Network Rail/Office of Rail and Road

Independent Reporter - Lot 1

L1AR003: Assessment of Renewal Volumes

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Background

Network Rail plans its renewals on an annual basis within the framework of a rolling plan and with overall target volumes agreed with the Office of Rail and Road (ORR) in the five-yearly final determinations. It publishes a Delivery Plan each year and reports delivery volumes against this annual plan in its Annual Return. As part of the on-going review of delivery, Network Rail (NR) is also required to provide the ORR with an update of the seven key renewal volumes it has delivered on a periodic basis, and at a more detailed level in line with their reforecasting process every quarter[1]. Information on renewal volumes is an important input to ORR's assessment of Network Rail's efficiency and delivery of its asset policies. Therefore it is important that these volumes are reported using a reliable and accurate data collection process.

During Control Period 4, the Part A Independent Reporter undertook a number of reviews of renewal volume data. The most recent was Mandate AO/046 in 2013 (*Audit of Renewal Volume Data*). Since the completion of this last audit more responsibility for data collection and reporting has been devolved to individual Route management teams.

Purpose of review and agreed scope change

The purpose of this new commission was to provide an updated review of the reliability and accuracy of reporting renewal volumes for the financial year 2014/15. A number of questions were posed in the Mandate from ORR and NR. The intention was to summarise our findings for each of the main assets in a confidence grade and to recommend actions for improvement.

The original Mandate also included a review of the reported renewal costs. However, because costs have been reviewed in other studies, it was subsequently agreed with ORR and NR to limit the review of costs in this commission to Signalling renewal projects. Five questions were asked to probe how NR manage and report costs prior to delivering volumes on such large and complex projects.

Approach

Three NR Routes (Anglia, London North Western and Wales) were chosen to be representative of the national network. We selected a sample of their projects that reported volumes in 2014/15 and requested evidence to demonstrate the delivered volumes, including records from the report database, authorisation / sign off sheets and details in investment papers (including change control).

The derivation of the sample size was undertaken by the University of Sheffield Statistical Services Unit with reference to both NR and ORR. The sample size for each asset was chosen to be large enough to gauge the accuracy of the population

[1] Presented by NR in Quarterly Assurance Reports at periods 3, 6, 9 and 11.5 in 2014/15.

to within 1% (sample sizes are detailed in **Table 1** in Chapter 2 of this report). Projects were then randomly selected.

We then met each of the Routes to understand their reporting processes with reference to some of the sampled projects. Telecoms reporting is undertaken by a Central team who we met separately. Finally, we met the Central reporting team at Milton Keynes to understand how they amalgamate and report volumes to the ORR and understand their checking processes.

We checked the accuracy of the reported volumes for all of the jobs within our sampled projects, based on the evidence provided. Any errors that we identified were discussed with the Central reporting team to provide the opportunity for clarification. We also checked that the amalgamated volumes from the Routes was accurately reported to the ORR in quarterly reports and in the 2014/15 Annual Return.

Conclusions

The audit looked to answer some questions posed in the Mandate and our comments against each question are shown below.

The clarity of the reporting mechanisms between planned workbank and delivered renewals volumes (including work in progress). NR's Cost and Volume Handbook provides the framework for reporting by defining the units of measurement and timing of reporting delivered volumes. Application of this framework was consistent across the Routes but the Routes are free to develop their own mechanisms and tools for reporting volumes.

The processes and procedures by which Network Rail captures, calculates and records its costs and volumes data to produce national aggregated information. Processes and procedures are in place in each of the Routes but they vary in terms of their leadership and automation. All Routes report to a Central Team who aggregate and report the data.

The degree to which period reporting of costs and volumes is governed and subsequently controlled for period, quarterly (rolling forecast) and annual reporting. Across all Routes, the Cost and Volume Handbook provides a high level framework for the reporting process. The Central function in NR audit the Routes periodically and do seek to ensure consistency and promote best practice across all Routes. An additional year-end review and validation process was put in place to ensure actual, system-reported, volumes were fully reviewed and signed-off by the Routes prior to the population of the 2015 Annual Return and Regulatory Accounts. This helped ensure greater accuracy whilst protracting the process; the long-term aspiration should be to eliminate the need for such amendments.

The visibility at national level of workbank progress and expenditure against the forecasts. Workbank progress and costs against forecasts are reviewed based on information provided by the Routes. The Central Team (Business Planning and Business Reporting functions) are able to highlight anomalies in the reported

data (against previous Periods) where these are clearly erroneous. Delivery plans are reported figures and are also challenged and tested through the review process.

With reference to correspondence between Network Rail and ORR, the treatment of workbank volumes rolled over from CP4, specifically for non-PR13 funding (i.e. electrification and buildings) and its accounting separation from the CP5 workbank. It was agreed with ORR that at the end of CP4, the work not delivered within Electrification and Buildings Renewals could be carried over and funded outside the PR13 renewals settlements, with these activities reported separately from a cost and volume perspective. This only affected one project on the three Routes reviewed (Great Eastern OLE Renewal on Anglia), and its rolled-over OLE wire-runs were separately identified and reported in the Annual Return.

The evidence supplied by Network Rail with regards to its own internal assurance and audit of figures reported. Within each of the Routes, audited evidence was found that due diligence is undertaken of the outputs and costs. This is undertaken by the 'lead' function (Finance or Engineering) within the Routes. This is supplemented by reviews and audits conducted by NR Centre of the process and data reported.

Summarise the overall approach by asset category at GB network level using a recognised confidence grading approach. The following table shows the confidence gradings based on the review undertaken during the audit. These are not directly comparable to earlier Control Period 4 Reporter confidence gradings for renewal volumes owing to the change in definition of the gradings themselves and that the reporting structure has changed significantly for many assets, for example buildings and off-track volumes are newly reported and track and Signalling are reported in more detail.

The audit gave the following confidence grades for the assets reviewed.

Confidence grades for the assets reviewed

Asset	Confidence Grade
Track (PL)	C3
Track (S&C)	C2
Civils (EW)	C2
Civils (Structures)	C4
Buildings	C2
Fencing	C5
E&P	C1
Non-Electrification	C1*
Signalling	C1*
Telecoms	B1*

We consider that there are improvements that can be delivered in all asset types. These are mostly arising from asset system limitations across asset types – probably arising from devolution. This is because a standard front-end process is

no longer mandated, which has fragmented the Route-by-Route approach, whilst roles and responsibilities vary nationally, which can lead to a lack of clarity.

The Cost & Volume Handbook provided by NR Centre, provides the framework for the 'reporting' process, but it would still benefit from more definition. Anglia has developed their own Route-based document that provides greater clarity on their processes.

Across all asset types, we found a lack of consistent sign off evidence and quality (process) for on-site confirmation of volumes. This is a key process issue and should be rectified through more standardised requirements and clarity over roles and responsibilities.

Recommendations

Based on the Route visits and the follow up meetings with NR, the following recommendations have been proposed to improve the reporting of renewal volumes.

Recommendations

Reference	Recommendation	Benefit	Report Ref	Owner	Suggested completion date
2016REN01	All assets - consistency of sign off of volumes and dates when completed. This is a general recommendation for all assets as the recording of volume and dates in sign off sheets was not as clear during the audit as it should be. Although a lot of detail was provided for this review, it was not clear which forms gave the definitive sign off and a number of forms contained signatures or volume but not both. It is recommended that where applicable the Substantial Completion/On Job Completion form records a volume as well as a signature to provide greater transparency.	Improve transparency and reduce risk of reporting error	Section 3.8	NR	January 2017
2016REN02	Network Operations Track – automate the conversion of track distances from imperial to metric, or record in metric in the first place.	Reduce reporting errors	Section 4.3	NR	January 2017
2016REN03	IP Track – improve the discipline and consistency within IP Track of recording volume at site level within Primavera.	Assist auditing of volumes	Section 4.6.1	NR	January 2017
2016REN04	IP Track – update the Cost and Volume handbook to reflect the revised approach to Plain Line renewals undertaken as part of S&C renewals.	Reduce risk of reporting error	Section 4.5	NR	January 2017
2016REN05	Signalling – introduce an embedded sign-off process showing volumes delivered Accepted on the basis that an embedded sign-off process will close the recommendation, otherwise further clarity will be required.	Improve transparency and auditability	Section 11.3	NR	January 2017
2016REN06	Fencing – improve the sign off and recording of volumes for fencing to improve accuracy and assist the auditing of the volumes delivered. Clearer evidence from the contractors supplying the works would also assist the process.	Improve transparency and reduce risk of reporting error	Section 8.3	NR	January 2017
2016REN07	Telecoms process document. It is recommended that a process document is produced which describes the recording of Telecoms volumes.	To help share the knowledge and provide a robust example during staff absence/staff leaving	Section 12.4	NR	January 2017

1 Introduction

1.1 Background

Network Rail plans its renewals on an annual basis within the framework of a rolling plan and with overall target volumes agreed with the Office of Rail and Road (ORR) in the five-yearly final determinations. It publishes a Delivery Plan each year and reports delivery volumes against this annual plan in its Annual Return. As part of the on-going review of delivery, Network Rail (NR) is also required to provide the ORR with a four-weekly update of the renewal volumes it has delivered.

1.2 Purpose and Scope of Review

The purpose of this commission was to provide an updated view of the reliability and accuracy of reported renewal volumes. This involved meeting staff responsible for reporting and reviewing sample data from three NR Routes chosen to be representative of the national network (Anglia, LNW and Wales).

This audit was specifically aimed at a review of the renewal volumes reported for the financial year 2014/15. Whilst this was the prime focus of the study the opportunity was also taken to gather information regarding any procedural changes which had taken place, or are planned, within the Routes or within the Central reporting team at Milton Keynes during 2015/16.

The precise scope of the review is:

- The clarity of the reporting mechanisms between planned workbank and delivered renewals volumes (including work in progress).
- The processes and procedures by which NR captures, calculates and records its costs and volumes data to produce national aggregated information.
- The degree to which period reporting of costs and volumes is governed and subsequently controlled for period, quarterly (rolling forecast) and annual reporting.
- The visibility at national level of workbank progress and expenditure against the forecasts.
- With reference to correspondence between NR and ORR, the treatment of workbank volumes rolled over from CP4, specifically for non-PR13 funding (i.e. electrification and buildings) and its accounting separation from the CP5 workbank.
- The evidence supplied by NR with regards to its own internal assurance and audit of figures reported.
- Summarise the overall approach by asset category at GB network level using a recognised confidence grading approach.

The Mandate describing the scope of works to be delivered for this audit is included in **Appendix A** to this report.

1.2.1 Agreed change to the Scope

The original Mandate shown in **Appendix A** stipulates the auditing of costs as well as volumes for renewal projects. However, NR felt auditing costs was not required on the following grounds:

- Previous independent reviews of renewal volume accuracy have not included an assessment of cost; it was felt that a combined approach would be more intrusive and non-comparable;
- Network Rail's cost allocation and capital works accounting are already audited through Arup's Mandate linked to the Regulatory Accounts and (now) through National Audit Office's review of accounting; therefore it would represent a duplication of effort to assess this further (and potentially contradict previously published findings); and
- ORR's interest is predominantly about understanding how projects with long development cycles prior to volume declaration (i.e. substantive sunk costs) are assessed, in terms of substantive progress, internally within NR between client (Route) and deliverer.

It was subsequently agreed that the key points to test on costs would be as follows:

- Linkage between principal contractor payments and scheme progress;
- Linkage between scheme progress and Cost of Work Done reported;
- Understanding of any regularised review mechanism between Route and deliverer for in-flight schemes; and
- Reference to how financial efficiency associated with these schemes is managed on a year by year basis (assessed through the Financial Performance Measure process run by NR Group Finance and audited by Arup in 2014/15).

As set out in an e-mail of the 17th December 2015, ORR and NR agreed that the most pragmatic and cost effective way to review the above would be via a sample of projects from the Signalling asset which were in development through 2014/15 across the three audited Routes.

The Signalling asset was chosen as the most extreme example although complex Structures, Geotechnical and Buildings interventions, in particular, can also be affected.

1.3 Report Structure

The report is structured as follows:

- Section 2 describes the general approach taken in the audit;
- Section 3 presents the findings from three Route reviews which were undertaken covering each of the disciplines;

- Sections 4 through 12 present the findings of the audit describing the outcome for each of the nine disciplines in turn;
- Section 13 contains our assessment of the Confidence Grades awarded for each asset;
- Section 14 contains comments on the Network Rail to ORR period reporting; and
- Section 15 presents our conclusions and recommendations.

2 Approach to Audit

2.1 Introduction

The methodology which has been adopted in previous reviews, and was again used in the delivery of this commission, was based on a structured series of meetings with representatives from three NR Routes (Anglia, London North Western and Wales) and with the Centre Team at Milton Keynes. At these sessions there were two broad aims:

1. To understand the processes which were applied by the Routes and the Centre Team with regard to the reporting of volumes from the planning of the works, through their delivery to the final statements made in the Annual Return; and
2. To review a sample of projects by tracking their progression, and in particular the volumes in the various systems, through the various stages identified in the declared process. This also included reviewing the documentation associated with the change control process, primarily for additional context in terms of local Route process.

They provide the basis for an assessment of the reliability and accuracy of the volume reporting, which is reflected in Section 13. This needs to reflect the different approaches used by the Routes in managing and assuring the quality of the data provided.

2.2 General Approach – Data Analysis

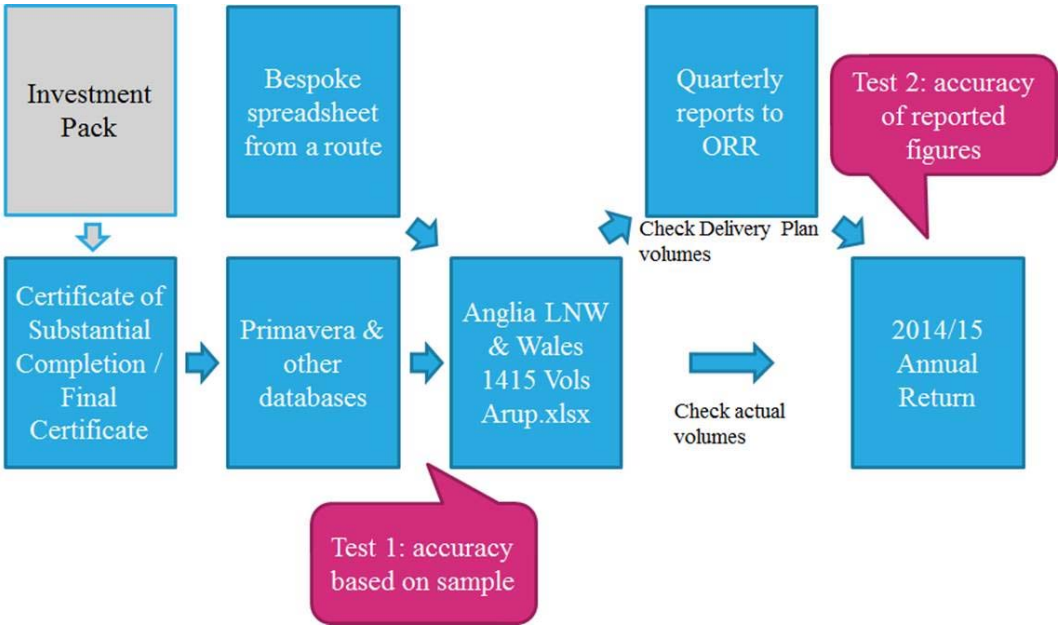
Our approach needed to test the accuracy of the reported volumes. In doing this there were two main tests undertaken as follows:

Test 1 - we were provided with an excel spreadsheet file 'Anglia LNW & Wales 1415 Vols Arup.xlsx' which consolidated the Route volumes data. We tested its accuracy against source data derived from Primavera / other databases and other bespoke spreadsheets provided by the Routes.

Test 2 - once we had confirmed the accuracy of Test 1, it was then necessary to ensure the consistency of data consolidated in the spreadsheet with the Quarterly Reports to ORR and then within the 2014/15 Annual Return.

These tests are shown in **Figure 1**.

Figure 1: Overview of checking accuracy of reported volumes



2.3 Sample Sizes

As it was not practical to review all projects for certain asset types across the three Routes, a number of (representative) sample projects were selected. Sample sizes were chosen to be large enough to gauge the accuracy of the population to within 1%[2], resulting in the sample sizes shown in **Table 1**. Projects were then randomly selected. Note that those asset types with a small number of projects with reported volumes (such as Signalling) were not sampled, instead all of the projects were reviewed.

More details of the method of sampling that was agreed with NR and ORR can be found in **Appendix B**.

[2] Assuming errors with a variation of 5% Standard Deviation, at the 95% confidence level

Table 1: Sample size (number of projects)

Asset	Population	Sample
Track (PL)	72	44
Track (S&C)	28	22
Civils (EW)	29	21
Civils (Structures)	88	47
Buildings	23	20
Fencing	3	3
E&P	14	14
Non-PR electrification	1	1
Signalling	8	8
Telecoms	3	3

2.4 Data Sources

We asked the Routes to provide us with the following evidence of volumes delivered for each job within our sampled projects:

- Cost and volume records in the reporting database (by period);
- Authorisation / sign off sheets of work done on each job; and
- Investment papers and any change control of planned cost and volumes.

The evidence that we received varied by Route and by asset type and this is summarised in **Table 2**. Ideally we wanted to use the sign off sheets as the primary source of evidence of volume delivered and to trace through what was recorded in the database and then to the Centre. If no sign off sheets were provided, we then used the database as the source. In such cases, we tried to use the Investment Papers as an alternative check but often found they did not provide sufficient breakdown of volumes. For a few projects we received no evidence, and so we had to remove them from our sample. This resulted in smaller samples and hence less certainty in the accuracy of the reported volumes for the population.

Table 2: Data sources received at job level – All Routes

Asset	Number of Jobs Sampled	Evidence Provided		
		Sign-off	Database	Nil
Track (PL)	244	127	116	1
Track (S&C)	54	3	51	0
Civil (EW)	49	1	48	0
Civil (Structures)	72	0	72	0
Buildings	21	0	19	2
Off Track - Fencing	9	0	9	0
Electrification & Fixed Plant	41	0	41	0
non-PR Electrification	4	0	4	0
Signalling	11	0	11	0
Telecoms	3	0	3	0

2.5 Meeting Structure

The schedule of meetings which were undertaken is shown in **Table 3**. There was good co-operation from Network Rail throughout the planning and execution of these meetings.

Table 3: Schedule of meetings

Attendees	Date	Purpose of meeting
NR/ORR/Arup	10th November 2015	Inception Meeting
NR/ORR/Arup	1st December 2015	Sampling Meeting
NR/Arup	16th December	Route Telcons
NR/Arup	25th January 2016	Anglia Route Meeting
NR/Arup	28th January 2016	LNW Route Meeting
NR/Arup	1st February 2016	Centre Meeting
NR/Arup	2nd February 2016	Wales Route Meeting
NR/ORR/Arup	25th February 2016	Interim Presentation
NR/Arup	3rd March 2016	Interim Presentation follow up meeting

3 Route Reviews

3.1 Introduction

This section of the report provides a review of the information which was gathered from the individual meetings with the NR Routes and Centre reporting teams.

3.2 Background – Network Rail

2014/15 was the first year of CP5 and involved some significant changes to the reporting of renewal volumes to ORR. Some of the assets have different reporting volumes, for example Switch & Crossings now report point ends. In addition, fencing is a new volume to be reported whilst a suite of volumes relating to the Buildings asset are reported for the first time. All definitions are documented within the Cost and Volume (C&V) Handbook, which is a new publication produced by the Safety, Technical & Engineering (STE) Finance team.

Another change is the advent of devolving much of the reporting from the Centre to the Routes. They now report costs and volumes to the Centre who consolidate, assure and review prior to reporting to ORR. Whilst this has resulted in different approaches being employed to report the volumes/ costs by the Routes, the Centre has acted to identify any clearly erroneous entries wherever possible, with the intention of reducing any potential risk to data accuracy and reliability. However, it should be noted that the Central Team is not close enough to the data or activities to undertake this in detail, and it is only undertaken on a 'by exception' basis, using specific tests and experience, where clear errors in the figures are apparent.

The C&V Handbook introduces a level of consistency regarding the reporting requirements and expectations at Route level. During our audits, all NR staff were aware of and stated they applied this document. We were provided with this document as part of our audit and found it to be very clear for defining reportable volumes. It provides some examples and illustrations which aids the clarity. It does mandate a process for calculating the volumes from the source data systems (Primavera and OP), but does not mandate how the Routes choose to capture, review and validate the information locally. One Route had implemented its own – more specific – guidance document to compliment the C&V Handbook.

This review has examined the arrangements established at Route level and with the Centre Team. The review within each of the three sample Routes covered all of the asset types stated in the Mandate. However, it was noted from the central Telecoms review that there had been no devolution of responsibility in that discipline to the Routes. As a result, none of the Route reviews considered Telecom renewals.

The following sub-sections consider each of the Route engagements in turn.

3.3 Route Review – Anglia

A brief summary of the Anglia Route asset management organisation was provided by Network Rail. The reporting process is managed on a day-to-day basis by the Engineering Team. The Route is responsible for monitoring changes to the business plan throughout the year.

The following were present at the meeting.

Organisation	Position
Network Rail	Principal Analyst – NR Centre
Network Rail	Senior Financial Analyst – NR Centre
Network Rail	Anglia Route Financial Controller
Network Rail	Anglia Project Manager (Change)
Network Rail	Works Delivery Manager (Anglia Building & Civils)

Checks are undertaken at a local level within Anglia prior to the data being reported to the Project Manager responsible for reporting volumes and costs to the Central Team. Project sponsors within the Route look after the delivery process and Route Asset Managers (RAMs) undertake the initial scoping work. It is the Project Manager's responsibility to ensure the robustness of the volumes and costs reported to NR's Centre Team.

All reporting is monitored on a Periodic basis by the Route. At year-end a special wash-up session is undertaken to review the accuracy of reported volume. Schemes are reported at 'substantial completion' – as stated in the C&V Handbook.

There had been a change in contractor which had caused some issues in the delivery of track renewals during the year. This was highlighted in Quarterly Reports to the ORR but has now been addressed.

Anglia initiatives included applying its own 'local' handbook for reporting of volumes and we do think this is a positive initiative, indicating their commitment to consistency and process improvement.

This document provides additional detail to the C&V Handbook. It provides a detailed overview to the management of the live workbank and its associated reports and how to undertake change control. It is a useful document as it provides a detailed description of the process to be followed and is a good introduction for new staff. It includes a flow chart describing the periodic change control cycle, the creation of automated change control log and further information on the process to follow for buildings and civils assets.

3.4 Route Review – London North Western (LNW)

LNW has been split into north and south sub-routes. This is a reflection of the size of the LNW asset portfolio. There are two posts with the title of Senior Route Asset Manager (SRAM) – one covering track and civil engineering, with the RAM for track and civil engineering reporting to this post. A second SRAM

covers signalling, power and buildings. The reporting process is managed on a day-to-day basis by the Finance Team. The Route is responsible for monitoring changes to the business plan throughout the year. All change control is managed at Route level for all disciplines. Change control is invoked for any 'material' change of volume, cost or timescales within an authorised project.

The following were present at our meeting with the Route.

Organisation	Position
Network Rail	Senior Financial Analyst – NR Centre
Network Rail	LNW Programme Finance Manager
Network Rail	LNW Management Accountant
Network Rail	LNW Track Senior Asset Engineer (SAE)
Network Rail	LNW Drainage/Off track Route Asset Manager (RAM)
Network Rail	LNW Earthworks RAM
Network Rail	LNW Earthworks SAE
Network Rail	LNW Structures SAE
Network Rail	LNW Signalling SAE
Network Rail	LNW Buildings RAM
Network Rail	LNW E&P SAE
Network Rail	LNW E&P SAE

Checks are undertaken at a local level between the RAM and Finance (who lead the process for LNW). Finance are able to identify significant volume changes which would then be discussed with the RAM. Monitoring and audit of figures is carried out by RAMs along with the reporting of the process. Auditing on the ground (to confirm delivery of volumes) is also the RAMs responsibility.

All reporting is monitored on a Periodic basis by the Route. At year-end a special wash-up session is undertaken to review the accuracy of data. Schemes are reported at 'substantial completion' – as stated in the C&V Handbook.

There is a change control panel which reviews any change to volumes/ costs. LNW apply the C&V Handbook but do not have further local procedures to supplement this. It was felt by LNW staff that the C&V Handbook provided sufficient detail and arrangements were understood. LNW initiatives include the use of 'Workbank Bubbles' whereby locations are identified where they can get efficiencies (one was shown for Holmes Chapel). This is where there is lots of work going on in the same area and this work is planned to be undertaken at the same time - reducing Schedule 4 (possession) costs through only closing the infrastructure once. This is managed by an integrated team led by the Network Operations Possession Planning team.

3.5 Route Review – Wales

The Route is comparatively new, only coming into existence in November 2011 (previously being part of Great Western). A brief summary of the Wales Route

asset management organisation was provided by NR. The reporting process is managed on a day-to-day basis by the Finance Team. The Route is responsible for monitoring changes to the business plan throughout the year. All change control is managed at Route level for all disciplines. Change control is invoked for any 'material' change of volume, cost or timescales within an authorised project.

The following were present at the meeting.

Organisation	Position
Network Rail	Principal Analyst – NR Centre
Network Rail	Senior Financial Analyst – NR Centre
Network Rail	Wales Programme Finance Manager
Network Rail	Wale Route Financial Controller
Network Rail	Wales Route Asset Manager E&P

The Finance team hold the business plan for the Route and are able to review every scheme on a periodic basis – this is because the Route is comparatively small. Costs are captured through both IP and Primavera which is consistent with other Routes. The costs and volumes of work undertaken are reviewed on a Periodic basis. This review involves the Finance team, Programme Manager and the RAM. Monitoring and audit of figures is carried out by RAMs along with the reporting of the process. Auditing on the ground (to confirm delivery of volumes) is also the RAMs responsibility. There is a change control panel which reviews any change to volumes/ costs. Any changes to volumes/ costs are managed through a change control log which the RAMs populate. This log is maintained on a shared drive.

3.6 Centre – Telecoms

Reporting of Telecoms volumes/ costs is not devolved to the Routes and is instead managed by a Central team in Milton Keynes. The volumes are derived from IP. There are six Engineers ('Telecoms RAMs') located across the Routes who are responsible for ensuring delivery of outputs on the ground. These site based Engineers check the data and the Central Team enter the data into P3e and provide the reporting.

The delivery of Telecoms is confirmed from the delivers (via test acceptance certificates and completion reports) to the Engineers, who then report to the Central Team that the work has been undertaken. Any discrepancies are challenged by the Central Team and any adjustments are made by the deliverer in the next period. Telecoms volumes are reported on a period basis internally in NR but only on a quarterly basis to ORR. The Central team carry out additional checks on the workbank at year end.

This process benefitted from being applied consistently throughout NR. The process is clearly understood by the Central Team at Milton Keynes.

The following were present at the meeting.

Organisation	Position
Network Rail	Principal Analyst – NR Centre
Network Rail	Senior Financial Analyst – NR Centre
Network Rail	Business Planning Specialist – NR Centre

3.7 Centre - Reporting

A Central reporting team in Milton Keynes collates all the data from the Routes for reporting to ORR. They also carry out a number of checks on the data supplied and request further clarification from the Routes if required. They analyse reported data using exception-based tests and experience gained e.g. specific volume threshold levels, estimated cost linked to a volume and cost/volume or deliverer/activity mismatches. However, it is not possible for this to be undertaken at a detailed level, given they are not close enough to the individual projects. Therefore accountability and ownership of reported volumes rests with the Routes.

In addition to this, the Central team also carries out a number of internal audits on the Routes and runs workshops to discuss the reporting of volumes – seeking to continuously improve the process, despite the Routes being structured in different ways and having some variance between the approaches employed. We were provided with an example of an audit document undertaken by this team (Assurance Process for Cost and Volumes v9.doc). The audit document follows very closely the process followed for this audit and uses a similar scoring system to grade the assets.

The following were present at the meeting.

Organisation	Position
Network Rail	Principal Analyst – NR Centre
Network Rail	Senior Financial Analyst – NR Centre
Network Rail	Senior Management Accountant – NR Centre

3.8 Observations from meetings

All Routes are employing the C&V Handbook and there is good understanding of its requirements. They have each developed their own management structure for reporting to the Central Reporting Team.

Evidence of local ‘best practice’ is apparent. NR could seek to consolidate this across all Routes (potentially through a more detailed C&V Handbook) to provide a more standardised approach that promotes robust business planning and change control by the Routes. This would contribute to the ongoing review and improvement to drive better processes.

Data for the audits was not readily available before our Route meetings. This lack of easy transparency suggests it is difficult to audit reported volumes and made the audit process more protracted. It could also contribute to inaccurate reporting if checking becomes more difficult.

It is recognised that approaches to reporting volumes have developed in isolation between assets, and with devolution Routes have the ability to change the approach adopted locally including using different systems and resources. This inevitably has introduced some differences in approach. We observe that sign-off evidence is not clearly evidenced or consistent for many assets. We identified this as a concern across all Routes. In confirming that the planned volumes had been delivered, we sought to audit actual 'sign-off' reports from RAMs who had been to site to confirm this. In many cases, this information was not available or 'signed-off'.

All Routes are progressing with further improvements to managing data locally. Accordingly, we should expect improvements to Confidence Grades for a 2015/16 audit.

4 Track

4.1 Introduction

This section of the document provides a description of the process and findings with regard to the reporting of Track Plain Line (PL) and Switch & Crossings (S&C) volumes in 2014/15.

Track Plain Line consists of Plain Line Conventional, Plain Line High Output and Plain Line Refurbishment. **Table 4** shows the definitions, volume measurements and volume recognition.

Table 4: Track Plain Line – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Plain line conventional	Renewals cover all works undertaken within Categories 4, 10, 11, 16, 14, 2 and 1, which collectively cover steel relay, complete renewal (with or without formation) and double or single rail based works.	Linear kilometres of Track	On full (job by job) completion
Plain Line High Output	High Output cover all works undertaken within Categories 20a, 24, 24a, 5, 8, Heavy Refurb, 20, 22 and 32, which collectively fall within the High Output (ABC), High Output (rail/sleeper relay) or Heavy Refurb (concrete – high or medium output) categories.	Linear kilometres of Track	On full (job by job) completion
Plain Line Refurbishment	Covers all works undertaken within Categories 6, 7, 9, 12, 13, Heavy Refurb (other), 3, Medium Refurb (concrete), 21 and Medium Refurb (other) which collectively sit within Heavy Refurb (other), Medium Refurb (concrete) and Medium Refurb (other). Refurbishment work is intended to extend the life of the existing track asset rather than fully renew it.	Linear kilometres of Track	On full (job by job) completion

Track S&C consists of Renewal and Refurbishment. **Table 5** shows the definitions, volume measurements and volume recognition.

Table 5: Track Switches and Crossings - reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
S&C Renewal	Covers all works undertaken with Categories 70, 71, 72 and 73 which sit within either Full Renewal or Abandonment.	Point Ends	On full (job by job) completion
S&C Refurbishment	Covers all works undertaken within Categories 74, 75, Heavy Refurb (concrete), Heavy Refurb (other), Medium Refurb (concrete) and Medium Refurb (other), which sit within the Heavy Refurb or Medium Refurb roll-up.	Point Ends	On full (job by job) completion

4.2 Reporting process

Track is reported by both Infrastructure Projects (IP) and Network Operations at the Route level. All Track Plain Line is recorded in miles and yards or miles and chains. The IP volumes are automatically converted into kilometres after being input into Primavera (through Business Objects) whereas Network Operations volumes are converted manually off-line and entered into OP in kilometres.

The volumes for the sampled IP jobs were largely provided to the Reporter team by the Central reporting team in the form of Primavera screenshots. Network Operations jobs were evidenced by the Routes from Asset Management Process (AMP) forms which show the details of the work undertaken and the mileage. These provided a recorded signoff of the works undertaken.

S&C renewals are also split between IP and Network Operations with evidence again provided by Primavera screen shots and AMP forms respectively.

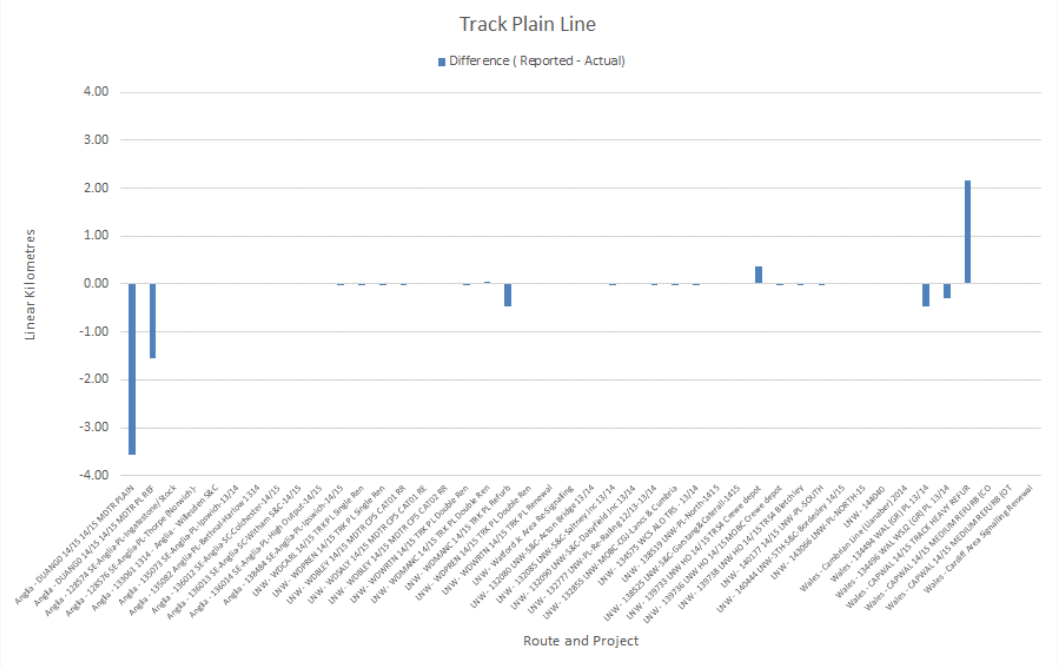
The evidence for Track Plain Line and S&C was in a consistent format for all three Routes.

4.3 Accuracy – Plain Line

Our sample of Track Plain Line projects across the three Routes consisted of a total of 244 jobs, 127 of which had a sign off sheet with miles and yards/chains of the work undertaken, 116 were evidenced from a database record and 1 job had no evidence.

For each job we compared the volume reported to the Centre against the evidence provided and recorded any errors. **Figure 2** summarises the errors by project and ordered by Route at the project level. The graph shows the difference between the reported volume and the actual evidenced volume.

Figure 2: Error on Track Plain Line Volumes – Project Level



The graph shows that five projects under-reported their volumes and two projects over reported volumes across all three Routes. Of the five projects which under-reported, three were delivered by Network Operations and two by IP Track. One IP Track project and one Network Operations project made up the over reported volumes, with the project delivered by Network Operations having the greatest variance.

A more detailed analysis at the job level reveals there are more errors on jobs delivered by Network Operations than those by IP. Some of these errors are small as shown in **Table 6**.

Table 6: Errors in Network Operations and IP

Route	% of Net Ops jobs with errors	% of IP jobs with errors	No. of Net Ops jobs with errors >0.1km	No. of Net Ops jobs with smaller errors
Anglia	60%	3%	16	10
LNW	32%	2%	11	13
Wales	20%	29%	6	5

The analysis of jobs supports the view that the manual conversion process from imperial to metric measures for Network Operations is not as reliable as the automatic process for IP Track.

When applied statistically to the population of Track Plain Line projects on these three Routes, the results indicate that the reporting of Track Plain Line volumes in 2014/15 was accurate to within 5.47%.

4.4 Accuracy – S&C

There were 54 track S&C jobs across the three Routes in our sample. Of these, 3 jobs had a sign off sheet, and 51 jobs were evidenced from a database record.

No errors were found in the reporting of these jobs.

4.5 Plain Line associated with S&C Renewals

In addition to the above analysis, a separate error came to light that affects both Plain Line and S&C volumes. IP separately record the amount of Plain Line that is renewed as part of S&C renewal jobs, within a radius of about 50m of the S&C. The purpose of this is to differentiate between associated and disassociated PL in order to gain greater clarity over costing and unit rates.

IP record the cost of associated PL with the lead S&C renewal. Network Operations tend not to do full S&C renewals, but it is unclear whether they would follow this convention. This is inconsistent and the guidance should be clearer.

In 2014/15 this approach within IP Track led to the associated Plain Line being misreported as S&C point ends. Whilst the base data is split correctly, the amalgamation within an Excel spreadsheet, used to format it for reporting purposes, contained an error. The result is that nationally Network Rail over-stated S&C volumes by 6.68 Point Ends in 2014/15 and under-stated Plain Line volumes by 6.68km. In percentage terms, this equates to 0.9% of total S&C volume and 0.5% of total PL reported volume so the materiality impact is fairly small. This has since been corrected and NR assure us that safeguards are now in place to ensure it does not happen again.

As it happens, a large proportion of the erroneously reported volumes are on LNW and Anglia Routes, affecting eight audited projects. They lead to an over-reporting of 3.64 Point Ends (2.8%) and under-reporting of 3.64 km of Plain Line (1.4%) in 2014/15.

NR have now corrected the reporting error which was demonstrated to the Reporter team.

4.6 Areas for improvement

4.6.1 Plain Line

All three Routes could improve the transparency of reporting volumes on the AMP forms for jobs delivered by Network Operations. The audit found a number of examples where the AMP forms showed the miles and yards/chains which were not consistent with other evidence for the same job provided from a database. This may suggest that the AMP form records the distance over the whole site whilst the database records the volume actually completed.

The manual process for converting from miles/yards to km on Network Operations jobs appears to cause some errors. An automatic process would be more robust.

Few sign off sheets were seen for jobs delivered by IP and a greater use would improve transparency of reporting. Within their database, the recording of each job on a project should be made clearer. We found it difficult to cross-reference a job held at the project level with its detailed delivery information held at the database level. Job site names are often incorrect at this lower level. NR understand that this is an issue and are pushing for clearer recording of job sites when reporting the volumes delivered. We would endorse this action to improve the auditability of the data and reduce the risk of confusion.

4.6.2 S&C

The reporting of S&C has been corrected by NR so that the point ends and associated Plain Line are reported separately for both IP and Network Operations projects.

5 Civils (Earthworks)

5.1 Introduction

Civil (Earthworks) cover the following categories in the Cost and Volume Handbook:

- Embankments;
- Rock Cuttings;
- Soil Cuttings;
- Other; and
- Drainage.

They are shown in **Table 7** by description, volume measurement and volume recognition.

Table 7: Civil (Earthworks) – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Embankments	A construction (formed of earth) that allows railway lines to pass at an acceptable level and gradient over low-lying ground or ground that is susceptible to flooding, and appears in the Network Rail earthworks asset register as an earthwork.	Number of Embankment interventions. Earthwork assets are contained entirely within, or otherwise bounded by, the Earthworks inspection 5 chain start and end locations in which they lie. Slopes on either side of the railway are treated as separate assets.	On substantial completion.
Rock Cuttings	An excavation (through rock) that allows railway lines to pass at an acceptable level and gradient through the surrounding ground, and appears in the Network Rail earthworks asset register as an earthwork asset of the asset type ‘rock cutting’.	Number of Rock Cutting asset interventions. Earthwork assets are contained entirely within, or otherwise bounded by, the Earthworks inspection 5 chain start and end locations in which they lie. Slopes on either side of the railway are treated as separate assets.	On substantial completion.
Soil Cuttings	An excavation (through soil) that allows railway lines to pass at an acceptable level and gradient through the surrounding ground, and appears in the Network Rail earthworks asset register as an earthwork asset of the asset type ‘soil cutting’.	Number of Soil Cutting asset interventions. Earthwork assets are contained entirely within, or otherwise bounded by, the Earthworks inspection 5 chain start and end locations in which they lie. Slopes on either side of the	On substantial completion.

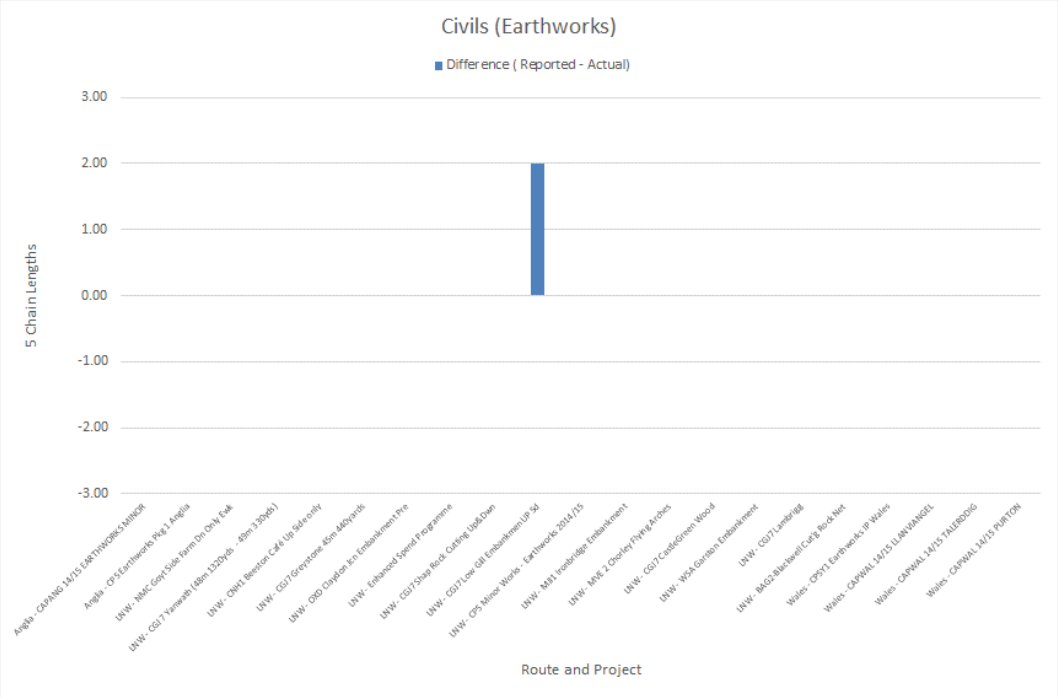
		railway are treated as separate assets.	
Other	Covers all works which are not specifically toed to Embankments, Rock or Soil Cuttings as stipulated above. This specifically includes monitoring and alarm-based works, deep, shallow or surface mine workings, climate change and loading/traffic adaption.	Much of the work carried out under Other is classified as non-volume, but volume reporting is required for some work-types, all of which are quantified as 'number of (undertaken)'.	On substantial completion.
Drainage	Earthworks drainage works are associated with the management of the earthworks and are often standalone discrete interventions, generally in "maintenance" and "refurbishment" work types or an integral part of an earthworks renewal scheme.	All drainage works shall be measured in linear metres or number. The volume of earthwork benefiting from the drainage work shall also be measured in "asset 5 chain lengths".	On substantial completion.

5.2 Accuracy Civils (Earthworks)

There were a total of 49 Civils Earthworks job in our sample across the three Routes. One job had a sign off sheet showing the volume. Several jobs had substantial completion sheets although they lacked a volume and so could not be used as evidence. The remaining 48 jobs were evidenced from a database record or a job completion report (which showed the volume but without a sign off).

Figure 3 shows the error on the Civils Earthworks volumes by Route at the project level. The graph shows the difference between the reported volume and the evidenced actual volume delivered.

Figure 3: Error on Civils (Earthworks) Volumes – Project Level



The graph shows that only one project (on LNW) had an error, over-reporting by two 5-chain lengths according to what was recorded in the database. Although this did have a substantial completion report, it did not show the volume completed. When the results are applied to the population of projects on the three Routes, the accuracy of volume reporting is within 1.62%.

5.3 Areas for improvements

It would assist future checking and potentially reduce errors if the substantial completion reports contained the volume delivered.

6 Civils (Structures)

6.1 Introduction

Civil (Structures) cover a number of different structures as described in **Table 8** below.

Table 8: Civil (Structures) – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Coastal & Estuarial Defences	A section of works which protects the railway infrastructure from erosion or flooding by river waters or other non-tidal watercourse. AFC of £50k+.	Meters (length) of track stabilised by works undertaken.	On substantial completion.
Culverts	A structure with a Span or diameter greater than 450mm but less than 1800mm whose primary purpose is usually (but not exclusively) to permit a Watercourse, open channel drainage system or service to pass under or adjacent to a railway, road or other Network Rail infrastructure. AFC of £50k+.	Meters^2 internal treated area.	On substantial completion.
Footbridges	A structure whose original function is to give pedestrians access by crossing over tracks, a concourse or a road, and includes any associated steps, stairs or ramps. Footbridges include high level walkways between buildings. AFC of £50k+.	Meters^2 plan area worked.	On substantial completion.
Major Structures	Underline or overline bridges that have unique form or construction, or are historically significant. AFC of £50k+.	There will be no reportable volume measure of work in CP5.	Not applicable.
Overbridges	A structure of one or more spans greater than or equal to 1.8m whose prime purpose is to allow traffic to pass over a road, river, railway etc. AFC of £50k+.	Meters^2 plan area worked on.	On substantial completion.
Overbridges BG3	Cost of work carried out on overbridges within the Bridgeguard 3 programme, with an AFC>£50k. An overbridge is a bridge which	Meters^2 plan area worked on.	100% on substantial completion.

Asset	Definitions	Volume Measurements	Volume Recognition
	passes over the railway and is no more than 50m in length measured along the railway.		
Retaining Walls	A structure built to support ground at a higher level on one side than the other including any associated strutting, reinforcements or anchors. AFC of £50k+.	Meters^2 of surface area remediated.	100% on substantial completion.
Tunnels	A structure provided to allow a railway or services to pass under higher ground, buildings or water. AFC of £50k+.	Meters^2 of internal treated area.	100% on substantial completion.
Underbridges	A structure of one or more spans greater than or equal to 1.8m, whose prime purpose is usually to carry traffic or services. AFC of £50k+.	Meters^2 of planned area worked on.	On substantial completion.
Structures Minor Works	All standalone works across the Structures portfolio with an AFC of less than £50k.	Not applicable.	Not applicable.
Structures Other Programmes	All other (Hazard Management and Vegetation-based) works.	Not applicable.	Not applicable.

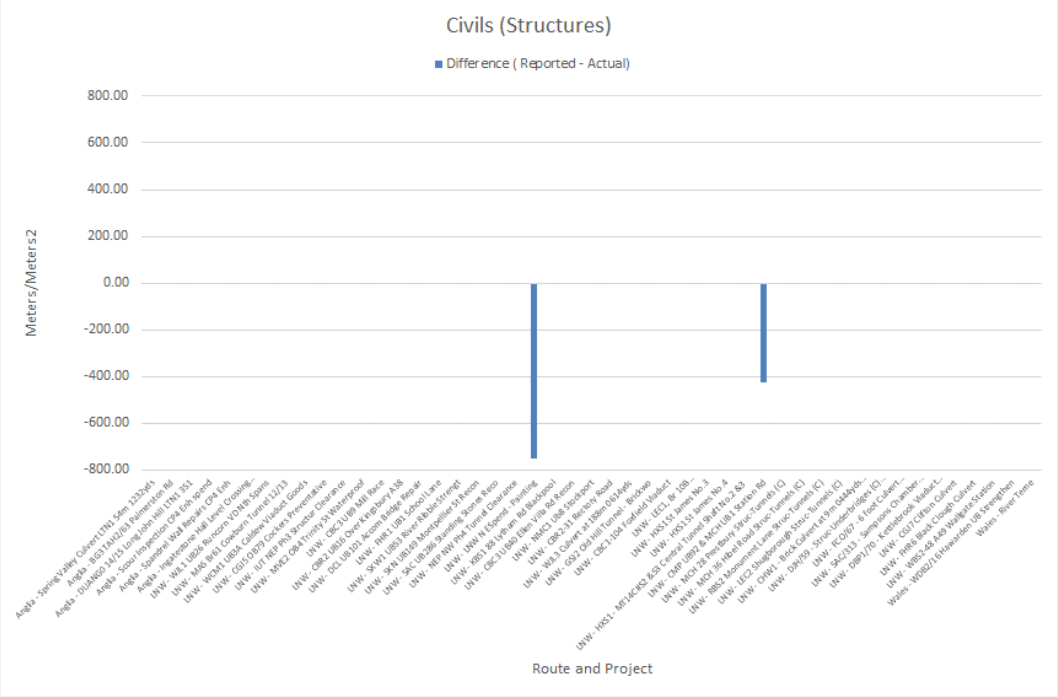
6.2 Accuracy – Civils (Structures)

Our sample of 72 jobs consisted of the following structures:

- Overbridges – 12 jobs
- Underbridges – 42
- Culverts – 5
- Tunnels – 11
- Retaining Walls - 1

They were all evidenced from volumes provided in database records. **Figure 4** shows the errors identified on the reported volumes, by Route at the project level.

Figure 4: Error on Civils (Structures) Volumes – Project Level



The graph shows that two underbridge projects suffered from significant under-reporting of the volume delivered. Within each project (OP 132850 and 143782) a single job accounted for the error. In the latter case the reported volume was half that recorded in the database.

These results indicate that the reporting of all Civils (Structures) projects across the three Routes is accurate to within 10.84%.

6.3 Route Variations

The two errors were on the LNW Route but this is not necessarily surprising given the Route had the majority of projects. In our reviews we found that all three Routes recorded volumes in a consistent manner.

6.4 Areas for improvements

In common with other asset types, having signed off sheets for completed works which show the volumes delivered would provide additional transparency.

7 Buildings

7.1 Introduction

Buildings cover a number of categories which are shown in **Table 9** by description, volume measurement and volume recognition.

Table 9: Buildings – reportable volumes (taken from the Cost & Volume Handbook)

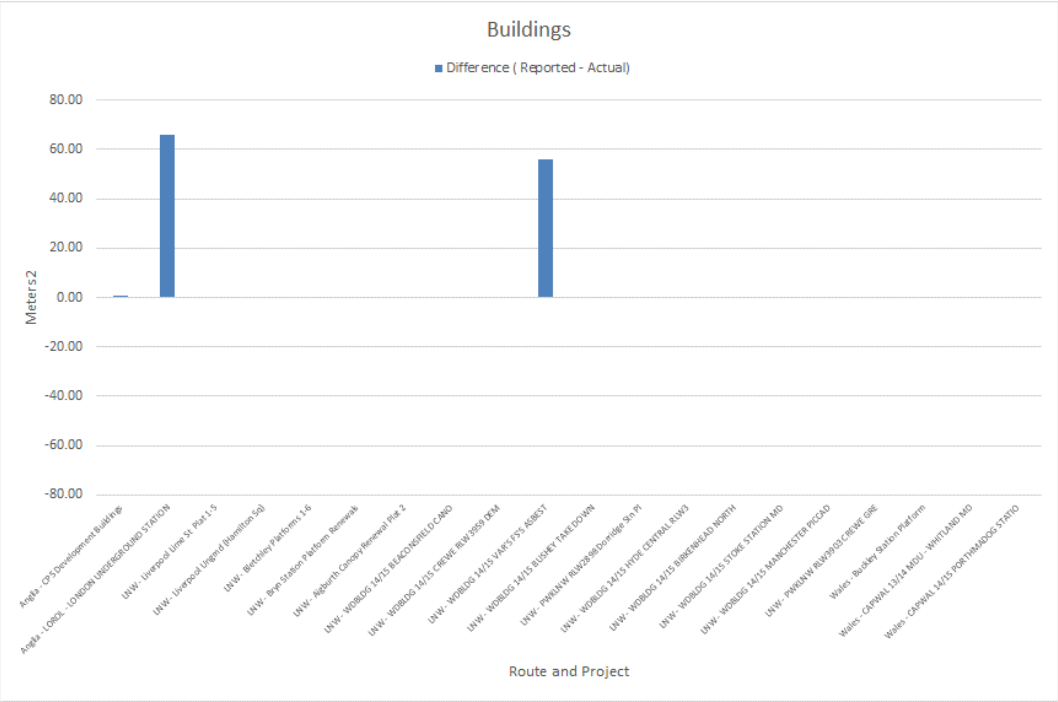
Asset	Definitions	Volume Measurements	Volume Recognition
Managed Stations	Any buildings-based renewals activity located within the confines of a designated Network Rail Managed Station.	Metres^2 or number of units.	On substantial completion.
Franchised Stations	Any buildings-based renewals activity located within the confines of a designated TOC managed Franchised Station.	Metres^2 or number of units.	On substantial completion.
Light Maintenance Depots	Any buildings-based renewals activity located within the confines of a designated Light Maintenance Depot.	Metres^2 or number of units.	On substantial completion.
LMD Depot Plant	Any renewal activity associated with LMD-based fixed plant.	Number of units.	Not applicable.
Lineside Buildings	Any buildings-based renewals activity located within the confines of a designated Lineside Building.	Metres^2 or number of units.	On substantial completion.
MDU	Any buildings-based renewals activity located within the confines of a designated MDU building.	Metres^2 or number of units.	100% on substantial completion.
NDS Depot	Any buildings-based renewals activity located within the confines of a designated NDS Depot building.	No volume measure in CP5.	Not applicable.

7.2 Accuracy - Buildings

Our sample consisted of 21 jobs. The Routes provided a database record as evidence of volumes delivered for 19 of the jobs (no sign off sheets were provided).

Figure 5 shows the errors identified on the reported Buildings volumes by Route at the project level.

Figure 5: Error on Building Volumes – Project Level



There was significant over reporting of volumes on two projects. The Anglia project (OP140899) has been acknowledged by NR as a reporting error, and the LNW project (146099) has been identified as a double count which NR advise they will rectify in the 2015/16 reporting.

These results indicate that the reporting of all Buildings projects across the three Routes is accurate to within 4.38%.

7.3 Route Variations

Volume reporting for Buildings is new in CP5 and therefore no existing process was devolved to the Routes relating to volume sign-off. They have all approached it in different ways. The three Routes provided evidence for the volumes in the audit in various forms. Anglia provided Primavera screenshots, LNW provided Atrium screenshots and Wales provided screenshots with the measurements from a GIS output (via Marlin). Examples of these are shown in **Figure 6** to **Figure 8** respectively.

Figure 6: Anglia screenshot

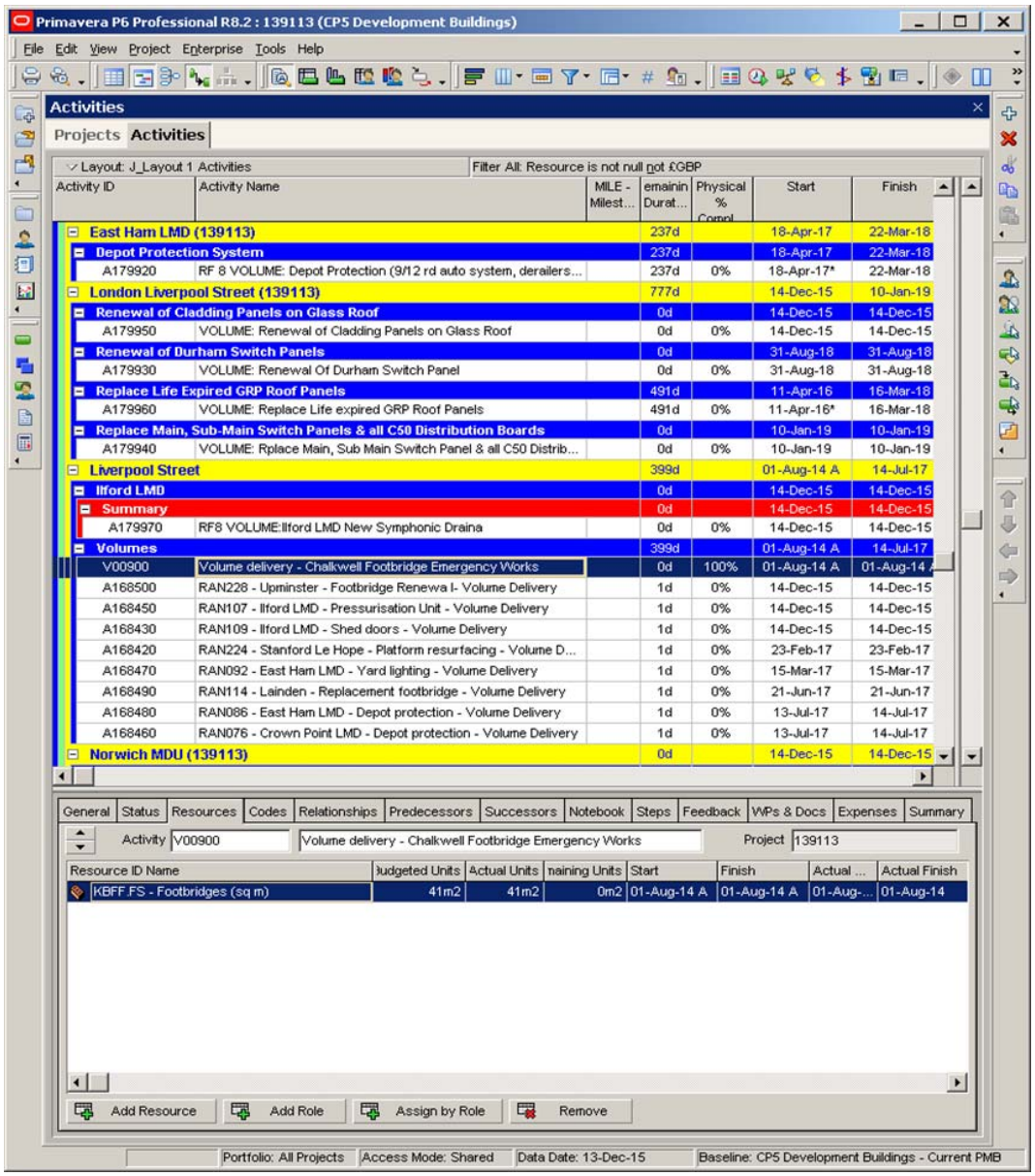


Figure 7: LNW screenshot

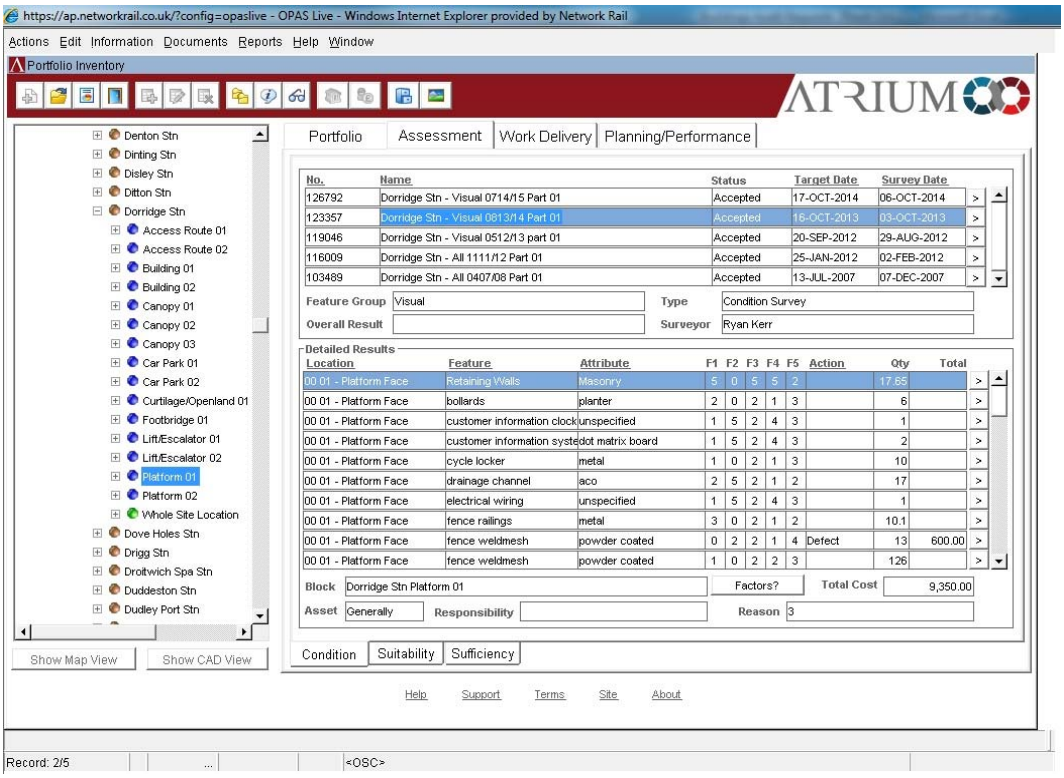


Figure 8: Wales screenshot

7.4 Areas for improvements

Overall, the Routes' processes appeared to be appropriate with each Route using Primavera and Oracle Projects as source information for the reportable projects. Inconsistencies occur, though, with the collection of information to measure, validate and sign-off the volume and any review should seek to reduce the number of databases used and the measurement approach (i.e. GIS) applied. The audit did

not identify any specific concerns with the use of GIS to measure building size, but we were not advised of any audits undertaken to confirm that GIS was giving appropriate measurements for reporting purposes.

8 Off Track (Fencing)

8.1 Introduction

Fencing covers the following types in the Cost and Volume Handbook:

- Fencing Renewal Cat 1;
- Fencing Renewal Cat 2; and
- Fencing Renewal Cat 3.

Fencing is shown in **Table 10** by description, volume measurement and volume recognition.

Table 10: Fencing – reportable volumes (taken from the Cost & Volume Handbook)

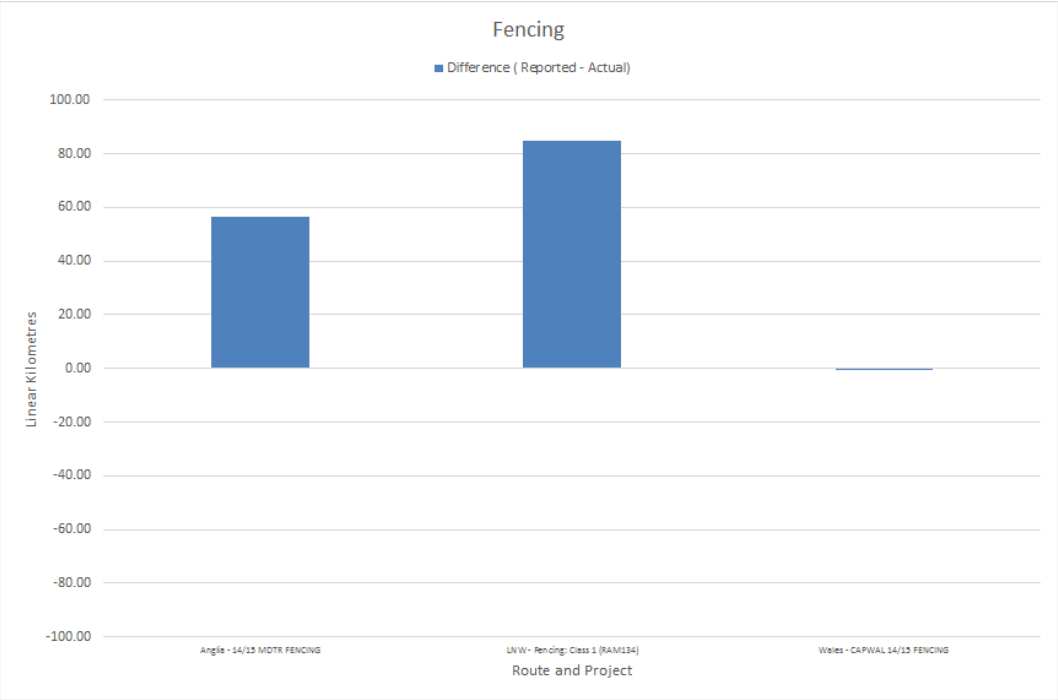
Asset	Definitions	Volume Measurements	Volume Recognition
Fencing	A boundary measure asset designed to meet the railway's legal obligation to provide a barrier to prevent unauthorised access and in so doing reduce the risk to safe railway operations.	Linear kilometres of fencing	On full (job–by-job) completion.

8.2 Accuracy – Off Track (Fencing)

We reviewed all nine jobs (three projects) that reported volumes across the three Routes. Evidence was provided for all of them in the form of a database record. No jobs had a sign off sheet and it transpired that nothing had been put in place locally, by the Routes in question, in response to the requirement to record Fencing volume in CP5.

Figure 9 shows the error of reporting Fencing volumes by Route at the project level.

Figure 9: Error on Off Track Fencing Volumes – Project Level



Two of the three projects had significant over-reporting errors. It is acknowledged by NR that the Anglia volumes were double counted. The evidence of the LNW volume is drawn from various documents and difficult to follow, and it is possible that evidence was not provided for one or more of the jobs.

The overall accuracy of the reporting of Fencing volumes across the three Routes is to within 39.75%.

8.3 Areas for improvements

This is a new volume to be reported to the ORR and all Routes would benefit from clearer reporting and sign off on the amount of fencing being delivered. Anglia especially suffered reporting errors with all volumes for the three fencing categories being over reported. Evidence provided by LNW lacked transparency.

9 Electrification and Fixed Plant

9.1 Introduction

The reportable volumes for Electrification and Fixed Plant are shown in **Table 11** below.

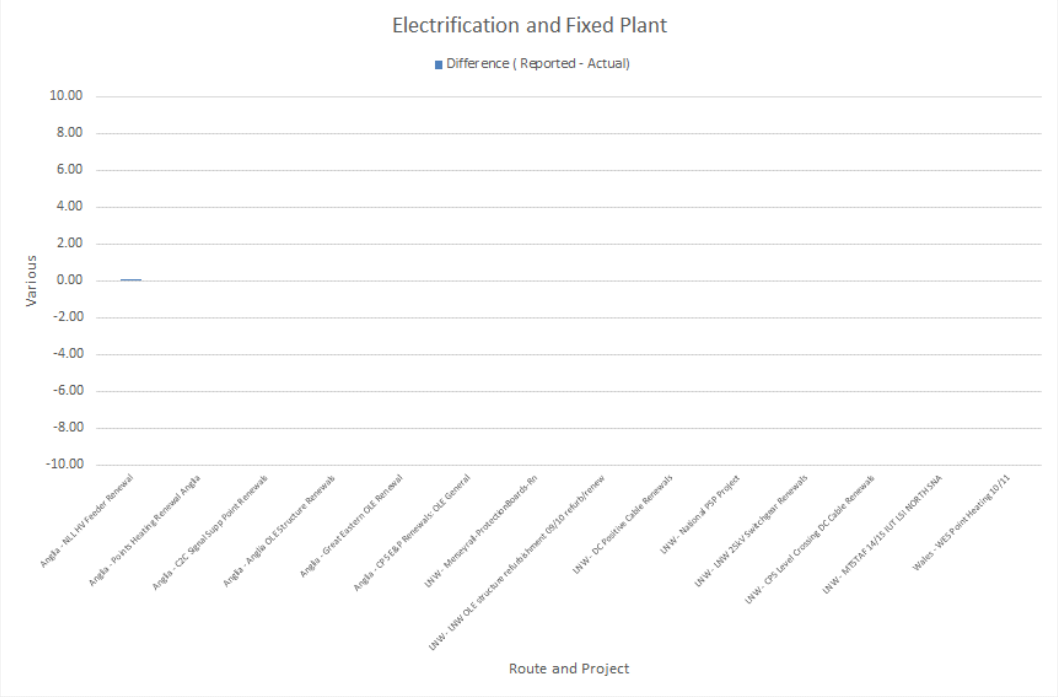
Table 11: Electrification and Fixed Plant – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Overhead Line	Overhead electrification power consisting of wires and support structures, used to supply power to overhead electrified railway.	Number of Wire Runs completed and Structures (units) delivered.	On completion of 'Form E' process.
Conductor Rail	Electrified, ground-level contact rail and associated equipment, used to supply power to third-rail electrified railway.	Kilometres of Conrail Renewed or Refurbished and the unitary number of Manual Hook Switches renewed.	On completion of 'Form E' process.
AC Distribution	Switchgear, protection relays, booster transformers and other alternating current-based distribution assets.	Unitary number of HV Switchgear, Protection Relays or Booster Transformers renewed.	On completion of 'Form E' process.
DC Distribution	Switchgear, protection relays, booster transformers and other direct current-based distribution assets.	Unitary number of HV Switchgear, Transformer Rectifiers, LV Switchgear or Protection Relays renewed.	On completion of 'Form E' process.
SCADA	Electromechanical and electronic supervisory control equipment for Electrical Control Rooms and substations.	Unitary number of Remote Terminal Units renewed.	On completion of 'Form E' process.
Fixed Plant	Fixed Plant relates principally to facilitative plant which is permanently attached to the track, electrification or signalling infrastructure.	Kilometres of Signalling Power Cable renewed and the unitary number of Points Heaters and Signalling Supply Points fully renewed.	On completion of 'Form E' process.

9.2 Accuracy – Electrification and Fixed Plant

The 41 Electrification and Fixed Plant jobs were evidenced from database records provided by the Routes (no sign-off sheets were seen). **Figure 10** shows that we identified no significant errors in the volumes reported.

Figure 10: Error on Electrification and Fixed Plant Volumes – Project Level



Overall, the reported volumes across the three Routes were accurate to within 0.16%.

9.3 Route Variations

There was a high degree of consistency within each of the Routes, with the processes being understood and managing the process appropriately.

However, the three Routes all evidenced the volumes in different ways for the audit, with Anglia using Primavera (**Figure 11**), LNW using a Microsoft Access database (**Figure 12**) and Wales using an email trail including spreadsheets and sign off forms. Whilst NR advise that all three Routes will have used Form E's, they may not have been included as evidence to us because they did not show the volumes delivered. NR have indicated that for 20016/17 all Form E's will require the volume to be recorded.

Figure 11: Anglia Screenshot

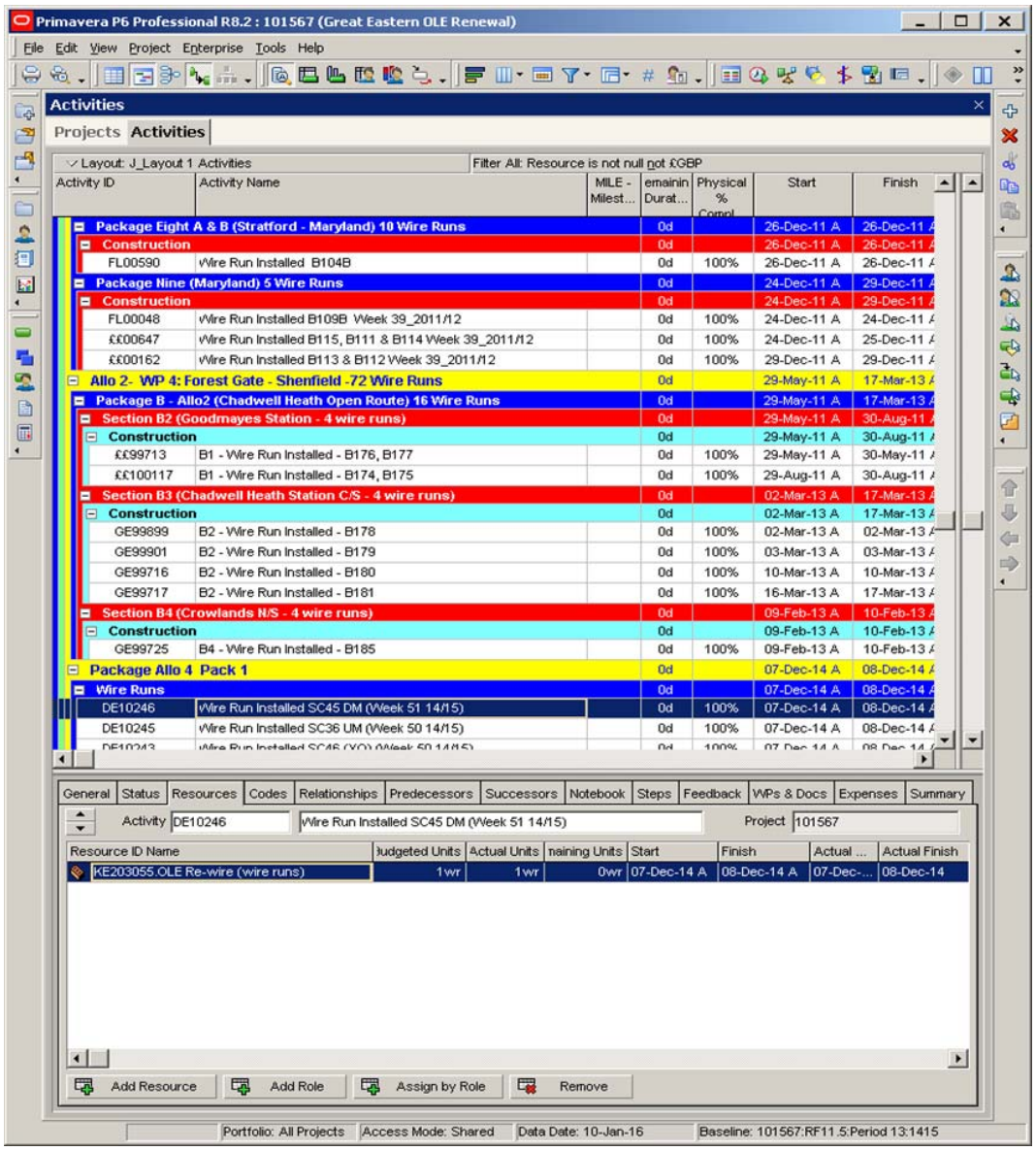
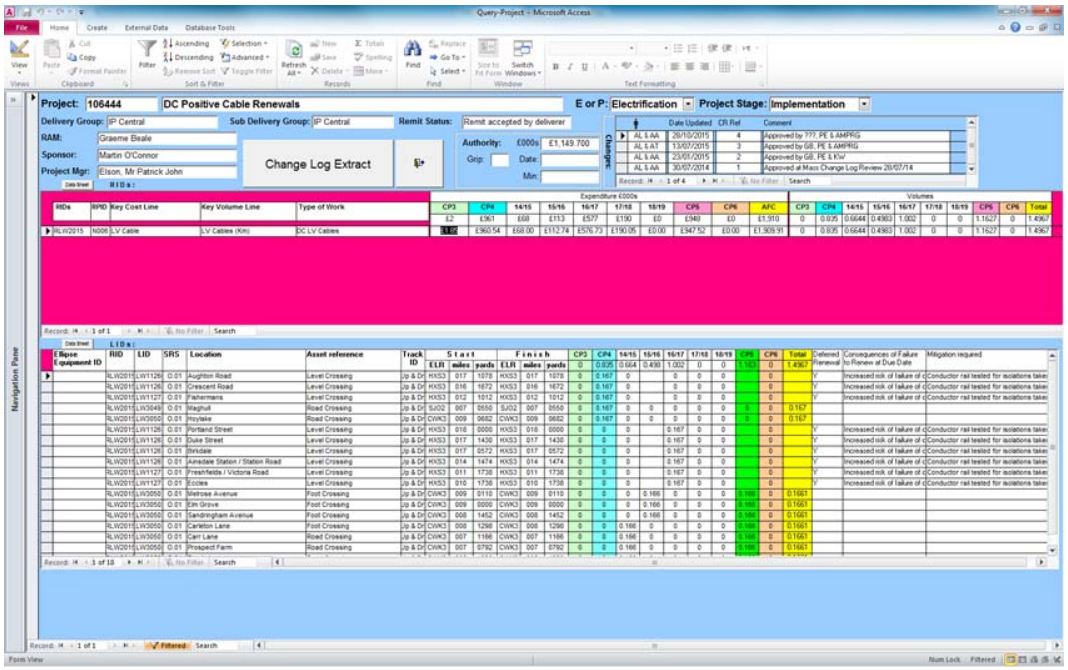


Figure 12: LNW Screenshot



9.4 Areas for improvements

It is suggested that Wales may find an easier method for reporting the volumes in a similar fashion to Anglia and LNW. A better practice may be to collate the information in a central location and report it via a database. This would certainly improve the auditing of the volumes.

Overall, the Routes manage the process well, but processes could be improved to assist with the auditing of the volumes delivered.

10 Non-PR Electrification

10.1 Introduction

Only one project across the three Routes reported any volumes in 2014/15. This project was 101567, Great Eastern OLE Renewal, which had the following description in the Investment Paper:

The Great Eastern Overhead Line Renewal project will renew the fixed termination Overhead Line Equipment (OLE) from Liverpool Street to Chelmsford, with a modern, high reliability system designed by Furrer and Frey (F+F). This system will be capable of supporting a very high traffic intensity (above 350 pan passages per day) of mixed multiple unit and loco hauled train formations and enable a line speed of 100mph.

The project is planning to install a total of 345 new wire runs of OLE, including new support structures and associated registration assemblies.

This includes re-wiring through Shenfield.

10.2 Accuracy – Non-PR Electrification

Evidence of the four volumes reported as being delivered in 2014/15 for this project was provided in the form of Primavera screenshots, and a number of Take Over Certificates (TOC) which showed the sign-off of works delivered. There was no variance between recorded and reported volumes.

10.3 Areas for improvements

Whilst TOCs were provided which show the distance and a signoff, the volume is not recorded within these forms. This would be a useful addition to provide additional transparency.

11 Signalling

11.1 Introduction

There are a number of reportable volumes for Signalling which are shown in **Table 12**.

Table 12: Signalling – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Full Conventional Resignalling	All work undertaken under Work Types 1 & 2.	Units (Pre-SEU Weighting).	On commissioning.
Modular Resignalling	All work undertaken under Work Types 16.	Units (Pre-SEU Weighting).	On commissioning.
ERTMS Resignalling	All work undertaken under Work Types 17, 20, 25, 29, 31, 34 and 35.	Units (Pre-SEU Weighting).	On commissioning.
Partial Conventional Resignalling	All work undertaken under Work Types 3, 5, 7, 8, 9, 10, 11, 12, 13, 41, 60, 61, 62, 63 and 64.	Units (Pre-SEU Weighting).	On commissioning.
Targeted Component Renewal	All work undertaken under Work Types 15, 51, 52, and 53.	Units (Pre-SEU Weighting).	On commissioning.
Level Crossings	All work undertaken under any of the 9 LX work types.	Number of Level Crossings renewed (by type).	On commissioning.

11.2 Accuracy - Signalling

The ‘unit of measure’ for reporting volume in this discipline is the Signalling Equivalent Unit (SEU) and Level Crossing Units (Number Of). Across the three Routes, all 11 jobs were evidenced from database records. None had a sign-off sheet of work delivered.

All 11 jobs were found to have reported volumes accurately, with no errors identified.

11.3 Route Variations

Given the comparatively small number of projects reviewed, a larger sample of projects would be needed before clear variations between Routes could be noted. We again had concerns with regard to the quality of ‘sign-off’ employed to confirm Signalling volumes had been delivered. This is illustrated when reviewing a scheme in LNW, whereby the Signalling volumes completed were counted from the final Signalling sketch, rather than being assured ‘on the

ground' and signed-off on an appropriate form by the RAM. Whilst the number of outputs delivered were confirmed through this approach, the use of a sign-off sheet would make the audit assurance of these assets more straightforward.

11.4 Signalling Costs

In addition to reviewing the volumes, ORR requested that the costs of Signalling be looked at with particular regard to the following questions posed in the Mandate for this review:

"The ORR wishes to be assured that work in progress is managed appropriately such that reported financial costs reflect the work delivered. How does Network Rail monitor work in progress particularly for civils and signalling assets?"

Many of these projects have a long lifespan, incurring costs over several years but only reporting work volumes when the renewal is delivered and commissioned for use. In the absence of any reported volumes, ORR have asked us to provide assurance that the reported costs on such projects reflect the work done.

ORR and NR agreed to test the level of assurance by asking the three Routes to answer five questions about their 2014/15 Signalling projects which incurred significant costs prior to declaring any volumes. These projects are shown in **Table 13**.

Table 13: Signalling Costs

Project Title	OP Number	Stage	Funder	Route	Current Authority (£)	Anticipated Final Cost All Stages (£)	Cost Of Work Done Project to Date (£)	2014/15 YTD Actual (£)
Bromsgrove Corridor Resignalling	134527	GRIP6	Resignalling-Full Conv (S)	LNW	43,623,012	33,250,013	7,666,362	7,421,844
Bromsgrove Corridor Resignalling	134527	GRIP6	Resignalling-Partial Conv (S)	LNW	0	12,187,000	5,096,000	3,990,000
Bromsgrove Corridor Resignalling	134527	GRIP6	Level Crossings (S)	LNW	0	1,033,000	903,000	324,000
Birmingham New Street Area Re-Signalling	104531	GRIP6	Resignalling-Full Conv (S)	LNW	75,047,815	130,657,221	7,510,138	3,126,427
Cambridge Interlock Renewals	133838	GRIP3	Resignalling-Full Conv (S)	Anglia	7,324,271	46,880,000	5,766,828	2,969,609
Cambridge Interlock Renewals	133838	GRIP3	F005 NRDF	Anglia	45,000	1,363,000	45,000	30,000
Cambridge Interlock Renewals	133838	GRIP3	S&C Delivered-Full (Tr)	Anglia	107,000	507,000	107,000	47,000
Norwich to Yarmouth and Lowestoft Resignalling	119433	GRIP5	Resignalling-Full Conv (S)	Anglia	5,714,125	32,797,098	4,993,329	2,577,000
North Wales Coast Phase 1	116374	GRIP5	Resignalling-Modular (S)	Wales	5,629,334	33,114,274	4,200,653	1,710,740
North Wales Coast Phase 1	116374	GRIP5	S&C Delivered-Full (Tr)	Wales	206,000	9,427,001	206,001	1
Newport to Shrewsbury Re-Sig	131669	GRIP4	Resignalling-Modular (S)	Wales	3,215,000	56,835,107	2,562,823	1,069,684
Newport to Shrewsbury Re-Sig	131669	GRIP4	Level Crossings (S)	Wales	0	9,504,940	194,940	194,940

The questions and evidence provided by the Routes for these projects is summarized in **Appendix C**. It should be noted that the Routes provided evidence from 2015/16 rather than from 2014/15 as requested. That said, overall we judge that the evidence shows a good level of assurance that the costs incurred on such projects reflect the amount of work done. Payments are tied to deliverables via the contractor's resource programme and on an earned value basis. There was some variation in the way that Routes monitor progress made and anticipated final costs although all do so every period. Anglia and LNW Routes referred to using specific tracking spreadsheets as tools.

There was less evidence provided on reviewing and managing financial efficiency on these projects. Only LNW provided clear evidence for one project of a project efficiency scorecard which is refreshed from "time to time".

11.5 Areas for improvements

Overall, Signalling appears to be well reported on the small sample of jobs reviewed. We would suggest that improvements could be made to local process, volume recording and assurance at Route level.

12 Telecoms

12.1 Introduction

The reportable volumes for Telecoms are shown in **Table 14** by description, volume measurement and volume recognition.

Table 14: Telecoms – reportable volumes (taken from the Cost & Volume Handbook)

Asset	Definitions	Volume Measurements	Volume Recognition
Operational Communications	Relates primarily to telecoms-based equipment intrinsic to the operation of the railway network such as radio, power and concentrators.	Number of utilised lines, car stops, mirrors, crossing, HMIs or systems.	On completion.
Network	Network-based works.	Number of Network Transmission Nodes.	On completion.
Station Information and Surveillance Systems	The collective term for telecoms infrastructure at railway stations relating to electronic information displays, CCTV, public address systems and supporting equipment.	Number of SISS displays, systems, speakers, cameras, help points or clocks.	On completion.

12.2 Accuracy - Telecoms

The bulk of the programme of Telecoms renewals in 2014/15 was delivered by the Infrastructure Projects (IP) team. As with other projects delivered by IP the Telecoms team used P3e as its project planning system. All projects were referenced from the database and there was no reported variance between actual and reported volumes across the three Routes.

12.3 Route Variations

It was stated by NR that the impact of devolution on Telecoms reporting has been minimal. This is because the Telecoms organisation has not devolved in the same way as the other disciplines. This asset type is reviewed and analysed solely by a central team and there was a high degree of consistency, with the process being understood.

12.4 Areas for improvements

The reporting of Telecoms was clear and accurate, although a documented process would assist in the training and understanding of how the reporting is undertaken.

13 Confidence Grades

13.1 Introduction

This section provides an account of the Confidence Grades which the Reporter team believe are appropriate to the individual asset types based on the evidence gathered during the study as documented in this report.

The following sub-sections consider the grading awarded to each asset type in turn. The reasons for the individual grading for reliability and accuracy are described. We have not made a comparison against the previous corresponding grades because (a) the grading system for reliability has been refined since then and (b) devolution and reporting requirements have significantly changed most reporting processes.

Table 15 shows the definition of the system reliability grading used within this report and agreed with the ORR and NR[3]. We have assigned for each asset type a single grade that covers all three Routes examined. This means that where there is one Route that has comparatively robust processes for an asset type (scoring 'B'), but two Routes less so (scoring 'C'), then the reliability band would be 'C' for that particular asset type.

Table 15: System reliability grading system

System reliability band	Description
A	Sound textual records, procedures, investigations or analysis properly documented and recognised as the best method of assessment.
B	As A but with minor shortcomings. Examples include old assessment, some missing documentation, some reliance on unconfirmed reports, some use of extrapolation.
C	Extrapolation from limited sample for which Grade A or B data is available.
D	Unconfirmed verbal reports, cursory inspections or analysis.

Notes:

1. System reliability is a measure of the overall reliability, quality, robustness and integrity of the system that produces the data.
2. Some examples of the potential shortcomings include old assessment, missing documentation, insufficient internal verification and undocumented reliance on third-party data.

Table 16 shows the accuracy grading applied to the reported volume in 2014/15 according to the extent of any errors identified in our checking of sampled

[3] This table is an update to the one included in the original mandate (and shown in Appendix A) and has been used at the request of both ORR and NR.

projects. The size of the samples have been chosen to provide a level of precision to within 1% (at the 95% confidence level) meaning that if we found no errors in the sample we could attribute an accuracy grade of 1 to the entire population of projects. For some assets which had relatively small numbers of projects we checked the accuracy of all projects, thus permitting a grade of 1* if no errors were found.

These grades can be considered to reflect the reporting of projects across all Routes assuming that the three Routes reviewed are representative of the network.

Table 16: Accuracy grading system

Accuracy Band	Description
1*	Data used to calculate the measure is accurate to within 0.1%
1	Data used to calculate the measure is accurate to within 1%
2	Data used to calculate the measure is accurate to within 5%
3	Data used to calculate the measure is accurate to within 10%
4	Data used to calculate the measure is accurate to within 25%
5	Data used to calculate the measure is accurate to within 50%
6	Data used to calculate the measure is inaccurate by more than 50%
X	Data accuracy cannot be measured

Notes:

1. Accuracy is a measure of the closeness of the data used in the system to the true values.
2. Accuracy is defined at the 95% confidence level – i.e. the true value of 95% of the data points will be in the accuracy bands defined above.

13.2 Track

13.2.1 Reliability Grading

We consider that this is the asset type where there is most scope for improving the reliability of the process across all Routes. Key issues related to:

- Conversion of distances (yards to meters). This conversion is manually undertaken for renewals delivered by Network Operations, giving rise to the potential for error. We found that 35% of jobs delivered by Network Operations contained errors (albeit some being small). This suggests that the manual process of entering the distance is not as reliable as the automatic process used by IP Track.
- The process for reporting Plain Line associated with S&C renewals by IP contained an error in 2014/15. Although it has subsequently been corrected by NR we have included the error in our assessment of reporting in 2014/15.

- Reporting of volumes could be more transparent. Recording volumes delivered (not just start and end locations of work carried out) on AMP forms from Network Operations would allow direct matching with database volume records. Few sign off sheets were seen for jobs delivered by IP and their widespread use would be beneficial.
- Recording of site names for IP jobs should be more accurate to aid traceability of volumes.

On this basis, the Reporter team judge that an alpha confidence grade of 'C' is appropriate.

13.2.2 Accuracy Grading

In terms of accuracy, our sampling demonstrates an accuracy for Plain Line to be within 5.47%, with nine projects recording an error. The reporting error for Plain Line associated with S&C accounted for an additional national error of 0.5%. This results in a combined confidence score of 3.

For Track S&C, our sampling found no errors which resulted in an accuracy of within 0.96% (dictated by the size of the sample). The reporting error for plain Line associated with S&C accounted for an additional national error of 0.9%, which results in a confidence score of 2.

13.3 Civils (Earthworks)

13.3.1 Reliability Grading

We consider that the overall process for this asset type is understood within Routes, but some differences exist in the details of its implementation. Key issues related to:

- Sign-off evidence is not clearly provided or consistent across all Routes. Our audit noted that a number of jobs that had a completion report but these lacked a sign-off (signature) of the works.
- Very little documented evidence of volumes was provided. The completion reports did not contain the volume delivered. Only one audited project had a sign off sheet showing the volume.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.3.2 Accuracy Grading

In terms of accuracy, the sample demonstrated this to be within 1.62% (with one project showing an error), which is a confidence grade of 2.

13.4 Civils (Others)

13.4.1 Reliability Grading

We consider that the overall process for reporting this asset type is understood within Routes. The key issue related to sign-off evidence not being clearly provided or consistent across all Routes. For this asset type, no jobs had a specific sign-off sheet showing volume delivered with an authorised signature (RAM or similar). The remainder were evidenced from database records provided by the Routes.

This lack of sign-off could have contributed to the significant under-reporting of two projects on the LNW Route.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.4.2 Accuracy Grading

The two errors identified in the sampled projects were large ones and this has resulted in an overall accuracy of volume reporting to be within 10.84%. This is a confidence score of 4.

13.5 Buildings

13.5.1 Reliability Grading

We consider that the overall process of reporting this asset type is understood within Routes. Key issues that we identified related to:

- Sign-off evidence of work delivered is not clearly provided or consistent across all Routes. From our audit we were not provided with a single sign-off form (with volume delivered and authorised signature). Instead, we were provided with database records to show volume delivered – although a very small number (two projects) had no such confirmation.
- Whilst all Routes use Primavera and Oracle Projects as sources of reportable projects, there is no consistent approach to measuring, validating and signing-off volumes. Anglia provided Primavera screenshots, LNW provided Atrium screenshots and Wales provided screenshots with the measurements from a GIS output (via Marlin). We did not identify any issues with this difference in approach between Routes. However, it does not aid the process of data auditing.
- We noted the use of GIS to determine building size. Whilst this approach is useful, we were not made aware of any internal audits undertaken to confirm the appropriateness of the GIS output. For example, a sample comparison of a building size could be made between using GIS and manual measurement.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.5.2 Accuracy Grading

The sample demonstrated accuracy to be within 4.38% which is a confidence grade of 2. Three projects recorded errors, with two being significant.

13.6 Off Track

13.6.1 Reliability Grading

Off track fencing is a new volume NR have started to report on during this Control Period. We identified a number of errors with regard to the amount of fencing volume reported and recorded. Key issues related to;

- Significant errors in reporting volumes. Anglia especially had issues with the reporting of this asset type, with all volumes for the three fencing categories being over reported. LNW reported double the volume delivered. Wales had a slight mismatch but overall showed a better result.
- Measurement issues across all Routes. Given this is a more recent measure, we identified issues concerning process across all areas. We identified that this was mainly due to issues of conversion at a local level (miles and chains to linear kilometres of fencing).
- Sign-off evidence is not clearly provided or consistent across all Routes. From our audit we were not provided with a single sign-off form (with volume delivered and authorised signature). Instead, we were provided with database records to show volume delivered.

An alpha confidence grade of 'C' is considered to be appropriate (although the Reporter team judge that it is at the lower end of this grade).

13.6.2 Accuracy Grading

The sampling of projects demonstrated an accuracy of reported volumes to be within 39.75% which is a confidence grade of 5. All three Routes showed errors with the data reported.

13.7 Electrification and Fixed Plant

13.7.1 Reliability Grading

We consider that the overall process for reporting this asset type is understood within Routes. However, key issues related to;

- Sign-off evidence is not clearly provided or consistent across all Routes. From our audit we were not provided with a single sign-off form (with volume delivered and authorised signature). Instead, we were provided with database records to show volume delivered. This is linked to Form Es, which record job completion but not volume which makes them less useful for the purposes of this audit.

- There is no consistent database across the Routes. All Routes evidenced the volumes in different ways for the audit, with Anglia using Primavera, LNW using a Microsoft Access database and Wales using an email trail including spreadsheets and sign off forms. We consider the Wales method to be the least robust. We propose it would be better practice to collate the information in a central location and report it via a database.

This has an impact on the robustness of the overall 'asset-type' reporting, with the Reliability Grade reflecting this variance across the Routes.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.7.2 Accuracy Grading

The sampling of projects demonstrated an accuracy of reported volumes to be within 0.16% which is a confidence grade of 1.

13.8 Non-PR Electrification

13.8.1 Reliability Grading

Across the three Routes reviewed, there was only one project that reported volumes. This makes it difficult to determine an appropriate reliability grade for this asset type. An issue that we did identify related to;

- Whilst a 'Take Over Certificate' was provided which showed the distance and a sign-off signature, the volume was not recorded on the form. This would be a useful addition and assist with the auditing process as well as aid the overall robustness of reporting.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.8.2 Accuracy Grading

No errors were found in the one project that was reported. This corresponds to an accuracy band of 1* but the small sample size should be borne in mind.

13.9 Signalling

13.9.1 Reliability Grading

Whilst the overall reporting process is understood within Routes, some key issues were identified relating to;

- Sign-off evidence is not clearly provided. From our audit we were not provided with a single sign-off form (with volume delivered and authorised signature). Instead, we were provided with database records to show volume delivered.

- Derivation of volumes delivered. Whilst the sample size was comparatively small (11 jobs), we did have concerns over the approaches used to obtaining volumes delivered (given the lack of sign-off). This is illustrated when reviewing a scheme in LNW, whereby the Signalling volumes delivered were assured by counting the assets from the final Signalling sketch on the assumption that this is what was delivered.

On this basis, an alpha confidence grade of 'C' is considered to be appropriate.

13.9.2 Accuracy Grading

No errors were identified in any of the projects that reported volumes on the three Routes which corresponds to a grade of 1*.

13.10 Telecoms

13.10.1 Reliability Grading

We consider that the process for this asset type is robust. It is led by the Network Rail Centre based on information from six engineers across the network. A process document would assist in the understanding of the reporting, but the central control and unambiguous process (with no local Route variation) means that this asset type scores a higher reliability grade than the other asset types.

On this basis, an alpha confidence grade of 'B' is considered to be appropriate.

13.10.2 Accuracy Grading

No errors were found in the three projects reviewed, resulting in a confidence grade of 1* (although the small number of projects tested should be borne in mind).

13.11 Confidence Grade Summary

Table 17 provides a summary of the Confidence Grades.

Table 17: Confidence grades for renewal volumes reported in 2014/15

Asset	Confidence Grade
Track (PL)	C3
Track (S&C)	C2
Civils (EW)	C2
Civils (Other)	C4
Buildings	C2
Fencing	C5
E&P	C1
Non-Electrification	C1*
Signalling	C1*
Telecoms	B1*

The C&V Handbook provided by the NR Central Team, is a helpful framework for the 'reporting' process. Definitions of the volumes to be reported are provided and all three Routes use the handbook. Anglia has taken this a step further by developing their own Route-based document which provides greater clarity, and other Routes might benefit from a similar approach.

The Routes have developed their own processes for reporting some of the asset types. We feel that in some cases it would be beneficial to prescribe the reporting requirements in more detail. Two such issues that are highlighted in the above sub-sections are:

- a lack of sign off evidence and quality (process) for on-site confirmation of volumes is inconsistent. Template 'sign-off' sheets would be helpful.
- Variability in change control across asset types and across Routes (two Routes have no 'formal' change control meetings although they undertake the process through correspondence). Consistent change control would assist with the tracking of changes to volumes post Plan.

14 Centre to ORR Period Checks

As part of the audit, ORR asked the Reporter to carry out a check on the Period 4, Period 8 and Annual Return reports submitted by NR to ORR. The NR Centre team provided a number of items which evidenced the reports issued to ORR. These included spreadsheets and emails from the three Routes to confirm the volumes they were reporting at year-end following their ratification. The following sub-sections describe the findings of our checks.

14.1 Period 4

Network Rail provided the following files to assist with the check of the reports submitted to ORR:

- P4 Volume report FY15.xls;
- P4 reconciliation.docx; and
- P4-15 Finance Pack.pdf.

The P4 Volume report FY15.xls contains the raw data from all the Routes for both Network Operations and IP and the P4 reconciliation.docx document provides a summary of the data. These two files were checked for consistency and found to match. The P4-15 Finance Pack.pdf which is issued to ORR was checked and the volumes in the report to ORR were found to be consistent with the raw data in the spreadsheet and the reconciliation document.

14.2 Period 8

Network Rail provided the following files to assist with the check of the reports submitted to ORR:

- P8 Volume report FY15.xlsx;
- P8 reconciliation.docx;
- RE 139546 Con rail Volumes 5km.msg;
- RE netops volumes.msg;
- FW 980 Kent Thameslink Bridge Prj 128737 .msg; and
- P8 Volume Report.pdf

The P8 Volume report FY15.xlsx contains the raw data from all the Routes for both Network Operations and IP. The data within this spreadsheet was checked against the P8 reconciliation.docx document and this in turn was compared against the P8 Volume Report.pdf. The emails listed above contain evidence of changes to the volumes from Centre checks which are retained as an audit trail of amendments made.

All volumes reported by the Centre to ORR were found to be correct.

14.3 Annual Return

The following documents were checked:

- Anglia LNW & Wales 1415 Vols Arup.xlsx;
- 2014/15 Annual Return; and
- ORR RF11 5 final.pdf

The spreadsheet was provided by the NR Central team and summarised the 2014/15 renewal volumes by project from each Route. We compared these volumes against the volumes reported as being delivered in the Annual Return for each of LNW, Anglia and Wales Routes. No errors were found.

We carried out further spot checks of Delivery Plan volumes for consistency between those reported in the Annual Return and those reported in the Quarter 4 report to ORR (ORR RF 11 5 final.pdf). They should be identical and no discrepancies were found.

14.4 Findings

No issues were found with the periodic reporting from NR to ORR. This is a well understood process provided by the Centre team.

15 Conclusions and Recommendations

15.1 Conclusions

The Mandate scope asked for the following to be assessed:

The clarity of the reporting mechanisms between planned workbank and delivered renewals volumes (including work in progress). The C&V Handbook provides the framework for reporting by defining the units of measurement and timing of reporting delivered volumes. It is up to the Routes to develop their own mechanisms for reporting these volumes and for some asset types they use different databases. Change control between planned and delivered volumes is undertaken by all three Routes on a monthly basis. Clarity was particularly evident at Anglia who had produced their own supplementary document to the C&V Handbook.

The processes and procedures by which Network Rail captures, calculates and records its costs and volumes data to produce national aggregated information. Within each of the Routes, NR has processes and procedures in place. Our audits found these vary between being led by the Engineering function or the Finance function (although in practice, both play a role in the process). Some of these systems are automatic and some are manual, for example Track renewals is automatic for IP projects but manual for Network Operations. Some assets have sign-off sheets showing the amount and date of volumes delivered. All asset costs and volumes are recorded in databases, although in some instances Routes use their own locally controlled databases for this purpose. All Routes report to the centre for national aggregation (and review). This is then aggregated by the Central function in NR for reporting purposes. As agreed with NR and ORR, costs were not reviewed during the audit.

The degree to which period reporting of costs and volumes is governed and subsequently controlled for period, quarterly (rolling forecast) and annual reporting. Across all Routes, the C&V Handbook provides the framework for the reporting process, although this is at a comparatively high level. Anglia Route has produced its own local document to support the handbook which gives guidance to the change control process and management of the live workbank. The Routes are responsible for providing figures each period which are reviewed by the RAMs, although we note that our review has found a lack of sign-off sheets which would aid this process. The Central function provides due diligence. They audit the Routes throughout the year and do seek to ensure consistency and promote best practice. However, the extent of implementation of change varies across the Routes as a result of devolution. Routes also undertake additional year end checks to confirm planned/ actual volumes and costs as part of the sign-off process.

The visibility at national level of workbank progress and expenditure against the forecasts. Workbank progress and costs against forecasts are reviewed based on information provided by the Routes. NR Centre (Business Planning and Business Reporting functions) are able to highlight anomalies in the reported data (against previous Periods) where these are clearly erroneous. For Signalling costs and volume consistency, this was tested by reviewing Signalling projects on

LNW, Anglia and Wales Routes that reported costs but no volumes in 2014/15. In all cases, costs are tied to project deliverables and progress is reviewed across the portfolio of projects on a periodic basis. Some bespoke tools have also been developed by the Routes to aid tracking progress on a project.

With reference to correspondence between Network Rail and ORR, the treatment of workbank volumes rolled over from CP4, specifically for non-PR13 funding (i.e. electrification and buildings) and its accounting separation from the CP5 workbank. It was agreed with ORR that at the end of CP4, certain work not delivered within Electrification and Buildings renewals could be carried over and funded outside the PR13 renewals settlements, with these activities reported separately from a cost and volume perspective. On the three Routes that we reviewed, there was only one non-PR13 funded scheme that was rolled over from CP4 (Great Eastern OLE Renewal on Anglia).

There were two elements to this project in 2014/15. OLE wire runs were renewed, of which 4 were non-PR13 funded and 16 were PR13 funded. They have been reported separately, with the 16 volumes included in the Annual Return table 10.90, and the 4 mentioned as additional roll-over activity in the commentary. In addition, 35 OLE structures were renewed during the year but these have not been treated as a separate ring-fenced activity because their volumes were not reported prior to CP5. They have therefore been funded and reported in CP5 and included in table 10.90 with an explanation in the accompanying commentary.

The evidence supplied by Network Rail with regards to its own internal assurance and audit of figures reported. Within each of the Routes audited, evidence was found that checking is undertaken of the outputs and costs. This is undertaken by the 'lead' function (Finance or Engineering) within the Routes. This is supplemented by internal audits by NR Centre of the process and data reported. These audits are undertaken across all Routes on a periodic (4-weekly) basis. An example audit paper was provided to the Reporter Team as evidence of the internal audits NR are undertaking.

Summarise the overall approach by asset category at GB network level using a recognised confidence grading approach. The Confidence Grades for each asset category can be found in Section 13 and are summarised below in **Table 18**. It should be noted that the grading definitions have been updated, as have the reporting requirements for the renewal volumes, which means that grades cannot be directly compared with those from previous Reporter reviews.

Table 18: Confidence grades for renewal volumes reported in 2014/15

Asset	Confidence Grade
Track (PL)	C3
Track (S&C)	C2
Civils (EW)	C2
Civils (Other)	C4
Buildings	C2
Fencing	C5

Asset	Confidence Grade
E&P	C1
Non-Electrification	C1*
Signalling	C1*
Telecoms	B1*

15.2 Recommendations

There are two outstanding recommendations from previous Reporter reviews. One of these (2013REN01) related to sign off sheets and is replaced by our new recommendation 2016REN01. The other (2013REN06) related to improving the transparency of Signalling project updates in SSADS and, we understand, was being considered as part of the wider update of SSADS.

Based on our Route visits and follow up meetings with Network Rail within this review, the following recommendations have been proposed to improve the reporting of renewal volumes.

Table 19: Recommendations

Reference	Recommendation	Benefit	Report Ref	Owner	Suggested completion date
2016REN01	All assets - consistency of sign off of volumes and dates when completed. This is a general recommendation for all assets as the recording of volume and dates in sign off sheets was not as clear during the audit as it should be. Although a lot of detail was provided for this review, it was not clear which forms gave the definitive sign off and a number of forms contained signatures or volume but not both. It is recommended that where applicable the Substantial Completion/On Job Completion form records a volume as well as a signature to provide greater transparency.	Improve transparency and reduce risk of reporting error	Section 3.8	NR	January 2017
2016REN02	Network Operations Track – automate the conversion of track distances from imperial to metric, or record in metric in the first place.	Reduce reporting errors	Section 4.3	NR	January 2017
2016REN03	IP Track – improve the discipline and consistency within IP Track of recording volume at site level within Primavera.	Assist auditing of volumes	Section 4.6.1	NR	January 2017
2016REN04	IP Track – update the Cost and Volume handbook to reflect the revised approach to Plain Line renewals undertaken as part of S&C renewals.	Reduce risk of reporting error	Section 4.5	NR	January 2017
2016REN05	Signalling – introduce an embedded sign-off process showing volumes delivered Accepted on the basis that an embedded sign-off process will close the recommendation, otherwise further clarity will be required.	Improve transparency and auditability	Section 11.3	NR	January 2017
2016REN06	Fencing – improve the sign off and recording of volumes for fencing to improve accuracy and assist the auditing of the volumes delivered. Clearer evidence from the contractors supplying the works would also assist the process.	Improve transparency and reduce risk of reporting error	Section 8.3	NR	January 2017
2016REN07	Telecoms process document. It is recommended that a process document is produced which describes the recording of Telecoms volumes.	To help share the knowledge and provide a robust example during staff absence/staff leaving	Section 12.4	NR	January 2017

Appendix A

L1AR003: Assessment of Renewal Volumes Mandate

INDEPENDENT REPORTERS: Assessment of Renewals volumes

Mandate for Independent Reporter Lot 1

Title	Assessment of Renewals volumes
Unique Mandate Reference Number	[TBC]
Date	17/09/2015
ORR Lot Lead	Redacted
ORR lead for this inquiry	Redacted
Network Rail Lot Lead	Redacted
Network Rail lead for this inquiry	Redacted

Background

Network Rail has obligations under Part III.A.1 of its licence agreement to secure maintenance and renewal of the network (amongst others). It has had difficulty in providing consistent and accurate progress reporting detailing its maintenance and renewals programme against its own delivery plans for Control Period 5 (CP5) and has as a consequence implemented several process improvements.

Purpose

The Office of Rail and Road (ORR) wishes to verify the consistency and accuracy of Network Rail's reporting processes, procedures and associated governance, to assure that the correct volumes and costs are being reported against delivery plans. There can sometimes be a lag between the reporting of expenditure and volumes (as volumes are not reported until commissioned), and the ORR wishes to be assured that Network Rail is able to provide effective monitoring at national level against the forecast for period reporting. We would also like assurance that there are adequate internal assurance processes where Network Rail's management reporting is gradually improving.

Scope

Under this mandate the reporter will assess:

- The clarity of the reporting mechanisms between planned workbank and delivered renewals volumes (including work in progress).
- The processes and procedures by which Network Rail captures, calculates and records its costs and volumes data to produce national aggregated information.
- The degree to which period reporting of costs and volumes is governed and subsequently controlled for period, quarterly (rolling forecast) and annual reporting.
- The visibility at national level of workbank progress and expenditure against the forecasts.
- With reference to correspondence between Network Rail and ORR, the treatment of workbank volumes rolled over from CP4, specifically for non-PR13 funding (i.e. electrification and buildings) and its accounting separation from the CP5 workbank.
- The evidence supplied by Network Rail with regards to its own internal assurance and audit of figures reported.
- Summarise the overall approach by asset category at GB network level using a recognised confidence grading approach (as noted in Appendix 3).

In responding to this Mandate the reporter should have regard to how it will engage with Network Rail effectively and efficiently to avoid undue disruption to Network Rail's activities.

INDEPENDENT REPORTERS: Assessment of Renewals volumes

The Lot 1 Independent Reporter will carry out the review for a sample of projects covering each of the following asset groups:

- Track
- Off-track
- Buildings
- Drainage
- Civils
- Signals and Telecoms
- Electrification.

This includes a review of:

- Processes and procedures
- Asset renewals workbank
- Period, quarterly and annual reporting.

1) Processes and procedures

The review will build on the findings of the reporter mandates AO/025: Audit of Renewal Volumes Data[1]; Independent Reporter A - Audit of renewals volume data update for Electrification and Plant (E&P) and telecoms[2]. It will include a 'light touch' assessment of the extent to which recommendations in these reports have been adopted. These reports will provide the Reporter with an indication of the extent of this audit.

The Reporter shall work with Network Rail (and ORR as required) to firstly identify and agree appropriate tolerances for assessing the accuracy of reporting The Reporter is to review the renewals volumes as reported within the first year of CP5 against the Delivery Plan reporting framework. The Reporter shall then:

- Undertake a statistically significant sample to assess the accuracy of reporting (see Appendix 3) which may include any combination of the items listed in Appendix 4 & 5.
- Confirm that Network Rail is complying with the Cost & Volume Handbook, relevant Asset Reporting Manual(s).
- Assess whether the process of collating and reporting the figures for all the items in Appendix 4 & 5 is robust and consistent in-period, quarterly and for annual reporting.
- If the Reporter finds that the processes have not been applied correctly identify, where possible, the reasons for this

2) Period, quarterly and annual reporting

The reporter is to review the costs and volumes reported on a periodic and quarterly basis for governance, accuracy and consistency across Routes and over the year, referencing the minimum investigation criteria in Appendix 2 which is aimed at establishing:

- How has the maturity of data capture changed from previous reports?
- To what extent is Network Rail able to monitor at portfolio level its expenditure against volume delivered and demonstrate accurate monitoring of forecasts and reconciliation against relevant funding?

[1] http://orr.gov.uk/__data/assets/pdf_file/0015/2724/arup-renewal-report-2012.pdf
[2] http://orr.gov.uk/__data/assets/pdf_file/0009/4968/ep-telecoms-renewals-030912.pdf

- To what extent are any retrospective changes accounted for and explained? What are the dominant reasons for those changes?

- The Reporter shall pay particular attention to the reporting of underbridges and signalling which from the ORR's perspective have seen the most significant variances.

3) Audit / Assurance

The reporter is to investigate the degree to which Network Rail carries out its own audit and quality assurance activities on its reporting processes and procedures and in particular assessing that:

- Audit / assurance functions are applied consistently and embedded.
- Costs and volume information is being assured prior to publication.
- The scope and remits are in line with good practice and the frequency of audits is timely.
- Evidence that the recommendations are tracked and implemented as appropriate.

Methodology

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

1. Attend a kick-off meeting to confirm the methodology and programme, and receive a briefing on reference documents and concurrent ORR analysis.
2. Work with Network Rail (and ORR as required) to identify and agree appropriate tolerances for assessing the accuracy of reporting.
3. Engage with Network Rail's representatives from the Routes and the Centre to assess their processes and practices.
4. Review the latest volume reporting documents in the context of the workbank delivery and understand Network Rail's internal assurance and improvement activity.
5. Review Network Rail's workbanks and delivery plans for 2014/15.
6. Select a representative sample of projects to examine per asset class.
7. Assure that the project completion forms have been signed-off and correctly entered into cost and volumes reporting systems (e.g. Ellipse, CARRs etc).
8. Assure that the reported costs and volumes (period, quarterly and annual) have been aggregated accurately.
9. Review audit and assurance procedures to establish whether they are embedded and effective.
10. Having agreed appropriate tolerances and using the grading system provided in Appendix 3, evaluate the governance and accuracy of reported cost and volume information at a confidence level of 95% (see note on accuracy).
11. Prepare and submit draft and final reports, setting out the main observations and conclusions and recommendations arising from the review process.

Note:

For the avoidance of doubt the Reporter will not be required to carry out any site verification work, this audit will be conducted wholly as a desktop exercise. The Reporter shall determine a grading score for the processes and procedures and accuracy of the reported renewals volumes and costs within the financial year 2014/15. The accuracy grading is concerned with the quality of the reported volumes by checking that the project information (on volumes and costs) has been

collected and entered correctly and completely and that reporting tools are calculating the outputs correctly. The accuracy of a system is the degree of closeness of measurement of a quantity to that quantity's true value, where the true value is defined as the volume of work reported by the delivery agent and agreed with the client. We would expect that accuracy should be commensurate with the processes so it would be unlikely to obtain a D1 for example.

Timescales and deliverables

The formal deliverables for this project are:

1. Minutes of meetings and a summary of the reporters' views of the challenge workshops, to be provided with the draft and final reports.
2. Brief (1-2 page) reports summarising progress to date, next steps, project risks, and emerging issues.
3. Interim presentation.
4. Draft Report.
5. Final Report.

The key milestones for the project are as follows:

Milestone	**Date**
Issue of Invitation to Tender	[September 2015]
Receipt of Tenders	[ITT date plus 1 week]
Award of contract	[ITT receipt plus 1 week]
Kick-off meeting with ORR and Network Rail	[Award of contract plus 1 week]
Progress reports	Fortnightly after Kick-off meeting
Phase 1 Interim presentation to outline emerging findings Phase 2	 After 80% of planned interviews with NR have been completed To be confirmed
Draft report	Kick-off date plus 12 weeks.
Final report	Draft report submission plus 2 weeks.

Independent Reporter Proposal

The Reporter shall prepare a proposal for review by the ORR and Network Rail on the basis of this mandate. ORR and Network Rail will review the proposal with reference to the criteria for selection – see attached guidance document.

The final approved proposal will form part of the mandate and shall be attached to this document.

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.

Appendix 1 – Joint ORR and Network Rail Guidance to Reporters

1. The purpose of this document is to describe the trilateral relationship between ORR, Network Rail and each Reporter. It sets out in a practical context what both ORR and Network Rail expect from Reporters, and seeks to encourage best practice. This will help Reporters to deliver work in a way which meets these expectations and requirements. These requirements will be taken into account as part of the Reporter Framework (as provided to Reporters).

2. This guidance is owned and updated as necessary jointly by ORR and Network Rail. In the event of any discrepancy between this document and the Reporter contract, the latter will prevail. This guidance does not provide an exhaustive list of responsibilities and should Reporters wish to discuss these guidelines further they should contact the following for a trilateral discussion:

    - Andy Lewis for ORR; and
    - Jonathan Haskins for NR.

The trilateral relationship

3. Licence Condition 13 (LC13) of Network Rail network licence states:

    - "The role of the Reporter is to provide ORR with independent, professional opinions and advice relating to Network Rail's provision or contemplated provision of railway services, with a view to ORR relying on those opinions or advice in the discharge by ORR of its functions under, or in consequence of, the Act. Where appropriate, ORR shall give the licence holder an opportunity to make representations on those opinions or advice before relying on them."

4. Reporters should be familiar with the obligations as set out in LC13 and the terms of the contract.

5. For the avoidance of doubt, in delivering this role, ORR and Network Rail expect that Reporters will also add value to Network Rail in helping it to improve its performance and business as provider of railway services, wherever possible. However, it is recognised that this is not the primary purpose of the Reporter under the Licence and that this may not always be possible to deliver each mandate.

Role & duties of the reporters

6. Reporters must provide an independent view and remain impartial throughout the review.

    For example:

    - information should be shared equally and at the same time with both clients. Any correspondence or clarifications sought by Reporters should also be dealt with in the same way; and
    - communication between all three parties should be open e.g. both ORR and Network Rail should be invited to or made aware of meetings or discussions even if the meeting is more appropriate with only one client.

Identifying Reporter work

7. ORR will identify instances where there is a requirement to engage a Reporter. In practical terms, this is likely to arise from on-going discussions with Network Rail and in most cases (except urgent or exceptional cases) the potential for engagement of Reporters will have been identified in advance.

Mandates – Reporter Proposals

8. Clause 4 of the contract sets out the key requirements around provision of services. Requirements for reporter work normally arise from the day to day discussion of issues between ORR and Network Rail.

9. ORR will prepare a draft mandate for each piece of work and will in most cases agree this with Network Rail.

10. Mandates will be presented in a standard format for consistency and will clearly set out:

    - the purpose;
    - the scope;
    - why the review is necessary;
    - what it will achieve;
    - the expected outputs; and
    - timescales for providing reports.

11. Once agreed with Network Rail, ORR will email the mandate to the relevant Reporter(s), asking for comments and a proposal for the work, which should include costs and CVs for the proposed Reporter team. The Reporter has seven working days to respond with a proposal or such other timescale as determined by ORR. Every proposal must include:

    - costs;
    - resources;
    - CVs of the proposed mandate team – when providing proposals, Reporters should make the most efficient use of their resources including the most appropriate make-up of the review team;
    - methodology for delivering the aims of the mandate;
    - timescales;
    - framework of meetings, including a tripartite findings meeting before issue of the draft report;
    - expected deliverables and a concise explanation of how the aims of the mandate will be met; and
    - for larger scale reporter studies, the project management approach and project plans should be made explicit

12. Where there are multiple Reporters on a Lot, the ORR and Network Rail will use the following criteria to determine which Reporter they will select to conduct the work:

Procedure for Call Off under the Framework Agreements

Where more than one Contractor has been selected for any particular lot, ORR and Network Rail will allocate mandates on the basis of the following criteria:

1. The expertise required is only available from one source. This may be due to ownership of exclusive design rights or patents.
2. Where the mandate constitutes follow up work, which is directly related to a recently completed study.
3. The Contractor which demonstrates the greatest expertise in the subject matter of the mandate or the approach required.
4. The Contractor's performance against the performance framework
5. An overall assessment of value for money based on cost and complexity of work.

If the ORR and Network Rail cannot determine the most appropriate Contractor for a mandate using the above criteria, ORR and Network Rail will conduct a mini-tender with the Contractors who have been awarded the relevant lot using the following criteria in order to determine the most economically advantageous proposal:

1. The Contractor demonstrates sufficient knowledge of subject matter and possesses the technical skills, resource and competencies required for the work.
2. Contractor Costs.
3. The Contractor demonstrates innovation and value for money in its proposal.
4. The Contractor's performance against the performance framework.

13. Prior to conducting such a mini-tender, ORR and Network Rail will inform Contractors of the relative weighting of the above criteria and of any additional sub-criteria applicable in the context of a particular mandate.
14. ORR and Network Rail will endeavour to discuss the proposals received and to confirm by e-mail within **five working days** that the proposal is acceptable (or otherwise). There may be circumstances where ORR and Network Rail need longer to respond.
15. ORR will then formally instruct the reporter to start work, and the reporter will arrange a start-up meeting with key representatives from both ORR and Network Rail.

Mandates – During Delivery

16. The following sets out some key points regarding conduct of any inquiry. Reporters must provide an independent view and remain impartial throughout the inquiry. They should expect to discuss their progress and findings trilaterally with ORR and Network Rail and for some challenge to be given – particularly in relation to the factual accuracy of the findings.

Costs and expenses

17. If additional funds are required to deliver a mandate beyond those agreed at the outset, a timely proposal and justification must be given to ORR and Network Rail (as soon as the issue arises). The Reporter should notify ORR and Network Rail who will discuss and respond in a reasonable timescale. Additional work (and cost) must not proceed without approval.
18. Any reasonably incurred expenses will be reimbursed by Network Rail. Only expenses that have been incurred in accordance with Network Rail's expenses policy will be paid. It should be specifically noted that reporters must use standard class travel and plan journeys in advance as

much as possible. In addition no claims for lunch will be processed even if submitted. In the event that a Reporter is working on a 'call out' during the night which takes them into the morning, the Reporter will be eligible to claim up to £7.50 for breakfast. No other scenario qualifies for claiming breakfast. Hotel accommodation costs will only be paid up to the maximum rate limit (per person per night, including VAT) as set out in Network Rail's expenses policy.

19. All invoices should be sent to Katherine Bird at Network Rail prior to being sent to Network Rail Accounts Payable.

Amendment to mandates

20. For practical reasons it may be necessary for a mandate to be revised once work has commenced or awarded. For the avoidance of doubt this will not lead to the ORR and Network Rail seeking to re-run the award of the mandate unless ORR and Network Rail agree that the revision constitutes a material change to the original mandate.

Meetings

21. Unless otherwise directed, all key meetings must be trilateral and both parties should be made aware of any other meetings taking place.
22. The Reporter should take minutes of meetings, which should be provided to all parties within 7 working days.

Issues or concerns

23. Should a situation arise whereby either ORR or Network Rail is dissatisfied with the quality of a piece of work, we will explain clearly our reasons, gain approval from the other client and then, if we deem appropriate, may request the Reporter to re-do that part of work at no additional cost.
24. Should the Reporter encounter any issues with an inquiry (review) the Reporter should notify:
    - Andy Lewis for ORR
    - Jonathan Haskins for NR

Reports

The report document

25. **All** Reports must include an 'Executive Summary' which should be written clearly, concisely and highlight key findings and key recommendations.
26. The full reports should also be written concisely in plain English, and should provide a brief 'Introduction' outlining the aims of the mandate and how these have been met. They should provide further detail on what is mentioned in the Executive Summary and there should not be any material points raised in the main report which have not already been mentioned in the Executive Summary.
27. Where there is commercially sensitive information in the report, the Executive Summary will be published on ORR's website, with any necessary redactions, instead of the full report. Otherwise, usually the full report will be published unless any redactions are appropriate due to a Freedom of Information Act exemption.

Recommendations

28. A recommendation is a specific action that the Reporter considers, following its analysis, should be undertaken by either Network Rail, or any other party. While the majority of recommendations are likely to be for Network Rail, not all need to be.
29. Reporters should make all recommendations SMART (Specific, Measureable, Achievable, Realistic and Timebound). The Reporter should:
    - provide a clear description of the recommendation and the benefit that implementation will deliver;
    - outline the evidence which is required in order for the recommendation to be closed out; and
    - discuss and agree a target date for completion of the recommendation with ORR and Network Rail.
30. Recommendations should only be included in the report if they actually add value to either ORR or Network Rail or another industry party and the benefits are sufficient to justify implementation. It is acceptable for a report not to include recommendations, as long as key requirements of the mandate have been met (e.g. if an inquiry finds that Network Rail is fully compliant with its requirements). A smaller number of well-targeted and SMART recommendations which will deliver tangible improvements is preferable to a large number of general recommendations.
31. In order to add further value, the report may also include observations on areas for improvement which do not need to be captured in a formal Recommendation if they are not central to delivery of the mandate requirements.
32. Recommendations will be tracked by the Reporter which generated them.

Payment

33. Reporters must include the purchase order number, and unique mandate reference (UMR) number for work when invoicing Network Rail for payment.
34. The clients can query invoices and have the right to check timesheets (and expenses) and investigate work before payment is agreed.

Post-mandate review

35. The clients will provide feedback on the work carried out, having assessed performance using the Performance Framework on a per mandate basis. This will reflect any issues or concerns raised with the Reporter during delivery of the mandate.
36. The clients will also hold formal feedback sessions with each Reporter every six months to review progress.

Appendix 2: Minimum investigation criteria for volume reporting

i. Inputs

- How have the inputs been checked and audited by Network Rail (at Route and Head Office)?
- The level of consistency between route and aggregated numbers.
- How are post-reporting volume data changes controlled and updated?
- Does the reporting of volumes align with the relevant expenditure?

ii. Process:

- How has input data been obtained by the Routes, and is this a reliable basis?
- Can Network Rail monitor at portfolio level its expenditure against volume delivered and demonstrate accurate monitoring of forecasts?
- The ORR wishes to be assured that work in progress is managed appropriately such that reported financial costs reflect the work delivered. How does Network Rail monitor work in progress particularly for civils and signalling assets?

iii. Outputs:

- How have the outputs been checked, audited and signed off by Network Rail prior to issue (at Route and Head Office level)?

Appendix 3: Confidence Grading Methodology

System reliability grading system

System Reliability Band	Description
A	Appropriate, auditable, properly documented, well-defined and written records, reporting arrangements, procedures, investigations and analysis shall be maintained, and consistently applied across Network Rail. Where appropriate the systems used to collect and analyse the data will be automated. The system is regularly reviewed and updated by Network Rail's senior management so that it remains fit for purpose. This includes identifying potential risks that could materially affect the reliability of the system or the accuracy of the data and identifying ways that these risks can be mitigated. The system that is used is recognised as representing best practice and is an effective method of data collation and analysis. If necessary, it also uses appropriate algorithms. The system is resourced by appropriate numbers of effective people who have been appropriately trained. Appropriate contingency plans will also be in place to ensure that if the system fails there is an alternative way of sourcing and processing data to produce appropriate outputs. Appropriate internal verification of the data and the data processing system is carried out and appropriate control systems and governance arrangements are in place. The outputs and any analysis produced by the system are subject to management analysis and challenge. This includes being able to adequately explain variances between expected and actual results, time-series data, targets etc. There may be some negligible shortcomings in the system that would only have a negligible effect on the reliability of the system.
B	As A, but with minor shortcomings in the system. The minor shortcomings would only have a minor effect on the reliability of the system.
C	As A, but with some significant shortcomings in the system. The significant shortcomings would have a significant effect on the reliability of the system.
D	As A, but with some highly significant shortcomings in the system. The highly significant shortcomings would have a highly significant effect on the reliability of the system.

Notes:

1. System reliability is a measure of the overall reliability, quality, robustness and integrity of the system that produces the data.

2. Some examples of the potential shortcomings include old assessment, missing documentation, insufficient internal verification and undocumented reliance on third-party data.

INDEPENDENT REPORTERS: Assessment of Renewals volumes

Accuracy grading system

Accuracy Band	Description
1*	Data used to calculate the measure is accurate to within 0.1%
1	Data used to calculate the measure is accurate to within 1%
2	Data used to calculate the measure is accurate to within 5%
3	Data used to calculate the measure is accurate to within 10%
4	Data used to calculate the measure is accurate to within 25%
5	Data used to calculate the measure is accurate to within 50%
6	Data used to calculate the measure is inaccurate by more than 50%
X	Data accuracy cannot be measured

Notes:

1. Accuracy is a measure of the closeness of the data used in the system to the true values.

2. Accuracy is defined at the 95% confidence level - i.e. the true value of 95% of the data points will be in the accuracy bands defined above.

Appendix 4: Renewal Volume Assessments

Principal Category	Reportable Volume	Units
Track	**Conventional plain line**	
	Heavy refurbishment (concrete, MO)	km
	Rail renewal	km
	Single rail	km
	Steel relay	km
	Complete Trax	km
	High output	
	High output (ABC)	km
	Heavy refurbishment (concrete, HO)	km
	High output (rail sleeper relay)	km
	Plan line refurbishment	
	Heavy refurbishment (other)	km
	Medium refurbishment (concrete)	km
	Medium refurbishment (other)	km
	S&C	
	Abandon	S&C units
	Full renewal	S&C units
	Heavy refurbishment	S&C units
	Medium refurbishment	S&C units
	Off Track	
	Fencing	km
Signalling	**Resignalling**	
	Full conventional resignalling	SEUs
	Modular resignalling	SEUs
	ERTMS resignalling	SEUs
	Partial conventional resignalling	SEUs
	Targetted component renewal	SEUs
	Level crossings	
	Level Crossings	Level crossings
Civils	**Structures**	
	Overbridges - major works	m2
	Underbridges - major works	m2
	Bridgeguard 3 - major works	m2
	Footbridges - major works	m2
	Tunnels - major works	m2
	Culverts - major works	m2
	Retaining walls - major works	m2
	Coastal / estuary defences - major works	m
	Major structures - major works	m2
	Earthworks	
	Embankments – renewal	5-chain lengths
	Embankments – refurbishment	5-chain lengths
	Rock cuttings – renewal	5-chain lengths
	Rock cuttings – refurbishment	5-chain lengths
	Soil cuttings – renewal	5-chain lengths
	Soil cuttings – refurbishment	5-chain lengths

INDEPENDENT REPORTERS: Assessment of Renewals volumes

Principal Category	Reportable Volume	Units
Buildings	**Franchised stations**	
	Building - Roof Structure (m2)	m2
	Platform - Surface (m2)	m2
	Canopy - Roof Structure (m2)	m2
	Train Shed - Roof Structure (m2)	m2
	Footbridge - Surface (m2)	m2
	Managed stations	
	Building - Roof Structure (m2)	m2
	Platform - Surface (m2)	m2
	Canopy - Roof Structure (m2)	m2
	Train Shed - Roof Structure (m2)	m2
	Footbridge - Surface (m2)	m2
Electrical power and fixed plant	**AC distribution**	
	HV switchgear	number of
	Booster transformers	number of
	Overhead line	
	Rewiring	wire runs
	Mid-life refurbishments	wire runs
	Structure renewal	number of
	DC distribution	
	HV switchgear	number of
	HV cables	km
	LV switchgear renewal	number of
	LV cables	km
	Transformer rectifiers	number of
	Electrical traction equipment	
	Conductor rail	km
	Fixed plant	
	Signalling power cables	km
Telecoms	**Operational communications**	
	PABX Concentrator	Number of
	Processor Controlled Concentrator	Number of
	DOO CCTV	Number of
	DOO Mirror	Number of
	PETS	Number of
	Voice recorders	Number of
	HMI Large	Number of
	HMI Small	Number of
	Legacy Radio	Number of
	GSMR Radio	Number of
	Power	Number of
	SISS	
	CIS	Number of
	PA	Number of
	CCTV	Number of
	LIU	Number of
	Clock	Number of
	Help Point	Number of

Appendix B

Sampling Methodology

Sampling plan for reportable volumes

University of Sheffield Statistical Services Unit (SSU). 4th Dec 2015 (updated 27th April 2016).

As it is not possible to review all projects for certain asset types, it is appropriate to closely examine a representative sample of projects and extrapolate the results across the wider population. This document specifies sample sizes which will enable the results of the review to be considered statistically robust.

The aim of the sampling plan is to ensure that the results obtained from the sample are representative of the population as a whole, and achieve a suitably precise estimate for the overall outcome measure for use in an accuracy grading. A representative sample is best achieved by taking a stratified random sample within each asset group, stratified by any factors that are suspected to influence the magnitude of the accuracy measure, such as specific categories within asset groups, or size of project. A stratified sample is conveniently achieved by a systematic sampling approach.

For the second aim of achieving a suitable level of precision, an appropriate sample size can be determined using formulae (based on approximations to the normal distribution) depending on the characteristics of the population, the sampling method used, what is being measured and the desired level of accuracy for the results. Determining a sample size typically depends on five considerations:

1. Population and available resources;
2. Desired precision of results;
3. Desired confidence level;
4. Degree of variability; and
5. Response rate.

1. Population and Resources

The size and characteristics of the overall population should be considered first. If the population is small and resources allow then it may be preferable to do a census of the entire population, rather than use a sample. The characteristics of the population influence the choice of sampling method. If there are differences between groups within the population then it is recommended that stratified sampling be used which will have implications on the sample size.

For the Anglia, LNW & Wales lines, there are 71 “Track (plain line)” projects, 30 “Track (S&C)”, 34 “Civils (EW)”, 88 “Civils (other)”, and 24 “Buildings” projects.

2. Precision of Results

The level of precision is the closeness with which the sample predicts the true value of the population. A precision level of ± 2% means that the population value is predicted to lie within a band (“confidence interval”) of 4% around the value provided by the sample. The tighter the level of precision that is specified the larger the sample size that is required. In practice, the precision is a function of both the sample size and the underlying variability

in the data.

Care is needed in terminology here, since the terms “more precise” or “greater precision” imply a *smaller* numerical value for precision as defined above.

3. Confidence Level

This is the level of certainty that the sample value does not differ from the true population value by more than the specified precision level. The higher the confidence that is specified the larger the sample size required. Confidence levels of 95% are typically used.

4. Degree of Variability

The degree of variability within the population, as measured by the standard deviation, will impact the accuracy of the sample. The greater the observed variability the larger the sample size that is required to provide a specified level of accuracy. Population standard deviations are rarely known in reality and often have to be estimated or derived from similar studies.

5. Response Rate

The base sample size is the number of complete observations required for analysis. If not all observations can be included for whatever reason then it is necessary to increase the sample size from the outset in order to cater for any null observations that will be returned. There may be null observations from the sampling so the response rate will need to be taken into account.

Accuracy as a weighted mean

The overall accuracy estimated from the sample is calculated as the total of the sampled discrepancies (d_i) divided by the total of the sampled volumes (V_i):

$$A = \sum_i d_i / \sum_i V_i \qquad (1)$$

Note that this is subtly different from the average of the accuracies from each project, which is used for reasons of simplification in the sample size calculations described later.

$$A' = \sum_i (d_i / V_i)/n \qquad (2)$$

The overall accuracy as defined above is actually a *weighted mean* of these accuracies, i.e.:

$$A = \sum_i (w_i a_i) / \sum_i w_i \qquad (3)$$

where $a_i = d_i/V_i$ and $w_i = V_i$.

Note that these two quantities will be identical if the weights are constant, i.e. if all project reported volumes are equal. The effect of this difference on the expected precision may need further inspection, but early indications suggest that confidence bands become slightly wider with variable weights compared with constant weights.

Confidence interval for Accuracy

The accuracy confidence grading system specifies that "Accuracy is defined at the 95% confidence level". This is interpreted to mean that the 95% confidence interval for the estimated overall accuracy should fall within the specified cut-off for each accuracy band. Note that as a consequence, if discrepancies all occur in the same direction, an accuracy grade of 1 ("accurate to within 1%") is only achievable if a precision of ±0.5% is obtained (which is generally only possible if the underlying variability is very small, unless a full population census is undertaken). If discrepancies in opposite directions cancel each other out, then an accuracy grade of 1 is possible with a precision of ±1%. In contrast, accuracy grades of 2 ("accurate to within 5%") or above will be less affected by the precision of the estimate, but arguably a precision of ±1.0% would seem desirable.

The confidence interval for the weighted estimate of overall accuracy, $\bar{a}_w$, can be obtained using the sampled accuracies $a_i = d_i/V_i$, with weights $w_i = V_i$, and incorporating the finite population correction[1], as follows:

$$\bar{a}_w \pm [z_{1-\alpha/2} \times (1-f) \times se(\bar{a}_w)] \qquad (4)$$

where the sampling fraction f is the sum of the sample volumes divided by the sum of the volumes from the full population, and z is the percentile of the standard normal distribution for a 100(1-α)% confidence level.

The weighted mean is:

$$\bar{a}_w = \frac{\sum_i w_i a_i}{\sum_i w_i} \qquad (5)$$

The standard error of this estimate[2] is:

$$se(\bar{a}_w) = \sqrt{\frac{{s_w}^2 \sum_i {w_i}^2}{(\sum_i w_i)^2}} \qquad (6)$$

which uses the unbiased weighted estimate of the population variance:

$${s_w}^2 = \frac{\sum_i w_i (a_i - \bar{a}_w)^2}{\sum_i w_i - (\sum_i {w_i}^2 / \sum_i w_i)} \qquad (7)$$

For the a special case where no discrepancies are observed in any items in a sample, these formulae would return a zero-width confidence interval, which gives a false impression of the precision in the estimate. In such a case, the confidence interval would be constructed from a confidence interval for the binomial probability of observing a non-zero discrepancy, multiplied by the expected accuracy for non-zero discrepancies. An ad-hoc estimate of 50% is suggested, which covers the majority of observed discrepancies in the previous two audits.

For the confidence interval for the binomial probability, the 'Jeffreys' method[3] is recommended, for which the upper 95% confidence limit (using MS Excel syntax, and including the finite population correction) is:

BETA.INV(0.95, 0.5, n+0.5) × $\sqrt{(1-f)}$

E.g. for a sample size of n=60 from a population of 100, f=0.6, and the value from the inverse Beta distribution is 0.0314 so the upper confidence limit for $\bar{a}_w$ would be 0.0314 ×$\sqrt{(1-0.6)}$ × 50% = 0.99%, giving an accuracy grade of 1.

Sample Size Equation

As commented upon earlier, determining a statistically robust sample size in part depends on the degree of the variability in the population at large, quantified by the standard deviation, *s*. This is used in an equation for determining the sample size (n_{inf}) for an infinite population as:

$$n_{inf} = \frac{s^2 \times z_{1-\alpha/2}{}^2}{p^2} \qquad (8)$$

where *s* is the standard deviation, *z* is the inverse of the standard normal distribution for confidence level 100(1-α)% , and *p* is the level of precision (i.e. half the width of the confidence interval).

The sample size is adjusted for finite populations using:

$$n = \frac{n_{inf}}{1 + (n_{inf}/N)} \qquad (9)$$

where N is the population size. The resultant value is rounded up to the nearest integer to provide the final target sample size. The calculation for a confidence interval with no observed discrepancies is then conducted using that sample size, to check that a confidence grade of 1 is achievable under those circumstances (i.e. the upper confidence limit is <1%).

Sample Size Scenarios

The population standard deviation (SD) of the accuracy measure for individual projects may vary between asset types. Based on limited information from the samples taken in the 2012 and 2013 audits, SD for track assets appears to be in the range of 1.5% to 5%, whereas for civils projects the magnitude of discrepancies can be greater, leading to a larger SD.

Due to the shortage of information on standard deviations it is not possible to calculate a definitive sample size. Instead equations (8) and (9) have been applied using a range of standard deviations and a range of precision levels. The results for a population size of 100 and using a confidence interval of 95% are presented in Table 1. It is observed that as the standard deviation increases or the precision level increases then the recommended sample size also increases.

Utilising a sample size of 50 from a population of 100 would achieve a precision of at worst ±1% based on the most generous estimate of SD. Alternatively, if ±1.5% precision were acceptable then a sample of around 30 would be sufficient. For Civils assets, the information available is much less clear: the data available from the 2013 audit suggests that underlying variability is much greater (due to some very large errors on a small number of projects),

whereas in 2012 no errors were observed at all. A sample size of around 50 is suggested here, to achieve precision of ±2% with s=10% or ±4% with s=20%.

Table 1: Sample size scenarios for a population of 100

Precision Level (p)	Standard Deviation (s)							
	1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**
0.5%	14	39	59	72	80	94	99	100
1.0%	4	14	26	39	**49**	80	94	98
1.5%	2	7	14	22	**30**	64	88	94
2.0%	1	4	8	14	20	**49**	80	90
2.5%	1	3	6	9	14	39	72	85
3.0%	1	2	4	7	10	30	64	80
3.5%	1	2	3	5	8	24	56	74
4.0%	1	1	3	4	6	20	**49**	69

Based on an assumed SD of 5%, a precision of 1%, and the number of projects listed for each asset type (excluding zero-volume projects), the proposed sampled numbers of projects are as follows:

	Track (plain)	Track (S&C)	Civils (EW)	Civils (other)	Buildings
#projects in population	71	30	34	88	23
Target sample size assuming sd=5%, for precision +/-1%	41	23	26	46	19
Upper conf limit with no observed discrepancies in sample	0.96%	0.92%	0.83%	0.97%	0.83%
Sampling fraction	58%	77%	76%	52%	83%
Approx Sample pattern	6 in 10	8 in 10	8 in 10	11 in 20	17 in 20

Stratified random sampling scheme

In order to achieve a representative sample, a stratified random sample using systematic sampling is recommended. For example, if a sample size of ~30 is required from a population of 100, one out of every 3 assets would be inspected. The stratification would be achieved by sorting the list of projects/jobs within an asset type, for example sorting by route and reported volume. A random number between 1 and 3 would be generated to select which of the first 3 projects in the list is to be audited, and then every third project down the list would be selected. Irregular sampling fractions such as 0.6 can be accommodated by, for example, taking every 10th item down the list starting from 6 randomly selected starting points from 1-10 (e.g, 1,2,4,5,7,9).

References:

[1] Janet D. Elashoff (2007) nQuery Advisor Version 5.0 User's Guide. Los Angeles, CA

[2] https://en.wikipedia.org/wiki/Weighted_arithmetic_mean

[3] Brown LD, Cai TT, DasGupta A. Interval estimation for a binomial proportion. *Statistical Science* 2001; **16**:101-117.

Appendix C

Summary of Signalling Cost Questions

Each of the three Routes that we reviewed was asked five questions about their signalling projects that reported costs but no volumes in 2014/15. The evidence they provided is summarized below.

Question	**Anglia**	**LNW**	**Wales**
1. Deliverer: What milestones exist within scheme development and how are they linked to contractual payments?	Contracts are Cost Reimbursable with a Not To Be Exceeded Contract Price. Payments are based on actual hours worked which are booked against specific tasks and deliverables. Validation of application for payment is completed in conjunction with a review of the supplier's periodic programme to monitor actual expenditure against forecast (i.e. % complete £ versus % complete to date), and any perceived non-productive time is challenged accordingly. Example provided for Cambridge Interlock Renewals.	For Birmingham New Street Area Re-Signalling (BNSAR), NR advise they measure and review the main contract progress on the fixed price contract as follows:- 1. The contract programme is used as the vehicle for measuring progress against the planned baseline. 2. The supplier cost loaded the programme, which is then used for calculating the value of works completed based on a % complete of the task/milestones. 3. The supplier then applies progress on a periodic basis using the output of the cost loaded programme to calculate the value of measured work complete. 4. The application is reviewed and verified by the project team (Planner, Engineers, Site teams, PM, Commercial) to ensure the progress claimed is correct.	Example Earned Value & Cost Report provided for North Wales Coast Phase 1 (OP 116374) which links costs to progress made.

Question	Anglia	LNW	Wales
		5. To support the review of progress, various trackers have been set up to monitor and verify progress. 6. The supplier also provides a highly cost forecast for the works to go. 7. The application + the cost forecast are then used to support the Cost of Work Done calculation. An Application for Payment from the BNSAR and from the Bromsgrove Corridor Re-signalling suppliers were seen. A difference between the two was that the former provided earned value analysis whereas the latter did not.	
2. Deliverer: Please outline progress made on the schemes specified within 14/15 for the cost incurred e.g. milestones met, GRIP stages passed etc…	A snapshot for the above project, which is currently at GRIP 4, was provided (for period ending 05/03/16).	A snapshot for the two projects was provided in the above Applications for Payment (February 2016).	High level reports to the Project Review Group (PRG) which describe progress against GRIP stages.
3. Deliverer: Briefly describe the project accounting and reporting process for schemes in development. Please provide evidence linked to the projects detailed.	NR has developed a deliverable tracker that reviews current progress of deliverables against the baseline programme from the supplier's periodic programme. It shows both supplier submission and NR approval dates for agreed deliverables. It identifies any slippage and provides a revised completion date. A periodic review is undertaken with the supplier where any change is discussed in detail and commentary is then included in	See answer to question 1.	Periodic reporting is derived from the Contractor's programme / forecast wherever possible. An example was provided for North Wales Coast Phase 1 (OP 116374).

Question	Anglia	LNW	Wales
	the tracker for records. Mitigation and recovery measures are discussed and agreed and if necessary issues are escalated if appropriate. A tracker was provided for the above project although it contained no values.		
4. Route: How are scheme progress and periodic costs across the signalling portfolio reviewed and assessed on an on-going basis, particularly prior to GRIP6 implementation? Please provide evidence pertaining to the project(s) in question e.g. MBR/RAM review packs, details of regular client-deliverer meetings etc…	Monthly Business Reports (MBR) are reviewed at the periodic Signalling Deliverability Review. They describe progress and costs on a periodic basis and include • Period achievements / progress • Issues for discussion • Issues for action • Opportunities • Top 3 risks • Schedule and variances • Financial summary There are also weekly reviews held with the Project Managers.	NR advise: "Each period the team produce a capex reporting pack and provide comments on schemes with significant variances against forecast and budget. Each period a CAPEX review is held with RAMs and SRAM to discuss periodic progress and any issues. The whole workbank would have been reviewed in advance of any of the rolling forecasts. This would compare workbanks against current deliverers Anticipated Final Costs (AFC's). A discussion/review would then be had with deliverer to determine why the change. If the change was agreed it would be reflected in the workbank. Bromsgrove Resignalling: - Monthly Steering Group across the programme (new third party funded station, electrification enhancement project, and resignalling) – LNW and Western RAM reps - Infrastructure Projects MBR: usually attended by a project sponsor, which	Progress is reported to the PRG in a standard reporting template. However, the level of information provided varied for the 2 projects examined, with Newport to Shrewsbury providing less detail in the report seen. These are augmented with more detailed internal review meetings (which Route representatives occasionally attend), and ad hoc meetings & workshops with the Rout Asset Manager. It was noted that the Route Sponsor is reviewing periodic project reporting.

Question	Anglia	LNW	Wales
		covers the detail of earned value, COWD, milestones etc - RAM/Sponsor/IP meeting on a monthly basis looking at the LNW portfolio and tracking the overall signalling programme Birmingham New St Area Resignalling - Monthly New St Area Resignalling Steering Group (Sponsor, Programme Manager, RAM, Area Ops, Area Maintenance) - Infrastructure Projects MBR: usually attended by a project sponsor, which covers the detail of earned value, COWD, milestones etc" - RAM/Sponsor/IP meeting on a monthly basis looking at the LNW portfolio and tracking the overall signalling programme - Stage gate reviews held on milestones, and also 'pre-stage gate' reviews to assess readiness and products requiring more work/completion before formal stage gate session. An example of RAM/Sponsor/IP meeting notes was seen.	
5. Route: Briefly explain how financial efficiency was assessed and measured within 14/15 as part of the Financial Performance Measure (FPM) process for long-	Unclear how to interpret the information provided.	The Route advises that they review increased AFC's on all schemes via their change control process. So if Bromsgrove or BNS's AFC had increased, a paper would be presented to PRG to consider if the scheme was still worth doing.	No evidence provided.

Question	Anglia	LNW	Wales
running Signalling schemes. [1]		FPM is mostly considered at year end on the basis of COWD and revised AFC and any revised volumes. Financial efficiency is assessed using a project efficiency scorecard. The Route refreshes this from "time to time". An example was provided for Bromsgrove resignalling (dated June 2015).	

[1] NB: Network Rail's Financial Performance Measure (FPM) is a measure of efficiency used on a continual basis by Network Rail to monitor financial performance. FPM involves the comparison of outturn financial performance against the PR13 assumptions. Arup has reviewed Network Rail's reported FPM at financial year-end as part of the Independent Reporter mandate to review the Regulatory Accounts in recent years.