td>
<td>ISO 14040</td>
<td>ISO 14040</td>
<td>ISO 14040</td>
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<tr>
<td>Life cycle phases</td>
<td>Construction</td>
<td>Maintenance and operation</td>
<td>Use (traffic)</td>
<td>Maintenance End of life</td>
</tr>
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<td>Impact assessment categories</td>
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<td>Cumulative energy consumption (CED)</td>
<td>Global warming (GWP)</td>
<td>Cumulative energy demand (CED)</td>
</tr>
</tbody>
</table>

**traffic** Use (Fuel consumption model for free flow traffic)
Proposing different methodologies for assessing the environmental performance of a road

- **Option 1**: Carbon Footprint (CF) (as Core criterion)
- **Option 2**: LCA (as a Comprehensive criterion)
  1. **Impact Category results**: aggregated results for each indicator
  2. **LCA tool score**: A single score by using a national/regional LCA tool (as Dubocalc)

**Comparability** (see Annexes)
- same LCIA method and life cycle inventory (LCI)
- **LCI quality requirements** (ISO 14067 for CF and ISO 14040-44 for LCA) + verified primary data and supplementary secondary data

*The need for expert evaluation of the design assessments*
Preparation of the ITT and LCAs critical review (ISO 14044, ISO 14065 and PEF Guide)

*The need of considering the project scale and economic value*
Defining the road life cycle, boundaries, main road elements and functional unit

- **Boundaries: cradle-to-grave**, including **construction** (+materials production and transportation) **maintenance** (and operation) and **EoL**
  - The pavement-vehicle interaction during the use phase has not been yet taken into consideration (stakeholders commented that it is too premature) ⇒ a specific criterion on rolling resistance is included

- A **common functional unit** such as **1 km of road** (or lane) and **service life** in years (usually 50 years)
### Main road elements at least to be included

<table>
<thead>
<tr>
<th>New construction or major extension</th>
<th>Maintenance and rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-grade, including earthworks and ground works</td>
<td>Base, binder and surface or concrete slabs</td>
</tr>
<tr>
<td>Sub-base</td>
<td></td>
</tr>
<tr>
<td>Base, binder and surface or concrete slabs</td>
<td></td>
</tr>
<tr>
<td>Additional ancillary road elements <em>(optional)</em></td>
<td></td>
</tr>
</tbody>
</table>

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**Decided by the public authority**

- Main road elements at least to be included
- Sub-grade
- Sub-base
- Base, binder and surface or concrete slabs
- Additional ancillary road elements *(optional)*
**Defining the LCIA Category indicators to be used**

- **GWP, ODP, AP, EP** and solid waste generation ⇔ **PED** (primary energy)
- relevant impacts related to NOx and VOCs emissions ⇔ **POCP**
- **ADP** (elements and energy/fossil fuels) and **land use** ⇔ under discussion in the scientific community
- **mass of non-renewable and secondary resources**

- In **Option 1 (CF)** ⇔ **GWP**
- In **Option 2 (LCA)** ⇔
  - **PED** (non renewable PED-NR and renewable PED-R)
  - **GWP**
  - **POCP**
  - secondary resources in mass

- **Assessment of Scenarios and Options towards a Resource Efficient Europe 2030 (UK built Environment)**
- **LCA studies review + PRC of Environdec**
LCA performance requirements of the main road elements
Criteria proposal

B14. LCA performance of the main road elements
This criterion may only be applied where a Bill of Quantities for a reference road is to be provided to bidders as the basis for comparison or where designs submitted by different bidders are to be compared during a competitive process.
Additional technical guidance shall be followed during the procurement process, as provided in Annex A (CF option) - Annex B (LCA option)
A technical evaluator specialised in LCA shall assist in preparing the ITT and shall carry out a critical review

Points will be awarded on the base of the improvement of the carbon footprint (CF) – Life Cycle Assessment performance (LCA) of the road including at least the main road elements listed in Table (c-d) in comparison with a reference road or other competing designs. The basis for the comparison shall be specified in the ITT.

<table>
<thead>
<tr>
<th>New construction or major extension</th>
<th>Maintenance and rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sub-grade, including earthworks and ground works</td>
<td>• Base, binder and surface or concrete slabs</td>
</tr>
<tr>
<td>• Sub-base</td>
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</tr>
<tr>
<td>• Base, binder and surface or concrete slabs</td>
<td></td>
</tr>
<tr>
<td>• Additional ancillary road elements (optional)</td>
<td></td>
</tr>
</tbody>
</table>
Option 1: Carry out a Carbon footprint (CF)
The performance shall be evaluated by carrying out a Carbon Footprint (CF) of the road in accordance with ISO 14067 or equivalent. The ITT shall specify the method that shall be used for the evaluation (see Annex A). The bidder that shows the lowest carbon footprint will be ranked with the highest value.

Option 2: Carry out a Life Cycle Assessment (LCA)
The performance shall be evaluated by carrying out a Life Cycle Assessment (LCA) of the road in accordance with ISO 14040/14044 or equivalent. The ITT shall specify which of the following methods shall be used for the evaluation (see Annex B):

(i) Impact Category results: The aggregated characterisation results for each indicator obtained using the specified LCA method; or

(ii) LCA tool score: A single score obtained using a national or regional LCA tool used by public authorities;

The methodology shall include, as a minimum, the Lifecycle Impact Category Indicators specified in Annex B.
Verification

The Design team (or DB-DBO) tenderer shall provide a **bill of materials** for the proposed design. The **comparison** with the **reference road** shall be written up in a **concise technical report** that **compares** the **design option(s)** and **calculates** the **improvement potential**.

*The technical report shall be subject to a critical review by the contracting authorities appointed LCA technical evaluator. The critical review shall follow the guidelines in Annex C.*
B. Detailed design

The successful tenderer shall prepare a **handover document** including the **assumptions** and **results** with specific regard to:

- **earthworks** and groundwork solutions
- materials suggested to be used, techniques applied such as WMA,HWMA,CMA and **recycled content**
- **transportation distances** from production site to the worksite (baseline mass haul plan)
- **% of recycling, reuse** of excavated **materials** and C&DW on-site and off-site
- **Maintenance activities** and **frequencies**

The **handover document** will be used by the **procurer** for the **future ITT** in case of **separated design and built** contracts or will be **updated** and further **improved** by the main construction contractor (or **DB - DBO contractor**) before starting the construction phase.

The successful tenderer shall conclude the design phase with the preparation of the handover document.

The successful **DB - DBO** tenderer shall prepare the handover document before starting the construction phase.
Recycled content

Rationale

- The use of **materials** with **high recycled content** is one of the practices with the greatest potential to **improve resource efficiency** \(\Rightarrow\) **diverting materials from landfill** and **saving natural resources**

- Case studies undertaken for a broad range of civil works: **most roads** have **>10%w recycled content** using **standard products**

<table>
<thead>
<tr>
<th>Material</th>
<th>Standard practice (% med.)</th>
<th>Good practice (% med.)</th>
<th>Best practice (% med.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse aggregates in concrete</td>
<td>0°</td>
<td>20°</td>
<td>100°</td>
</tr>
<tr>
<td>Coarse aggregate in low strength mass concrete</td>
<td>0°</td>
<td>30°</td>
<td>100°</td>
</tr>
<tr>
<td>Unbound in civil applications</td>
<td>0-50°</td>
<td>25-80°</td>
<td>100°</td>
</tr>
<tr>
<td>Aggregates in hydraulic bound and cement bound materials</td>
<td>0°</td>
<td>60°</td>
<td>100°</td>
</tr>
<tr>
<td>Aggregate in bituminous bound pavements (off-site)</td>
<td>0°</td>
<td>10°</td>
<td>40°</td>
</tr>
<tr>
<td>Aggregate in bituminous bound pavements on-site/off-site cold process</td>
<td>100°</td>
<td>100°</td>
<td>100°</td>
</tr>
<tr>
<td>Aggregates in road sub-base</td>
<td>100°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled concrete aggregates</td>
<td>30°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMA and/or WMA – RAP hot mix recycling, off-site</td>
<td>30-80°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMA and/or WMA – RAP hot mix recycling, off-site</td>
<td>30-50°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMA and/or WMA – RAP cold method in hot mix recycling, off-site</td>
<td>10-40°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMA – Cold mix recycling in a stationary plant</td>
<td>90°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMA and/or WMA – on-site hot mix recycling of RAP</td>
<td>100°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMA – on-site cold mix recycling of RAP</td>
<td>100°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic bound material and cement bound material</td>
<td>100°°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast in situ reinforced structural concrete (max C25-C30)</td>
<td>15-24°°</td>
<td>30-52°°</td>
<td>44-90°°</td>
</tr>
<tr>
<td>Cast in situ reinforced structural concrete (higher than C30)</td>
<td>0°°</td>
<td>7°°</td>
<td>26°°</td>
</tr>
<tr>
<td>Pre-cast reinforced structural concrete</td>
<td>20°°</td>
<td>22°°</td>
<td>23°°</td>
</tr>
<tr>
<td>Trench fill foamed concrete</td>
<td>0°°</td>
<td>40°°</td>
<td>95°°</td>
</tr>
<tr>
<td>Inert</td>
<td>75°°</td>
<td>95°°</td>
<td>100°°</td>
</tr>
</tbody>
</table>

- By using **cost-neutral good practice** and available construction products with higher recycled content: **15-30%w recycled content** obtained
• Monitoring recycled content: estimation accurately reported

• Verification:

  ⇒ Under **CPR 305/2011/EU**, several products with recycling potential covered by several **standards** (product performance). CEN is now assessing if and how **reliable information on recycled content** could be addressed

  ⇒ **Annual production average** for a dedicated production line is **readily verifiable**

  ⇒ Proposal of an approach based on a **mass balance for batches** of product **delivered to site** (as **ready mix concrete** or **asphalt** for which batch is tested prior to dispatch)

  ⇒ During the **construction** phase, **collection** of all the **certificates** including **product data sheets, batch documentation**, i.e. data from **mix design, FPC documentation** and **supporting certificates for recyclates**

  ⇒ **Verification by means of a third party audit**
B. Detailed design

Recycled content
Criteria proposal

B1 Minimum recycled content

A minimum recycled content, reused content and/or by-products of 10% by weight for the sum of the main road elements in Table (a)

The recycled content shall be calculated on the basis of an average mass balance of reused, recycled materials and/or by-products according to how they are produced (as applicable):

- The total number of ready mixed batches delivered to site in accordance with standards on:
  - aggregates like EN 13242, EN 13285;
  - asphalt pavement like EN 13043, EN 13108-1, EN 13108-2, EN 13108-3, EN 13108-4, EN 13108-5, EN 13108-6, EN 13108-7, EN 13108-8;
  - concrete pavement like N 206, EN 12620, EN13877;
  - hydraulically bound granular mixtures like EN 14227 part 1 to 5
  - Stabilised soil like EN 14227 part 10 to 15

- On an annual basis for factory-made slabs and elements with claimed content levels in accordance with standards like EN 12620 and EN 206, EN 13877 and national legislation
B15. Incorporation of recycled content

Points will be awarded to tenderers that achieve greater than or equal to 15% - 30% by weight of recycled content, reused content and/or by-products for the sum of the main road elements in Table (e). Points will be awarded in proportion to the total percentage reached.

The recycled content shall be calculated on the basis of an average mass balance of reused, recycled materials and/or by-products according to how they are produced (as applicable):

the same as in B1
Verification (B1 and B15)

The Design team (or DB - DBO tenderer) shall quantify the proportional contribution of the recycled content and/or re-used content to the overall weight of the specified road elements, based on the information provided by the potential supplier(s) of the construction material.

This information must include the average mass balance calculations as described above, supported by batch documentation and/or factory production control documentation. In each case this shall be verified by a third party audit.
C4. – E5. Incorporation of recycled content

When **materials** are **delivered** to the **work site**, **recycled content claims** with **clear traceability** shall be **verified** for **each representative batch/batches of product**. The main construction contractor (**or** DB - DBO contractor) shall **verify claims** by providing either:

- **an independent third party certification** of the **traceability** and **mass balance** for the **product** and/or **recyclate**
- **or equivalent documentation** provided by **suppliers**.
Questions to stakeholders

The verification would therefore need to be conducted by auditing of the manufacturer's process control records.

• Is this practical in reality?
• Could you please provide additional information and experience on the verification of these criteria?
Materials transportation
Rationale

- **Transportation** is one of the **main hot-spots**. It is **unique** to the **specific road projects**. Significant **GHG emissions** are produced.
- Stakeholders disagreement on considering materials transportation distances as a stand-alone criterion ⇒ **holistic LCA approach**
- If criteria on **CF** or **LCA** are not proposed, **CO2e emission / tonne of material transported** can be alternatively evaluated.
- **Several in-house or internationally available GHG calculators** can be used (ENCODE Protocol, ICE Demolition Protocol, DEFRA’s Guidelines for Company Reporting on Greenhouse Gas Emissions, WRAP’s CO2 Estimator Tool, the Flemish “Carbon Free-Ways”)
- **Sweden**: requirements set on **trucks** and **working machines**. **GPS** to measure quantities of excavated and filled soils is used but not mandatory ⇒ costs and benefit
B16. Performance requirements for CO2e emission from materials transportation

This criterion shall be applied in cases when the criterion on CF or LCA performance B14 is not applied

Points will be awarded on the base of the reduction in the CO2e emission/tonne of transported materials that are employed as a minimum in the main road elements listed in Table (g) in comparison with a reference road or other competing designs.

Methods and tools to evaluate the CO2e emissions of transported materials to be specified in the ITT.
Methods and tools to evaluate the CO2e emissions of transported materials to be specified in the ITT.

The BoQ of materials, the transportation distances from the production site to the work site and the CO2e/tonne of transported material shall be included in a baseline mass haul plan that constitutes part of the handover document prepared by the successful tenderer. The mass haul shall be used by the procurer for the future ITT in case of separated design and built contracts or optimised by the main construction contractor.

**Verification**

The Design team (or DB - DBO tenderer) shall provide the CO2e/tonne of transported material and the transportation distances from the production site to the work site and multiply this by the relevant quantities as stated in the BoQ.
Asphalt
Rationale on tar-containing asphalt

- Analysing the tar content in reclaimed asphalt is relevant if coal tar has been used in the past (in EU different age of roads that might contain tar)

- For pavements older than X years (X shall be fixed by the contracting authority) that could possibly contain tar, the possible tar content can be analysed before reclaiming asphalt by means of initial non-destructive tests (UV-lamp on site), sampling and laboratory analytical tests.

Limits for tar-containing (reclaimed) asphalt in different MSs

<table>
<thead>
<tr>
<th>Belgium</th>
<th>Sweden</th>
<th>the Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100 mg</td>
<td>&lt; 70 ppm</td>
<td>&lt; 75 ppm</td>
</tr>
<tr>
<td>PAH-10/kg</td>
<td>PAH-16 (appr. PAH-L, PAH-M and PAH-H)</td>
<td>sum of 10-PAH</td>
</tr>
</tbody>
</table>
If the tar content of reclaimed asphalt exceeds the limit set by the national legislation:

- restrictions in the Netherlands
- best available techniques that can be used to treat or reuse reclaimed asphalt
  - binding RAP containing tar
  - using only CMA and WMA techniques

Stakeholders suggested the definition of an upper threshold of tar content where the RAP could be reused and encapsulated using a cold process off-site and, above this limit, then only on-site cold recycling should be used ⇒ definition related to the national legislation and it cannot be generalised for EU-28
Asphalt
Criteria proposal

E1. Tar-containing asphalt
(For pavements older than X years that could possibly contain tar according to the public authority)

The possible tar content of surface layers (surface + binder) shall be analysed before reclaiming asphalt by means of initial non-destructive tests, sampling and laboratory analytical tests. If the tar content of reclaimed asphalt exceeds the limit set by the national legislation, best available techniques to treat or, eventually, reuse reclaimed asphalt containing tar shall be specified in a technical report.

X shall be fixed by the contracting authority according to the knowledge, available database and inventory
Verification

The main construction contractor (or DB - DBO contractor) shall submit a technical report consisting of:

(i) **results** of the **sampling** and analytical **tests**

(ii) **best available techniques** to treat or, eventually, use reclaimed asphalt containing tar through cold mixing on site and/or off site options

A system shall be used to **monitor** and account for tar-containing reclaimed asphalt and to track off site destination and on site reuse, specifying **amount** of materials and identifying the **location** (maps, GIS). **Monitoring data** shall be provided to the contracting authority and to the NRA or local authority.
Questions to stakeholders

A stakeholder underlined that surface dressing using cutbacks containing aromatic oils, such as creosote, have been used fairly recently and will give a positive testing result for tar. Therefore it would be difficult to gauge road age, because any road surface dressed up to the mid '90s could have had tar/tar oils included in the cutback or emulsion.

- Do you have any experience in this specific issue? Could you please provide further information?
Asphalt
Rationale on low temperature asphalt

- The environmental benefits of using **low temperature asphalt** are now **included** in the **holistic LCA performance approach**. HMA/WMA/HWMA/CMA free to be chosen.

- **Reduction of mixing and laying temperature** ⇒ decrease VOC, PAH, CO, SO2 and NOx emissions ⇒ significant improvement of the health and safety conditions of workers.

- In some MSs, **technical specifications** on a **maximum laying temperature** for **bituminous mixtures** are proposed (Italian GPP draft criteria, WMA Task Force of the Flemish Road Authority).

  ⇒ **120°C - 140°C** proposed in the criteria.
• Higher temperatures needed in case of **specific performance bituminous mixtures** realized with **special binders with higher viscosity** (such as rubberised asphalt pavements)

• At around **155° C**, **differences in viscosity** between the bituminous mixtures with different pulverised rubber contents **decrease** (Santagata et al., 2012 and Ecopneus)
Asphalt
Criteria proposal

B2. Low temperature asphalt

The design team (or DB -DBO tenderer) shall propose best practice and techniques for laying bituminous mixtures in order to decrease the health and safety exposure risk of workers.

The maximum temperature for laying the bituminous mixtures of surface and binder courses shall not exceed 140°C - 120°C.

Only in cases of higher viscosity special bituminous mixtures, laying temperatures up to greater than 140°C - 120°C, but lower than 155°C, shall be allowed.

Verification

The design team (or DB -DBO tenderer) shall provide a technical report and a workplan of the design activities, indicating the mixing and laying techniques and the maximum temperatures required by these techniques.

The laying temperature of the low temperature asphalt shall be verified for each representative batch/batches of product at the worksite.

The main construction contractor (or DB -DBO contractor) shall provide either:
- an independent laboratory certification of the maximum temperature of the asphalt
- or equivalent documentation provided by asphalt supplier
Questions

- Could this technical specification be applied in all MSs, or is it better to propose it as an award criterion?

- Could you please provide additional information and experience on the verification of these criteria?
Excavated materials and soil management

Rationale

- In **complex orography**, when **embankments** and **ground works** are needed, the impacts related to **earthworks** can account **up to 30%** of the project's emissions.

- **Environmental impacts** are **evaluated** by means of the **holistic LCA performance approach** (including stabilization and maximum amount of excavated materials reused on site).

- **Aim of an excavated materials and soil management plan** (Code of practice on soil management of DEFRA 2009)
  - **Optimization of recycling/reuse** of materials and **best practise**
  - **In greenfield**, the **separate management** of **topsoil**
B3. Excavated materials and soil management plan

Waste production during excavation, excluding C&DW, shall be recorded.

An excavation materials and soil management plan shall be prepared establishing systems for the separate collection of:

(i) excavated materials resulting from excavation activities (for example from site preparation and levelling, foundation, basement and trench excavation), typically soil and stones, including subsoil

(ii) topsoil.

Closed loop reuse on-site for both excavated materials and topsoil should be maximised according to the results of the carbon footprint or LCA performance assessment (see criterion B14).

Separate excavated material collection for re-use, recycling and recovery shall respect the waste hierarchy in Directive 2008/98/EC.
Verification

The design team (or DB-DBO tenderer) shall provide a **excavated materials and topsoil management plan** consisting of:

(i) **A BoQ** with estimates for **excavated materials** based on **good practices**, as defined in the Code of practice on soil management of DEFRA (2009) and/or in the ENCODE Protocol (2013)

(ii) **Estimates** of all **materials diverted from landfill** and identification of potential hazardous substances

(iii) **Estimates** of the **% reused and/or recycled** materials **on site**,

(iv) **Estimates** of the **% reused and/or recycled** materials **off site**,

(v) **Total amount** of **topsoil** and **strategies** to preserve its **quality**
C6. Commissioning of the excavated materials and soil management plan

The main construction contractor (or DB - DBO contractor) shall implement a system to monitor and report on actions involving excavated materials and soil during the progress of construction work on-site. This system shall include data accounting for the weights generated (topsoil and excavated materials), the percentages reused/recycled on site and percentages reused and/or recycled off site.

It shall also track and verify the destination of consignments of excavated materials. The monitoring and tracking data shall be provided to the contracting authority and to the NRA or local authority on an agreed periodic basis.
Questions to stakeholders

A stakeholder underlined that soil managements plan are mandatory in construction projects.

- Are the performance requirements proposed (such as the estimations of materials diverted from landfill, the % reused and recycled on-site and off-site, the best practices for topsoil) already applied in all road projects?
Waste management

Rationale

- **C&DW** has been identified as a priority waste stream in the **WFD** ⇒ minimum recycling target of 70% for reuse, recycling and other material recovery of C&DW by 2020
- In EU, average recycling percentage of 46% of recycling and reuse of C&DW (2011)

- Demolition waste management plan allows defining project-specific targets for total waste arisings (WRAP)
- A pre-demolition audit allows the identification of hazardous waste (risk assessment), a Demolition BoQ, estimates of the % reuse and recycling potential and of the % potential for other forms of recovery
• BIOIS, EC 2011 ⇒ 30-80% of RAP potentially absorbed by off-site recycling, 100% by on-site. Up to 75% of concrete waste potentially absorbed by recycled aggregates for road - 40-50% by recycled aggregates for concrete production

• WRAP, ENCODE and the ICE Demolition Protocol ⇒ at least 80% of C&DW to be reused/recycled/recovered (best practice in some MSs)

• EMAS Document (EC, JRC, 2012a) ⇒ backfilling not considered as best practice (down cycling)

• Backfilling can be considered in road construction due to the common practices of cut and fill and environmental rehabilitation with the following limitations
  ⇒ not be allowed in greenfield outside of the roadway
  ⇒ in permeable areas of the roadway (shoulders and embankments) backfilling only realised with (non-hazardous) excavated materials and soils
Waste management
Criteria proposal

E2. Demolition waste audit and management plan - F1. Demolition waste audit and management plan

A minimum of 70% - 90% by weight of the non-hazardous waste generated during demolition, including backfilling, shall be prepared for re-use, recycling and other forms of material recovery. This shall include:

(i) Concrete, RAP, aggregates recovered from the main road elements;
(ii) Materials recovered from ancillary elements.

Backfilling shall not be allowed in greenfield outside the roadway. Backfilling in permeable areas of the roadway shall be realised only with excavated materials and soils.
The main construction contractor (or DB- DBO contractor) shall carry out a **pre-demolition audit** in order to determine what can be **re-used**, **recycled** or **recovered**. This shall comprise:

(i) **Identification** and **risk assessment** of hazardous waste;
(ii) **A BoQ** with a breakdown of different road materials,
(iii) **An estimate** of the **% re-use** and **recycling potential** based on proposals for systems of separate collection during the demolition process.

The materials, products and elements identified shall be itemised in a Demolition BoQ.

**Verification:**
The main construction contractor (or DB-DBO contractor) shall submit a **pre-demolition audit** that contains the specified information.

A system shall be implemented to **monitor and account** for **waste production**. The **destination of consignments** of **waste** and **end-of-waste materials** shall be **tracked** using **consignment notes** and **invoices**.

Monitoring **data** shall be provided to the **contracting authority**.
Questions

- Could further limitations regarding backfilling conditions (such as the definition a maximum percentage of backfilling that can be accounted as a recovery operation) be defined?

- Could specific limitations regarding leaching limits set by national legislation in specific situations be set?
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on noise emissions
Noise emissions – importance of reducing them

• COM(2011) 321: external costs of noise in EU-27 = €52 billion
• Difficult to assume direct costs -> multiple assumptions
  • Reduction in real estate value….. About 1% each dB
  • Annoyance…. (>55dB $L_{den} = 125$ million EU citizens…)*
  • Premature deaths…. (30,000 EU citizens per year…)*
  • Hospital admissions… (130,000 EU citizens per year…)*

• Road pavement technology (up to 7dB reduction in noise)
• Just a 3dB reduction is equivalent to 50% less to halving the traffic

* From EEA Report No 10/2014 “Noise in Europe”
Noise emissions

The only source directly relevant to road construction. The **dominant source** with cars.

Installing **noise barriers** can help reduce all noise (in targeted areas only).

**Criterion 1: Low-noise pavements** (reduce noise emission)

**Criterion 2: Noise barriers** (shield receptor from existing noise)

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* Image from 2009 ACPA report "Transportation Noise and Concrete Pavements"

** Image from Donovan, 2003 "Assessment of highway pavements for tire/roadnoise generation"
Low-noise pavements – benefits of porosity

- Developed in 1960's-1970's
- Primary concern was safety (water spray)
- Became clear that it was beneficial for noise emissions as well

Design porosity control:
Same basic principles for concrete & asphalt
1) aggregate grading
2) binder content
**Example of double porous layer pavements**

- Clogging an issue (top layer protects lower layer)
- Further improve noise reduction performance (but also cost?)

**Asphalt-based**
Well established in the Netherlands

**Cement-based**
Pre-fabricated slabs
Promising but not yet cost-competitive with DLP A

*Image of "Modieslab" cross section*
Approaches to low-noise pavements in GPP in different countries

(i) Denmark

• Provide specific guidance to tenderers about how to measure/show compliance.
• Only required in "priority areas", i.e. residential and recreational areas where annual average $L_{den} > 58$ dB
• >30 low-noise pavement contracts up until 2012
• From 2012 onwards ⇒ changed approach
• Now performance is specified not against a reference pavement, but against SPB limits as a function of vehicle speed:

<table>
<thead>
<tr>
<th>Speed (kph)</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPB reference* values (dB)</td>
<td>72.0</td>
<td>74.6</td>
<td>76.9</td>
<td>78.9</td>
<td>80.8</td>
<td>82.5</td>
<td>84.1</td>
</tr>
</tbody>
</table>

• But, taking SPB measurements is time consuming and only gives spot data
• So, they allow CPX data to be converted to estimated SPB data like this:
• $*SPB_{ref} = 0.921 \times CPX - 13.68$
• Not sure about technical basis for equation, but very practical approach.
(ii) The Netherlands

Regulations that push for low-noise road surfaces (primary + non-primary roads)

- Thin-surfacings used if <80kph (PA not suitable in low speed roads)
- SLPA / DLPA used if >80kph
- Uses the concept of $C_{\text{road}}$ ($C_{\text{wegdek}}$) value.
- Based on SPB measurements of a new road
- Compared to standard DAC 0/16.
  - At least 100 car measurements
  - At least 50 truck measurements
  - Over at least 5 test sections
  - Temperature corrected (rain?)
  - Plot A-weighted max noise vs speed
  - Data quality (95% CI $\leq 0.3$ dB)
  - Single SPB value from regression line

- Examples of some durability requirements
  - E.g. Groningen: $4\text{dB}(A)$ reduction in new road
  - Plus $2\text{dB}(A)$ reduction after 5 years $\rightarrow$ penalties/bonuses??
Noise criteria: minimum tech. spec. or award?

Really depends on individual project, local regulations and procurer. Possible noise barrier vs low noise pavement conflict too. So, approach is to provide minimum technical criteria with the following caveats:

- For noise emissions during construction:

  *When planning permission or local/national legislation requires, or when specifically requested by the contracting authority*

- For noise emission reduction performance of the road pavement:

  *When local or national legislation requires, or when low noise levels from this road are considered a priority*

- Distinction between core (3.0dB) and comprehensive (4.5dB) ambition levels.

- Award criteria to encourage higher performance roads.

- Durability of performance requirements introduced (potential big impact)
**B. Detailed design**

**Noise emission in construction/maintenance**

**Criteria proposal**

**B6. Performance of noise emission during construction and maintenance**

(When planning permission or local/national legislation requires, or when specifically requested by the contracting authority)

The design team (or DB - DBO tenderer) shall provide details of how temporary noise barriers (or permanent if part of the final design) shall be erected to reduce noise levels in the defined receptor area to less than \( X \) dB(A) as averaged \( L_{den} \) and \( Y \) dB(A) as averaged \( L_{night} \) values as defined in Annex I of the Environmental Noise Directive (2002/49/EC).

**Verification:** The design team (or DB - DBO tenderer) shall submit:

- a **plan** of the works site and receptor area as defined by the Environmental Impact Assessment, legislation or contracting authority where relevant.
- a **timetable** of works, highlighting when the most noisy works are to take place.
- specification of the **noise barrier location** and approximate properties coupled with **basic acoustic calculations** that demonstrate that **noise mitigation** in the receptor area will be feasible.
C12. – E7. Monitoring noise emission during construction - maintenance

During construction/maintenance works, the main construction contractor (or DB or DBO contractor) shall ensure that:

- an **appropriate noise barrier** is in place in accordance with or exceeding the design,
- **noise levels** in the **receptor** area shall be **monitored** during the timetable agreed with the contracting authority.
- **noise data** is processed to produce **singular L_{den} and L_{night} values** for **each day during the works timetable** that can be compared to the limits agreed upon with the contracting authority.

**If** the $L_{den}$ and or $L_{night}$ values during the agreed monitoring period are **found to exceed the limits** defined in the accepted tender, the **contracting authority can stop the works** or **introduce penalties** as defined in the invitation to tender. Any **penalties** shall **increase in proportion** to the product of the **number of dB(A)** by which the limits were **exceeded** and the **time during** which **non-compliance** occurred.
Low noise pavements
Criteria proposal

B7. Minimum requirement for low-noise pavement
(When local or national legislation requires, or when low noise levels from this road are considered a priority)

The design team (or DB -DBO tenderer) shall provide basic technical details of the proposed low-noise pavement with claims, supported by their own technical data and any third party published reports indicating that:

- **Conformity of production:**
  A minimum **3.0 dB(A) – 4.5 dB(A)** reduction in noise emission will be achieved in the new pavement compared to a reference dense asphalt concrete (0/16) surface (or other reference material defined by the contracting authority).

- **Durability of performance**
  A minimum **2.0 dB(A) – 3.0 dB(A)** reduction in noise emission will be achieved in the pavement during the first 5 years of service life compared to a reference dense asphalt concrete (0/16) surface or other reference material defined by the contracting authority.
Verification

The design team (or DB - DBO tenderer) shall describe the nature of the proposed low noise pavement such as aggregate grading, aggregate maximum size, binder used, expected voids volume and expected minimum noise reduction of at least 3.0 dB(A) or 4.5 dB(A).

The expected noise reduction performance of the new pavement values shall be based on laboratory and real life measurements of test road sections, either by the tenderer themselves or from peer-reviewed published literature.

The expected noise reduction performance during the 5 year service life will be estimated based on the tenderers experience and relevant data, where available. With respect to the reference surface, this shall be defined by any national or local systems in place. In the absence of such a system, noise reduction should be compared to a "virtual" reference road and corrections applied for aggregate size where necessary.
B20. Performance of low noise surface pavements

Points will be awarded if the pavement design claims to achieve a noise reduction performance that exceeds the minimum technical requirements (see previous criterion). The allocation of points shall be as follows:

Conformity of production

- That the new pavement performance claim is $>1.0\text{dB}(A)$ better than the minimum technical requirement (0.25X points)
- That the new pavement performance claim is $>2.0\text{dB}(A)$ better than the minimum technical requirement (0.50X points).

Durability of performance

- That the pavement performance after 5 years of service life is $>1.0\text{dB}(A)$ than the minimum technical requirement (0.25X points)
- That the pavement performance after 5 years of service life is $>2.0\text{dB}(A)$ than the minimum technical requirement (0.50X points)

Verification: Same as stated in the verification for the previous criterion
C13. Minimum requirements for low-noise pavement

The main construction contractor (or DB - DBO contractor) shall submit to testing of noise emissions from the road surface and provide test reports using SPB and CPX data gathered according the methodology defined in ISO 11819-1 and ISO/CN 11819-2 respectively.

Where CPX equipment is not available, certain other techniques may be used as proxy measures by following the guidance set out in the SILVIA Guidance Manual.

The initial measurements shall be taken within 1-3 months after the opening of the road surface and used to demonstrate conformity of production with 3.0 dB(A) – 4.5 dB(A) (or other higher claimed value) of noise reduction. After 4-5 years of service life, the noise emission measurements shall be repeated on the same test sections and ideally under the similar meteorological conditions as when the conformity of production test was carried out.
The **noise reduction** performance claims for **low noise pavements** that are made by the design team, DB contractor or DBO contractor at the design stage shall be **used as a benchmark** to determine if any **penalties or bonuses** shall **apply** when the "**conformity of production**" testing of new pavements and "**durability of performance**" testing of **5 year old pavements** is carried out.

The framework for any applicable penalties, bonuses or remedial action shall be clearly stated in the invitation to tender.
Questions to stakeholders

- Should the monitoring of noise emissions be specifically mentioned as being carried out by qualified and independent 3rd parties or may this create a potential conflict if for example, it is measured by a government agency responsible for implementing the Environmental Noise Directive which could be argued as not being completely independent of the National Road Authority which also forms part of the government?
Noise barriers
Criteria proposal

B8. Noise barrier design and material properties

(When planning permission or local/national legislation requires, or when low noise levels from this road are considered a priority)
The design team (or DB - DBO tenderer) shall provide basic technical details about the noise barrier placement, dimensions and material(s). For barriers using modular or prefabricated elements, the details shall include as a minimum the performance class according to EN 1793-2 for reflective noise barriers, EN 1793-1 for absorbing noise barriers and the expected durability of performance according to EN 14389-1 for either type of barrier. The tenderer shall also declare a minimum noise reduction performance of X dB(A) - Y dB(A) across the noise barrier from a fixed point on the road to a defined receptor area that shall be achieved with their proposed design.

Verification: The tenderer shall provide design details of the proposed noise barrier as well as a test report of noise barrier material assessment carried out in accordance with the requirements of EN 14389-1 and EN 1793-1 or EN 1793-2 (or equivalent). The tenderer shall state the minimum claimed noise reduction performance across the noise barrier between defined points.
C1. Testing of in-situ constructed noise barrier

During an **agreed period after construction** of a noise barrier, the tenderer shall submit to **conformity of production testing** of the noise barrier by an independent body, in accordance with EN 1793-6 or other standard tests specified clearly in the invitation to tender. Results shall comply with the **minimum X dB(A) - Y dB(A)** noise reduction requirements stated in the original proposal.

**Verification**

A **test report** produced by an **independent body** stating compliance with the **in-situ sound insulation values** (if tested according to EN 1793-6) shall be provided.
C14. In-situ performance of the noise barrier

The contracting authority shall provide plans of the site drawn to scale and with existing features marked and a clearly defined receptor area or areas which should be protected by the noise barrier. **Reference points** shall be marked which shall be used to define where noise measurements should be taken to later measure the in-situ performance of the constructed noise barrier. A minimum required noise reduction performance of $X \text{ dB}(A) - Y \text{ dB}(A)$ shall also be clearly communicated in the invitation to tender.

After construction, the main construction contractor (or DB - DBO contractor) shall submit to **independent testing** of the **in-situ performance** of the noise barrier. Testing may be carried out according to EN 1793-6 or other relevant and equivalent methods that are agreed upon with the contracting authority.

If the noise reduction performance across the noise barrier fails to meet the minimum technical requirements, the main construction contractor (or DB - DBO contractor) shall undertake remedial **action at no additional cost** to the contracting authority.
Questions to stakeholders

Considering possible criteria on noise barrier material embodied energy would you support:

A. A minimum technical specification? If so, how would you propose to set it?

B. Only as an award criterion? If so, how would you propose to set it?

C. As a combination of a minimum technical specification and award criterion? Again if so how would you propose to set it?

D. No criterion on this subject would be preferred? If so, any supporting reasons for this opinion?
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on water and habitat preservation
Water and habitat preservation
Why are combined sewers relevant?

- Road and drainage networks = key infrastructure → linked together
- Huge impermeable areas = Huge quantities of stormwater
- If drainage → combined sewers
  e.g. complicates WWTP design/operation
  e.g. overflow of raw-sewage → rivers
  e.g. backflow of raw sewage → streets
- But if drainage → natural watercourses

Need to consider:
- Transport of sediments & pollutants
- Rapid run-off → decreased flood risk on but increased flood risk downstream.
Water and habitat preservation

Why is drainage system design relevant-1: habitat

- Big infrastructure = big impact on natural land and land use
e.g. habitat loss, fragmentation, wildlife road deaths
- Road drainage infrastructure → should be designed for:
  Pollutant removal from stormwater
  Flood risk management (retention capacity)
- Can achieve by traditional or green designs:
  • i.e. SuDS → potential habitat creation
Water and habitat preservation

Why is drainage system design relevant-2:flood risk

- Flooding a major concern in certain parts of EU
- In period 1998-2009: insured losses due to flooding = €52 billion
- EU Floods Directive 2007/60/EC
- Flood risk maps
- Impermeable areas
- Climate change uncertainty
- **Traditional** drainage inadequate
- **Green** drainage – mimics nature
  i.e. retention on or near site
  i.e. restricted runoff rates

![Graph showing flow change over time for greenfield site and urban area](image-url)
Water and habitat preservation

Why is drainage system design relevant-3: link to wildlife corridor

- Roads fragment habitat
- Wildlife mortality, especially with small mammals and frogs
- Special concern in areas of high conservation value
- Over-land passes out of scope (like bridges), but not low-kerbs
- Underpasses can be included if linked with drainage culverts
- Key is to ensure safe passage
- Dry paths (for mammals)
- Minimum water depth (for fish)
Water & habitat criteria: min. tech. spec. or award?

- Really depends on site-specific constraints, local regulations and procurer..
- Higher priorities in areas of high watercourse quality.
- Higher priority in areas of high flood risk

So the approach is to provide minimum technical criteria with the following caveats:

For preventing connections to combined sewers:

"Unless sewer connections are specifically required by local regulations or specific circumstances"

For drainage designs that incorporate stormwater drainage capacity:

"When local or national legislation requires, or when specifically requested by the contracting authority"

Green drainage system solutions are subject to award points in all cases
Introducing water pollution control components in drainage systems

Criteria proposal

B4. Performance requirements for water pollution control components in drainage systems

(Unless sewer connections are specifically required by local regulations or specific circumstances)

a) Road drainage systems shall not be connected to mains sewers.

b) The drainage system shall also contain drainage components that aid the removal of any sediment and solid particles from storm-water.

Verification: The design team (or DB – DBO tenderer) shall make it clear where drainage water shall be routed to and where and which sediment removal devices shall be incorporated into the drainage system.
B17. Requirements for water pollution control "soft engineered" components in drainage systems

**Points** shall be awarded for drainage systems that incorporate "soft engineered" components that incorporate storm-water pollutant load removal, improved aesthetics and potential habitat creation in drainage infrastructure as follows:

- **Filter trenches** with low or no kerbs at roadside covering at least 40% of the roadside (0.25X points)
- **Grassed swales** covering at least 40% of the roadside (0.5X points)
- **Vegetated retention basins** with unlined bases for infiltration through which all road drainage is directed prior to reaching the local surface watercourse (0.5X points)
- **Vegetated retention ponds** with linings to create artificial wetlands and/or a permanent water body in all or part of the basin which all road drainage is directed through prior to reaching the local surface watercourse. (0.75X points)

.....

**Verification:**
The design team (or DB -DBO tenderer) shall provide details of these drainage solutions and clearly indicate them in the design. Where relevant, reference shall be made to best practice design details and how these are incorporated in the design.
C7. Inspection of water pollution control components in drainage systems

The contractor shall perform site inspection to establish the drainage system dimensions, pathways and connections between drainage components and that these are in accordance with the design plans. Information shall be sent to the NRA or local authority based upon an agreed timetable.

C8. Construction of water pollution control "soft engineered" components in drainage systems

The contractor shall perform site inspections both during and after the installation of the vegetated drainage components and ensure that appropriate measures are taken in accordance with best practice guidelines for the establishment of vegetated covers in SUDS drainage components. Information shall be sent to the contracting authority based upon an agreed timetable.
Introducing **storm-water retention capacity in drainage systems**

Criteria proposal

**B5. Performance requirements for storm-water retention capacity in drainage systems**

*(When local or national legislation requires, or when specifically requested by the contracting authority)*

The **drainage system** shall be designed so as to be **capable of**:  

- **retaining** the **rainfall from a design storm** with a return period (**frequency**) of 1 in X years and **duration of Y minutes** across a defined drained area.  

- **restricting maximum runoff rates** from the drainage system to **no more than that of an equivalent greenfield site** or another specific value clearly defined by the procuring authority in the invitation to tender.
Verification

The design team (or DB - DBO tenderer) shall be provided with the appropriate rainfall data for the design storm by the procuring authority. Using this data, they shall run a hydraulic simulation using appropriate modelling software. The simulation shall show that:

- **At no point** during the design storm event is the capacity of the drainage system exceeded and,

- **At no point** during the design storm event does the runoff rate exceed the value specified by the procuring authority.
B18. Requirements for storm-water retention capacity in drainage systems that incorporate "soft engineered" components

Points shall be awarded for drainage systems that incorporate "soft engineered" components (often referred to as SuDS) that incorporate storm-water retention devices that improve site aesthetics and contribute to potential habitat creation as follows:

- **Grassed swales with check dams** and an **orifice plate** at the base to act as retention devices during intense rainfall events but normally be dry (0.50X points)

- **Vegetated retention basins** with unlined bases for infiltration and overflows for severe conditions through which all road drainage is directed prior to reaching the local surface watercourse (0.50X points)

- **Vegetated retention ponds** with linings to create artificial wetlands and/or a permanent water body in all or part of the basin which all road drainage is directed through prior to reaching the local surface watercourse. (0.75X points)

....

**Verification:** The design team, DB tenderer or DBO tenderer shall provide details of these drainage solutions and clearly indicate them in the design. Where relevant, reference shall be made to best practice design details and how these are incorporated in the design.
C9. Inspection of storm-water retention capacity in drainage systems

The main construction contractor (or DB - DBO contractor) shall inspect the drainage system during the construction stage to ensure that it follows the agreed design and ensure that it meets the dimensions, slopes and other technical details specified in the design.

C10. Inspection of storm-water retention capacity in drainage systems that incorporate "soft engineered" components

The main construction contractor (or DB - DBO contractor) shall be responsible for carrying out site inspections both during and after the installation of the vegetated drainage components and ensure that appropriate measures are taken in accordance with best practice guidelines for the establishment of vegetated covers in SuDS drainage components.
Introducing wildlife corridors across the road and other measures to reduce the likelihood of wildlife fatalities on the road

Criteria proposal

B19. Performance requirements for wildlife corridors across the road

Points shall be awarded for drainage infrastructure (culverts or underpasses) that aids the safe passage of small fauna and amphibious or aquatic species across the road. Points shall be awarded as follows:

- **Filter trenches** with low (<25 mm) or no kerbs at roadside covering at least 40% of the roadside (0.5X point).
- At least 60% of all culverts shall provide flat and dry walkways for small fauna (0.5X point).
- All culverts that channel permanent surface water courses do not prevent the upstream migration of fish or amphibious species (0.5X point).
Culverts that permit the passage of small fauna or aquatic species shall be designed according to best practice guidelines, for example as published in the COST 341 Handbook or any similar documentation suggested by the procuring authority.

Verification
the design team (or DB -DBO tenderer) shall highlight the details of any filter trenches or culverts that meet the award criteria in the road drainage design and comparison shall make to the best practice guidelines
C11. Inspection of wildlife corridors across the road and other measures

The main construction contractor (or DB - DBO contractor) shall undertake inspection of any filter trenches or culverts included in his offer both during and immediately after construction and ensure that they meet the minimum requirements of the technical details specified in the design and that they meet the conditions required for the award of points.
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on congestion
Congestion
Rationale

- **Congestion** is caused by lane and road closures necessary for road construction and/or maintenance. It can greatly influence vehicle fuel consumption due to queues and associated slowdown
  - low traffic rural and local roads: impacts are negligible
  - motorways and highways: extra fuel consumption is prominent

- Effective traffic management (lane closure, traffic diversion) and phasing of the roadwork into off-peak hours (night shifts) reduce the environmental impacts of road maintenance works

- Planning the use of hard shoulders during peak-hours could be beneficial

- Specific design requirements: tidal flow lanes and devices to support the Intelligent Traffic Systems (ITS) of the Traffic Management Authorities
### Congestion Criteria proposal

**B10. Traffic congestion mitigation plan**

A **traffic congestion mitigation plan** shall be presented including:

- **Timeline** with expected construction and/or maintenance **activities** for the road service life.
- **Alternative routes** for diverted traffic during such activities, if necessary.

If the design team (or DB - DBO tenderer) includes congestion solutions based on **tidal flow lanes** or **hard shoulders** to be used as lanes, they shall present a **LCC analysis**, including user cost **externalities** due to congestion.

For those roads where **ITS** are implemented for traffic management, the road shall be equipped with the **devices** needed to support the ITS: cameras, traffic lights, information screens and variable road signs.

**Verification:**  
The design team (or DB - DBO tenderer) shall provide the **detailed traffic congestion mitigation plan**, the LCCA in accordance with **ISO 15686-5** (if required) and the descriptions of the ITS devices (if required).
C15. – E8. Commissioning of the traffic congestion mitigation plan

The main construction contractor (or DB -DBO contractor) shall provide documentary evidence of the correct implementation of the congestion mitigation plan. The Road authority will verify the specific requirements for congestion (ITS devices, tidal flow lanes and hard shoulder) after the construction before the road opening and 6 months after the opening (in-service road).
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

GPP draft criteria proposal on maintenance and rehabilitation strategies
Durability
Rationale

- Materials **deterioration rate**, dependent on their mechanical and chemical properties, and the **appropriate design** and **construction** of the road ⇒ biggest influence on the **service life** of the road and its needs for maintenance

- **Most durable materials** might entail larger construction **costs**, but those expenses could be **offset** by **less demand** of **maintenance**

- **Ageing effects** can be monitored during operation, but **ex-ante criteria** aimed at selecting the most **appropriate design** in terms of **durability** would lead to an **optimized maintenance strategy**
**Procurement guidance:**
Examples of *expected maintenance frequencies* on rigid, semi-rigid and flexible pavements ⇒ *dependant* on type of material, road and proportion of truck traffic borne by the road (in flexible pavements)

**Draft Italian GPP criteria:** *minimum serviceability* of *surface course* (**5 years**), *binder course* (**10 years**) and *base course* (**40 years**)

*Perpetual pavements* (APA, 2000) designed to last longer than **50 years**; periodic resurfacing within **20 years**. *Superpave* (US projects)

⇒ A common *minimum durability* for the surface (applicable to *asphalt surface* on rigid and flexible pavements) and for the *binder course*

⇒ For the *base*: relevant *differences* between *rigid and flexible pavements*
Durability
Criteria proposal

B11. Performance requirements for durability of pavement surface and rehabilitation
The road pavement road shall comply with the following minimum durability:

- **5 years** for the *surface course*
- **10 years** for the *binder course* (excluding the surface)
- **40 years** for the *base course*

Verification
The Design team (or DB - DBO tenderer) shall provide a *technical report* specifying the minimum durability (service life) of the surface, binder and base courses. The report shall include the evaluation of the *bearing capacity* and the *fatigue resistance*, the *viscoplastic* and *fracture strains* of the road pavement layers and materials. The report shall include appropriate *data* and information, specifically related to *materials* physical-mechanical performances, construction *technologies* and *process*, design activities *workplan*
Questions to stakeholders

- Do you think that is feasible to include the durability of pavement surface and rehabilitation as a technical specification?

- Could you please provide durability data for rigid and semi-rigid pavements in order to set a similar criteria proposal?
Maintenance and rehabilitation plan

Rationale

- It is widely agreed that the maintenance of road network is a relevant part of the road management ⇒ proposed criteria on rolling resistance, noise, congestion, durability are related to this phase
- The results of the maintenance effort must be measured to assess to what degree the objectives are achieved and also to assess the effectiveness of maintenance
- Maintenance activities should be planned and scheduled in time so congestion can be minimized
- The maintenance strategy needs to be structured by means of ⇒ a monitoring plan covering target and thresholds values of the performance parameters ⇒ A maintenance plan describing the actions to be taken along the service life of the road
- Definition of the **main parameters** and of the proper **monitoring, data acquisition method** and **threshold values**

<table>
<thead>
<tr>
<th>Performance parameter</th>
<th>Monitoring frequency</th>
<th>Acceptance threshold</th>
<th>Warning threshold</th>
<th>Action threshold</th>
<th>Maintenance action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unevenness</td>
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<tr>
<td>Rutting</td>
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<tr>
<td>Other structural defects (ravelling, bleeding, etc.)</td>
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<tr>
<td>Bearing capacity</td>
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<tr>
<td>Texture (optional)</td>
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<tr>
<td>Noise (optional)</td>
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</tbody>
</table>

- **The maintenance actions, defining methods, frequency, amount and cost** of the **maintenance and rehabilitation**, for each section of road

- **The maintenance plan** consistently linked to the **performance parameters** and the **congestion mitigation plan**

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>First year</th>
<th>Frequency</th>
<th>Performance parameters affected</th>
<th>Congestion mitigation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine maintenance</td>
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<td>Periodic</td>
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<tr>
<td>Rehabilitation</td>
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</tbody>
</table>
Maintenance and rehabilitation plan
Criteria proposal

B12. Maintenance and rehabilitation (M&R) plan

The design team (or DB - DBO tenderer) shall include in the detailed design a maintenance plan. For each section of road specifically characterised by specific construction methods, materials, environmental conditions, meteorological conditions and use, the tenderer shall define as a minimum the following aspects:

a) Monitoring plan:

- Including performance parameters to be monitored, frequency of monitoring, data acquisition method, threshold values, and the maintenance actions triggered by the thresholds values.
- Including also; safety, service quality and durability parameters and their respective frequency:
  (to be defined by the Road Authority)
- The monitored parameters shall include MPD and noise, if the respective award criteria on rolling resistance and noise apply
b) **Maintenance and rehabilitation (M&R) plan**

- Including **routine, periodic** and **rehabilitation** actions
- Optimizing the **cost-benefit ratio** of the maintenance works
- Aligning with the environmental performance of the main road element (carbon footprint CF - LCA if applicable).
- **Including the cost**, the **first year** after the construction, **frequency**, the **congestion mitigation plan** and the **waste management plan** for each action.

**Verification:**

The Design team (or DB - DBO tenderer) shall provide a **technical report** including appropriate data and information and the design activities workplan.
D1. Commissioning of the maintenance and rehabilitation (M&R) plan
The main construction contractor (or DB - DBO contractor) shall commit to monitor the road performance parameters according to the monitoring plan presented in the design phase. Any update/improvement of this plan shall be previously discussed with the contracting authority and the NRA/local authority.

Verification:
Provide a report with the results of the monitoring for all the performance parameters, and the maintenance activities carried out.

E3. Commissioning of the maintenance and rehabilitation (M&R) plan
The main construction contractor (or DB - DBO contractor) shall commit to maintain the road according to the M&R plan presented in the design phase.

Verification:
Provide a technical report including appropriate data and information and the activities workplan.
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

Developing guidance for the procurement of road construction - LCC
Indicative sequence of procurement activities

**Project process**

- **Preparation**
  - Assessment of need
  - Appraisal
  - Strategic briefing
  - Project briefing
- **Design**
  - Concept design
    - A. Selection criteria
    - B. Detailed design
- **Construction**
  - C. Construction
- **Use**
  - Handover
    - D. Use
- **Pavement performance assessment**
- **End of Life**
  - E. Maintenance & operation
  - F. EoL / decommissioning

**Procurement phase**

- **Client led procurement of**:
  - Consultants - design cost, engineering, quantity surveyors, other specialists
  - Design team
  - Main contractors (for DB, DBO, PPP contracts)

- **SEA/EIA**
  - DB design and build
  - DBO design build operation
  - PPP public private partnerships

- **Client led procurement traditional contractor(s): Main contractor(s)**
  - Main contractors led procurement (subcontractors, materials, temporary labour, plant and equipment)
  - Sub-contractor(s) led procurement led procurement (further subcontractors, materials, plant and equipment, trades)
  - Trades procurement (materials, plant and equipment, labour)

- **Client or contract led procurement**
  - Operator management services
  - Maintenance services

According to SCI guide

- Delivery consortia/partners Aliancing
- Aliancing Framework contract

**PPP contracts are widely used in road construction**

**ECI Early Contractor Involvement when there is significant scope for input from the supply chain**
Questions to stakeholders

A stakeholder suggested that NRAs and local authorities should compare and select alternative types of pavement structure and materials through the use of alternate bids (process developed by the FHWA, US)

- Could you please provide further information on alternate bids, providing specific examples of application in Europe?
Detailed design

Putting the team together ⇒ reform of the Public Procurement Directives (published in the OJ 28.03.2014 and requiring transposition by MSs within 24 months), it is explicitly stated (Art. 66 of Directive 2014/24/EU) that the organisation, qualification and experience of staff assigned to performing the contract can be a criterion for awarding a contract.

A1. Selection criteria on the competency of the project manager and the design team

Verification: This shall be supported by CVs for personnel who will work on the project.

A2. Selection criteria on the competency of the construction/maintenance/rehabilitation contractors

Verification: Evidence in the form of information and references related to relevant contracts in the last 3 years in which the above elements have been carried out. This shall also be supported by CVs for personnel who will work on the project and their relevant project experience.
LCC

**Total cost of infrastructure in EU** - IMPACT study (Doll and van Hessen, 2008)

**Externalities** - Handbook on external costs estimation (Maibach et al., 2008 + Ricardo AEA, 2014)

**Life Cycle Cost Analysis (LCCA)**

**LCC to support the development of GPP criteria for road construction**

Several examples of road construction and maintenance costs data collected from different LCC analyses for the following scenarios:

1. **Motorway and/or highway** (with 2 lanes per carriageway)
2. **Secondary or regional road**
3. **Local road** (urban and rural)

**Collection of cost data of highways and motorways** (OECD, 2005)
Collection of additional cost data for road construction and maintenance

<table>
<thead>
<tr>
<th>Cost adapted from [€/km-lane]</th>
<th>Course</th>
<th>Thickness (mm)</th>
<th>HMA</th>
<th>WMA*</th>
<th>CMA*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface</strong></td>
<td>40</td>
<td>Motorway/highway</td>
<td>High 35,000 Medium 29,000-31,000 Low 29,000 Secondary/regional High 30,000 Medium 26,000-20,000 Low 26,000</td>
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<tr>
<td>40</td>
<td></td>
<td>Motorway/highway</td>
<td>High 50,000-33,000 Medium 26,000-31,000 Low 26,000-30,000 Secondary/regional High 26,000-30,000 Medium 23,000-20,000 Low 23,000-26,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ARA (2011)</strong></td>
<td>100-140</td>
<td>Motorway/highway</td>
<td>High 90,000 Medium 70,000-85,000 Low 64,000 Secondary/regional High 60,000 Medium 48,000-50,000 Low 48,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-100</td>
<td></td>
<td>Motorway/highway</td>
<td>High 81,000-90,000 Medium 65,000-85,000 Low 56,000-64,000 Secondary/regional High 54,000-60,000 Medium 43,000-49,000 Low 43,000-48,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Base</strong></td>
<td>150-200</td>
<td>Motorway/highway</td>
<td>High 18,000 Medium 16,000-18,000 Low 16,000 Secondary/regional High 17,000 Medium 16,000 Low 16,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-100</td>
<td></td>
<td>Motorway/highway</td>
<td>High 15,000-17,000 Medium 15,000-17,000 Low 15,000-17,000 Secondary/regional High 15,000-17,000 Medium 15,000-17,000 Low 15,000-17,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>35</td>
<td>Motorway/highway</td>
<td>67,000 Secondary/regional 67,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td>Motorway/highway</td>
<td>60,000-67,000 Secondary/regional 60,000-67,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Motorway/highway</td>
<td>Local 30,000-35,000</td>
<td>Motorway/highway CMA not used Secondary/regional 67,000 Local 55,000</td>
<td></td>
</tr>
<tr>
<td><strong>COWI (2014)</strong></td>
<td>56</td>
<td>Motorway/highway</td>
<td>70,000 Secondary/regional 70,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td></td>
<td>Motorway/highway</td>
<td>63,000-70,000 Secondary/regional 63,000-70,000</td>
<td>Motorway/highway CMA not used Secondary/regional CMA not used Local road (6mm) No binder</td>
<td></td>
</tr>
<tr>
<td><strong>Base</strong></td>
<td>144</td>
<td>Motorway/highway</td>
<td>140,000 Secondary/regional 140,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>Motorway/highway</td>
<td>126,000-140,000 Secondary/regional 126,000-140,000</td>
<td>Motorway/highway CMA not used Secondary/regional CMA not used Local road (6mm) No binder</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td>Motorway/highway</td>
<td>60,000 Secondary/regional 60,000</td>
<td>Motorway/highway CMA not used Secondary/regional CMA not used Local road (6mm) No binder</td>
<td></td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>200</td>
<td>Motorway/highway</td>
<td>18,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>260</td>
<td></td>
<td>Motorway/highway</td>
<td>47,000-59,000</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td>Motorway/highway</td>
<td>16,000-18,000</td>
<td>n.a.</td>
<td></td>
</tr>
</tbody>
</table>

**Cost of road construction**
- Cost of earth works, ground works, soil preparation and stabilization
- Cost of surface, binder and base courses
- Cost for rigid and semi-rigid pavements

**Cost of maintenance**
- Cost of routine maintenance
- Cost of periodic maintenance
- Cost of rehabilitation

*Converted from OKR – 7.4557 exchange rate July 2014*
*Calculated based on information received on HMA and CMA from Norway and Sweden (COWI, 2014)*
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

Conclusions
## Conclusions

### GPP criteria application in different scenarios

<table>
<thead>
<tr>
<th>GPP criteria</th>
<th>Scenario where</th>
<th>Large potential benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement-vehicle interaction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrotexture</td>
<td>Little or no potential benefits</td>
<td>Low traffic flow. Low heavy traffic</td>
</tr>
<tr>
<td></td>
<td>Large potential benefit</td>
<td></td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>Pavements with low structural demands (e.g., low AADTT, temperate climate) that require less material</td>
<td>Pavements with high structural demands (e.g., high AADTT, extreme climate) that require more material. Under development market for recycled materials and by-products in local area.</td>
</tr>
<tr>
<td></td>
<td>Pavements with high structural demands (e.g., high AADTT, extreme climate) that require more material. Under development market for recycled materials and by-products in local area.</td>
<td></td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td>Low overall material demand. Locally available materials, especially aggregates. Use of on site recycling strategies. Any long-distance travel utilizes efficient transportation modes (i.e. by train)</td>
<td>High overall material demand. Materials need to be shipped over long distances, especially aggregates. Long-distance travel using inefficient modes. Use of virgin materials for each process.</td>
</tr>
<tr>
<td><strong>Noise – low noise pavement and noise barriers</strong></td>
<td>Roads remote from populated areas. In low traffic roads. In low speed limit roads (&lt;50km/h).</td>
<td>Roads from densely populated areas and/or high speed roads. In medium-high speed roads (&gt;50km/h) of freely flowing traffic.</td>
</tr>
<tr>
<td><strong>Drainage -flooding</strong></td>
<td>In arid or rural areas with no previous history of flooding.</td>
<td>In river basins with identified flood risks. In areas with high urban development.</td>
</tr>
<tr>
<td><strong>Drainage - water pollution</strong></td>
<td>In arid areas with little rainfall. In areas remote from sensitive water bodies. In low traffic flow roads.</td>
<td>In areas near sensitive water bodies. In high traffic flow roads.</td>
</tr>
<tr>
<td><strong>Congestion</strong></td>
<td>Pavement sections with low traffic or where capacity is much higher than demand. Sections with readily available detours. Use of lane closures during off-peak traffic periods</td>
<td>Pavement sections with high traffic or where capacity is comparable to demand. Sections where detours are not readily available. Lane closures occur during peak traffic periods</td>
</tr>
<tr>
<td>Scenarios</td>
<td>Pavement-vehicle interaction</td>
<td>Congestion</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Low traffic flow</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>High traffic flow</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Freely flowing</td>
<td>Red</td>
<td>Yellow</td>
</tr>
<tr>
<td>Not freely flowing</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>Low speed road (&lt;50km/h)</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Medium-high speed road (&gt;50km/h)</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Rural road near populated area</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>Rural road remote from populated area</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Urban road</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Within river catchment with known flooding risk</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Within arid area with no previous flooding risk</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Road area with unsuitable subgrade soil</td>
<td>Red</td>
<td>Red</td>
</tr>
</tbody>
</table>

* green the criterion is not important for the scenario stated
** yellow indicates that the criterion may be important but it would depend on other information.
*** red indicates that the criterion is important under that particular scenario.
Example of criteria selection web for a high traffic rural road close to populated areas with congestion problem

Example of criteria selection web for a low traffic rural road close to populated areas or in urban areas with flooding risk
Road construction

2nd Ad Hoc Working Group Meeting for the revision of the Green Public Procurement criteria

28th January 2015

Next steps and closure
GPP criteria process development

Product Group Identification (GPP AG)

Preparatory work

Preliminary Report

Technical report (draft criteria areas and guidance on procurement)

1st AHWG 12.03.2014

Translate criteria areas into criteria

Technical report (draft criteria and guidance on procurement)

2nd AHWG 28.01.2015

Today

Final Draft Criteria
Final Draft GPP Criteria

Written Consultation (optional)

Inter-service consultation

Final GPP Criteria

GPP Advisory Group

EC website – ENV GPP
http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm
Next steps

1. **Minutes** and **presentations** of the meeting will be sent in the coming weeks

2. Stakeholders can provide comments on working document until **22.02.2015**

3. Comments need to be transmitted in BATIS. Using the BATIS system (HTML + folder)

4. Comments will be used to prepare the **final draft GPP criteria**. *If needed a further written consultation will be carried out*
Thanks for your attention

Contact

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