Office of Rail Regulation and Network Rail

Part A Reporter Mandate AO/049: Review of updated Earthworks Asset Policy for CP5 years 3-5

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 223767-27

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<td>BCAM</td>
<td>Buildings and Civils Asset Management</td>
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<td>CAM</td>
<td>Civils Adjustment Mechanism</td>
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<tr>
<td>CCT</td>
<td>Common Consequence Tool</td>
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<tr>
<td>CP4</td>
<td>Control Period 4 – April 2009 – March 2014</td>
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<tr>
<td>CP5</td>
<td>Control Period 5 - April 2014 – March 2019</td>
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<tr>
<td>CSAMS</td>
<td>Civil Strategic Asset Management Solution</td>
</tr>
<tr>
<td>DP15</td>
<td>Delivery Plan update 2015 (due 31st March 2015)</td>
</tr>
<tr>
<td>EHC</td>
<td>Earthworks Hazard Category</td>
</tr>
<tr>
<td>EACB</td>
<td>Earthworks Asset Criticality Band</td>
</tr>
<tr>
<td>FDP</td>
<td>NR’s Final Delivery Plan for CP5</td>
</tr>
<tr>
<td>FWI</td>
<td>Fatalities and Weighted Injuries</td>
</tr>
<tr>
<td>MAA</td>
<td>Moving Annual Average</td>
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<tr>
<td>NERRP</td>
<td>National Earthworks Risk Reduction Programme</td>
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<td>NR</td>
<td>Network Rail</td>
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<td>ORR</td>
<td>Office of Rail Regulation</td>
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<tr>
<td>PAnTS</td>
<td>Powerpack Analysis Tool Set</td>
</tr>
<tr>
<td>PowerPack</td>
<td>Tier 3 tool to support Policy implementation and assurance</td>
</tr>
<tr>
<td>RSHI</td>
<td>Rock Slope Hazard Index</td>
</tr>
<tr>
<td>RSSB</td>
<td>Railway Safety and Standards Board</td>
</tr>
<tr>
<td>SBP</td>
<td>Strategic Business Plan</td>
</tr>
<tr>
<td>SCAnNeR</td>
<td>Strategic Cost Analysis for Network Rail (Tier 1/2 Model for Earthworks and Drainage assets)</td>
</tr>
<tr>
<td>SRM</td>
<td>Safety Risk Model</td>
</tr>
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<td>SSSI</td>
<td>Soil Slope Hazard Index</td>
</tr>
<tr>
<td>WLCC</td>
<td>Whole Life Cycle Cost</td>
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</table>
1 Executive Summary

1.1.1 Arup have been appointed by the Office of Rail Regulation (ORR) and Network Rail (NR) as Part A Independent Reporter to provide assurance as to the quality, accuracy and reliability of NR’s data that is used to report performance to ORR, the Department for Transport (DfT) and the wider industry.

1.1.2 In their Strategic Business Plan (Jan. 2013) NR adopted a new Earthworks Asset Policy for CP5 (dated December 2012). At that time NR noted that their CP5 policy was new and largely untried in practice. To reflect this the Final Determination set out a Civils Adjustment Mechanism (CAM) to allow a more complete workbank for years 3,4 and 5 of CP5 to be submitted by NR at the end of year 1 (31st March 2015).

1.1.3 As part of their continuous improvement activity, NR have prepared an updated CP5 Earthworks Asset Policy (dated August 2014). This revised Policy is currently being used by the Routes as a basis for planning and developing their workbank for years 3, 4 and 5 of CP5.

1.1.4 At present NR are still developing their CAM submission and this report summarises our findings from a review of the updated CP5 Earthworks Asset Policy. Our findings have been discussed with NR and ORR following submission of our Draft report.

Key Changes

1.1.5 Key changes in the updated Asset Policy relate to available asset inventory & condition data, and the formation of the ‘safety risk matrix’ which is used with condition and consequence data to select soil slopes for intervention.

1.1.6 Since the previous Asset Policy NR have undertaken a significant number of specific activities to improve the quality of their inventory & condition data.

1.1.7 NR have also undertaken a detailed review of their historic failure data for soil slopes looking at the linkage between condition data collected in their examinations and actual failures. This has led to NR proposing a revised condition index (EHC - Earthworks Hazard Category) that replaces the previous Soil Slope Hazard Index used in policy derivation.

1.1.8 In their CP5 Asset Policy NR adopted an explicit ‘risk-based approach’ which was a significant step forward. In the revised policy NR have further developed that approach linking to wider work being undertaken by NR’s Safety and Sustainability Team on a ‘Common Consequence Tool’. NR have implemented this common consequence tool for earthworks through an update to their ‘safety risk matrix’ adopting a revised consequence scale (Earthworks Asset Criticality Band – EACB).

General Comments

1.1.9 The Asset Policy is underpinned by asset inventory, condition & failure data. It is very positive that NR are continuing to develop their earthworks asset knowledge and are taking measures to improve data quality. It is suggested that these activities should be more clearly defined in a time-bound improvement plan with clear data quality targets similar to those set out for Track in NR’s March 2014 Final Delivery Plan.

1.1.10 In terms of the updated ‘safety risk matrix’ there is evidence that for historic failure data (prior to CP5) the new EHC (x-axis of matrix) provides an improved
relationship between soil slope condition and failure probability. However, whilst the new consequence scale EACB (y-axis) does not seem unreasonable, there is limited evidence to demonstrate the difference it makes over the previous scale at present.

1.1.11 At the time of writing, there is still limited feedback as to the effectiveness of the CP5 asset policy – NR are collating material on the volumes of work activity undertaken, policy implementation and failure data for the first year of CP5.

1.1.12 In addition, a number of concerns raised in our previous review of the CP5 Asset Policy (Dec 2012) still remain as set out below.

Policy Robustness

1.1.13 On the basis that the Earthworks Asset Policy has a clear linkage to asset outputs (e.g. Condition Index), is based on reasonable inventory and condition information and has an explicit risk based intervention approach, we still consider it reasonably likely that the Asset Policy will be robust and capable of delivering a reduction in asset risk in the short-term. There is however not yet any significant feedback to draw on.

1.1.14 The focus of the Asset Policy is rightly primarily on the selection of sites based on safety risk. However, we note that NR under their licence has performance obligations to also meet. At present there is no guidance to Routes on selection of sites driven by performance. This might also consider network resilience – for example the importance of a line that is a ‘diversion route’.

Policy Sustainability and Whole System Cost

1.1.15 We continue to support the Policy principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk. However we still consider it uncertain as to whether the Earthworks Asset Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. Our concerns relate to the reduction in the volume of more 'traditional' 'heavier' 'renewal' interventions.

1.1.16 At present NR have yet to provide their Tier 1 / Tier 2 Whole Life Cycle Cost (WLCC) / SCAnNeR analyses to demonstrate policy optimisation and so we are unable to comment on the impact of the revised policy on whole system cost.

Policy Implementation

1.1.17 NR are continuing to use their PowerPack Tool to support Earthworks Policy implementation at a Route Level. This seems to be a very effective mechanism for providing a clear basis for central review of workbanks and policy alignment.

1.1.18 The documents that we have seen so far suggest that policy alignment currently varies significantly between Routes. The source of policy mis-alignment may originate from many sources but it does reinforce that significant Route level judgement will be needed to select the appropriate workbank. This is potentially of concern as our discussions with the Routes in 2013 indicated that there was a varied level of understanding of asset management principles in the Routes and that the local application of Asset Policies was at different stages of maturity.

1 Robustness: whether assets will deliver the required outputs; and
2 Sustainability: whether asset policies continue to deliver the outputs over the longer term
1.1.19 We still have concerns related to the constraint of reducing risk and condition at a Route Level but maintaining overall ‘average’ risk and condition, in that this seems to suggest that the earthworks condition at some Routes may deteriorate and the risk at some Routes could increase. We are still unclear as to whether this approach complies with NR’s Statutory Obligations under ALARP principles\(^3\). This should be addressed by NR in their CAM submission.

1.1.20 The new Earthworks Hazard Category potentially provides improved guidance on targeting ‘the right slopes’ for intervention. However, as yet there is little objective feedback that the maintenance and refurbishment interventions can be practically implemented and that they will be effective in reducing safety risk. This still poses a risk to delivery of performance improvement and the achievement of cost & efficiency targets in CP5.

**Review and Continuous Improvement**

1.1.21 We still have concern that there is little evidence of a structured continuous improvement approach to monitor the effectiveness of the CP5 Earthworks Policy. Specifically the Asset Policy update seems to have been undertaken before there was formal feedback and learning from the Dec 2012 policy. It is suggested that NR implement a more formally controlled continuous improvement process.

**Conclusion**

1.1.22 The CP5 Earthworks Asset Policy (Dec 12) introduced a new largely untried approach to the management of earthworks assets involving targeting an increased number of maintenance and refurbishment interventions and a reduced number of major renewal activities. The new policy (Aug 14) does not change this but potentially provides an improved way of selecting the ‘right’ earthworks for intervention using the new EHC index and the consequence scale. It is very positive that NR have extended the risk based principles to move towards a common ‘cross-asset’ consequence scale.

1.1.23 The CP5 Asset Policy has only been in use since April 2014 and so at present there is little evidence that the policy is able to be implemented by the Routes and is effective in reducing safety risk.

1.1.24 In summary our view is that the updated Policy is likely to be an improvement on the December 2012 policy, but there is not yet sufficient evidence from the first year of CP5 to demonstrate this with any certainty.

1.1.25 It is recommended that NR explicitly reviews the emerging effectiveness of the Asset Policy by considering a number of real examples with each Route to confirm that the Policy does, as they expect, identify key sites and appropriate interventions that will reduce safety risk. [2015EWP-01]

1.1.26 We recommend that NR provides explicit guidance to Routes on selection of sites driven by performance. This would complement the current safety related guidance. [2015EWP-02]

1.1.27 We also recommend that to improve confidence in the updated ‘safety risk matrix’, NR should undertake a more detailed calibration exercise to ensure alignment

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\(^3\) NR have a duty under the Health & Safety at Work etc. Act (1974) to manage safety risks to a level as low as reasonably practicable (ALARP). Our interpretation of this is that safety improvements should be implemented unless the costs are grossly disproportionate to the safety benefits.
between failure data, assessment methods, policy recommendations and actual example slopes. This would include both rock and soil slopes.  [2015EWP-03]

Acknowledgement

1.1.28 The Independent Reporter Team would like to thank both NR and ORR staff for their assistance with this review activity, for openly explaining progress and their thinking as well as providing documents / plans.
2 Introduction

2.1 General

2.1.1 Arup have been appointed by the Office of Rail Regulation (ORR) and Network Rail (NR) as CP4 Part A Independent Reporter to provide assurance as to the quality, accuracy and reliability of NR’s data that is used to report performance to ORR, the Department for Transport (DfT) and the wider industry.

2.1.2 At present, Network Rail are in the process of developing their civils workbanks for Years 3 to 5 of CP5. These will be submitted to ORR in March 2015 for their agreement under the Civils Adjustment Mechanism (CAM) [Doc. 19].

2.1.3 As part of their continuous improvement activity, NR have prepared an updated CP5 Earthworks Asset Policy (dated August 2014) [Doc. 4] which will be used by the Routes as a basis for planning and developing their ‘bottom-up’ workbanks.

2.1.4 This report summarises our findings from a progressive assurance review of the updated CP5 Earthworks Asset Policy.

2.1.5 The review has been undertaken by Arup in response to Independent Reporter Mandate AO/049. A full copy of the Mandate is included in Appendix A.

2.1.6 The findings detailed herein represent our current understanding based on our work to date. The findings have been reviewed with NR and ORR following submission of our Draft report.

2.1.7 Key reference documents provided for our review are listed in Appendix C2 and referenced in square brackets [Doc xx].

2.2 Previous Reports and Comments

2.2.1 As part of the ORR review of NR’s Strategic Business Plan in 2013, Arup undertook a detailed review of the CP5 Earthworks Asset Policy dated December 2012 and the Whole Life Cycle Cost (WLCC) Models that NR had developed to inform their Policy. Three key reports produced under Mandate AO/030 are relevant:

- Arup 2013a PR13 Maintenance & Renewals Review – Policy and WLCC Model Review’ Ref AO/030/02 Issue 1 May 2013. [Ref 3.]
- Arup 2013b PR13 Maintenance & Renewals Review – Earthworks Tier 1 Model Review’ Ref AO/030/03C Issue 1 May 2013.[Ref 4]

2.2.2 In our review we have referred back to these reports as appropriate and we have included a summary of our key findings in Appendix B.
2.3 Report Structure

2.3.1 This Report is structured as follows:

- Section 3 sets out the purpose, scope and our approach to this review;
- Section 4 sets out our understanding of the overall NR Asset Management approach as applied to Earthworks and provides a factual context for our review;
- Section 5 presents our findings / comments from our review;
- Section 6 sets out our conclusions
- Section 7 lists key references.
- A copy of the Mandate is included in Appendix A.
- Comments from our review of the previous CP5 Earthworks Asset Policy are summarised in Appendix B.
- A list of interviewees / documentation provided for this Mandate is included in Appendix C.
- A copy of the ‘Question Log’ used in tripartite meetings with ORR and NR to explore specific aspects is included as Appendix D.

Observations, Comments and Recommendations

2.3.2 Within the report key observations, comments and recommendations are highlighted by the use of green boxes like this.

2.4 Management of Potential Conflict of Interest

2.4.1 In accordance with our framework contract as an Independent Reporter, for each individual Mandate we review potential for conflict of interest with NR and ORR before we are appointed to undertake the work.

2.4.2 Our conflict of interest review for this Mandate identified that a separate team in Arup was / had been involved in developing some of the material that has been used by NR in their Asset Policy. This was highlighted to NR and ORR. It was agreed with both NR and ORR that this review would be undertaken by a separate and independent team in Arup.

2.5 Acknowledgement

2.5.1 The Independent Reporter Team would like to thank both NR and ORR staff for their assistance with this review activity, for openly explaining progress and their thinking as well as providing documents / plans.
3 Purpose, Scope and Review Approach

3.1 Purpose and Scope

3.1.1 At present NR are developing their Civils Adjustment Mechanism (CAM) submission which is due to be issued in March 2015. The CAM submission will be considered in detail by ORR at that time.

3.1.2 This review is part of progressive assurance of CAM being undertaken by ORR ahead of formal issue of the CAM submission. Specifically the Mandate is to review the updated Earthworks Asset Policy - dated August 2014 [Doc. 4] and comment on the key changes that NR have made since the Earthworks Asset Policy (dated December 2012) [Doc. 1] that was used to develop the CP5 Strategic Business Plan [Doc. 33] and CP5 Final Delivery Plan [Doc. 22].

3.1.3 A reporting date of February 2015 for our Draft Report was agreed to suit availability of information from NR.

3.1.4 To reflect the fact that NR are still preparing their CAM submission it was agreed that Arup would address aspects in the Mandate in stages. At the time of writing it has not been possible to review the following specific aspects of the Mandate:

- Tier 3 ‘PowerPack’ Tool (and the PAnTS Powerpack Analysis Tool Set) – these have not been provided by NR so we have been unable to review whether changes to the Asset Policy have been accurately modelled;
- Whole Life Cycle Cost (WLCC) / SCAnNeR analyses – these are presently being updated by NR and have not been provided.

3.1.5 It has also been agreed that review of the Mining Policy is not required.

3.1.6 In undertaking this Policy review we have been provided with some information on the Common Consequence Tool (CCT). We have not been provided with the CCT itself and have only considered the information provided in the general context of the 'safety risk matrix’ – specifically we have not reviewed the CCT work.

3.1.7 In progressing our review we have considered:

- Compliance with the Network Licence, particularly Section 1 relating to Network Management; and
- ORR tests of robustness, sustainability and minimum whole lifecycle, whole system cost and further criteria for assessing asset policy as shared with NR.

3.2 Approach

3.2.1 Our approach has been a desk-top based review of policy documentation supplemented by written answers provided by NR to specific questions raised in the Question Logs and meetings. A list of meetings is included as Appendix C1, together with a copy of the final Question Log in Appendix D. We have not had the opportunity to make any site visits or meet with the Route teams.

3.2.2 We have based our review on the key documents provided by NR (and ORR) as listed in Appendix C2.
4 Context

4.1 Introduction

4.1.1 The aim of this section is to summarise our understanding as to how the NR Asset Policies fit into the overall Asset Management System and how they are related to models, outputs and the volumes quoted in the CP5 Delivery Plan. It provides a factual context for the subsequent sections that review and comment on the Asset Policy.

4.2 Asset Management System

4.2.1 NR’s overall asset management system is described in their Asset Management Policy [Doc. 20] and Asset Management Strategy [Doc. 21]. These are dated March 2014 and October 2014 respectively.

4.2.2 NR’s asset management framework is shown in Figure 4-1 below. This defines the cycle of NR’s asset management decisions and activities in a Plan-Do-Review sequence.

![Network Rail Asset Management Framework](Doc. 21)

**Figure 4-1: Network Rail Asset Management Framework [Doc. 21]**

4.3 Asset Policies

4.3.1 Asset Policies are a key part of NR’s asset management framework and NR [Doc. 21] explains the purpose of Asset Policies as:

“Asset Policies Specify how to select the major inspection, maintenance and renewal interventions for each asset discipline to deliver the required outputs at lowest whole lifecycle cost (WLCC) ...”

“...rules to ensure objectives are delivered consistently...”
This is shown schematically in Figure 4-2 below.

4.3.2 The NR Asset Policies are informed by ‘Tier 2’ Whole Life Cycle Cost (WLCC) models and in turn then inform the Route Plans and the Delivery Plans.

Earthworks ‘SCAnNeR’ WLCC Model

4.3.3 The December 2012 CP5 Earthworks Asset Policy [Doc 1] was derived from analyses using a ‘Tier 1/ Tier 2’ WLCC Model known as ‘SCAnNeR’. This model informed NR’s selection of optimum maintenance and renewal interventions that represent lowest whole lifecycle cost. The model was also used to inform the volumes of interventions proposed for CP5. Further detail is included in our previous reports [Arup, 2013a,b].

Figure 4-2: Network Rail Asset Management System Documents [Doc. 21]

Earthworks ‘PowerPack’ Tools

4.3.4 NR have embedded their CP5 Earthworks Asset Policy principles and their inventory & condition data into a ‘Tier 3’ spreadsheet tool known as ‘Powerpack’. Powerpack is a workbank planning tool that aligns intervention activity to assets. Planned future works can then be analysed against policy application. The tool has been provided to the Routes to help them develop their workbanks for CP5.

4.3.5 NR have also developed a PAnTS tool (Powerpack Analysis Tool Set) to enable workbank output modelling.

4.4 Asset Output Measures

4.4.1 In January 2013, NR’s CP5 Strategic Business Plan [Doc. 33] set out a series of asset output measures relating to:

- ‘robustness’
- ‘sustainability’
- ‘renewal volumes’
At that time the robustness measure was still under development, and an ‘earthworks risk index’ was proposed as the sustainability measure. The Network-wide renewal volumes for earthworks are summarised in Figure 4-3 below.

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<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthworks (5 chain-length)</td>
<td>3,554</td>
<td>3,549</td>
<td>3,547</td>
<td>3,552</td>
<td>3,554</td>
<td>17,757</td>
</tr>
</tbody>
</table>

Source: NR Strategic Business Plan for CPS – page 41

**Figure 4-3: SBP Network-wide earthworks renewal volumes [Doc. 33 page 41]**

4.4.2

For their CP5 Final Delivery Plan [Doc. 22] NR have developed their SBP asset output measures into a set of Regulated Outputs\(^4\) and Indicators\(^5\) that they plan to be delivered in CP5. For the Earthworks asset these comprise the following indicators:

- ‘asset condition reliability’
- ‘asset condition sustainability’
- ‘renewal volumes’

The Network-wide specific values are summarised below in Figures 4-4, 4-5 and 4-6 respectively.

**Asset Condition Reliability**

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</thead>
<tbody>
<tr>
<td>Earthworks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthwork failures</td>
<td>109</td>
<td>105</td>
<td>101</td>
<td>98</td>
<td>94</td>
<td>90</td>
</tr>
</tbody>
</table>

Source: NR Delivery Plan for CPS – Table 24

**Figure 4-4: FDP Network-wide Asset Condition Reliability [Doc. 022 Table 24]**

**Asset Condition Sustainability**

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<tbody>
<tr>
<td>Earthworks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthworks - Condition banding</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.74</td>
</tr>
</tbody>
</table>

Source: NR Delivery Plan for CPS – Table 25

**Figure 4-5: FDP Network-wide Asset Condition Sustainability [Doc. 022 Table 25]**

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\(^4\) Regulated outputs: - Outputs that, if Network Rail fails to deliver, ORR would consider whether this amounts to a licence breach and hence may take enforcement action.

\(^5\) Indicators:- Used for specific monitoring purposes to indicate trends which may raise concern about Network Rail’s likely future compliance with a regulated output.
4.4.3 We understand from NR that the reduction in renewal volumes (about 9.5% reduction) between the SBP (Figure 4-3) and the Final Delivery Plan (Figure 4-6) relates to the fact that the SBP volumes were determined by top down modelling whereas the FDP volumes came from detailed bottom-up workbanks produced by the Routes.

4.5 **Civils Adjustment Mechanism (CAM)**

4.5.1 In their Strategic Business Plan [Doc.33] NR noted that whilst they believed that all their asset policies would deliver the required outputs in CP5, their view was that their policies for civils assets (structures, earthworks, drainage) were new and (while supported by models) were largely untried in practice. NR suggested an approach of:

‘delivering increased activity levels while continuing to review whether the revised asset policies are recovering the backlog and reducing the level of risk relating to civils assets.’

NR Strategic Business Plan page 41 [Ref 033]

4.5.2 ORR were unable to conclude on CP5 civils expenditure in their 2013 Periodic Review because of the level of uncertainty in Network Rail’s SBP submission. In recognition of this the ORR Determination set out a Civils Adjustment Mechanism (CAM).

The CAM requires NR to submit an updated civils asset management plan to demonstrate that it has in place a bottom-up workbank for years 3, 4 and 5 of CP5 (2016/17 to 2018/19), created by applying its asset policies to the civils asset portfolio, in accordance with condition 1.19 of its Network Licence. NR’s plan is required to justify the proposed expenditure.

4.5.3 At present NR are still developing their CAM submission. This is due to be issued to ORR by 31st March 2015.

|------------------|---------|---------|---------|---------|---------|-----|

Source: NR Delivery Plan for CP5 – Table 32

**Figure 4-6: FDP Network-wide civils renewal volumes [Doc. 022 Table 32]**
5 Review and Comment on Policy

5.1 General

5.1.1 As part of their continuous improvement activity, NR have prepared an updated CP5 Earthworks Asset Policy (dated August 2014) [Doc. 4].

5.1.2 This updated Asset Policy replaces the previous Asset Policy (Dec 2012) [Doc. 1] and is being currently used by the Routes as a basis for planning and developing their ‘bottom-up’ CAM workbanks for years 3, 4 and 5 of CP5.

5.1.3 NR have also further developed their ‘Tier 3’ ‘PowerPack’ spreadsheet tool to support the Routes in developing their workbanks. As noted earlier, a review of the policy implementation in the ‘PowerPack’ tool has not been possible at present.

Key Changes

5.1.4 The December 2012 Asset Policy was based on the following key inputs:

- Inventory and Condition data;
- Analysis of failure data;
- Adoption of a ‘risk based’ approach with assumed relationships between asset condition and consequence;
- Intervention effectiveness and cost assumptions;

5.1.5 The update to the Policy relates to the first three of these aspects for soil cuttings and embankments. The interventions are unchanged and the ‘top down’ SCAnNeR modelling has not yet been re-run by NR to demonstrate policy optimisation. In addition NR have extended the risk based principles to move towards a common ‘cross-asset’ consequence scale.

5.1.6 The key changes are discussed below with our comments and observations. Feedback on the CP5 policy implementation to date is also discussed.

5.2 Inventory and Condition Data

5.2.1 Based on information available at the time, in March 2013 our understanding of the earthworks inventory data was that:

- the earthworks inventory comprised 175,123 asset 5 chain lengths (see Figure 5-1);
• only about 1% of the national database of assets remained to be examined;
• there was some variability in asset data between Routes, but we assessed that at a National Level there was low uncertainty associated with the overall NR earthworks inventory

5.2.2 In terms of condition data, our view in March 2013 was that:

• the condition profile (SSHI/RSHI) for the earthworks asset was as presented in Figure 5-2:

<table>
<thead>
<tr>
<th>Serviceable</th>
<th>Marginal</th>
<th>Poor</th>
<th>Top Poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment</td>
<td>54959 (56.2%)</td>
<td>36800 (37.6%)</td>
<td>5295 (5.4%)</td>
<td>761 (0.8%)</td>
</tr>
<tr>
<td>Soil Cutting</td>
<td>39222 (57.6%)</td>
<td>25981 (38.2%)</td>
<td>2033 (3.0%)</td>
<td>849 (1.2%)</td>
</tr>
<tr>
<td>Rock Cutting</td>
<td>4388 (47.6%)</td>
<td>3788 (41.1%)</td>
<td>762 (8.3%)</td>
<td>285 (3.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>98569</td>
<td>66569</td>
<td>8090</td>
<td>1895</td>
</tr>
</tbody>
</table>

Figure 5-2 Condition Data (as at 15/02/12) – [Ref 3 - Arup 2013a]

• the majority of NR earthworks five chain lengths had had at least one examination and so there was a reasonably low uncertainty associated with earthworks condition data.
• there was some variability in asset data between Routes and that the last examination, in some instances, may have been up to 10 years ago.

5.2.3 The updated Asset Policy indicates that the earthworks inventory is now known to comprise at least 184,551 asset 5 chain lengths (see Figure 5-3) – this is approximately 5% greater than in Feb 2012 (Figure 5-1). NR have developed their definition of ‘inspection 5 chains’ and so the total number of ‘earthworks inspection 5 chains’ has changed from 159,407 to 332,774.

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Earthwork assets</th>
<th>Earthwork Inspection 5 chains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankments</td>
<td>98,329</td>
<td>332,774</td>
</tr>
<tr>
<td>Soil Cuttings</td>
<td>70,149</td>
<td></td>
</tr>
<tr>
<td>Rock Cuttings</td>
<td>15,073</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>184,551</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5-3 Inventory Data (as at 02/05/14) – [Doc. 4]

5.2.4 Of the 184,551 assets, 172,249 asset 5 chain lengths are listed [Doc 4 Table 2-3] as having full examinations – i.e. 93%.

5.2.5 NR are continuing to improve their understanding of the asset inventory and condition, specifically they have recently made improvements to earthworks inspection terminology with introduction of categories such as ‘never inspected’, ‘inspection unfinished’, ‘incomplete examination’ etc. to reflect the fact that some of the inspection and examination records were incomplete.
5.2.6 The updated information suggests that at October 2014, there are actually 62,224 5-chain lengths that have never been inspected for earthworks and where it is not currently known whether there are any earthworks assets present or not – See Figure 5-4. This represents approximately 19% of the total asset length.

5.2.7 Of the potential 19%, NR believe that once Route level data improvement has been undertaken that the never inspected earthwork inspection 5-chains assets may fall to about 7%.

5.2.8 Figure 5-5 shows the variations in asset count by asset type and route. The exact source of these changes is unclear – i.e. whether due to a further inspection seasons between 2012 and 2014 or data cleansing / improvement activity but it is positive that NR are still actively developing their asset knowledge.

Figure 5-4 Never Inspected Earthworks (Inspection 5-chains) [Doc 34]

Figure 5-5: Variation in earthworks asset inventory by route and earthwork type between 15/02/12 data set and 02/05/14 data set.
Data Quality

5.2.9 NR have produced a detailed Data Quality Report [Doc. 12] dated January 2014, which provides a consolidated view on asset data quality. The document summarises the results of several exercises that have resulted in reviews of earthwork asset data quality including:

- ORBIS: Asset Data Improvement Programme (ADIP) analysis, Nov 2011
- Data processing report for CeCost model, Oct 2012
- Issues noted during CP5 policy development
- Issues noted during development of the adverse weather risk prioritisation, 2013
- Data clean-up activities with Route teams (during 2013) CP5 earthworks team/JBA Consulting (JBA) data quality assessment 2013.

5.2.10 The document also provides a collated summary of the data quality issues list identified by CP5 earthworks team and JBA based on analysis undertaken on 26 June 2013.

5.2.11 Issues are prioritised and quantified. These comprise 8 ‘red’ concerns that may lead to significant uncertainty and 12 ‘amber’ concerns. The ‘red’ concerns are reproduced below.

<table>
<thead>
<tr>
<th>RAG</th>
<th>Summary of issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>1. Duplicate assets (same real asset, two or more IDs at asset level)</td>
</tr>
<tr>
<td></td>
<td>2. Inconsistency between asset types listed at exam level and actual assets in database</td>
</tr>
<tr>
<td></td>
<td>3. Not all Rail 5 chains (BIDs) attributed with required data for asset criticality calculations</td>
</tr>
<tr>
<td></td>
<td>4. Base data for asset criticality calculation out of date, particularly for track quality data? Route classification?</td>
</tr>
<tr>
<td></td>
<td>5. There are sections of the network where potential assets have been identified by LiDAR, that have yet to become complete asset records (grey assets)</td>
</tr>
<tr>
<td></td>
<td>6. There is not complete coverage of the NR network with ‘earthworks’ data. Yet ground related hazards can impact on sections at grade as well</td>
</tr>
<tr>
<td></td>
<td>7. Mixed slopes; currently not possible for NR to definitively state how many mixed rock/soil slopes they have.</td>
</tr>
<tr>
<td></td>
<td>8. Drainage data link/overlap with asset data (whether earthwork there or not)</td>
</tr>
</tbody>
</table>

Figure 5-6: Summary of Data Quality Issues (as analysed at 26/06/13) [Doc.12]
5.2.12 It is very positive that the report defines actions to resolve these issues and sets out acceptance criteria. The Data Quality Report [Doc. 12] also recommends that steps should be taken to prevent these (and other) data quality issues from reoccurring. The steps identified are:

**Data validity**
- Validation checks in field tool
- Checks built into data upload
- Annual re-analysis of the data quality checks and correction

**Data accuracy**
- Consider a 100% re-survey requirement
- Use available data sets to check and verify examination data
- Use linked datasets (rather than data cuts)

**Standards**
- Remove incomplete or incompatible data
- Consider impact of changes in examination standard to existing data
- Re-configure dataset to be ‘asset centric’ (rather than examination time-based)

**Competence and training**
- Review competence
- Provide training

5.2.13 We note that a specific asset data quality trajectory for the Track asset is included in NR’s FDP (dated 31 March 2014). We have not been provided with the current asset data quality score for Earthworks or a trajectory for improvement but note that the FDP states that asset data quality for earthworks will be reported in the 2015 Delivery Plan update. Mention of this is not included in the Data Quality Report (dated January 2014).

5.2.14 We understand that as part of their CSAMS\(^6\) work, NR have an ongoing workstream to improve data quality of the earthworks asset dataset and that a data quality update should be available shortly.

5.2.15 The Data Quality Report (Jan 2014) makes a number of useful recommendations on how to improve data quality considering process, data and technology. This is very positive.

5.2.16 It is very positive that NR are actively improving the quality of their earthworks inventory and condition data, however we have not seen any evidence of a time-bound improvement plan or the linkage to the asset data quality trajectory mentioned in the FDP. It is suggested that such an improvement plan should be prepared by NR (and actions implemented if not already underway) with clear data quality targets similar to those set out for Track in NR’s March 2014 Final Delivery Plan.

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\(^6\) Civil Strategic Asset Management Solution
5.3 Analysis of Failure Data

5.3.1 Since December 2012, NR have spent considerable effort in reviewing the earthwork examination data (for soil slopes) to investigate and improve on the relationship between condition and failure. This has involved detailed statistical analysis to try to better represent the likelihood of failure by weighting particular key condition features [Doc. 5, 13]. This is very positive.

5.3.2 A revised condition index (Earthworks Hazard Category - EHC) has been developed which replaces the existing Soil Slope Hazard Index (SSHI) algorithm. EHC has five categories (A, B, C, D & E) which replaces the four SSHI bands.

5.3.3 NR have not revised the Rock Slope Hazard Index (RSHI) algorithm.

5.3.4 A comparison of failure probabilities is shown in Figure 5-7 and Figure 5-8 below.

![Figure 5-7 Annual Failure Probabilities (SSHI/RSHI compared)](Doc. 5)

![Figure 5-8 Annual Earthwork Failure Probabilities](Doc. 4)
5.4 Risk Based Approach

5.4.1 The key improvement in the December 2012 CP5 Earthworks Asset Policy was the adoption of a ‘safety risk matrix’ to guide selection of sites for intervention.

5.4.2 At that time the ‘x-axis’ likelihood score was represented by Earthworks Hazard Index (EHI) and the ‘y-axis’ consequence by ‘Modified EPM’. This gave the 3x4 matrix shown in Figure 5-9 below.

5.4.3 The ‘safety risk matrix’ has now been updated to use Earthworks Hazard Category – EHC (x-axis) and a 5 band ‘consequence scale’ Earthworks Asset Criticality Band – EACB (y-axis) to give the 5x5 matrix shown in Figure 5-10 below.

The following sections set out our comments on NR’s updated risk based approach.

Figure 5-9 Earthworks Risk Matrix (CP5 Policy December 2012 [Doc 1])

Figure 5-10 Updated Earthworks Risk Matrix (CP5 Policy August 2014 [Doc 4])
5.4.4 NR Safety & Sustainability Team have developed a Common Risk Scoring Matrix for Safety ('Safety Risk Matrix') that can compare various asset / functional / operational risks on a consistent basis. The aim is to be able to evaluate and compare different safety investments [Doc 16].

5.4.5 At present we understand that NR have completed Phase 2 of their development which includes a ‘common consequence tool’ (CCT) to provide a consistent means of modelling consequences of derailment for any location. Specifically the CCT assesses consequence in terms of Fatalities and Weighted Injuries (FWI) which can be used across the entire safety risk space and permit cost asset comparison.

5.4.6 Although not directly part of this review, we consider that the development of the ‘common consequence tool’ (CCT) to support cross-asset safety investment trade-off decisions is a very significant step forward. The potential benefit was indicated in our review of Civil Structures in 2011 [Ref 1] and SBP Review [Ref 2], where we identified that cross-asset trade-offs were an area for future development.

5.4.7 A diagrammatic representation of the CCT and the linkage to the RSSB Safety Risk Model is shown in Figure 5-11 below.

5.4.8 We note that the NR Earthworks Team have adopted a ‘bow –tie’ risk analysis approach – see Figure 5-12 below. We consider that this reflects ‘best practice’ – and is consistent with British Standard BS EN 31010⁷.

![Diagram showing safety risk model for cuttings](Doc 15)

**Figure 5-12 Bow tie diagram showing safety risk model for cuttings [Doc 15]**

5.4.9 As noted above, we consider the development of a common consequence approach to supporting the prioritisation of safety investments to be a very positive step forward. However, in terms of further development, this approach should be extended to consider wider railway performance to provide balanced guidance to Routes on workbank development. At present we have not seen any such central guidance (qualitative or quantitative). This is discussed further below.

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⁷ BS EN 31010:2010  Risk management - Risk assessment techniques
5B Common Consequence Tool – Overview

Consequences for each possible outcome are derived from the RSSB Safety Risk Model and depend significantly on speed, and at this stage assume average passenger loading.

From asset tool or average consequences from SRM Table B1
Dependent on primary event

From SRM average values for maintaining clearance for an open track derailment, speed dependent

Values for tunnel and station cases taken to calculate the tunnel and station modifiers

From SRM average consequences per event for a derailment with no secondary collisions or striking line side object, open track, speed dependent

From SRM the average consequences per event for a secondary collision, weighted for the probability of passenger train or freight train at that location

Safety Risk Model v7.5 has been used

Figure 5-11 AD Little Common Consequence Tool – Overview [Doc 16]
5.4.10 NR have defined a new hazard index for soil cuttings and embankments utilising parameters in the existing 065 earthworks examination inspection database but weighting them in a different way to more closely fit the CIV/028 failure database. Our understanding of this is outlined below.

5.4.11 The 065 examination database has been re-assessed by NR to determine a Hazard Index which is a numerical score that better represents the statistical likelihood that an earthwork may fail resulting in a possible safety incident. The previous Soil Slope Hazard Index (SSHI) data has been re-worked and linked to CIV028 failure data to weight the parameters to effect an improved index linking asset condition to failure events [Doc 5].

5.4.12 The range of possible Hazard Index scores has been segmented into five categories – A to E – which are termed Earthwork Hazard Categories (EHCs). Category A being the statistically least likely to fail and category E - the most likely to fail – see Figure 5-10.

5.4.13 This data analysis is a very positive step and considerable work has been undertaken by NR to make the best use of available data in this regard.

5.4.14 It is noted, however, that the analysis was constrained by a limited quantity of linked clean asset and failure information to permit correlation; only 197 soil cutting and 105 embankment failure records were able to be used – approximately a quarter of the total available / recorded safety-related asset failures. The correlation methods used by NR have combined statistical assessment and the application of engineering judgement to arrive at an improved index that is indicated by NR to improve alignment between earthwork asset condition and potential for failure.

5.4.15 It is also recognised that correlation between pre-failure condition and failure is potentially hampered by the interval between the examination date / record and the failure event. Information provided by NR – Figure 5-13 – indicates that only 50% of the failures had a condition record made in the 1.5 years preceding its failure. The application of engineering judgement in the correlation approach will have accommodated some of the inevitable variances but this will have introduced some level of additional uncertainty.
As indicated by NR’s Earthworks Safety Risk Bow-Tie Diagram (Figure 5-14) - the assessment method combines condition and non-condition related failures. However we note that despite analysis work (for example NR review of adverse weather [Doc 47]) at present NR are generally unable to separate out adverse weather related failure events. It is suggested that this is an area for further development.
NR have implemented changes in the earthwork examination standards NR/L3/CIV/065 and performance reporting NR/ARM/M33PR as a result of their analysis work. This includes changes to earthwork classification to align with the EHC and revision of inspection frequencies and, we understand, data capture requirements. For example, the planned inspection interval for ‘marginal’ / B+C category soil cuttings has been reduced from 5 to 3 years. There have also been changes made to the reporting of earthwork failures – NR/ARM/M6PR. This implementation of improvements arising from the data review is very positive.

Rock cuttings have not been re-evaluated in the same detail, however, an interim re-categorisation of RSHI data to a similar 5-point scale has been applied [Doc 5].

In the Dec 2012 Asset Policy the categorisation of rock cuttings appeared to be inconsistent in that the predicted estimated annual probability of failure is higher for category D than E – ref [Doc 1]. This concern remains with the updated Asset Policy – see Figure 5-15 below.

![Figure 5-15 – Estimated annual probability of failure for rock cuttings by Earthworks Hazard Category (EHC) [Doc 5].](image-url)
5.4.22 Anomalies with RSHI still exist – for example RSHI category E Rock Cuttings have a lower failure probability (0.36%) than RSHI category D Rock Cuttings (0.39%). It is understood that NR intend to review rock cutting data in due course – however no timing for this improvement work has been advised by NR. It is suggested that this is included in a time-bound improvement plan.

5.4.23 NR have provided three specific examples [Doc 49] that the re-categorisation of earthwork assets using the revised EHC approach has improved the selection process. This seems a very limited sample.

5.4.24 To assist in our review in Table 5-1 we have calculated the likely number of asset failures for each earthwork type derived from the estimated failure likelihoods presented by NR [Doc 5]. This indicates that the failures of 51 soil cuttings, 27 embankments and 23 rock cuttings could be predicted per annum.

<table>
<thead>
<tr>
<th>Total earthwork assets (Table A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Soil Cuttings</td>
</tr>
<tr>
<td>Embankments</td>
</tr>
<tr>
<td>Rock Cuttings</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated Annual Probability of Failure (Table B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Soil Cuttings</td>
</tr>
<tr>
<td>Embankments</td>
</tr>
<tr>
<td>Rock Cuttings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated Annual Failures (Table AxB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated annual failures</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Soil Cuttings</td>
</tr>
<tr>
<td>Embankments</td>
</tr>
<tr>
<td>Rock Cuttings</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Table 5-1 Estimation of likely Annual Failures [ref Docs 4 and 5]

**Note:** The calculation uses the quantum of assets by type and EHC presented in the Aug 14 policy [Table 2-3, Doc 4] and the estimated annual failure probabilities provided in both the Hazard Index derivation [Doc 5] and summarised in the Aug 14 policy [Doc 4].

5.4.25 NR have also provided information on recorded failures of earthwork assets as part of the EHC method validation. The data for failures in the period to Feb 2013 is summarised on Table 5-2. The numbers of failure seen in the partial year’s data is broadly consistent with the estimated annual failures. It is suggested that NR monitors the trajectory of failures.
Actual Failures – to Feb 2014

<table>
<thead>
<tr>
<th>EHC</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Total</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Cuttings</td>
<td>3</td>
<td>12</td>
<td>14</td>
<td>9</td>
<td>2</td>
<td>40</td>
<td>Figure 10-1 Doc 5</td>
</tr>
<tr>
<td>Embankments</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>17</td>
<td>Figure 10-2 Doc 5</td>
</tr>
<tr>
<td>Rock Cuttings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No data provided</td>
</tr>
</tbody>
</table>

Table 5-2 Recorded Asset Failures [from Doc 5]

5.4.26 NR have explained how the re-categorisation of EHC was carried out such that “parity” was retained between the quantities of earthworks assets in each hazard category under the old metric and under the new metric at the point of changeover. The impact of this approach has been discussed with NR and at present we still remain unclear as to the implications.

Consequence of Failure (y-axis)

5.4.27 The Dec 2012 Asset Policy adopted a semi-quantitative criteria known as the ‘Modified Earthworks Priority Model’ (‘Modified EPM’) which relied heavily on engineering judgement rather than an explicit assessment of potential severity of consequence [Doc. 15].

5.4.28 In developing their Aug 14 Policy update, NR have applied the principles of the ‘Common Consequence Tool’ and used this to derive a single value of Fatalities and Weighted Injuries (FWI)/event for each earthwork. The relationship with the CCT is shown diagrammatically below in Figure 5-16.

5.4.29 NR have split the FWI data into a 5 point criticality scale [Doc. 11]. We note that NR considered several ways of splitting the consequence data, and that NR eschewed their recommended approach of drawing boundaries based on criticality values and instead adopted an approach to maintain consistency with the previous Modified EPM scale to maintain a ‘smooth transition’. NR have not explained the implications of this approach and we are concerned that this may lead to the adoption of a classification that does not accurately reflect consequence.
The Common Consequence Tool

Common or ‘cross-asset’ (non-geotechnical)

Earthworks P(earthwork failure) – X-axis work

Common Consequence Tool

Earthworks P(derailment given failure)

Source: Arthur D. Little

Figure 5-16 Interface with Common Consequence Tool [Doc 32]
**Overall Risk Evaluation**

5.4.30 As noted above, we consider it very positive that NR has developed an updated condition index (EHC - Earthworks Hazard Category), an updated consequence index (EACB- Earthworks Asset Criticality Band) and is adopting a common consequence tool approach for earthworks.

5.4.31 NR have provided material to indicate that they have kept the total national number of assets the same in each condition category and that asset volumes may change at a Route level. We understand that NR have calculated these changes in asset volumes at Route level, however, at present these have not been provided to us.

5.4.32 Accordingly, we are unclear as to the exact implications of imposing requirements to maintain consistency between the previous axes and the revised scales. Specifically, we are uncertain as to the practical change that comes from introducing the updated Aug 2014 ‘safety matrix’.

5.4.33 We are also unclear as to the extent that the risk levels of specific earthworks may have changed simply due to the ‘parity’ requirement rather than the actual ‘re-classification’. It is suggested that NR undertakes a review to satisfy itself that the new matrix gives an improved criteria for selection of earthworks safety interventions.

5.4.34 Going forward it would be useful if a clear improvement plan was developed and presented to allow future continuous improvement to be understood.

5.4.35 It is recommended that to improve confidence in the updated ‘safety risk matrix’ NR should undertake a more detailed calibration exercise to ensure alignment between failure data, assessment methods, policy recommendations and actual example slopes. This would include both rock and soil slopes.

**Policy Implementation**

5.5.1 In 2013 we reviewed the December 2012 Earthworks Asset Policy in detail. This is presented in our previous reports [Ref 2,3 4] and a summary of the key points is included in Appendix B.

5.5.2 In their Strategic Business Plan (Jan. 2013) NR noted that their CP5 policy was new and largely untried in practice.

5.5.3 At present there is still very limited feedback as to the effectiveness of the CP5 asset policy – the policy was only due to be implemented in April 2014 and NR are still collating material on the volumes of work activity undertaken, policy implementation and failure data for this first year of CP5.
5.5.4 This lack of feedback is unfortunate as it means that a number of our previous uncertainties related to the December 2012 Asset Policy still remain in relation to the:

- ability of the CP5 policy to reduce asset risk in the short-term;
- long term sustainability associated with reduction in the volume of more ‘traditional’ ‘heavier’ ‘renewal’ interventions
- degree to which the Routes will be able to practically apply the asset policy and target ‘the right slopes’ for maintenance and refurbishment activities.

5.5.5 It is suggested that NR reviews CP5 policy implementation by the Routes and the degree to which it is reducing earthworks risk.

5.5.6 NR have provided CP5 condition score forecasts in their FDP together with predicted CP4 exit values [Doc. 022]. These are summarised below in Figure 5-17.

<table>
<thead>
<tr>
<th>Route / National</th>
<th>Earthworks condition score</th>
<th>2014/15</th>
<th>2015/16</th>
<th>2016/17</th>
<th>2017/18</th>
<th>2018/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglia</td>
<td>1.68</td>
<td>1.69</td>
<td>1.70</td>
<td>1.72</td>
<td>1.73</td>
<td>1.74</td>
</tr>
<tr>
<td>Kent</td>
<td>1.87</td>
<td>1.79</td>
<td>1.79</td>
<td>1.80</td>
<td>1.80</td>
<td>1.81</td>
</tr>
<tr>
<td>LNE</td>
<td>1.68</td>
<td>1.71</td>
<td>1.71</td>
<td>1.72</td>
<td>1.72</td>
<td>1.72</td>
</tr>
<tr>
<td>LNW</td>
<td>1.79</td>
<td>1.85</td>
<td>1.84</td>
<td>1.83</td>
<td>1.82</td>
<td>1.81</td>
</tr>
<tr>
<td>Midlands</td>
<td>1.60</td>
<td>1.69</td>
<td>1.69</td>
<td>1.69</td>
<td>1.68</td>
<td>1.68</td>
</tr>
<tr>
<td>Scotland</td>
<td>1.55</td>
<td>1.55</td>
<td>1.55</td>
<td>1.54</td>
<td>1.54</td>
<td>1.54</td>
</tr>
<tr>
<td>Sussex</td>
<td>1.81</td>
<td>1.74</td>
<td>1.74</td>
<td>1.74</td>
<td>1.74</td>
<td>1.74</td>
</tr>
<tr>
<td>Wales</td>
<td>2.00</td>
<td>2.01</td>
<td>2.00</td>
<td>1.99</td>
<td>1.98</td>
<td>1.97</td>
</tr>
<tr>
<td>Wessex</td>
<td>1.71</td>
<td>1.69</td>
<td>1.69</td>
<td>1.71</td>
<td>1.72</td>
<td>1.73</td>
</tr>
<tr>
<td>Western</td>
<td>2.07</td>
<td>1.99</td>
<td>1.96</td>
<td>1.93</td>
<td>1.92</td>
<td>1.91</td>
</tr>
<tr>
<td>England &amp; Wales</td>
<td>1.79</td>
<td>1.80</td>
<td>1.80</td>
<td>1.79</td>
<td>1.79</td>
<td>1.79</td>
</tr>
<tr>
<td>England, Scotland &amp; Wales</td>
<td>1.74</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.74</td>
</tr>
</tbody>
</table>

Figure 5-17: Earthworks Asset Condition Sustainability Indicator Forecasts at March 2014 [Doc. 018 / 022]

5.5.7 At present, NR are in the process of re-running their analyses to provide an updated set of earthworks condition forecasts for CP5 that will take the CP4 exit position into account. However, in the meanwhile we have been advised by ORR that the actual CP4 exit position (SBP and DDP) is different from that shown in Fig 5-17.

5.5.8 As noted previously we still have concern that maintaining a national average condition implies that the earthworks condition at some Routes may deteriorate during CP5 (for example Anglia). We are unclear as to the implication this will have on risk at a Route level. We are also unclear whether the proposed policy / intervention mix will comply with Statutory Obligations under ALARP principles. It is suggested that NR address this point when they re-run their modelling of the new Policy.
5.5.9 Notwithstanding the fact that the CAM submission is still under development and discussions are ongoing with the Routes it appears that there is currently a significant difference in the level of ‘policy alignment’ across the Routes [Ref 035] - see Figure 5-20 below.

5.5.10 Specifically, in Kent, Route feedback suggests that at 16th December 2014 [Doc 43]:

- Only 39% of the total CP5 workbank aligned to Policy (344/891 schemes).
- Only 38% of the years 3-5 workbank had been aligned to Policy (188/498 schemes)

See Figures 5-18 & 5-19 below.

![Figure 5-18 Alignment of CP5 Workbank to Policy [Doc 43]](image1)

![Figure 5-19 Alignment of CP5 Year 3-5 Workbank to Policy [Doc 38]](image2)
5.5.11 We note that the Earthworks Asset Policy is to provide guidance to the Routes, and that it is for the Routes to decide where and how to intervene based on local knowledge and experience, however the low level of policy alignment is potentially of concern as it does rely on the maturity of the Route team and / or central review and assurance.

5.5.12 Our BCAM Embedment Review undertaken in Autumn 2013 [Ref 5] indicated a significant variation in asset management maturity between Routes. Whilst this is now some 18 months ago, this does raise the concern that Route level choices may introduce significant inconsistency into the management of the earthworks asset.
Figure 5-20: Route and National RAG Status for SBP Policy (Dec 2014) [Doc. 35]
6  Summary and Conclusions

6.1  General

6.1.1  The Asset Policy is underpinned by inventory, condition and failure data. It is very positive that NR are continuing to develop their earthworks asset knowledge and are taking measures to improve data quality.

6.1.2  Generally, at present there is still very limited feedback as to the effectiveness of the CP5 asset policy – for example NR are still collating material on the volumes of work activity undertaken, policy implementation and failure data for the first year of CP5.

6.1.3  In addition, a number of concerns raised in our previous review of the CP5 Asset Policy (Dec 2012) still remain as set out below.

6.2  Inventory and Condition Data

6.2.1  The Data Quality Report (Jan 2014) makes a number of useful recommendations on how to improve data quality considering process, data and technology. This is very positive.

6.2.2  It is also very positive that NR are actively improving the quality of their earthworks inventory and condition data, however we have not seen any evidence of a time-bound improvement plan or the linkage to the asset data quality trajectory mentioned in the FDP. It is suggested that such an improvement plan should be prepared by NR (and actions implemented if not already underway) with clear data quality targets similar to those set out for Track in NR’s March 2014 Final Delivery Plan.

6.3  Analysis of Failure Data

6.3.1  Since December 2012, NR have spent considerable effort in reviewing the earthwork examination data (for soil slopes) to investigate and improve on the relationship between condition and failure. This has involved detailed statistical analysis to try to better represent the likelihood of failure by weighting particular key condition features [Doc. 5, 13]. This is very positive.

6.3.2  NR have also taken steps to improve the quality and consistency of failure recording and reporting through their updates to the NR Asset Reporting Manual and specifically the M6 ‘Earthworks Failure’ measure. This is also very positive.

6.4  Risk-based Approach

6.4.1  Although not directly part of this review, we consider that the development of the ‘common consequence tool’ (CCT) to support cross-asset safety investment trade-off decisions is a very significant step forward. The potential benefit was indicated in our review of Civil Structures in 2011 [Ref 1] and SBP Review [Ref 2], where we identified that cross-asset trade-offs were an area for future development.

6.4.2  As noted above, we consider the development of a common consequence approach to supporting the prioritisation of safety investments to be a very positive step forward. However, in terms of further development, this approach should be
extended to consider wider railway performance to provide balanced guidance to Routes on workbank development. At present we have not seen any such central guidance (qualitative or quantitative). This is discussed further below.

6.4.3 It is positive that NR have recognised the importance of weather-related triggers and their potential linkage to the failure of better condition earthwork assets. Specifically we note that NR have undertaken studies associated with their management of earthworks in extreme weather events [Doc 47]. This is very positive, however at present NR are generally unable to separate out adverse weather related failure events. We are unclear how improvement in this area is being considered in NR’s future plans.

6.4.4 Anomalies with RSHI still exist – for example RSHI category E Rock Cuttings have a lower failure probability (0.36%) than RSHI category D Rock Cuttings (0.39%). It is understood that NR intend to review rock cutting data in due course – however no timing for this improvement work has been advised by NR. It is suggested that this is included in a time-bound improvement plan.

6.4.5 NR have explained how the re-categorisation of EHC was carried out such that “parity” was retained between the quantities of earthworks assets in each hazard category under the old metric and under the new metric at the point of changeover. The impact of this approach has been discussed with NR and at present we still remain unclear as to the implications.

6.4.6 NR have split the FWI data into a 5 point criticality scale [Doc. 11]. We note that NR considered several ways of splitting the consequence data, and that NR eschewed their recommended approach of drawing boundaries based on criticality values and instead adopted an approach to maintain consistency with the previous Modified EPM scale to maintain a ‘smooth transition’. NR have not explained the implications this approach and we are concerned that this may lead to the adoption of a classification that does not accurately reflect consequence.

6.4.7 We are also unclear as to the extent that the risk levels of specific earthworks may have changed simply due to the ‘parity’ requirement rather than the actual ‘re-classification’ itself. It is suggested that NR undertakes a review to satisfy itself that the new matrix gives an improved criteria for selection of earthworks safety interventions.

6.5 Policy Robustness

6.5.1 On the basis that the Earthworks Asset Policy has a clear linkage to asset outputs (e.g. Condition Index), is based on reasonable inventory and condition information and has an explicit risk based intervention approach, we still consider it reasonably likely that the Asset Policy will be robust and capable of delivering a reduction in asset risk in the short-term. There is however not yet any significant feedback to draw on.

6.5.2 The focus of the Asset Policy is rightly primarily on the selection of sites based on safety risk. However, we note that NR under their licence has performance obligations to also meet. At present there is no guidance to Routes as to on selection of sites driven by performance. This might also consider network resilience – for example the importance of a line that is a ‘diversion route’.

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10 Robustness: whether assets will deliver the required outputs; and
6.6 Policy Sustainability\textsuperscript{11} and Whole System Cost

6.6.1 We continue to support the Policy principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk. However we still consider it uncertain as to whether the Earthworks Asset Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. Our concerns relate to the reduction in the volume of more 'traditional' 'heavier' 'renew' interventions.

6.6.2 At present NR have yet to re-run their Tier 1 / Tier 2 Whole Life Cycle Cost (WLCC) / SCAnNeR analyses to demonstrate policy optimisation and so we are unable to comment on the impact of the revised policy on whole system cost.

6.7 Policy Implementation

6.7.1 NR are continuing to use their PowerPack Tool to support Earthworks Policy implementation at a Route Level. This seems to be a very effective way of providing a clear basis for central review of workbanks and policy alignment.

6.7.2 The documents that we have seen so far suggest that policy alignment currently varies significantly between Routes. The source of policy mis-alignment may originate from many sources but it does reinforce that significant Route level judgement will be needed to select the appropriate workbank.

6.7.3 Our BCAM Embedment Review undertaken in Autumn 2013 [Ref 5] indicated a significant variation in asset management maturity between Routes. Whilst this is now some 18 months ago, this does raise the concern that Route level choices may introduce significant inconsistency into the management of the earthworks asset

6.7.4 It is suggested that NR reviews CP5 policy implementation by the Routes and the degree to which it is reducing earthworks risk.

6.7.5 The new Earthworks Hazard Category potentially provides improved guidance on targeting ‘the right slopes’ for intervention. However, as yet there is little objective feedback that the maintenance and refurbishment interventions can be practically implemented and that they will be effective in reducing safety risk. This still poses a risk to delivery of performance improvement and the achievement of cost & efficiency targets in CP5.

6.7.6 As noted in our SBP review in 2013 [Ref 2.] we still have concern that maintaining a national average condition implies that the earthworks condition at some Routes may deteriorate during CP5 (for example Anglia). We are unclear as to the implication this will have on risk at a Route level. We are also unclear whether the proposed policy / intervention mix will comply with Statutory Obligations under ALARP principles\textsuperscript{12}. This should be addressed by NR in their CAM submission.

\textsuperscript{11} Sustainability: whether asset policies continue to deliver the outputs over the longer term

\textsuperscript{12} NR have a duty under the Health & Safety at Work etc. Act (1974) to manage safety risks to a level as low as reasonably practicable (ALARP). Our interpretation of this is that safety improvements should be implemented unless the costs are grossly disproportionate to the safety benefits.
6.8 Review and Continuous Improvement

6.8.1 Generally we still have concern that there is little evidence of a structured continuous improvement approach to monitor the effectiveness of the CP5 Earthworks Policy. Specifically the Asset Policy update seems to have been undertaken before there was formal feedback and learning from the Dec 2012 policy. It is suggested that NR implement a more formally controlled continuous improvement process.

6.9 Conclusion

6.9.1 The CP5 Earthworks Asset Policy (Dec 12) introduced a new largely untried approach to the management of earthworks assets involving targeting an increased number of maintenance and refurbishment interventions and a reduced number of major renewal activities. The new policy (Aug 14) does not change this but potentially provides an improved way of selecting the ‘right’ earthworks for intervention using the new EHC index and the consequence scale. It is very positive that NR have extended the risk based principles to move towards a common ‘cross-asset’ consequence scale.

6.9.2 The CP5 Asset Policy has only been in use since April 2014 and so at present there is little evidence that the policy is able to be implemented by the Routes and is effective in reducing safety risk.

6.9.3 In summary our view is that the updated Policy is likely to be an improvement on the December 2012 policy, but there is not yet sufficient evidence from the first year of CP5 to demonstrate this with any certainty.

6.10 Recommendations

6.10.1 The following recommendations are made in relation to this review.

<table>
<thead>
<tr>
<th>No.</th>
<th>Recommendation</th>
<th>Benefits</th>
<th>Evidence of implementation</th>
<th>Owner</th>
<th>Target date for completion</th>
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<td>2015 EWP-01</td>
<td>Policy Effectiveness</td>
<td>Feedback and learning on CP5 Asset Policy</td>
<td>Feedback Review</td>
<td>NR Prof. Head for Earthworks</td>
<td>End of October 2015 (post annual return)</td>
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<td>2015</td>
<td><strong>EWP-02</strong> Performance based interventions</td>
<td>Improved consistency of CP5 Workbanks</td>
<td>Guidance Note to Routes</td>
<td>NR Prof. Head for Earthworks</td>
<td>End of March 2016</td>
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<td></td>
<td>We recommend that NR provides explicit guidance to Routes on selection of sites driven by performance. This would complement the current safety related guidance.</td>
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<td>2015</td>
<td><strong>EWP-03</strong> Calibration</td>
<td>Improved confidence in risk based approach to site selection</td>
<td>Feedback Note on Calibration</td>
<td>NR Prof. Head for Earthworks</td>
<td>End of March 2016</td>
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<td>We recommend that to improve confidence in the updated ‘safety risk matrix’ NR should undertake a more detailed calibration exercise to ensure alignment between failure data, assessment methods, policy recommendations and actual example slopes. This would include both rock and soil slopes.</td>
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7 References


Appendix A

Independent Reporter Part A - Mandate AO/049
Mandate for Independent Reporter Part A

Audit Title: Civils Cost Adjustment Mechanism (March 2015 submission): review of updated earthworks asset policy developed and issued to Routes for planning and developing compliant workbanks for Years 3 to 5 of CP5.

Mandate Ref: AO/049

Document version: Draft A

Date: 01/10/2014

Draft prepared by: James P. McGregor

Network Rail reviewer:

Authorisation to proceed

ORR

Network Rail

Background

Network Rail’s SBP submission (and hence ORR’s Draft and Final Determinations) was based on asset policies which reflected Network Rail’s best view of robust, sustainable and efficient policy at that time. The asset policy documents and supporting evidence were reviewed by the ORR, supported by the independent reporters. Subsequently, Network Rail updated its Earthworks Asset Policy and embedded its principles in the spreadsheet-based system (known as PowerPack) issued to the Routes to help them develop their workbanks for Years 3, 4 and 5 of CP5. These workbanks in turn form the basis for Network Rail’s Civils Cost Adjustment Mechanism (CAM) submission which is due to be presented to ORR by 31 March 2015.

The updated Earthworks Asset Policy contains a number of significant developments from the previous version. In particular, it replaces the previous earthworks “condition” classes (Top Poor, Poor, Marginal and Serviceable) with a new 5-band classification system; and for soil embankments and soil cuttings it replaces the previous failure likelihood metric (Soil Slope Hazard Index) with a new Hazard Index which Network Rail believes is better able to predict the propensity for failure as it exhibits a stronger correlation with its records of previous failed earthworks.

Network Rail must submit evidence to ORR to demonstrate that it is making sufficient progress in developing a robust CAM submission. This is termed progressive assurance. Network Rail will submit its revised Earthworks Asset Policy and supporting evidence for review as part of this progressive assurance.

Purpose

The work covered by this mandate is intended to assist ORR in assessing whether the changed Earthworks Asset Policy on which the CAM submission is based will enable Network Rail to manage its earthworks assets in a robust, sustainable, safe and efficient manner.

Scope

Under this mandate the reporter will assess:
• The updated Earthworks Asset Policy;
• The evidence supplied by Network Rail relating to the basis for the changes to its Earthworks Asset Policy;
• Any other evidence provided by Network Rail under progressive assurance relating to the updated Earthworks Asset Policy or its application in the development of the PowerPack.

In doing so it will consider whether and if so to what extent changes to the policy impact upon:

• Compliance with the Network Licence, particularly section 1 relating to Network Management; and
• Our tests of robustness, sustainability and minimum whole lifecycle, whole system cost and further criteria for assessing asset policy as shared with Network Rail.

Network Rail has also updated its Structures Asset Policy but its consideration is not included in this Mandate, which is currently limited to the Earthworks Asset Policy alone. Should significant changes be made to the Mining Asset Policy and/or the Drainage Asset Policy, further Mandates may be issued for their review.

Network Rail submitted its updated Earthworks Asset Policy to ORR on 26 August 2014. The reporter will provide a progressive assurance report and feedback to ORR and Network Rail by 5 December 2014.

Asset policy documents

The review will build on the findings of the reporter mandate AO/030: PR13 Maintenance & Renewals Review - Policy and WLCC Model Review. Changes to the Policy will be assessed against the impact (whether positive or negative) they may have on the criteria of robustness, sustainability and lowest whole life, whole system cost and the further indicators of good asset stewardship which were assessed under mandate AO/030 and which are detailed again in Appendix 1.

PowerPack

The reporter will consider whether the changes to the Policy have been accurately modelled in the PowerPack tool. The review of computational accuracy of the PowerPack is not included within this mandate.

Methodology

As part of this workstream the reporter will undertake the following activities:

1. Attend all relevant progressive assurance, policy presentation and policy challenge meetings;
2. Undertake a review of the changes to the asset policy and policy justification documents;
3. Undertake a review of any other relevant supporting documents and information;
4. Prepare and submit draft and final reports, setting out the main observations and conclusions arising from the review process;

The reporter will produce a detailed methodology in presenting its proposals.

As far as possible, it is intended that the reporters shall co-ordinate their activities with the analysis being carried out by the ORR in order to avoid duplication of work.

The Reporters shall also avoid duplicating activity already undertaken or in progress under any other Mandates.
Deliverables

1. Minutes of meetings and a summary of the reporters’ views of the challenge workshops.


Timescales

The key milestones for the work are as follows:

- Network Rail provided ORR with its updated Earthworks Asset Policy on 26 August 2014.
- Close out meeting and presentation of findings to ORR and Network Rail on 14 November 2014.
- Reporter to provide draft report by 21 November 2014.
- Reporter to provide final report by 5 December 2014.

Independent Reporter proposal

The Reporter shall prepare a proposal for review and approval by the ORR and Network Rail on the basis of this mandate. The approved proposal will form part of the mandate and shall be attached to this document.

It is anticipated that the work under this mandate should take approximately 10 man days. The reporter should take cognisance of this in preparation of the proposal. The proposal will detail methodology, tasks, programme, deliverables, resources and costs.

Given the importance of this review, the Reporter shall provide qualified personnel with direct experience in the respective disciplines to be approved by the ORR and Network Rail. The contractor is asked to submit details of the previous experience and qualifications of such personnel as part of their proposal. For consistency and to minimise the learning curve / extent of re-work required, the Reporter should, where possible, use staff who were involved in progressive assurance of the SBP Earthworks Asset Policy.
Appendix 1 – Policy review

The review will consider asset policies against three high level criteria:

1. **Robustness**: Is it reasonable to believe that the policy can deliver the required outputs, for England & Wales and Scotland? In testing the robustness of the policy the reporter should consider whether the policy and plans have been demonstrated to be capable of delivering the outputs required for CP5 (2014-2019). This includes consideration of outputs, KPIs and condition measures as disaggregated by operating route.

2. **Sustainability**: If demand on the network were to remain steady, would application of the asset policy continue to deliver the outputs specified indefinitely? A sustainable asset policy is one which delivers (at least) the agreed outputs for the final year of the control period in the long term (to at least end of CP11) if demand on the system remains within the capacity limits of the current network and any enhancement schemes already committed to by industry. The demonstration of compliance with this test is likely to involve forecasting and modelling as part of the submission. This test is to ensure that, in managing within CP4 funding, Network Rail is making genuine efficiencies and is not deferring essential work at the cost of inefficiently higher expenditure in later control periods.

3. **Lowest whole life, whole system cost**: Has asset policy been demonstrated to deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets? In demonstrating minimum whole life cost Network Rail must demonstrate that both scope and unit cost efficiencies have been fully considered.

In assessing against these high level criteria the reporter will also consider the ‘Indicators of Good Asset Stewardship’ as set out below. They will assess whether comprehensive and convincing rationales have been provided demonstrating good asset stewardship in compliance with Network Rail’s licence obligations.

The reporter will assess against the following key tests (i.e. not an exhaustive list) as a sub-set of the overall asset management capability, that are generally associated with good asset stewardship and that are likely to give rise to compliance with the Licence obligations relating to asset management policies and plans.

1. **Performance Requirements / Outputs** – have these been defined at system and individual asset group level taking into account strategic objectives? How are these influenced by demand? What level of risk can be tolerated for each performance requirement? What level of system resilience etc.? 

2. **Line of Sight** – is there a clear relationship from business objectives (performance, demand, capacity etc.), policy/strategy down to specific outputs defined in the route asset management plans and route delivery plans.

3. **Asset Knowledge** – is there adequate accuracy and completeness of asset inventory data, capability, including structure and critical component / element details, age, condition, maintenance history, failure modes, service life etc.

4. **Asset Behaviour and Criticality** – is there an adequate understanding of asset behaviour, criticality, critical components, and failure modes.

5. **Asset Degradation** – is there an adequate understanding of deterioration rates of critical components and materials?

6. **Renewal and Maintenance interventions** - Has a suitable range of intervention options been considered taking into account any enhancement requirements due to interoperability, asset system interfaces etc.? Do these interventions simply reflect current / historic practice or have materials and techniques used by others (e.g. identified from benchmarking activity) and other future developments / techniques been considered?

7. **Asset Cost Data** – is there adequate maintenance and renewal cost data for the identified maintenance and renewal interventions to enable suitably accurate lifecycle cost estimation? Are suitable unit rates available for calculating the works and other costs (e.g. access, possession costs, mobilisation etc.)?
8. **Lifecycle Option Preparation** – have a suitable range of alternative lifecycle management options been considered for the critical asset types and components, based on adequate asset knowledge an understanding of asset behaviour, maintenance and renewal options? How has resilience been considered? Have any Scotland specific issues been identified and considered? How have sub-options been rationalised and optimised?

9. **Lifecycle Option Selection and Strategies** – have clear alternative lifecycle strategies been considered? Typical strategies may be:
   - “Do Minimum” Strategy – the minimum required to sustain safety across the analysis period, e.g. infrequent/irregular but major interventions to satisfy/meet the minimum safety and performance targets.
   - Preventative Strategy – regular and frequent minor interventions to maintain the condition of the asset by slowing down the rate of deterioration.
   - Targeted Strategies – with interventions aimed towards:
     - Minimising Whole Life Costs while satisfying safety/performance targets;
     - Minimising network disruption; satisfying the disruption targets;
     - Delivering a required condition score;
     - Etc.

Where asset policies deviate from lowest whole lifecycle, whole system cost, has the inefficiency caused by funding constraints been quantified to understand the long-term cost and risk implications?

10. **Preferred Lifecycle Option** - How are the preferred lifecycle options for different asset types reflected in the asset policies and plans?

11. **Sensitivity testing** – Has sensitivity testing been carried out to understand levels of uncertainty within confidence limits, both for underlying asset information and in the decision support tools used in the development of asset policy?

12. **Overall Planning Process** – is it clear how ‘top-down’ decisions will be used in practice to influence local asset maintenance and renewal choices? How are ‘bottom-up’ unconstrained asset needs evaluated against ‘top-down’ asset policies and a planned workbank produced (e.g. how a workbank at an SRS level is derived)?

13. **Systems Approach** – has the policy adopted a systems engineering approach which considers cross-asset groups and cross-industry requirements? Has interaction between asset types/overall system been considered? (e.g. if head hardened rails are specified has the impact on wheels been considered).

14. **Risk and Review** – is it clear how asset risks will be managed and reviewed? Is there definition of tolerable risks and is this applied in practice? What level of resilience is required, has a RAMS (reliability, availability, maintainability and safety) approach been adopted?

15. **Deliverability** – is it clear how the proposed asset management approach will be delivered? – is it feasible that the policy can be delivered given known constraints e.g. technology, supply chain, training, experience etc. (e.g. Maintenance – does the policy adequately consider the maintenance implications in terms of numbers of staff, skills, training, and equipment?) Are roles and responsibilities defined?

16. **Continuous Improvement** – research and development, feedback and efficiency improvements.
Appendix B

Review of CP5 Earthworks Policy (Dec 2012)
B1 CP5 Earthworks Policy (Dec 2012)

B1.1.1 The following section summarises the key points raised in our review of the CP5 Earthworks Policy in 2013 [Ref 2, 3 and 4].

General

B1.1.2 The CP5 Final Delivery Plan (dated 31 March 2014) for earthworks was based on the CP5 Earthworks Policy dated December 2012 [Doc 001].

B1.1.3 When we undertook our previous Earthworks review in March 2013 (Arup 2013, a and b) and Mandate AO/45 in Autumn 2013 we reviewed the December 2012 CP5 Earthworks Policy and concluded that:

B1.1.4 NR had made significant progress with developing their Asset Policies since CP4 adopting a standard format and a specific Asset Policy for Earthworks.

Risk Based Approach

B1.1.5 It was very positive that the Earthworks Asset Policy had adopted a 'risk based approach' to the identification of sites for remedial work and that interventions should be primarily driven by 'safety' issues rather than say 'track performance'.

B1.1.6 We were however unclear how NR had equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gave rise to a significant uncertainty that assets might be funded to achieve different levels of safety risk. This concern also linked back to an earlier review of Civil Structures Asset Management (Arup 2011).

Policy Derivation

B1.1.7 NR had used their SCAnNeR model as a strategy evaluation tool to determine an optimum policy by varying intervention strategy combinations considering the output of the asset population as a whole. They had then derived ‘top-down’ costs and volumes for the SBP for the preferred intervention strategy. We had a number of concerns about some of the values used in the modelling.

Policy Robustness

B1.1.8 On the basis that the Earthworks Asset Policy had a clear linkage to asset outputs (e.g. Risk Index), was based on reasonable inventory and condition information and had an explicit risk based intervention approach, we considered it reasonably likely that the Asset Policy would be robust and capable of delivering a reduction in asset risk in the short-term.

13 Robustness: whether assets will deliver the required outputs; and
Policy Sustainability\textsuperscript{14} and Whole System Cost

B1.1.9 We supported the Policy principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk. However we considered it uncertain as to whether the Earthworks Asset Policy would deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. Our concern related to the reduction in the volume of more 'traditional' 'heavier' 'renew' interventions.

Policy Application

B1.1.10 NR had explicitly disaggregated their national Earthworks SCAnNeR outputs to a Route level and provided the Route teams with a ‘PowerPack’ tool to help them develop their CP5 constrained workbanks and achieve alignment with policy.

B1.1.11 Discussions with Routes in Autumn 2013 indicated The use of the PowerPack Tool seemed to have been very effective – providing a clear basis for detailed discussion as to priorities and that this had generally led to the emphasis on interventions in Rock and Soil cuttings which pose the higher safety risk.

B1.1.12 Discussions with the Routes did however indicate that there was a varied level of understanding of asset management principles in the Routes and that the application of Asset Policies was at different stages of maturity.

B1.1.13 The use of the PowerPack Tool to support Earthworks Policy implementation at a Route Level seems to have been very effective – providing a clear basis for detailed discussion as to priorities.

B1.1.14 We had concerns related to the constraint of reducing risk and condition at a Route Level but maintaining overall 'average' risk and condition, in that this seemed to suggest that the earthworks condition at some Routes could deteriorate and the risk at some Routes (such as Scotland) could increase. We were we are unclear as to whether the proposed policy / intervention mix would comply with Statutory Obligations under ALARP principles\textsuperscript{15}.

B1.1.15 We also had concerns relating to the degree to which the Routes would be able to effectively apply the ‘top down’ modelling in practice and target ‘the right slopes’ for the proposed maintenance and refurbishment activities. We considered that this would potentially impact on both the performance improvement that could be achieved, and the cost of achieving that improvement.

Review and Continuous Improvement

B1.1.16 We noted that the Earthworks Policy implied a new way of working at Route level with the focus on 'lighter' pro-active intervention

\textsuperscript{14} Sustainability: whether asset policies continue to deliver the outputs over the longer term

\textsuperscript{15} NR have a duty under the Health & Safety at Work etc. Act (1974) to manage safety risks to a level as low as reasonably practicable (ALARP). Our interpretation of this is that safety improvements should be implemented unless the costs are grossly disproportionate to the safety benefits.
activities. We had a concern that we had seen little evidence of a structured continuous improvement approach to monitor the effectiveness of such a ‘new approach’.
Appendix C

Meetings and Documents
Provided
# Meetings Held

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<tr>
<th>Date / Location</th>
<th>Topic</th>
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C2 Documents Provided

The key documents provided as a basis for our review are listed on the following sheets.
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<td>0001</td>
<td>Earthworks Asset Policy.pdf</td>
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<td>0002</td>
<td>Examination of Earthworks.pdf</td>
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<td>0003</td>
<td>Management of Earthworks.pdf</td>
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<td>0004</td>
<td>Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure.pdf</td>
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<td>Definitions for the Reporting of MB Earthworks Failures.pdf</td>
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<td>Procedures for the Reporting of M6 Earthworks Failures.pdf</td>
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<td>Definitions for the Reporting of M33 Earthworks Condition Banding.pdf</td>
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<td>Network Rail Earthworks Data Quality Report.pdf</td>
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<td>Assessment of changes from SSHI to new Hi definition.pdf</td>
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<td>0013</td>
<td>Earthworks CPS Roadmap: Review of Asset Criticality (Safety).pdf</td>
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<td>Establishing a Common Risk Scoring Matrix for Safety across Network Rail.pdf</td>
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<td>0032</td>
<td>032 2014-03-20 Update on NRIP 2011-12 and 2012-13 actions rev05.pdf</td>
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<td>038 Year 3-5 Pie Chart un-alignment.pdf</td>
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<td>041 Geotech Remit Allington Rock Cutting 41 0000-41 0220 V2.pdf</td>
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<td>042 Geotech Remit Borough Green V2.pdf</td>
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<td>0046</td>
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<td>050 CAM evidence - Kent (Geotech).pdf</td>
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<td>0051</td>
<td>051 FW: Second update to actions following 20th Jan meeting</td>
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Appendix D

Question Log
D1  Question Log

Specific discussion points were raised with NR using a Question Log. These points were then explored through correspondence and face to face meetings. A copy of the final Question Log is appended.

A status has been assigned to each question as to whether or not it is considered to be ‘closed out’.
<table>
<thead>
<tr>
<th>Comment No.</th>
<th>Document title</th>
<th>Topic</th>
<th>Question / Issue</th>
<th>Date of question (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
<th>Importance of question / comment</th>
<th>NR response date (DD/MM/YYYY)</th>
<th>Originator of response</th>
<th>NR response</th>
<th>ORR / ARUP view: question closed?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthworks/001</td>
<td>Earthworks Asset Policy</td>
<td>Page 21, last para of 1.4.2</td>
<td>States “A validation exercise has been carried out to identify earthworks previously omitted…” but NB: LSC/19/025 issue 4 (as confirmed on page 22) indicates all “never inspected” 5ch lengths are to be inspected by 1 April 2017. Please clarify this apparent contradiction and, in light of this, please comment on the robustness of the “validation exercise”.</td>
<td>06/10/2014</td>
<td>Jim McGregor</td>
<td>H</td>
<td>Simon Abbott</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Earthworks/002</td>
<td>Earthworks Asset Policy</td>
<td>Page 21 / 22</td>
<td>Please provide a copy of the Network Rail (January 2014) Data Quality Report.</td>
<td>06/10/2014</td>
<td>Jim McGregor</td>
<td>M</td>
<td>Tim Spark</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Earthworks/003</td>
<td>Earthworks Asset Policy</td>
<td>Page 22</td>
<td>If not stated in the Data Quality Report, please confirm by route (a) the number of “never inspected” 5ch lengths (b) the number of paper records which have still to be entered into the database (c) the number of null records without locational information and (d) the number of missing ELRs.</td>
<td>06/10/2014</td>
<td>Jim McGregor</td>
<td>R</td>
<td>Simon Abbott</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Earthworks/004</td>
<td>Earthworks Asset Policy</td>
<td>Page 22, para 1.4.5</td>
<td>Please comment on the implications (if any) of using one data cut (on 02/05/2014) for the policy update and another data cut (on 02/05/2014) for the policy modelling and a different data cut (on 02/05/2014) for the policy's asset statistics and work bank development. In particular, please comment on whether the conclusions of the modelling exercise would have been significantly different - and if so, in what respect(s) - if the modelling had been re-done using the 02/05/2014 data cut.</td>
<td>06/10/2014</td>
<td>Jim McGregor</td>
<td>R</td>
<td>Tim Spark</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
The percentage of category E assets seems particularly ORR Jim Simon Abbott p14 Section 1.2.1 clarifies the approach to cuttings where components of soil and rock exist the components are examined and recorded separately. "Mixed Cutting: A cutting composed of both soil and rock, either one component overlying the other, or interbedded. For management purposes the soil and rock components are examined and recorded separately." p22 of previous policy version details assets in similar charts.

UPDATE JAN 15: Inspection Sch’s consist of the actual Sch on the ground. An inspection Sch may contain more than one earthwork asset. For example - where there is the presence of an embankment and cutting within a Sch section or where there is a soil cutting above a rock cutting within the Sch section. Therefore for management purposes each element counts as an earthwork asset. We have Inspection Sch’s which represent the total length of the network and then Earthwork assets that represent the total number of exams.

Earthworks/005 Earthworks Asset Policy Page 26, para 2.3 Please clarify how "mixed ground" slopes are dealt with in this section. 06/10/2014 ORR Jim McGregor M Simon Abbott p14 Section 1.2.1 clarifies the approach to cuttings where components of soil and rock exist the components are examined and recorded separately. "Mixed Cutting: A cutting composed of both soil and rock, either one component overlying the other, or interbedded. For management purposes the soil and rock components are examined and recorded separately." p22 of previous policy version details assets in similar charts.

Earthworks/006 Earthworks Asset Policy Page 27, para 2.4 When will the results of the RSSB "Embankment Vulnerability to Traffic Damage" project be available? 06/10/2014 ORR Jim McGregor L Eilin Evans Update: The Final report can be obtained from the link below (you may need to register for an account to download):

http://www.rsb.co.uk/pages/research-catalogue/1678.aspx

Earthworks/007 Earthworks Asset Policy Pages 29 & 30, Figs 2.3 & 2.4 and Table 2-3 Please review Figs 2.3 and 2.4 in light of the data in Table 2-3 e.g. Fig 2.3 appears to show that LNE, Scotland & Wales do not have any category E assets whereas Table 2-3 shows Scotland having one of the largest populations of category E assets. 06/10/2014 ORR Jim McGregor L Simon Abbott Western has the highest percentage of EHC grade E assets totalling 1.1% of its route. This is shown in Fig 2.4. LNW & Scotland have the second and third highest total of assets in ‘E’ and these equate to 0.4% of the routes total asset portfolios. The small percentage and numbers of actual assets is slightly lost in the scale of the charts - hence the reason for the production of the data in Table 2-3.

Earthworks/008 Earthworks Asset Policy Page 30, Table 2-3 The percentage of category E assets seems particularly low for some Routes, especially LNE and Midland. Please comment. 06/10/2014 ORR Jim McGregor M Simon Abbott At the time of the May 2014 data cut there were 12,302 earthworks in Western with 104 being in category E, giving a percentage of 0.83%. This is one of the highest percentages for any Route.

Earthworks/009 Earthworks Asset Policy Page 30, Table 2-3 To allow "sense-checking" of the figures, please provide (by Route) the percentage of earthworks assets which were previously classed as Poor or Top Poor compared to those now in category D and E. Please also comment on any significant differences. 06/10/2014 ORR Jim McGregor R Tim Spink Will be provided under separate cover.

UPDATE JAN 15: Provided on 23rd Jan by email to ARUP and ORR.

Earthworks/010 Earthworks Asset Policy Page 31, para 2.6.1 Why has the failure data only been updated to P7 2012/13 (as this omits the large number of failures in the winter of 2012/13 and 2013/14)? 06/10/2014 ORR Jim McGregor R Simon Abbott Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.1 on p131) have not changed. The failure statistics were not updated.

ORR questions on Policy & EHC log rev 29.02.2015_28 UPDATED BY INDEP REP POST DRAFT 3 MTG 24 FEB 2015.xlsx
The report will be provided under separate cover.

Policy update has not been a complete rewrite but an update of key sections around SoS matrix, EHC, and EACB. This section has therefore not been updated. The ORR’s comments are noted and will be considered in the development of the CP6 earthwork Policy.

ORR / ARUP question - question closed?

Comment No. Document title Text ref. if applicable (page no. - para no. - table no., etc.) Topic Question / Issue Date of question (DD/MM/YYYY) Originator of question / comment Importance H/M/L NR response date (DD/MM/YYYY) Originator of response NR response Comment

Earthworks/011 Earthworks Asset Policy Page 32, para 2.6.2 & Table 2.4 It would be helpful if this section included number of incidents where trains collided with failed earthworks but did not derail. Is this data available? 06/10/2014 ORR Jim McGregor H Simon Abbott Policy update has not been a complete rewrite but an update of key sections around SoS matrix, EHC, and EACB. This section has therefore not been updated. The ORR’s comments are noted and will be considered in the development of the CP6 earthworks Policy. Yes See 03/05/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)

Earthworks/012 Earthworks Asset Policy Page 34, para 2.6.1 and Page 36, para 2.6.6 While delay minutes may provide an indirect measure of incident severity & recovery speed, there is no strong evidence that “the total number of Schedule 8 delay minutes accumulated … is a good indication of the management of the asset”. Nor is there strong evidence in this section that “expenditure on the earthworks and earthworks drainage asset has addressed a large proportion of the significant defects which required day-to-day maintenance management” - If the data had been extended to cover the winters of 2012/13 and 2013/14, I suspect the evidence would, in fact, show the contrary. 06/10/2014 ORR Jim McGregor H Simon Abbott Policy update has not been a complete rewrite but an update of key sections around SoS matrix, EHC, and EACB. This section has therefore not been updated. The ORR’s comments are noted and will be considered in the development of the CP6 earthworks Policy. Yes See 03/05/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)

Earthworks/013 Earthworks Asset Policy Page 36, Fig 2-12 I have generally ignored Mining aspects in reviewing the earthworks policy as I understand the Mining policy is due to be updated, but please confirm whether the earthworks policy will be updated where relevant in light of the revised mining policy e.g. will the “actual” and CP4 figure be used instead of the projected and CP4 figure in Fig 2-12? 06/10/2014 ORR Jim McGregor L Tony Wilcock To be advised Update: provided on 26/11/14. See document reference 9 above. Yes See 03/05/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)

Earthworks/014 Earthworks Asset Policy Page 39, para 3.1 Please provide a copy of “Earthworks CP5 Roadmap: Understanding Safety Risk - Development of Cutting and Embankment Safety Risk Models” (April 2014). 06/10/2014 ORR Jim McGregor H Juliet Mian The report will be provided under separate cover. Update: provided on 28/11/14. See document reference 7 above. Yes See 03/05/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)

Earthworks/015 Earthworks Asset Policy Page 39, para 3.1 Please provide a copy of “Asset Criticality - Yash: (Phase 1 Implementation of Common Consequence Tool - Earthworks)” (August 2014). Please also comment on what action has been taken or is being taken in response to ORR’s comments when this subject was presented to DRR in Kemble Street on 25/09/2014. 06/10/2014 ORR Jim McGregor H Juliet Mian The report will be provided under separate cover. Work is ongoing to address the issues raised. Update: provided on 28/11/14. See document reference 9 above. Yes See 03/05/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)

Earthworks/016 Earthworks Asset Policy Page 39, para 3.1 CCT should more properly be called “Derailment Common Consequence Tool”. Please also confirm how the policy addresses non-derailment consequences. 06/10/2014 ORR Jim McGregor H Juliet Mian / Tim Spark Overall CCT, as an integral component of EACB, is considered to be a positive step forward in our understanding of consequence compared to the previous EPM. EACB is fully quantitative, whereas EPM was qualitative. Also, we consider that in comparison to other asset groups who use SRS as a consequence measure, EACB represents a considerable advance.

In the case of earthworks, as shown in the SRM, and supported in work preceding the CCT (NERRP and Adverse Weather), the significant safety impact of a failure is derailment. The non-derailment consequences of an earthwork failure are included in a single node of the CCT event tree, which is considered appropriate.

For other assets and operations, the CCT is not yet rolled out and would be reviewed and sense checked in the same way. The intention is for the tool to model all safety consequences in a common framework.

UPDATE JAN 15: discussed and explained at meeting on 20th Jan with ARUP and ORR. NR would like to consider this closed. No Response indicates non-derailment consequences are included in CCT – further information on how this is included would be helpful.

March 2015 update: 20/1/2015 meeting NR agreed to provide a summary of what’s included / not included in CCT. Item remains open as this still not resolved. NR agreed again to provide this at 24/2/2015 meeting.
### Earthworks Asset Policy

**Comment No.** Earthworks/017  
**Document title** Earthworks Asset Policy  
**Page** 41, Table 3-2  
**Topic** The percentage of EACB category 5 assets seems particularly low for some Routes, especially Kent, Wales, Wesssex and (to a lesser extent) Scotland. Please comment.  
**Date of question** 06/10/2014  
**Originator of question / comment** ORR Jim McGregor  
**Importance** M  
**NR response date** 09/10/2014  
**NR response** Juliet Milan  
**ORR / ARUP view - question closed?** Yes  
**Comment** See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)

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**Comment No.** Earthworks/018  
**Document title** Earthworks Asset Policy  
**Page** 51, para 5.2  
**Topic** Please provide a copy of ‘Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure. Addendum Report’.  
**Date of question** 06/10/2014  
**Originator of question / comment** ORR Jim McGregor  
**Importance** N  
**NR response date** 06/10/2014  
**NR response** Tim Spink  
**ORR / ARUP view - question closed?** Yes  
**Comment** This report will be provided as soon as it has been reviewed by NR and published. Update: due for publication in the New Year.

**Comment No.** Earthworks/019  
**Document title** Earthworks Asset Policy  
**Page** 57, Fig 5-17  
**Topic** Please confirm whether failure probabilities quoted are absolute or have been normalised by population size for each earthwork type. As this seems to contradict failure data, please comment particularly on the graph’s indication that rock cuttings in EHC bands D & E are considerably less likely to fail than soil cuttings and embankments in similar condition. ORR suspects from previous discussions this is due to the how (erroneously, in ORR’s view) the EHC boundary conditions for each earthwork type were chosen.  
**Date of question** 06/10/2014  
**Originator of question / comment** ORR Jim McGregor  
**Importance** N  
**NR response date** 06/10/2014  
**NR response** Tim Spink  
**ORR / ARUP view - question closed?** Yes  
**Comment** See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)

**Comment No.** Earthworks/020  
**Document title** Earthworks Asset Policy  
**Page** 59, para 6.1  
**Topic** Retaining parity by keeping the same quantum on the x and y-axis is only one possible way of calibrating the model, and as criticism of the old y-axis (modified EPM) is understood to be one of the reasons for changing, this might cast doubt on the appropriateness of this approach. What steps have been taken to verify the calibration? In particular, have previous slopes which failed been plotted on the new graph to establish whether they would have been in the top right (high risk) sector? If not, why not?  
**Date of question** 06/10/2014  
**Originator of question / comment** ORR Jim McGregor  
**Importance** N  
**NR response date** 06/10/2014  
**NR response** Simon Abbott / Tim Spink  
**ORR / ARUP view - question closed?** Yes  
**Comment** Policy update has not been a complete rewrite but an update of key sections around S5 matrix, EHC and EACB. The core objectives of the policy (see section 10.1 on p121) have not changed. In order to retain the policy, to utilise the Policy intervention matrices and to retain the Policy KPIs we must retain parity on both the likelihood and consequence axes of the risk matrix. The enhancement work that we have carried out on the likelihood and consequence axes definitions has been carried out whilst workbank development for CP5 has been going on, and therefore it has been essential to maintain a consistent approach to avoid derailing this process. If we had not maintained parity then it would not have been possible for either NR or the ORR to gauge the level of improvement that has been achieved, and it would not have been possible to assess CP5 delivery against the forecast KPIs committed in the Final Delivery Plan.

**UPDATE JAN 15:** Discussed on the 20th Jan with ORR and ARUP. The likelihood of failure is reflected in the EHC metric, and the distribution of the historic failures is recorded in the failure probability statistics presented in chapter 9 of the March 2014 Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure report. The EACB axis has no impact on where historic failures plot on the risk matrix, it indicates the level of consequence based on where the failures occurred; ie failures will never cluster top right in the matrix. NR would like to consider this closed.

**Comment No.** Earthworks/021  
**Document title** Earthworks Asset Policy  
**Page** 60  
**Topic** The boundaries for EACBs have been drawn so that the national distribution of assets is consistent with the former EPM approach, with the division between EACBS and EACBR to give an adequate national differentiation. This was a necessary step in managing the change in relation to the CP5 workbank (see comment 010). It was not appropriate to do this at a Route level as it was not desirable to have differing meanings to any given ‘TAGC’ across the routes. The CCT evaluation is not biased by route, and so the national distribution of assets across the EACBs is in line with the hazards present. This has resulted in some routes having fewer assets in EACBS than others, but based on the relative hazardousness, this appears to be the correct outcome.

**UPDATE JAN 15:** discussed and explained at meeting on 20th Jan with ARUP and ORR. NR would like to consider this closed.

**Comment No.** Earthworks/022  
**Document title** Earthworks Asset Policy  
**Page** 61  
**Topic** The failure probabilities are expressed as percentages (as is normal) when these percentages are multiplied by the number of assets in each EHC category the statistically assessed number of earthwork failures will be obtained. New metrics have been derived for soil cuttings and embankments (SCHI and SEHI) which have successfully optimised the failure probabilities for these two asset types, giving a failure probability range from category A to B of about 100. There has been no similar development of RSHI for rock cuttings at this time, and it retains its previous failure probability range of only 3. This fully explains the differences in the failure probabilities seen in Fig 5-17.

**UPDATE JAN 15:** NR would like to consider this closed.
Why is the risk matrix symmetrical rather than assymetrical to include C/5 (i.e. relatively high likelihood of catastrophic consequence) as Red? (See also item Earthworks/023 below.)

According to this figure (read in conjunction with Fig 6-1), there are only SBD (570 + 64 = 72) high risk slopes. This figure seems excessively low when compared with [a] the current annual failure rate [b] the degradation rates in Fig 5-19 which indicates 1.70% or 3250 slopes will degrade to poor / low poor / failed each control period and [c] the number of slopes identified as at risk during adverse weather. This suggests to me that the model has not been correctly calibrated. The numbers would, however, have more credibility if the risk matrix was assymetric and included C5 (250 slopes).

These figures overlay an assymetrical intervention matrix on a symmetrical risk matrix. The nature of the asymmetry indicates that Network Rail’s approach is still biased towards Condition (rather than either Consequence or Risk) as the driving factor. For example, in Fig 6-4, an embankment in Poor condition but whose failure will have very low consequence (C1)/1 will be refurbished but an embankment in Marginal condition but with the highest potential consequence (C5)/4) not refurbished. Please comment.

Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.2 on p121) have not changed. With reference to question Q23, parties has been retained so that the intervention matrices can be retained.

UPDATE JAN 15: The boundaries of intervention activity along e.g. y axes have not changed, nor has parity of the national asset distribution profile. We have not changed policy and have not modified these boundaries that existed in the previous policy. We recognise that potential improvements can be explored throughout the CP as we begin to embed the application of this policy. However, we are not at this stage changing the policy matrices. NR would like to consider this closed.

These are “typical” earthwork intervention types and mapped across the boundaries of intervention activity along x and y axes. There has been no significant change to the theory of increasing risk when combining EHC and EACB into a matrix. This is not a Policy chart to drive Intervention Activity, this is represented by Figs 6-4, 6-5, 6-6. NR would like to consider this closed.

This matrix demonstrates the theory of increasing risk when combining EHC and EACB into a matrix. This is not a Policy chart to drive Intervention Activity, this is represented by Figs 6-4, 6-5, 6-6. NR would like to consider this closed.

Many elements of the “likelihood of risk event” box apply equally (if not more so) to safety risk as to performance risk bow-tie.

Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.2 on p121) have not changed. With reference to question Q23, parties has been retained so that the intervention matrices can be retained.

UPDATE JAN 15: The boundaries of intervention activity along e.g. y axes have not changed, nor has parity of the national asset distribution profile. We have not changed policy and have not modified these boundaries that existed in the previous policy. We recognise that potential improvements can be explored throughout the CP as we begin to embed the application of this policy. However, we are not at this stage changing the policy matrices. NR would like to consider this closed.

Why does the “refurbish” entry for embankments of catastrophic consequence not include the crest which would be a requirement and enabler under the option EHC and EACB. This matrix demonstrates the theory of increasing risk when combining EHC and EACB into a matrix. This is not a Policy chart to drive Intervention Activity, this is represented by Figs 6-4, 6-5, 6-6. NR would like to consider this closed.

Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.2 on p121) have not changed. With reference to question Q23, parties has been retained so that the intervention matrices can be retained.

UPDATE JAN 15: The boundaries of intervention activity along e.g. y axes have not changed, nor has parity of the national asset distribution profile. We have not changed policy and have not modified these boundaries that existed in the previous policy. We recognise that potential improvements can be explored throughout the CP as we begin to embed the application of this policy. However, we are not at this stage changing the policy matrices. NR would like to consider this closed.

This graph suggests that failure or collapse does not affect track in a “controlled incident” in the context of train derailment, this may be valid but this ignores the potential for other significant consequence e.g. bridges or other structures being undermined and possibly collapsing, debris falling onto roads or other 3rd party land, etc.).

NR response: This matrix demonstrates the theory of increasing risk when combining EHC and EACB into a matrix. This is not a Policy chart to drive Intervention Activity, this is represented by Figs 6-4, 6-5, 6-6.
<table>
<thead>
<tr>
<th>Comment No.</th>
<th>Document title</th>
<th>Text ref. if applicable (page no. + para no. table no., etc.)</th>
<th>Topic</th>
<th>Question / Issue</th>
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<tbody>
<tr>
<td>Earthworks/027</td>
<td>Earthworks Asset Policy</td>
<td>Pages 79 - 81, para 7.5</td>
<td>This section on Tolerability of Risk contains various assertions (e.g. “There are no earthworks in the unacceptable risk category”) for which Network Rail does not offer any existential basis. ODR notes Network Rail’s view on these matters does not necessarily accept them.</td>
<td>20/10/2014</td>
<td>ODR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott</td>
<td>The content of section 7.5 of the Policy document was arrived at after lengthy discussions between NR and the ODR and their Reporter in 2012. We have not changed the agreed statements that were arrived at then, we have simply updated the section to bring in the advances made since then.</td>
<td>Yes</td>
<td>See 05/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)</td>
<td></td>
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</tr>
<tr>
<td>Earthworks/028</td>
<td>Earthworks Asset Policy</td>
<td>Page 81, fig 7-5</td>
<td>On what basis does Network Rail believe that out cuttings with Hazard Category A and EACB 4 and 5 are tolerable but embankments and rock cuttings with the same Hazard Category and EACB are broadly acceptable?</td>
<td>20/10/2014</td>
<td>ODR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott</td>
<td>This is an updated diagram to reflect EHC and EACB in the new 5x5 matrix. The definitions of locations on the matrices are mapped across from the 4x3 matrix.</td>
<td>Yes</td>
<td>See 05/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)</td>
<td></td>
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<tr>
<td>Earthworks/029</td>
<td>Earthworks Asset Policy</td>
<td>Page 81, para 7.5, 3rd bullet</td>
<td>“Risk” includes “likeness and “consequence” and asset criticality is a proxy for consequence, so the statement that “higher levels of risk can be accepted in areas of lower asset criticality” is terminologically incorrect. Furthermore, the legal obligation is to manage risk to “as low as reasonably practicable” (alarp) and this statement infers that differential levels of risk can be set purely on judgements of asset criticality, which is incorrect. It would therefore be more correct to state “higher likelihood of failure can be accepted in areas of lower asset criticality” as this statement would not contradict the obligation to manage risk to alarp.</td>
<td>20/10/2014</td>
<td>ODR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott</td>
<td>This bullet point exists on the Previous Policy on p73.</td>
<td>Yes</td>
<td>See 05/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)</td>
<td></td>
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<tr>
<td>Earthworks/030</td>
<td>Earthworks Asset Policy</td>
<td>Pages 81 - 85, para 7.6 &amp; 7.7, Figs 7.6, 7.7 &amp; 7.8</td>
<td>According to para 7.7, an optimum policy requires “… a search for the best combination of intervention matrices and intervention mixes that meet the required outcome…”, and the italicised note to para 7.6 &amp; 7.7 asserts that the only impact of the move to the new 5 point EHC &amp; EACB is to change the absolute values of parameters. However, a 5 x 5 approach has potentially many more intervention matrix options than the previous approach (see, for example, Fig 7-7). On what basis, therefore, does Network Rail conclude that (a) the previously optimum Policy selection remains valid and (b) the Policy will deliver the same “enhance / sustain / degrade outcome without having re-run the model to determine the potential impact of the wider range of intervention matrices available with the 5 x 5 approach?</td>
<td>20/10/2014</td>
<td>ODR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.1 on p121) have not changed. With reference to question Q20, parity has been retained so that the intervention matrices can be retained. The modelling will be re-run as part of the CAM development, and any differences identified from the SBP modelling will be advised as part of the CAM submission.</td>
<td>No</td>
<td>Need to explore further – response does not really address specific questions i.e. “On what basis, therefore, does Network Rail conclude that (a) the previously optimum Policy selection remains valid and (b) the Policy will deliver the same Enhance / Sustain / Degrade outcome without having to re-run the model to determine the potential impact of the wider range of intervention matrices available with the 5 x 5 approach?” March 2015 update – NR’s update still fails to address key issue – “believing” that the optimum policy remains valid is not the same as demonstrating evidentially that this is the case. However, ODR notes NR’s statement that “until modelling of workbanks is complete we will not be able to see what the application of policy delivers” and therefore proposes to keep open until results of modelling is provided.</td>
<td></td>
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</tbody>
</table>
This states that the Tier 3 CeCost model for embankments and soil cuttings "follows the SSHI algorithm closely"; that they "calculate the overall condition each time step by using the SSHI algorithm rules"; and that "interventions can be programmed to reflect the various characteristics depending on ... the SSHI algorithm rules". Please comment on the robustness of the CeCost output in light of the conclusions of the work to develop the new EHC algorithm i.e. that the SSHI algorithm was not well correlated to failure likelihood.

20/10/2014

DRR Jim McGregor
M
Tim Spink

Section 8 of the Policy relates to the modelling that was done in 2012 as part of the SBP Policy development. The main tool used to optimise and quantify the SBP submission was earthworks SCAnNeR, not CeCost. CeCost was used to validate the earthworks SCAnNeR model. The immediate plans are to modify earthworks SCAnNeR so that it will work with the new 5x5 risk matrix and this will be used for CAM modelling. CeCost would need a substantial rebuild if it is to be used for any further modelling.

UPDATE FEB 06: It has been decided not to progress the further development of the CeCost earthworks model. CAM modelling will be completed using the earthworks SCAnNeR model that has now been modified to work with the new 5x5 risk and intervention matrices.

No

Keep open until results of modelling is provided.

March 2015 update: An NR now no longer progressing development of CeCost earthworks model but instead intend using earthworks SCAnNeR model, propose keeping open until results of SCAnNeR modelling is provided.

---

Please provide envisaged timescales for the three future developments listed in this para.

20/10/2014

DRR Jim McGregor
L
Simon Abbott / Tim Spink

For earthworks SCAnNeR the modelling of phasing has been added, and it is currently being modified to handle the 5x5 risk matrix. The other limitations will be handled for the CAM modelling by the same means adopted at SBP.

Integration of the UCR and Powerpack capability into the CSAMS asset management system in the manner suggested in Figure 8-7 - circa 2016

Update: Development of a Tier 3 tactical/operational DST to assist the routes in refining their workbank plans - circa 2019

Yes

See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geo tech professional head)

---

This states that a key policy objective is to maintain the overall condition profile in CPS and beyond at the CPS entry level. DRR notes, however, that the actual CPS entry level was worse (and significantly worse in the case of Scotland Route) than anticipated at SBP. How is this being addressed?

20/10/2014

DRR Jim McGregor
M
Simon Abbott

This text has barely changed from Previous Policy version. As per current standard and definitions blue line entries are now known as "Never Inspected" and these totals are shown in response to Q-101.

UPDATE JAN 15: Grey assets are where an earthwork is known to exist, but has not yet had an examination and are now called "Not examined". Blue lines are what we now call "Never Inspected". The adopted SBP Option 2 contained no allowance for grey assets (see Fig 9-4 in the Policy document), as the SBP submission contained no contingency allowances.

Yes

See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geo tech professional head)

---

This states that a key policy objective is to maintain the overall condition profile in CPS and beyond at the CPS entry level. DRR notes, however, that the actual CPS entry level was worse (and significantly worse in the case of Scotland Route) than anticipated at SBP. How is this being addressed?

20/10/2014

DRR Jim McGregor
M
Tim Spink

This text will be amended in the CAM submission once modelling of actual workbanks is undertaken against the current actual portfolio condition.

No

Keep open until CAM submission received and reviewed to confirm that this it addresses this item.

---

A previous NRP report challenged the conclusions on landslide risk due to climate change & quoted additional risks. The conclusions of the work to develop the new EHC algorithm i.e. that the SSHI algorithm was not well correlated to failure likelihood.

20/10/2014

DRR Jim McGregor
M
Simon Abbott

Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.1.1 p132) have not changed. Further work will be undertaken to improve policy in areas of climate change in development of the CFS earthworks Policy.

WRCCA plans to be included in the CAM submission will include Geotechnical assets and focus on weather resilience and climate change. Investing in additional volume will add resilience into the network. This will provide a more reliable and safe geotechnical portfolio from the effects of weather.

UPDATE JAN 15: Increased rainfall events and duration of storms are likely to see the geotechnical asset base tested to a greater extent. Given the historical legacy of the construction (pre understanding of soil mechanics) this testing may result in a greater extent of earthwork issues, either serviceability and/or safety related. However, this remains an area of ongoing research that will feed into the CFS Policy. NR would like to consider this closed.

Yes

See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geo tech professional head)
<table>
<thead>
<tr>
<th>Comment No.</th>
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<th>NR response</th>
<th>OHR / ARUP view - question closed?</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Earthworks/036</td>
<td>Earthworks Asset Policy</td>
<td>Page 136, para 12.7</td>
<td>As deliverability is stated to depend on changes in working practices and staffing levels, please comment on what progress has been made in implementing the changed working practices and improved staffing levels in each route.</td>
<td>26/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott</td>
<td>Growth has occurred following project Darwin and devolution.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/037</td>
<td>Earthworks Asset Policy</td>
<td>Page 137, para 12.9</td>
<td>The robustness measure was defined by OHR as &quot;number of earthworks failures to be reported at route-level every period&quot; but the policy states Network Rail's definition is the &quot;annual average number of earthworks failures measured over 5 years&quot;. To calculate the 5-year average the period figures must be known but for the existence of doubt please confirm that the number of failures each period will also be reported.</td>
<td>26/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott / Tony Wilkinson</td>
<td>The level of reporting will be advised.</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Earthworks/038</td>
<td>Earthworks Asset Policy</td>
<td>Page 138, Fig 10.1</td>
<td>This shows the weighting applied to slopes in Earthworks Hazard Categories B and C as being the same, presumably since these were previously combined as &quot;Marginal&quot; condition. However, it is self-evident that C will have a higher likelihood of failure (and hence should have higher weighting) than B - if this was not the case, there would be no benefit in splitting marginal into B &amp; C and no basis on which to do so. Please comment therefore on (a) the robustness of the M33 metric in the light of this observation and (b) any plans to determine separate weightings for B and C slopes.</td>
<td>26/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Simon Abbott / Tony Wilkinson</td>
<td>With reference to question Q24, parity has been retained with the previous weightings so that the KPIs committed in the Final Delivery Plan (based on Serviceable, Marginal, Poor and Top Poor) can be monitored throughout CP5 using the new 5 point EHC. We envisage that the weightings will be reviewed with potentially a new KPI metric being defined for monitoring performance in CP6. UPDATE FEB 06: As noted in the OHR and ARUP meeting of 20th January, a period of stability is required, with the current metrics being utilised for the remainder of CP5. The metrics will be reviewed as part of the CP6 Policy development. NR would like to consider this closed.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/039</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 8, paras 2.2 &amp; 2.3</td>
<td>Given the very small sample size after elimination of CIV/028 data sets without prior exams and incomplete exam records, how can NR be assured that the &quot;used&quot; sample is of sufficient size to be statistically representative?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>Please refer to Network Rail, March 2014. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthworks Failure section 10 in which a validation exercise using the most recent failure data confirmed the conclusions of the main analysis.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/040</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 8, para 2.2</td>
<td>Did the analysis include all CIV/028 failures or only those scored &gt;20? If only those scored &gt;20, what is the likely impact on the robustness of the analysis of omission of those with lower scores?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>All CIV/028 failures used that could be located and which had a prior examination.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/041</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 8, para 2.2</td>
<td>Where a single event included multiple failures, was each failure individually analysed?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>Every failure that could be related to a specific earthwork was used.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/042</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 13, para 5.1</td>
<td>What other methodologies for identifying the most significant factors were considered and why was the &quot;Difference&quot; and &quot;Factor&quot; methodology chosen?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>Various statistical methods of multivariate analysis were considered (specifically multiple regression and neural network analysis), however it was decided that these methods were too &quot;black box&quot;, and that it was desirable to have a completely transparent method, the inner workings of which could be fully understood, picked apart and sensitivity tested. It was necessary that the method would stand up to rigorous scrutiny by the Earthworks Panel of Experts (and the OHR).</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/043</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 13, para 5.1 and Tables S.1 &amp; S.2</td>
<td>This states that &quot;group boundaries were determined in order to generate a roughly normal distribution of parameters per band&quot;. Please explain this further as this appears to suggest the analysis forced a roughly normal distribution within Group 1, a roughly normal distribution within Group 2, etc. (See also item Earthworks/041.)</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>This would be better worded: &quot;The group boundaries were determined in order to generate a roughly normal distribution of parameters across the bands.&quot;</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
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<td>Earthworks/044</td>
<td>Generation, Analysis, and Application etc</td>
<td>Page 14, Table 5-3</td>
<td>No explanation is offered as to how the boundary conditions in Table 5-3 were established, but I note that selection of these boundary conditions results in a small number of negative cells (7); a larger number of neutral cells (11); and an even larger number of positive cells (17). Although centred around Factor C, this does not appear to give a normal distribution as there is likely to be a much larger positive tail. Please comment further on how and why the boundary conditions in Table 5-3 were selected and why NR believes these boundary conditions are justified.</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>Absolute weightings are arbitrary - relative differences are important. These inevitably arise from the fact that the 065 parameters records are primarily associated with instability rather than stability - thus there are naturally more opportunities for negative weightings than positive ones. This is also good engineering sense - it is potentially harder to demonstrate that a slope is in DHC A than in EHC C because the burden of evidence is stacked against &quot;stabilising&quot; parameters.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/045</td>
<td>Generation, Analysis, and Application etc</td>
<td>Pages 14 &amp; 15, Para 6.2.1</td>
<td>Para 5.2 states that &quot;initial assignments of weightings... were based purely on engineering assessment&quot;, but does not state by whom or on what basis. Para 6.2.1 describes this as &quot;a sensible first attempt at a weightings distribution&quot;. Why was this approach (i.e. assignment of weightings on the basis of engineering assessment) adopted when there are statistical methods which could have been used to assess individual parameter weightings?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>See answer to question 047. This approach allowed the sensitivity analyses described in section 6, to fully understand the impact of different weightings and weighting distributions. This sensitivity analysis would not have been possible with a statistical black box method.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/046</td>
<td>Generation, Analysis, and Application etc</td>
<td>Page 15, para 5.4</td>
<td>If the new HI is believed to be a better metric for failure likelihood than SSHI (which NR's analysis now shows has a relatively poor record of predicting failure), why has NR assumed that the SSHI split provides a robust basis for allocating the number of slopes in each new Hazard Index category? In particular, as SSHI appears to have been a poor predictor of &quot;servicable&quot; slope failures, does this not suggest that the higher likelihood category / categories should have more slopes than were suggested by the SSHI method?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>See answer to question 047.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/047</td>
<td>Generation, Analysis, and Application etc</td>
<td>Page 15, para 5.4</td>
<td>As past failures suggest that cutting slopes have a higher failure rate than embankments and (normalised by no. of each type of slope) rock cuttings have a higher failure rate than soil cuttings, it would be expected that the higher likelihood category / categories are skewed accordingly but the analysis described here does not suggest that such considerations were taken into account in allocating the number of slopes to each category.</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>Our method has been a) the boundaries to retain parity. These boundaries are different for each asset type b) Determine the probability of failure for each category defined. The EHC categories have different failure probabilities for each of the three asset types. Under the AD Little cross asset risk matrix that aims to bring all such risk matrices together, this is perfectly acceptable. It is not appropriate to force the same risk categories on each asset type.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
<tr>
<td>Earthworks/048</td>
<td>Generation, Analysis, and Application etc</td>
<td>Page 15, para 5.4</td>
<td>One means of at least partially validating the calibration of the adopted model would be to re-assess each failed slope against the new likelihood criteria to assess how the boundary conditions (e.g. if a significant number of failed slopes do not lie in the higher likelihood categories it is likely that the boundary conditions need to be re-defined to include them). Has NR carried out such a validation exercise? If not, why not and is it now the intention to do so, and if so, by when?</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td>Our whole analysis is based on: a) Maximising the probability of failure to the higher EHCs (compared with what SSHI achieved) b) Minimising the probability of failure of the lower EHCs (compared with what SSHI achieved) c) And hence maximising the spread of probability between the lowest and highest EHC (compared with what SSHI achieved) d) Improving the shape of the probability distribution across the EHCs (compared with what SSHI achieved) e) Improving the distribution of the number of failed assets across the EHCs (compared with what SSHI achieved) f) Improving the distribution of the number of assets across the EHCs (compared with what SSHI achieved) All of this has been achieved by calibrating against the CIV22 dataset.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR's Simon Abbott (acting geotech professional head)</td>
</tr>
</tbody>
</table>
Earthworks/049

ORR Jim

Generation, Analysis, and Application etc

Page 16, para 6.1 and Page 18, para 6.2.11

The initial weightings (as noted in Earthworks/045 above) were based "purely on engineering assessment", and these weightings were then adjusted "by the application of engineering judgement" for runs 15 - 31. Run 23 was then taken forward as the new methodology for soil cuttings. It therefore appears that the final weightings are based solely on engineering judgement rather than on a robust statistical analysis of the future correlation of each parameter. This significantly undermines the confidence in the robustness of the new soil cutting index, particularly since the report itself admits (in para 6.2.8) that "several engineering based runs (15/16/17) were not having the desired effects".

27/10/2014

ORR Jim

NR

McGregor

H

Tim Spink

We disagree with the ORR statements. Refer to the answer of question 042 for why this approach was adopted.

We disagree with the ORR statements. Refer to the answer of question 042 for why this approach was adopted.

Normal multivariate analysis was initially considered but not used. Logistic regression or a neural network model would have been candidates for this. The decision was that a hybrid approach of expert judgement and numerical analysis, under a totally transparent framework, was preferable to complex, impenetrable statistical methods which, to work correctly, would require significant training datasets. "Robustness" in the true sense cannot be ensured by relying on statistical analysis alone - the comments in the report concerning trial runs 15/16/17 demonstrate this, since it was those runs that employed minimal engineering judgement, resulting in a less satisfactory model overall.

UPDATE FEB 06: The derivation of the weightings was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.

Earthworks/050

ORR / ARUP

Generation, Analysis, and Application etc

Page 20, Table 6-1 and Pages 20 & 21, para 6.4

From review of the table, it appears that if the various runs were ranked in terms of pseudo-probability of failure (i.e. accuracy in predicting slopes at risk of failure), the chosen run (run 23) would probably be somewhere in the middle of the table. This is confirmed in the final sentence of para 6.4.1: "The final run, Run 23, was chosen as a middle ground between Run 1 and 10". When compared with the SSHI run, it does not appear to give a dramatic predictability improvement. ORR also notes that "Run 1 generally proved the best option ... but could not be taken forward as a final option due to the presence of scores within the matrix that did not fit with engineering judgement". All of this suggests that the new index is not optimal and that the improvement on the previous index may be significantly less than the policy appears to suggest. A better outcome might therefore have been obtained by using a more robust statistical correlation analysis to determine the parameter weightings rather than engineering judgement and what appears to be relatively arbitrary numerical values (i.e. try 40, try 70, try 100, etc).

27/10/2014

ORR Jim

NR

McGregor

H

Tim Spink

We disagree with the ORR statements. Refer to the answer of question 048 on the objectives of the analysis. Run 21 was the optimal run when assessed against all of these objectives, and demonstrated considerable improvement over SSHI.

UPDATE FEB 06: The derivation of the weightings was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.

Earthworks/051

ORR / ARUP

Generation, Analysis, and Application etc

Page 22, para 7

See comment Earthworks/049 above, which is also applicable to the new embankments hazard index.

27/10/2014

ORR Jim

NR

McGregor

H

Tim Spink

See replies above.

UPDATE FEB 06: The derivation of the weightings was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.

Earthworks/052

ORR / ARUP

Generation, Analysis, and Application etc

Page 22, para 7.1.3

This states that all positive track movement indicators were allocated the maximum weighting. There does not appear to have been a run which tested intermediate values for track movement (Run 2 allocated a weighting of 0). With so few tests run, why does NR believe that all track movement indicators should have the maximum weighting?

27/10/2014

ORR Jim

NR

McGregor

M

Tim Spink

There were insufficient records in the database to generate a statistical weighting. This demonstrates the importance of the approach adopted that an engineering override could be applied (rather than a purely statistical approach which would give a nonsensical answer). For embankments, if the track defects become visible to the naked eye then there is something seriously wrong, and this should be reflected in the weightings.

UPDATE FEB 06: The derivation of the weightings was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.
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<th>Question / Issue</th>
<th>Date of question 047/048/049 (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
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<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Earthworks/053</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 22, para 7.1.3</td>
<td>This correctly notes that track movement indicators are significant only where they are due to embankment failure. However, it does not state what steps were taken to identify and exclude track movement indicators which are not genuinely indicative of embankment failure, nor is it clear that there is a robust process for excluding such data when the new index is in regular use (the Eisma Pocket Guide merely states on Page 30 that examiners should “record track movement which looks like it is associated with the embankment”). It is therefore possible that the index is potentially skewed by inclusion of factors which in fact only reflect poor track maintenance and that these factors have / will be given the maximum weighting [see also comment Earthworks/052 above].</td>
<td>27/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
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<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Earthworks/054</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 25, para 8.1.3</td>
<td>Please comment on the level of unreliability or uncertainty associated or introduced by the smoothed bootstrap scaling method adopted and comment on whether this methodology is likely to introduce any bias and, if so, what kind of bias.</td>
<td>28/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
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<td>Yes</td>
</tr>
<tr>
<td>Earthworks/055</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 26, para 8.1.5 &amp; 8.1.6</td>
<td>The failure probability varies significantly by earthwork type (cuttings fail more frequently than embankments and rock cuttings fail more frequently than soil cuttings) but it is not clear whether or how the method adopted for calculating failure probability took account of these significant differences (it appears from the narrative that only condition banding was taken into account) or even whether failed rock slopes were included in this analysis. Please clarify how (if at all) the greater propensity of some asset types to fail was taken into account in assessing failure probabilities.</td>
<td>28/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
<td></td>
<td></td>
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<td></td>
<td>Yes</td>
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<tr>
<td>Earthworks/056</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 28, Table 9-1</td>
<td>Please explain why the score ranges shown in Table 9-1 were chosen.</td>
<td>28/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
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<td>Yes</td>
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<tr>
<td>Earthworks/057</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 30, 1st bullet</td>
<td>Please explain the basis for splitting Marginal in the ratio 9.2 rather than some other ratio.</td>
<td>28/10/2014</td>
<td>ORR Jim McGregor</td>
<td>H</td>
<td>Tim Spink</td>
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<td>Yes</td>
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</tbody>
</table>
Earthworks/058  Generation, Analysis and Application etc  Page 31, 1st bulletin, Page 32, Fig 9-4, and Page 33, Fig 9-5
This states (eg Fig 9-4) that the peak in the number of assets failing is in Category C, however the earthworks policy focuses only on assets in categories D & E. ORR’s concern about Marginal slopes was that those near the SSHI boundary were in risk terms not really distinguishable from Poor slopes. Figs 9-4 and 9-5 appear to confirm this - one possible interpretation of the graphs is that in fact the boundary has been incorrectly defined and many of the Category C slopes should really be included in Category D. Alternatively, the policy should target slopes in categories C, D & E, rather than just those in D & E. Please comment.
29/10/2014 ORR Jim McGregor H Tim Spink Policy update has not been a complete rewrite but an update of key sections around 065 matrix, EHC and EACB. The core objectives of the Policy (see section 10.1 on p132) have not changed.
UPDATE FEB 06: Discussion in the DRR and ARUP meeting of 20 January, in which NR stated that a period of stability was required before the intervention matrices were adjusted again - this will be part of DPP Policy development. In the meantime the workbank prioritisation procedures developed for CAM and the revised D5G examination procedures will be applied to manage these identified risks in reduced examination intervals, consideration of adverse weather sites, consideration of water concentration features, consideration of evaluation recommendations, consideration of condition history, consideration of EHC and EACB, consideration of route asset knowledge. Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/059  Generation, Analysis and Application etc  Page 34, Table 9-2
Please explain why the score ranges shown in Table 9-2 were chosen.
29/10/2014 ORR Jim McGregor H Tim Spink See answer to question 056
UPDATE FEB 06: Parity was discussed in the meeting with ORR and ARUP on 20 January. NR would like to consider this closed.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/060  Generation, Analysis and Application etc  Page 36, 1st bulletin, and Pages 43 (last bulletin) & 44 (Fig 9-18)
Please explain the basis for splitting Marginal in the ratio 3:2 rather than some other ratio. In particular, I note that the comment on page 43 (last bulletin) says there is only a slight increase in failure probability from Category B to C (as the graph in Fig 9-18 also shows) and this would appear to suggest that a different split should have been adopted (ie one which shows a greater increase in failure probability from B to C). Please therefore also comment on whether different splits were tried, and how the evidence in Fig 9-18 on possible improved splits was addressed.
29/10/2014 ORR Jim McGregor H Tim Spink There was no analysis to redefine the weightings in RSHI. Marginal was split to create the 5 EHC categories. In the absence of any other means of determining the split point the 3:2 ratio achieved in both soil cuttings and embankments was adopted.
UPDATE FEB 06: The analysis process was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/061  Generation, Analysis and Application etc  Page 36, 2nd last bulletin, Page 37, Fig 9-10, and Page 38, Fig 9-11
This states (eg Fig 9-10) that the peak in the number of assets failing is in Category C, however the earthworks policy focuses only on assets in categories D & E. ORR’s concern about Marginal slopes was that those near the SSHI boundary were in risk terms not really distinguishable from Poor slopes. Figs 9-10 and 9-11 appear to confirm this - one possible interpretation of the graphs is that in fact the boundary has been incorrectly defined and many of the Category C slopes should really be included in Category D. Alternatively, the policy should target slopes in categories C, D & E, rather than just those in D & E. Please comment.
29/10/2014 ORR Jim McGregor H Tim Spink See answer to question 056
UPDATE FEB 06: See updated answer to 056.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/062  Generation, Analysis and Application etc  Page 39, para 9.1
NR has concluded that SSHI is not a good predictor of failure likelihood, so it is likely that RSHI will also be a poor predictor. Why therefore was no attempt made to revise the RSHI algorithm?
29/10/2014 ORR Jim McGregor M Tim Spink It is currently planned to attempt a similar analysis of RSHI in due course.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/063  Generation, Analysis and Application etc  Page 39, para 9.1
Please explain the basis for splitting Marginal in the ratio 3:2 rather than some other ratio - this para appears to suggest the only reason for doing so was because the same division was adopted for soil cuttings and embankments. (Please also see comment Earthworks/060 above which questions the validity of this split for embankments.)
29/10/2014 ORR Jim McGregor H Tim Spink See answer to question 060
UPDATE FEB 06: The analysis process was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
Earthworks/064  Generation, Analysis and Application etc  Page 39, Table 9-3
Please explain why the score ranges shown in Table 9-3 were chosen.
29/10/2014 ORR Jim McGregor M Tim Spink Only the boundary between B and C has been added (see answer to question 060), all the other boundaries are unchanged.
UPDATE FEB 06: The analysis process was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.
Yes See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)
<table>
<thead>
<tr>
<th>Comment No.</th>
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<th>Text ref. if applicable</th>
<th>Topic</th>
<th>Question / Issue</th>
<th>Date of question (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
<th>Importance (H/M/L)</th>
<th>NR response (DG/WM/YY/MM/YYYY)</th>
<th>Originator of NR response</th>
<th>NR response view - question closed?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthworks/065</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 45, para 10.1</td>
<td>While the results may be favourable compared to SSHI, the conclusion that this test &quot;is very encouraging&quot; may not be entirely valid since (a) although improved, there is still a significant number of serviceable / Category A failures (3 out of 41, or 7.3%) and (b) the number of Marginal / Category B &amp; C failures is still dominant (as Fig 10-1 shows). Even better results might therefore be obtained from a different index and / or boundary conditions. Please comment.</td>
<td>29/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>We have clearly demonstrated in our report that SCHI is a significant improvement over SSHI (against all of the parameters given in our answer to question 065), and we are encouraged by this validation test provided by an independent set of data. UPDATE FEB 06: The analysis process was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)</td>
<td></td>
</tr>
<tr>
<td>Earthworks/066</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 46, para 10.2</td>
<td>While the results may be favourable compared to SSHI, the conclusion that this test &quot;is very encouraging&quot; may not be entirely valid since (a) although improved, there is still a significant number of serviceable / Category A failures (2 out of 17, or 11.8%) and (b) the number of Marginal / Category B &amp; C failures is still dominant (as Fig 10-1 shows). Even better results might therefore be obtained from a different index and / or boundary conditions. Please comment.</td>
<td>29/10/2014</td>
<td>ORR Jim McGregor</td>
<td>M</td>
<td>Tim Spink</td>
<td>See answer to question 065. UPDATE FEB 06: The analysis process was discussed in the meeting with ARUP on 5 December and we believe it will be covered in their independent report.</td>
<td>Yes</td>
<td>See 03/03/2015 email from J McGregor to NR’s Simon Abbott (acting geotech professional head)</td>
<td></td>
</tr>
<tr>
<td>Earthworks/067</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 49, 4th sub-bullet for soil cuttings and embankments</td>
<td>Has the NR Panel of Geotechnical Experts reviewed the Case 1 exceptions for both soil cuttings and embankments? If so, what was the outcome of this review?</td>
<td>29/10/2014</td>
<td>ORR Jim McGregor</td>
<td>L</td>
<td>Tim Spink</td>
<td>Everything in our report was presented to the Earthworks Panel of Experts on several occasions. This work was presented to the Earthworks Panel of Experts who required further investigation. This further work will be reported in Network Rail, in press. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure, Addendum Report, once it has been reviewed by NR and published.</td>
<td>No</td>
<td>Keep open until Addendum Report received.</td>
<td></td>
</tr>
<tr>
<td>Earthworks/068</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 49, 5th sub-bullet for soil cuttings and embankments</td>
<td>Has there been discussion of whether Case 2 is realistic with the NR Panel of Geotechnical Experts? If so, what was the outcome of this discussion?</td>
<td>29/10/2014</td>
<td>ORR Jim McGregor</td>
<td>L</td>
<td>Tim Spink</td>
<td>Everything in our report was presented to the Earthworks Panel of Experts on several occasions. This work was presented to the Earthworks Panel of Experts who required further investigation. This further work will be reported in Network Rail, in press. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure, Addendum Report, once it has been reviewed by NR and published.</td>
<td>No</td>
<td>Keep open until Addendum Report received.</td>
<td></td>
</tr>
<tr>
<td>Earthworks/069</td>
<td>Generation, Analysis and Application etc</td>
<td>Page 49, final paragraph</td>
<td>Has the outcome of the intervention assessment been reviewed with the NR Panel of Geotechnical Experts? If so, what conclusion was reached regarding whether there should be any changes to the OES exam process and / or the new hazard index?</td>
<td>29/10/2014</td>
<td>ORR Jim McGregor</td>
<td>L</td>
<td>Tim Spink</td>
<td>Everything in our report was presented to the Earthworks Panel of Experts on several occasions. This work was presented to the Earthworks Panel of Experts who required further investigation. This further work will be reported in Network Rail, in press. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure, Addendum Report, once it has been reviewed by NR and published.</td>
<td>No</td>
<td>Keep open until Addendum Report received.</td>
<td></td>
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</tbody>
</table>
This table shows that the failure rate for Category C embankments and soil cuttings is almost twice the failure rate of Marginal slopes. Category C rock cuttings also have a higher failure rate than Marginal rock cuttings although the difference is not as pronounced as it is to be expected since the RSHI algorithm has not been altered. The only change has been to split Marginal into Category B and C. Since slopes in Category C are now "proven" to have a higher failure rate than Marginal slopes, it obviously keeps the question - what additional risk control measures has NR implemented to address this known increased risk, particularly for soil cuttings and embankments? ORR is unaware of the policy proposing any additional risk control measures to address this, though it has increased the risk associated with Category C slopes - the only additional measure identified is in NR/L/17/001 - D004 issue 4, which reduces the exam interval for Marginal Soil cuttings but not for Marginal embankments. Please comment.

Earthworks Options

Generation, Analysis, and Application etc

Page 50, Table 5.2

29/10/2014

ORR J. McGregor

NR response (DD/MM/YYYY):  29/10/2014

Comment: Are the colours correct?

NR response: No

Policy update has not been a complete rewrite but an update of key delivery plans. The Delivery Plan volumes are per asset (the terminology used may be useful to allow correlation between policy outputs and numbers of remediated sites in relevant units, would be a chart which shows about 6.5% of earthworks assets will be remediated. As a percentage this is around 330,000 5ch lengths stated in Table 11-2 shows about 10% total volume of interventions in CPS based on the SBP top down modelling of the earthworks asset as it stood at that time. The FOP shows 26,000 total volume of interventions on 184,551 earthworks assets determined by bottom-up workbank development. This equates to 8.7% of the total length that indicates at SBP and still awaits NR's updated CP5 trajectory. March 2015 update: Keep open until CAM submission received and reviewed to confirm that this it addresses this item.

Earthworks Options

Page 50, Table 5.2

29/10/2014

ORR J. McGregor

NR response (DD/MM/YYYY):  29/10/2014

Comment: Are the colours correct?

NR response: No

Policy update has not been a complete rewrite but an update of key delivery plans. The Delivery Plan volumes are per asset (the terminology used may be useful to allow correlation between policy outputs and numbers of remediated sites in relevant units, would be a chart which shows about 6.5% of earthworks assets will be remediated. As a percentage this is around 330,000 5ch lengths stated in Table 11-2 shows about 10% total volume of interventions in CPS based on the SBP top down modelling of the earthworks asset as it stood at that time. The FOP shows 26,000 total volume of interventions on 184,551 earthworks assets determined by bottom-up workbank development. This equates to 8.7% of the total length that indicates at SBP and still awaits NR's updated CP5 trajectory. March 2015 update: Keep open until CAM submission received and reviewed to confirm that this it addresses this item.
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<th>Date of question (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
<th>Importance f/M/L</th>
<th>NR response date (DD/MM/YYYY)</th>
<th>Originator of response</th>
<th>NR response</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>E002</td>
<td>Earthworks_Policy</td>
<td>P109, 125</td>
<td>Outputs</td>
<td>What does the new policy mean in practice? For example what sites would now be identified for intervention that previously would not have been and vice-versa? Please can you provide some real Route examples?</td>
<td>20/10/2014</td>
<td>Tim Spink</td>
<td>R</td>
<td>24/11/2014</td>
<td>Tim Spink</td>
<td>NR has moved from a qualitative Condition Rating to a quantitative Hazard Index that directly relates to likelihood of failure. Please refer to report for full details. Network Rail, March 2014. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthworks Failure.</td>
<td>Closed</td>
</tr>
<tr>
<td>E003</td>
<td>Earthworks_Policy</td>
<td>P109, 125</td>
<td>Outputs</td>
<td>Condition Score – please can you explain: - Current value (and derivation) - Full definition (Document M33DP ??) - what is the ‘baseline’ for CFS target values - what improvement has been achieved since the start of CFS - Please can you explain / provide the Route level values as well as National / Network level ?</td>
<td>20/10/2014</td>
<td>Tim Spink</td>
<td>M</td>
<td>24/11/2014</td>
<td>Tim Spink</td>
<td>Well be provided under separate cover.</td>
<td>Closed</td>
</tr>
<tr>
<td>E004</td>
<td>Earthworks_Policy</td>
<td>P109, 125</td>
<td>Outputs</td>
<td>The NR Delivery Plan has a series of figures for Earthworks Condition Banding. (e.g. Table 25 at sec) – how are these affected by the change in Asset Policy? How does the new M33 relate to the ‘condition banding’ in the Delivery Plan?</td>
<td>20/10/2014</td>
<td>Tim Spink</td>
<td>M</td>
<td>24/11/2014</td>
<td>Simon Abbott</td>
<td>Please refer to NR/M33P/M33DP: Definitions for the Rating of Earthworks Condition Banding (Network Rail, May 2014) for the full definition. The CFS baseline values were stated in the Final Delivery Plan, a formal change will be advised through the DF/14 update and CAM process. The CFS target values were stated in the Final Delivery Plan, any changes from these will be advised through the DF/14 update and CAM process after discussion and endorsement by NR Exec.</td>
<td>Closed</td>
</tr>
<tr>
<td>E005</td>
<td>Earthworks_Policy</td>
<td>P109, 125</td>
<td>Outputs</td>
<td>The new M33 is the Condition Banding stated in the Final Delivery Plan. The core objectives of the Policy (see section 10.1 on p121) have not changed. Parity has been retained between the old and the new systems and hence the national target volumes of interventions are retained.</td>
<td>20/10/2014</td>
<td>Tim Spink</td>
<td>R</td>
<td>24/11/2014</td>
<td>Tim Spink</td>
<td>The new M33 is the Condition Banding stated in the Final Delivery Plan. The core objectives of the Policy (see section 10.1 on p121) have not changed. Parity has been retained between the old and the new systems and hence the national target volumes of interventions are retained.</td>
<td>Closed</td>
</tr>
<tr>
<td>E006</td>
<td>Earthworks_Policy</td>
<td>P109, 125</td>
<td>Rock Cuttings</td>
<td>For rock cuttings Cat E does not seem to have a higher failure probability than Cat D. Similarly the probabilities for failure seems to be very similar for Cat B and Cat C. This seems to imply that the earthworks safety risk matrix using EHC may not be an appropriate way to prioritise rock cutting interventions. Please can you comment?</td>
<td>20/10/2014</td>
<td>Tim Spink</td>
<td>R</td>
<td>24/11/2014</td>
<td>Tim Spink</td>
<td>With reference to the answer to question D19. New metrics have been derived for soil cuttings and embankments (GCTV and STHI) which have successfully optimised the failure probabilities for these two asset types, giving a failure probability range from category A to E of about 100. There has been no similar development of ROH for rock cuttings at this time, and it retains its previous failure probability range of only 3. This fully explains the differences in the failure probabilities seen in Fig 5-17.</td>
<td>Closed</td>
</tr>
</tbody>
</table>
17007 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
Site Selection
At PR13 stage in 2012 / 2013 a key concern was that the SSR was not adequately identifying the 'right' sites to remediate – primarily because the over-riding factor was rainfall. Please can you explain / demonstrate the improvement due to the revised Asset Policy ?

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Tim Spink
Please refer to Network Rail, March 2014. Generation, Analysis and Application of New Hazard Index for Likelihood of Earthworks Failure. The new metrics have been entirely calibrated against the CIV028 failure record, and hence they are inherently related to rainfall triggered failures.

Closed
Answer noted

17008 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
Average Condition
We noted that one key implication of applying a constraint of maintaining overall 'average' condition leads to Routes with 'poor' start condition earthworks improving and Routes with 'better' start condition earthworks being allowed to deteriorate. We had concerns that this constraint seemed to suggest that the condition of earthworks in Scotland (which have the second highest number of failures) will overall deteriorate in CP5 – CP11. Please can you explain how this is addressed in the revised Policy ?

We were also unclear that allowing this deterioration complied with Statutory Obligations under ALARP principles. Please can you comment?

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Simon Abbott/Tim Spink
This will be addressed in the CAM submission when the modelling will be re-run as part of the CAM development.

Pending
Noted that this is to be considered by NR in due course as part of ongoing CAM development

17009 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
Progress in first 2 years of CFS
What evidence is there that the risk level has been reduced by the CFS Asset Policy ? (Dec 2012 version)

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Tim Spink
The condition and risk profile of the earthworks asset will be first revealed on completion of the current earthworks examinations season.

Pending
Noted that this is to be considered by NR in due course as part of ongoing development

17010 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
Progress in first 2 years of CFS
What evidence is there that the CFS Asset Policy has been / is being implemented in practice ? (Dec 2012 version)

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Simon Abbott
The Assurance carried out as part of CAM development and emerging period reports has satisfied NR that the Policy is being appropriately implemented.

UPDATE: This report - referenced as 24 in above list - was sent to ORR on the 2/12/14. It was later provided to ARUP on the 18/12/14.

Pending
Noted that this is to be considered by NR in due course as part of ongoing development

17011 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
How has feedback on practical implementation been taken into account in the update ?

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Simon Abbott
Policy update has not been a complete rewrite but an update of key sections around 5x5 matrix, EHC and EACB. The core objectives of the Policy (see section 10.1 on p121) have not changed.

However, the tool provided to the routes for workbank development (Powerpack) has been rebuilt for CAM development taking into account route feedback.

Closed

17012 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
What sample sites been considered to look at the actual effect of the revised policy ?

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Simon Abbott
Initial site visits have been undertaken as part of the Corporate Engineering Verification process.

Pending
Noted that this is to be considered by NR in due course as part of ongoing CAM development

17013 Earthworks_Policy_2014_Update_rev_09_2014-08-22 AS ISSUED
Have the targets proposed for the first years of CFS been achieved at a Network and Route level ?

- Asset Condition Reliability – Number of Earthworks Failures (Delivery Plan Table 24 et seq)
- Asset Condition Sustainability – Earthworks Condition Banding (Delivery Plan Tables 25 et seq)
- Renews Volumes (Delivery Plan Tables 32 et seq)

How has the risk level changed ?

10-Nov-14
Indep Reporter Team DMR
H
24/11/2014
Simon Abbott
In progress.

Pending
Noted that this is to be considered by NR in due course as part of future developments
Can NR provide the basis for the approach described in Section 8 and the scoring (weightings) described earlier?

Could NR confirm the level of analysis carried out on rock slopes?

NR provided further information at meeting on 5 Dec 14.

The reduction of data to allow analysis is described. It is intended that data on broadly 18% of soil cutting failures and 12% of the soil embankment failures was used due to missing inspection information. What is the impact of this reduced data sample on the analysis presented?

Could NR provide some examples of the parameter categorisation to confirm our understanding of the process described. How might the reduced failed data sample have affected this process?

Can NR provide the basis for the approach described using smoothed bootstrapping to 'repopulate data gaps'? Also on what basis is noise assumed to normally distributed and how does this noise reflect on the scoring (weightings) described earlier.

Would NR demonstrate the determination of failure probabilities to check our understanding?

For example Fig 9.4 indicates that 0.4% of all cuttings and 7.2% of failed cuttings are within HI category E, and Fig 9.5/Table 12.1 show the annual failure probability of 5.12%. Using these figures directly suggests a higher annual failure probability based on the totals of assets indicated in Section 2. How has this output been updated?

What is the impact on expected costs of managing the asset given the changes in categorisation?

The modelling will be re-run as part of the CAM development, and any differences identified from the SBP-modelling will be advised as part of the CAM submission. Please refer to Network Rail, March 2014: Generation, Analysis and Application of New Hazard Index for Likelihood of Earthwork Failure. There has been no analysis or optimisation of RSHI at the present time, only a splitting of Marginal into two bands to achieve the 5 point EHC scale. See reply to question 054. Statistical methods were adopted to make best use of the available data.

The earlier records have the highest proportion of missing data.

Further clarification of the question required.

The failure probabilities were derived by the method stated in Section 8 of the report, including the use of the bootstrapping process, and cannot be simply derived from numbers given on the plots in the report which are also the result (not the input) to the bootstrapping process. However, the key factors missing from the calculations that we suspect that you have carried out are:

a) the time interval of the CV028 observations, this must be used to normalise the outputs to achieve the annual failure probabilities
b) the bootstrapped failed and nonfailed asset population distributions
c) the kernel density estimation (KDE) approach adopted to bootstrap the dataset. Approach has enabled an interpretation of the dataset to be made and taken forward to an improved SHM

The shape of the failure distribution in the validation test is the same as in the main analysis. Compare Fig 10.1 and 10.2 with 9.4 and 9.10 which gives us confidence that the results are generally applicable.

Any changes in costs due to the re-categorisation are likely to be small due to the process adopted of retaining parity between the old and new systems.
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<th>CRR/ARUP view - question closed?</th>
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<td>EP023</td>
<td>NR New Hazard Index Report_r.ev03c_2014-03-31 AS 15/01/ED-PDF</td>
<td>L2</td>
<td>LF</td>
<td>Please can you explain this statement and its relevance</td>
<td>13-Nov-14</td>
<td>Indep Reporter</td>
<td>APW</td>
<td>M</td>
<td>24/11/2014</td>
<td>Tim Spink</td>
<td>Refer to answer to question 020</td>
<td>Closed</td>
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<tr>
<td>EP024</td>
<td>NR New Hazard Index Report_r.ev03c_2014-03-31 AS 15/01/ED-PDF</td>
<td>Statistical A1</td>
<td>Could NR provide information on the alternative methods that were considered to correlate earthworks failures with asset information other than the one selected?</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>APW</td>
<td>M</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>Closed</td>
<td>Noted</td>
<td></td>
</tr>
<tr>
<td>EP025</td>
<td>NR New Hazard Index Report_r.ev03c_2014-03-31 AS 15/01/ED-PDF</td>
<td>Statistical A1</td>
<td>Which additional data would be necessary to improve the Hi approach? Are there factors not represented in the SSHI information that may be important to determination of failure likelihood?</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>APW</td>
<td>M</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>Closed</td>
<td>Noted</td>
<td></td>
</tr>
<tr>
<td>EP026</td>
<td>NR New Hazard Index Report_r.ev03c_2014-03-31 AS 15/01/ED-PDF</td>
<td>Strategic Business Plan (page 41) compared with Delivery Plan Table 32</td>
<td>Outputs</td>
<td>We note that the volumes for earthworks renewals in the Delivery Plan dated 31 March 2014 (16,077 5 chain lengths) appear to be lower than the volumes stated in the Strategic Business Plan (17,737 5 chain lengths). Please can you confirm the logic for this and provide evidence that the outputs will still be achieved with this reduced volume of renewals?</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>DMRI</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>Closed</td>
<td>Pending</td>
<td>Noted</td>
</tr>
<tr>
<td>EP027</td>
<td>NR New Hazard Index Addendum Report</td>
<td>Additional R2</td>
<td>When will this Addendum report be available to review it?</td>
<td></td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Pending</td>
<td>Report awaited</td>
</tr>
<tr>
<td>EP028</td>
<td>Safety Risk Adendum v1 Report</td>
<td>Foot note page 6</td>
<td>Can we have a copy of the report: Earthworks CPS roadmap: understanding safety risk - embankment risk model (Feb 13)?</td>
<td>12-Dec-14</td>
<td>Indep reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP029</td>
<td>2014-12-10 NR - Earthworks CPS Roadmap - Review of Asset Criticality (Safety)</td>
<td>Page 4 (Section 1.1)</td>
<td>Can we have a copy of the report: Earthworks CPS Roadmap – Performance Risk Feasibility Study and Preliminary Performance Risk Model, February 2014?</td>
<td>12-Dec-14</td>
<td>Indep reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Document provided</td>
<td></td>
</tr>
<tr>
<td>EP030</td>
<td>2014-12-10 NR - Earthworks CPS Roadmap - Review of Asset Criticality (Safety)</td>
<td>Page 4 (Section 1.1)</td>
<td>Can we have a copy of the report: Earthworks CPS Roadmap – Performance Risk Feasibility Study and Preliminary Performance Risk Model, February 2014?</td>
<td>12-Dec-14</td>
<td>Indep reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Document provided</td>
<td></td>
</tr>
<tr>
<td>EP031</td>
<td>Delivery Plan</td>
<td>Additional R2</td>
<td>We have found it challenging to understand how all the various reports and initiatives fit together. Are there any other reports that are relevant, or perhaps executive summary that provides overview of the significant body of work undertaken by NR</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>EP032</td>
<td>Delivery Plan</td>
<td>Table 32 Outputs</td>
<td>What renewal volumes have been delivered so far in CP5 for earthworks? How do these compare with the planned civils renewal volumes in the first year of the Control Period ? (April 2014 – March 2015) - i.e. are NR on target to deliver the planned volumes in 2014/15 ?</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Pending</td>
<td>Noted that this is to be considered by NR in due course as part of ongoing development</td>
</tr>
<tr>
<td>EP033</td>
<td>Delivery Plan</td>
<td>Table 32 Outputs</td>
<td>What is the split of the planned national renewals between the Policy intervention categories of Maintain, Refurbish and Renew ? (by year in whole of CP5)</td>
<td>12-Dec-14</td>
<td>Indep Reporter</td>
<td>team</td>
<td>R</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Closed</td>
<td>Pending</td>
<td>Noted that this is to be considered by NR in due course as part of ongoing development</td>
</tr>
</tbody>
</table>
### Table: Policy Development and Performance Indicators

<table>
<thead>
<tr>
<th>Comment No.</th>
<th>Document title</th>
<th>Text ref. if applicable (page no. + para no. / table no. etc.)</th>
<th>Topic</th>
<th>Question / Issue</th>
<th>Date of question (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
<th>Importance</th>
<th>NR response date (DD/MM/YYYY)</th>
<th>Originator of response</th>
<th>NR response</th>
<th>ORR / ARUP view - question closed?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP034</td>
<td>Delivery Plan</td>
<td>Table 32 Outputs</td>
<td></td>
<td>What is the split of the actual national renewals between the Policy intervention categories of: Maintain, Refurbish and Renew? For 2013/14 and to date in 2014/15?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott / Tim Spink</td>
<td>Quarterly reporting of cost and volumes are provided to the Regulator. The ORR will see the RPR submission. This will detail a level of granularity that has previously been agreed. The answer to EP034 is also applicable here - but noting that the assurance report is in progress.</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>EP035</td>
<td>Delivery Plan</td>
<td>Table 24 Outputs</td>
<td></td>
<td>The Delivery Plan includes a reliability indicator for earthworks in terms of 'earthworks failures'. Please can you confirm that the target values in Table 24 of the Delivery Plan are still current? Can you also provide numbers of earthworks failures for 2013/14 and to date in 2014/15?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott / Tim Spink</td>
<td>The reliability indicator for earthworks will be reassessed as part of the CAM submission. Earthwork failures in 13/14 were 127. Failures to 19 December 2014 in 14/15 are 23. It should be noted that the reliability indicator is a measure and not a target.</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>EP036</td>
<td>Delivery Plan</td>
<td>Table 25 Outputs</td>
<td></td>
<td>The Delivery Plan includes a sustainability indicator for earthworks in terms of ‘condition banding’. Please can you confirm that the target values in Table 25 of the Delivery Plan are still current? Can you also provide condition banding figures for 2013/14 and to date in 2014/15?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>The condition band indicator for earthworks will be reassessed as part of the CAM submission.</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>EP037</td>
<td>Earthworks_Polic y, 2014_Update Rev_09_2014-08-22 AS ISSUED</td>
<td>Figure 6-2 Outputs</td>
<td></td>
<td>This provides a useful summary of the number of earthworks assets in each category of the safety risk matrix currently. Can NR please provide a similar matrix for the planned outcome at end CFS? Can NR please provide similar matrices for the previous classification system (2 May 2014 data and end CFS)?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>The predicted condition banding at the end of CFS will be assessed through modelling as part of the CAM submission.</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>EP038</td>
<td>Earthworks_Polic y, 2014_Update Rev_09_2014-08-22 AS ISSUED</td>
<td>Policy implementation</td>
<td></td>
<td>Ref EP010: At the meeting on 25th November, NR undertook to provide their NR interim assurance report by COR 5/12/14 - we believe that this is still awaited at 12 Dec 2014.</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>This report was issued to the ORR on the 3/12/14 (reference document 14 above). This was forwarded to Arup on the 18/12/14.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP039</td>
<td>Earthworks_Polic y, 2014_Update Rev_09_2014-08-22 AS ISSUED</td>
<td>Feedback on Policy Application</td>
<td></td>
<td>Further to Qn EP011 we take the answer as being that feedback on practical implementation has not yet been collected, evaluated and used to update the Asset Policy. Please can you confirm our understanding / provide details of the feedback? Please can you confirm when this feedback will be available and reviewed by NR?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott / Tim Spink</td>
<td>Assurance visits have been carried out and the outcome from these will feed into the development of CFS Policy. The driver for updating the policy document is to include the new 5x5 matrix, introducing EAC and EHC. The update has not changed the overall objectives of the policy or applicable interventions that are available. Answer to EP034 is also applicable here.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP040</td>
<td>Earthworks_Polic y, 2014_Update Rev_09_2014-08-22 AS ISSUED</td>
<td>Practical impact</td>
<td></td>
<td>Further to Qn EP013 - What does the new policy mean in practice? For example what sites would now be identified for intervention that previously would not have been and vice-versa? Please can you provide some real Route examples? - please can you confirm when this information will be made available?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Will be provided under separate cover in due course.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP041</td>
<td>Earthworks_Polic y, 2014_Update Rev_09_2014-08-22 AS ISSUED</td>
<td>Practical impact</td>
<td></td>
<td>The 'v-ones' report has some useful 'spot checks' ( Asset Criticality - Y-axis: Phase 3 implementation of Common Consequence Tool - Earthworks - pages 39-42): have similar checks been undertaken on the new Risk Matrix to check reasonableness of changes to some specific sites?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Will be provided under separate cover in due course.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP042</td>
<td>NR_New_Hazard _Index_Report_v036_2014-08-31 AS ISSUED.PDF</td>
<td>Rock slopes</td>
<td></td>
<td>The note that the analysis has not included Rock slopes: What are the plans and timescales for undertaking similar for rock slopes?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>A review of RSH will initially be considered as part of the scope for CFS - Policy development. This initial review is likely to take place in 2015.</td>
<td>Closed</td>
<td></td>
</tr>
</tbody>
</table>

**NR response**
- **Pending**: Noted that this is to be considered by NR in due course as part of ongoing development.
- **Closed**: Document provided.
- **Closed**: NR to consider the implications in future developments.
- **Closed**: NR to consider in future developments.
<table>
<thead>
<tr>
<th>Comment No.</th>
<th>Document title</th>
<th>Text ref. if applicable (page no. + para no. + table no., etc.)</th>
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<th>Date of question (DD/MM/YYYY)</th>
<th>Originator of question / comment</th>
<th>Importance (H/M/L)</th>
<th>NR response date (DD/MM/YYYY)</th>
<th>Originator of response</th>
<th>NR response</th>
<th>O/R / ARUF view - question closed?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP043</td>
<td>Powerpack version 5 User Manual rev 09 AS 2014-08-29</td>
<td></td>
<td>Policy Applic</td>
<td>We note that the focus of the Policy update has been around safety risk which is very positive. However, NR also has an obligation to meet various train performance regulated outputs and this will mean that some performance-related interventions may be required by the Routes. Please can you explain how this is to be managed?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>H</td>
<td>06/01/2015</td>
<td>Simon Abbott / Tim Spink</td>
<td>Performance issues relating to Geotechnical assets are typically pre-cursors to safety events. An embankment with frequent rough rides, associated with the embankment, are typically associated with a gradually failing slope. This would be identified from a ground investigation and monitoring. Even if unaligned to the Policy intervention matrix the policy allows for flexibility outside of normal renewal areas. The intervention matrices in the Policy are provided as a tool to the routes, but they are always permitted to address any issues that may not be Policy aligned if justification can be provided.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP044</td>
<td>NR_New_Hazard_Index_Report_r ev03c_2014-03-31 AS ISSUED.PDF and Asset Criticality – Y-axis</td>
<td>Phase 1 Implementation of Common Consequence Tool – Earthworks</td>
<td>Parity</td>
<td>Further to Qn EP005 – please could you explain whether parity of target volumes been-retained between Routes or simply at a National Level?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>Parity means - we have kept the total national number of assets the same in each category. Asset volumes may change at route level.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP045</td>
<td>NR_New_Hazard_Index_Report_r ev03c_2014-03-31 AS ISSUED.PDF and Asset Criticality – Y-axis</td>
<td>Phase 1 Implementation of Common Consequence Tool – Earthworks</td>
<td>Parity</td>
<td>From discussions we understand that the ‘parity’ assumption has been adopted as an ‘interim’ measure. Please can NR explain how they intend to develop/review this going forward and the anticipated programme for such review?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team DMR</td>
<td>M</td>
<td>06/01/2015</td>
<td>Simon Abbott / Tim Spink</td>
<td>This is not a correct statement. The parity approach is integral to the change over between the old and the new metrics. In time natural shifts in the portfolio will occur as more inspections are undertaken.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP046</td>
<td>Earthworks_Policy_2014_Update_Rev_09t_2014-08-22 AS ISSUED</td>
<td></td>
<td>Parity</td>
<td>If parity has been maintained at national level how are the volumes at route and/or earthwork type affected?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team DMR</td>
<td>M</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>The earthworks Policy and commitment to sustain condition is a National Policy and commitment. Volumes change route by route.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP047</td>
<td>Earthworks_Policy_2014_Update_Rev_09t_2014-08-22 AS ISSUED</td>
<td></td>
<td>Parity</td>
<td>How does the omission of rock slopes affect the parity of the work banks?</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team DMR</td>
<td>M</td>
<td>06/01/2015</td>
<td>Tim Spink</td>
<td>There is no change in the way rock slopes are managed.</td>
<td>Closed</td>
<td></td>
</tr>
<tr>
<td>EP048</td>
<td>Data Quality Report Earthworks data quality report_rev02d_2014-01-30 FINAL</td>
<td></td>
<td>Data Quality Improvements</td>
<td>Please would you confirm this constitutes your data improvement plan? What progress is being made with the issues and resolutions listed in the report? Have any other Data Quality reviews been undertaken? (we note that the DQ report provides limited information on overall “data quality” focusing on a selected list of consistency issues.)</td>
<td>12-Dec-14</td>
<td>Indep Reporter Team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>This report provides a snapshot of the data quality at the time it was produced. The NR Exec have currently put CSAMS on hold until Jan/Feb. The Asset Data Improvement Programme (ADIP) will look to address these issues during data migration. When CSAMS is up and running live data quality reports will be available for key attributes of asset data.</td>
<td>Pending</td>
<td>Report awaited</td>
</tr>
<tr>
<td>Comment No.</td>
<td>Document title</td>
<td>Task ref. if applicable (page no. - para no. - table no. etc.)</td>
<td>Topic</td>
<td>Question / Issue</td>
<td>Date of question (DD/MM/YYYY)</td>
<td>Originator of question / comment</td>
<td>Importance H/M/L</td>
<td>NR response date (DD/MM/YYYY)</td>
<td>Originator of response</td>
<td>NR response</td>
<td>ORR / ARUP view - question closed?</td>
<td>Comment</td>
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<tr>
<td>EP049</td>
<td>Data Quality Report Earthworks data quality report_rev02_d_2014-01-30 FRNAL</td>
<td></td>
<td>Data Quality</td>
<td>The DQ Report identifies a number of issues (for example 1 - issue 21) 14% coverage missing? Is this likely to impact on the selected policy approach? How will this be considered going forward?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>In October a presentation was previously provided to ORR following a meeting in Ramble St. This was sent to Arup on the 18/12/14. Following updated 055 standard some key changes to terminology were introduced. Never Inspected was introduced to show the extent of network where no record exists within JBA of whether an earthwork is present or not. In October this was 19% - but this includes a number of “never inspected” sites in some Routes that have converted 030 records to 055 records. Anglia is an example where the route has been walked but electronic records do not justify a complete asset inventory.</td>
<td>Pending</td>
<td>Noted that this is to be considered by NR in due course as part of ongoing development</td>
</tr>
<tr>
<td>EP050</td>
<td>2015-L ArthurDLittle (Phase 2) Establishing a Common Risk Scoring Matrix for Safety across Network Rail</td>
<td></td>
<td>Common Consequence Tool</td>
<td>To what extent has the AUD report and tool been reviewed and approved by NR Safety Team and/or external reviewers? (2014-02-20 NR-Arup - Earthworks CPS Roadmap - Review of Asset Criticality (Safety), Section 4.2.1 indicates that the model is being fully tested by NR? Please can you provide evidence of this review?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>N</td>
<td>06/01/2015</td>
<td>Juliet Mian / Simon Abbott</td>
<td>NR S&amp;O team have an ongoing commission (to be completed early 2015) reviewing the CTR. It is important to note that in the earthworks policy, EABC (which contains an element of CCT) has been used as a prioritisation measure, i.e. the absolute values of FWI calculated are not used directly, only to rank earthworks, therefore the testing of the logic and the spot checks of sites presented in the CCT Implementation report are evidence of review.</td>
<td>Closed</td>
<td>Noted</td>
</tr>
<tr>
<td>EP051</td>
<td>CCT Implementation Phase 1_hx1</td>
<td></td>
<td>CCT Implementation</td>
<td>We note that this is the first asset application of the CCT. To what extent have the CCT authors (AD Little) been involved in implementation/review of the application of their tool?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>N</td>
<td>06/01/2015</td>
<td>Juliet Mian</td>
<td>The steering group for the current CCT review (see above) comprises representatives from ADLittle and the RSSB as well as NR stakeholders. ADLittle are aware of the implementation but do not have asset domain knowledge or experience of data sources which are the key components of the implementation.</td>
<td>Closed</td>
<td>Noted</td>
</tr>
<tr>
<td>EP052</td>
<td>CCT Implementation Phase 1_hx1</td>
<td></td>
<td>Slide 48-49</td>
<td>Is it a good practice that next steps and recommendations are identified. How important are these and so if when are they to be addressed? Is there an update to the CCT to incorporate the guidance?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Juliet Mian</td>
<td>See reply to question EP051. A review and update is in progress, covering stakeholders, technical aspects, IT solutions and data.</td>
<td>Closed</td>
<td>Noted</td>
</tr>
<tr>
<td>EP053</td>
<td>CCT Implementation Phase 1_hx2</td>
<td></td>
<td>Section 5</td>
<td>We note that the x-axis has been constrained to maintain parity to the delivery plan. This is similar to the approach used to establish the y-axis. When is this to be updated to follow the recommendations of the report?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Simon Abbott</td>
<td>Future development is recommended before the Common Consequence Tool is rolled out as a fully-functioning cross-asset tool. As previously mentioned in EP051 the response to the NR S&amp;O team have an ongoing commission (to be completed early 2015) reviewing the CCT. A period of stability to allow embedment for both EABC and EHC are considered essential.</td>
<td>Closed</td>
<td>NR to consider in future developments</td>
</tr>
<tr>
<td>EP054</td>
<td>Safety Risk Addendum_v1</td>
<td></td>
<td>Tool note page 6</td>
<td>Data Can NR confirm that the adjustments made to the EP049 data referred to in the 5 Dec meeting are reflected in the determination of p(derail</td>
<td>fail)?</td>
<td>12-Dec-14</td>
<td>Independent reporter team</td>
<td>M</td>
<td>06/01/2015</td>
<td>Juliet Mian</td>
<td>p(derail</td>
<td>fail) was based on derailment and failure statistics up to 16 February 2014. Updated stats will affect the calibration of p(derail</td>
</tr>
</tbody>
</table>