Independent Reporter A

Reporter Mandate - Freight Cost Variability
Final Report

Halcrow Group Limited

Halcrow Group Limited
Vineyard House 44 Brook Green London W6 7BY
Tel +44 (0)20 7602 7282 Fax +44 (0)20 7603 0095
www.halcrow.com

Independent Reporter A

Reporter Mandate - Freight Cost Variability

Final Report

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Initial
1	0	Draft report compiled	17/11/06	MNG
1	1	Update Draft after comments	24/11/06	MNG
1	2	Final Report	27/11/06	MJ
1	4	Update Final after comments	30/11/06	MNG
2	0	Update Final after NR comment	04/12/06	MNG/MJ

Content

1 Introduction

1.1 Details of Review

1.1.1 As part of its role as Independent Reporter, Halcrow has been appointed jointly by Network Rail and ORR to undertake an assessment of the freight specific costs used by Network Rail as the basis for development of freight access charges. Our review has been focussed on two key elements of freight costs:

(a) Estimation of costs for Freight Only Lines (FOL)

(b) Variable costs for freight (assessed on the mixed use network)

1.1.2 Halcrow has worked in association with AMCL (Independent Reporters for Asset Management systems) on this review. AMCL have previously reviewed Network Rail's Infrastructure Cost Model (ICM) which is used to develop Network Rail's long term cost estimates used for business planning.

1.1.3 Our review has been largely focussed on the methodology and analysis underpinning Network Rail's initial estimate set out in their "Freight-only Costs and Variable Costs – Initial Estimates" paper released on the 20th of October 2006. Network Rail have updated the estimates of freight only network kilometres in a subsequent paper released on the 15th of November 2006 however the underlying analysis approach has not been altered. Results quoted in our report are from the updated (15th November) paper.

1.1.4 In conducting our review we have had a number of meetings with both the ORR and with Network Rail. In addition we have also met with EWS. A full list of meetings is given in Appendix A.

1.2 Background on the ICM Model

1.2.1 Network Rail has developed the Infrastructure Cost Model (ICM) as a support tool to assist in business planning. The ICM brings together data and analysis from a number of sources as inputs with varying amounts of analysis completed within the model. Outputs from the ICM are used for the subsequent derivation of FOL and variable costs. The table below gives an overview of the methods underpinning ICM cost estimates by discipline for renewals.

Asset type being renewed	***Techniques***
Track	Activity volume forecasts are based on the expected service life of asset components, defined in cumulative tonnage, with renewal predicted when this life is reached. Estimates are determined for each "Strategic Route Section" (SRS) which is considered to have a defined operating profile. Renewal costs are determined by applying network wide unit rates to aggregate volumes from each route section.
Signalling	Bottom up assessment of specific assets in specific locations by qualified expert engineer using the 40 year workbank.
Civils	Taken from SACP results, which contain aspects of a Life Cycle approach.
Operational property	Combination of Age steady state and Cost profile approaches.
Electrification Telecoms Plant and machinery	Combination of approaches for different asset types depending upon data availability and materiality of expenditure.

Figure 1.2.1 ICM Calculation Method for Renewals

1.2.2 The ICM models costs up to the end of CP10. Traffic and unit cost levels are taken as constant from the end of CP3 (including efficiencies projected up to the end of CP3).

2 Cost Allocation to Freight Only Lines

2.1 Network Rail's Modelling Methodology

2.1.1 In developing their estimates for Freight Only Line (FOL) costs, Network Rail has relied on two elements of analysis:

(a) Use of the ICM for calculation of maintenance and renewal costs for freight routes. The ICM contains estimates of long term costs by asset type for each Strategic Route Section (SRS), based on assumptions regarding asset life derived from asset type, usage and asset management policy. Each SRS is differentiated by route type[1], allowing identification of routes where freight is dominant.

(b) Adjustment of the ICM freight costs to separately identify costs for freight only routes and adjust costs to be more reflective of those associated with FOLs.

2.1.2 We note that the method for cost calculation varies for each discipline and in some cases costs are calculated independently of the ICM, with results then imported into analysis.

2.1.3 In the following sections we discuss the overall approach adopted, considering first the specific adjustments made to the costs extracted from the ICM to calculate FOL costs and then in more detail the key assumptions and method for cost allocation used for the major cost elements (covering both ICM calculations and subsequent adjustments in more detail).

2.2 ICM Cost Adjustments

2.2.1 As noted above, costs extracted from the ICM for freight routes are then adjusted to estimate FOL costs using several adjustments:

(a) Differentiate SRSs and assets to separate true "freight only" routes and costs from those that are also have an element of passenger or other traffic;

(b) Adjust the unit costs for renewals costs from the network averages used in the ICM to costs intended to be reflective of differences applicable to freight only routes;

(c) Exclusion of costs which are not related to freight operations; and

(d) Differentiate costs into those directly attributable to FOLs, those which can only in part be directly attributed (related) and those at a more general level which may be allocatable to FOLs.

2.2.2 These are discussed in the following sections.

Proportioning of ICM cost to FOL

Network Rail's Approach

2.2.3 Freight routes in ICM do not directly correlate to FOL as some of these route sections also carry mixed traffic. To determine costs for FOL from the ICM costs for freight routes, Network Rail has further disaggregated the SRS into "yes", "possible" and "no" categories for operation. To determine the costs that then apply to FOL, Network Rail has estimated costs on the basis of:

[1] Each Strategic Route Section within ICM has a route classification – London and South East; Primary; Secondary; Rural; Freight

(a) For signalling assets, a review of the specific assets within the freight routes to allocate assets, associated workbanks and costs to each category;

(b) For all other asset classes costs have been allocated pro-rata to the total track km in each category.

2.2.4 We have not had access to the criteria used for separation of signalling assets but understand that this is based on an appropriate "bottom up" review to identify each interlocking associated with the freight only routes.

2.2.5 The ICM gives 1371 track km of Freight routes. In their 15/11/06 paper Network Rail assessed 429km of these as "Yes" FOLs and 139km as "Possible" FOLs. It is understood that the ICM does not cover all route sections of the network and Network Rail have separately reviewed the total FOL identified from ICM against data from GEOGIS and previous lists of freight only routes by ORR. This gives an additional 228km of "Yes" and 34km of "Possible" FOL. The total track km from all sources is divided by the total freight track km in ICM (1371 km) to arrive at a percentage used to proportion the ICM Freight Route costs as shown in the table below. The lower range of FOL costs is based on the "yes" total FOL with the upper range calculated including "possible" FOL as well.

	ICM	ORR	Geog	Total	% of Total in ICM
Yes	429	194	34	**657**	**48%**
Possible	139	15	19	**172**	**13%**
No	803	171	32	**1006**	
Total	**1371**	**380**	**84**	**1836**	

Figure 2.2.1 Track km of FOL as of 15/11/06 NR Paper

Commentary on Network Rail's Approach

2.2.6 By taking a simple "pro-rata" approach across freight routes, the Network Rail approach assumes that the average traffic levels, asset density and asset condition for the Freight routes in ICM is the same as that of the FOLs. This may be a distortion and although this is partly catered for in the subsequent adjustments to costs (detailed below) we believe that further refinement is possible at this stage of analysis to improve accuracy. For example, mothballed lines which are included in ICM freight km (but which are classified as "No" for FOL) will have very low (or negligible) costs. By these routes being included in the total track km the average cost per km is lowered.

2.2.7 Within the "FO Route Register" release by Network Rail on the 15/11/06, there is 92.5km of track noted as mothballed. Of this we have been advised by Network Rail that only 42 km is within the ICM numbers as "no" FOLs. If we reduce total ICM km by this amount, assuming that there is no cost associated with these lines, it increases the total cost of Network Rail's upper range estimate from £75.1m to £76.7m. We acknowledge that the mothballed line costs will not be zero, due to off track maintenance activities such as vegetation control and fencing, however this analysis simply illustrates the sensitivity of this method of apportioning costs.

2.2.8 We note that the pro-rata approach based on total track km may not be a reflective measure across all asset groups. Network Rail has separately estimated signalling asset distribution and we would expect a similar, separate exercise should be completed for other asset classes, particularly civils where costs are significant.

2.2.9 We also note that there is some uncertainty on the definition of "FOL". Network Rail's submission of results on 20th October assumed a much higher proportion of freight routes as FOL (total "yes" and "possible" of 90% of freight routes including ORR and additional GEOGIS sections compared to 61% in the November submission).

Unit Rate Reductions for FOL

2.2.10 The unit rates used within ICM are network wide averages. For FOL, Network Rail accept that these costs should be adjusted downwards to reflect factors such as:

- Cheaper labour rates (often midweek work)
- Better access times – longer possessions with reduced diversion or bussing costs
- Cheaper material costs (due to use of cascaded, serviceable rather than new materials)

2.2.11 The following table gives the factors that Network Rail has adopted. No supporting detail was provided by Network Rail. Our understanding is that these have been arrived at by Network Rail using engineering judgement.

Track	Renewals	S&C	80%
Track	Renewals	Plain Line	90%
Track	Renewals	Other	90%
Signalling	Renewals	Resignalling	90%
Signalling	Renewals	Minor Works and Life Extension	90%
Civils	Renewals	Underbridges	90%
Civils	Renewals	Overbridges	90%
Civils	Renewals	Bridgeguard3	90%
Civils	Renewals	Earthworks	90%
Civils	Renewals	Other	90%
Operational Property	Renewals	Lineside Buildings	90%
Electrification	Renewals	OLE	90%
Electrification	Renewals	Conductor rail	90%
Electrification	Renewals	Distribution - AC systems	90%
Electrification	Renewals	Distribution - DC systems	90%
Electrification	Renewals	Grid Supply Points	90%
Electrification	Renewals	SCADA	90%
Telecoms	Renewals	GSM-R / FTN	90%
Telecoms	Renewals	Other operational	90%
Telecoms	Renewals	Other retail	90%
Plant and Machinery	Renewals	Fixed Plant	90%
Plant and Machinery	Renewals	Fleet and Machinery	90%
Other Renewals	Renewals	Corporate Offices	90%
Other Renewals	Renewals	Central renewals "contingency"	90%

Figure 2.2.2 Unit rate reduction factors

2.2.12 In the absence of supporting analysis it is difficult to support the figures presented above. In section 2.3.18 we have undertaken our own bottom up assessment of relative costs for the principal cost drivers which indicates that unit costs reductions for some of these items should be significantly greater for FOL. Our analysis indicates that for plain line track renewal a factor of 70% would be more appropriate. We also note that it was suggested by Brown & Root in 2000 that the cost of a plain line track renewal on a FOL would be in the order of 66% of that of the average network renewal cost.

Items excluded from the FOL Costs

2.2.13 The list below gives the ICM Cost lines that have been excluded from the FOL costs. The total value these items for Freight Routes in ICM is £1.6M.

- Operational Property Renewals - Managed Stations
- Operational Property Renewals - Franchised Stations

- Operational Property Renewals - Light Maintenance Depots
- Operational Property Renewals - MDU Buildings
- Operational Property Renewals - NDS Depots
- Plant and Machinery Renewals - Depot Plant
- Plant and Machinery Renewals - Remote Cond Monitoring
- Other Renewals - All IT renewals
- Other Maintenance Costs - Property Maintenance

2.2.14 We have not reviewed the full list of cost heading considered for exclusion but would expect that further costs may be excluded, particularly in the areas of central opex, management and overhead costs (this may be potentially covered by treatment of "attributable", "related" and "allocatable" costs discussed below).

Categorisation of Costs

2.2.15 Within the costs determined for FOL, Network Rail have applied a further categorisation of the costs in each area as either:

- attributable: costs of an activity contained within a route section, e.g. track maintenance;
- related: costs of an activity linked to a route section but not contained within it, e.g. renewal of a signalling interlocking; or
- allocated: costs of activity not directly related to route sections, e.g. overheads.

2.2.16 The values used to distribute the costs are shown below. In stating their expected range of costs, Network Rail have based lower range costs on Attributable only, with higher end estimates including all elements.

	Attributable	Related	Allocatable
Track Renewals – Plain Line	100%		
Track Renewals – S&C	90%	10%	
Signalling Renewals ("Yes")	25%	75%	
Signalling Renewals ("Possible")	15%	85%	
Civils Renewals	100%		
Electrification Renewals	50%	50%	
Telecoms Renewals		100%	
Fixed plant Renewals	100%		
Machinery Renewals			100%
Lineside buildings Renewals	100%		
Track Maintenance	100%		
Signalling Maintenance	100%		
E&P Maintenance	50%	50%	
Telecoms Maintenance		100%	
Civils Maintenance	100%		
Indirect Maintenance Costs			100%
Signalling Ops ("Yes")	25%	75%	
Signalling Ops ("Possible")	15%	85%	
Freight specific Opex support	100%		
Other central Opex costs			100%

Figure 2.2.3 Split of Cost to Attributable, Related and Allocatable

2.2.17 We note that the allocation of costs to attributable, related and allocatable has varying degrees of supporting analysis. We accept that the items which are 100% attributable are a reasonable reflection of costs but question the approach used for determining proportions of related costs which appear to be partly subjective. For example, we understand that for signalling renewals for interlockings, related costs are proportioned to route sections simply by dividing by the number of route sections served by an interlocking. We would expect a more robust approach could be applied to this analysis, particularly for elements interfacing with the shared network. This could include distributing costs pro-rata to route km served, trains per route, or adopting an "avoidable cost" approach based on removal of freight operations to determine costs or infrastructure saved. We also note a significant difference between the track S&C and signalling renewals cost distribution between attributable and related where we would expect greater alignment. Again, we believe more detailed analysis by Network Rail is warranted to determine cost categorisation by cost area and asset type.

2.3 Analysis of Cost Drivers for FOL

2.3.1 The figure below shows the split of Network Rail's upper range estimate of £75.1m for FOL costs:

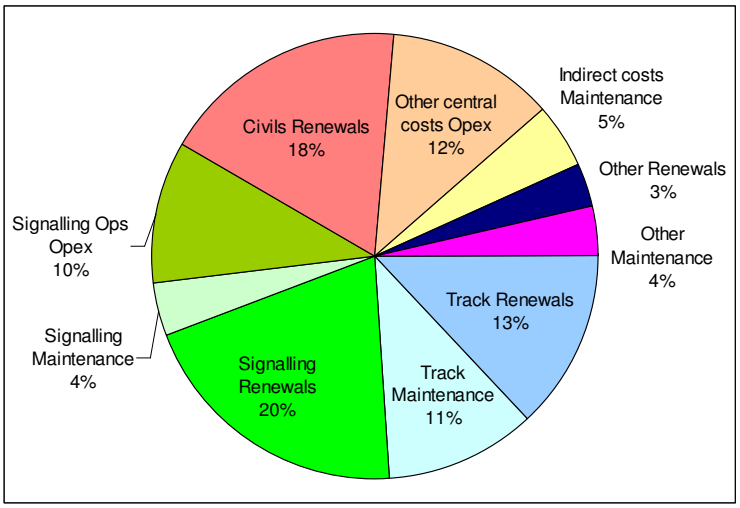

Figure 2.3.1 Split of FOL Costs

2.3.2 We have undertaken a more detailed review of the build up of the principal cost items which includes:

- Track Renewals (£9.9M)
- Track Maintenance (£8.2M)
- Civil Renewals (£13.6M)
- Signalling Renewals (£15.1M)

2.3.3 These items make up 62% of total FOL costs.

Track Renewals

2.3.4 The Total cost for track renewal has been estimated as £6.9M for plain line renewals and £3.0M for S&C renewals per annum. These estimates have been arrived at by using ICM's Service Life Curves to determine the volumes of renewal required per SRS. Within ICM, freight route service lives are extended by a factor of 1.2 to reflect expected deferral of renewals and acceptance of a lower standard of performance/asset condition.

2.3.5 As noted in the sections above, costs are determined by multiplying renewal volumes by network wide unit rates for renewals to generate an overall cost. For FOL, these rates are factored by 0.9 outside of the ICM to reflect potential differences in unit rates for FOL compared to network averages.

2.3.6 Both the service life extension and unit cost reduction factors are based on Network Rail's engineering judgement and we have not been provided with any supporting analysis as part of our review. In the following sections we outline results of our own bottom up analysis to compare/ validate Network Rails assumptions. We note that we have had limited access to cost data from Network Rail and our analysis has not been calibrated to actual, reported costs.

Track Asset Service Life

2.3.7 The output from Network Rail's modelling gives an average track service life of 62.5 years for FOL. This represents an average annual renewal rate of 1.6%. As noted above, this calculation is based on the service life curves (graphs) for each track type within the Infrastructure Cost Model (ICM) with a service life extension factor of 1.2 for freight routes. This implies a base (not uplifted) life of 52.1 years. The rationale for the uplift is that Network Rail will accept a lower quality output and will apply lower intervention levels on freight routes. In the following section we test the derivation of the overall service life for freight routes in ICM.

2.3.8 Network Rail have published the following table of Track Asset Service lives (years) in their Track Asset Policy document dated 30th June 2006.

Cat	CWR	Jointed Rail	Hardwood Sleepers	Concrete Sleepers	Softwood Sleepers	Steel Sleepers	Slab track	Ballast	S&C
1A	30	40	30	35	35	30	35	25	25
1	30	40	30	35	35	30	35	25	30
2	40	40	40	40	35	40	40	40	35
3	45	40	45	45	35	45	45	45	40
4	50	45	50	50	40	50	50	50	45
5	**70**	**60**	**50**	**55**	**40**	**50**	**55**	**60**	**50**
6	70	60	50	65	40	50	65	65	60

Figure 2.3.2 Track Service life (years) table

2.3.9 As can be seen this divides track types by Track Category. Network Rail have advised that only a small percentage of FOLs fall into the higher category lines with the majority in Track Categories 5 and 6. We have taken Track Category 5 as a representative category for FOLs.

2.3.10 We have then considered the population of track types on each freight only route. By calculating the total length of each track type, then multiplying this by the respective track asset service life according to the track asset policy (without life extension factors) this gives us a "Km Years" value for each track type. Rails, both Jointed and CWR are then grouped together, likewise with sleepers (concrete, hardwood, softwood and steel). An average service life has then been calculated from these groupings as shown in the table below. The full calculations are included in Appendix B.

	PL CWR	PL Jtd	Slab Track	Concrete	Hard-wood	Soft-wood	Steel	Ballast	S&C (units)
FOLs Total (Kms)	865.4	415.9	1.9	732.6	188.2	227.6	130.4	1,284.1	1,063
Service Life (Yrs)	70	60	55	55	50	40	50	60	50
Km Years	60,577	24,955	103	40,294	9,409	9,105	6,520	77,049	53,150
Ave Life (Yrs)	66.7			51.1				60.0	50
Ave Life (Yrs)	59.3								50

Figure 2.3.3 Cat.5 Average Track service lives for each track component grouping

2.3.11 If we consider complete track system renewal, rather than the individual replacement of components is driven by the sleeper life (as this is the shortest life) and therefore from the table above this shows that the composite track life for plain line track is 51.1 years and S&C is 50 years. If we further aggregate all asset groups we achieve an overall average of 59.3 years.

2.3.12 The value of 59.3 years is equivalent to an uplift factor of 14%. The average value of 59.3 years relies on the asset lives above being reflective of those on freight routes – total track category 5 line km are likely to include elements of mixed and passenger only traffic sections. We believe there are several factors that may influence the average lives given above when considering freight only operation:

(a) Policy to renew track assets so that age profile is maintained within each track category to avoid backlogs developing. This is the main driver of track renewals on the network, however it is often contended by freight operators that backlogs are allowed to accumulate to a greater level on the freight routes.

(b) The maintenance and renewal standards and the potential for deferral allowed. Standards for maintenance and renewal are not significantly different in regards to intervention levels required to rectify defects or replace components such as sleepers and rail. It is possible on freight routes, however, to defer renewals by management of condition through speed restrictions, increased maintenance and selected component renewal under a "perpetual maintenance" approach (e.g. a continuous cycle of partial resleepering). We note that the composite age of 59.3 years largely reflects this approach[2].

(c) Acceleration of renewals due to higher axle loads on FOLs compared to the mixed network. Using data taken from the Infrastructure Cost Model (ICM) we have calculated that the average axle load on the mixed network is approximately 16.2 tonnes while on freight only routes it is 18.8 tonnes (16% higher)

[2] If we assume a composite or complete renewal approach is adopted, then the average life would be closer to 51.1 years. This is driven by renewal of sleepers as the component with the shortest life

(d) Traffic specific influences such as ballast congestion due to spillage. This is known to be a factor on some routes, particularly where coal is carried however across the whole of freight only routes this is not considered significant.

2.3.13 From the factors above we can see that there are significant influences that may impact on overall service life. We note that the analysis based on current asset policy indicates a value already some 14% higher than that predicted by the service life curves. In particular, the understanding of the impact of axle loads on degradation and potential differences in maintenance policy may be significant. We believe that further analysis is necessary to determine the appropriate value and that care must be taken in determining charges that costs are not "double counted" by scaling vehicle type charges as well as freight only costs.

Unit Rate of Track Renewals

2.3.14 Network Rail have applied a factor of 90% to unit costs for renewals for FOLs in recognition that costs are lower when compared with those carried out on the shared network. The unit cost of a track renewal can be influenced by a number of factors such as:

- Renewal strategy to suit the category and strategy for the route (i.e. high output renewals, standard Traxcavate or Ballast Clean approach or low cost renewals)
- Possession access in terms of available occupation time (i.e. blockade, weekend 52Hrs or 28Hrs, midweek possessions etc.)
- Weekend or midweek rates for labour & plant particularly where possession access allows midweek renewals
- Specification for track materials according to the Track Category
- Renewal methodology driven by efficiencies and innovations
- Site specific characteristics and the logistics required for renewing track on single lines as opposed to twin track lines, in platforms, single bore tunnels, level crossings etc.
- The variations between DC, AC and non-electrified lines, dealing with conductor rail, overhead line equipment etc.

2.3.15 The 90% applied by Network Rail is understood to be based on their own engineering judgement of these variations when applied to FOLs. We have not reviewed the detailed calculations on how Network Average renewal costs are determined but we understand that this is simply derived from total renewal costs/total volumes. We believe that this will skew the network average towards the higher category lines where the majority of renewals are completed. As noted in the previous section, the majority of FOLs are in Track Category 5[3]. We have therefore assessed the relative costs for plain line track renewals for track cat. 1A/1 and 2 lines and track cat. 5 lines to estimate a unit cost reduction factor.

2.3.16 For track renewal scope, method and access assumptions, we have chosen a 439m length (24 x 60ft lengths) renewal carried out using a typical excavation, reballasting & relay (Traxcavate) method. For the Cat.1A/1 and Cat.2 examples we have assumed a typical 28 hour weekend possession with preparation and follow-up. For the Cat.5 example we have chosen midweek daytime possessions to carry out all the work. This is on the basis that FOL can generally be blocked during the week due to the greater flexibility of retiming and diverting freight traffic and the larger window of opportunity between freight movements to take planned possessions.

[3] there a few exceptions such as the freight only lines to Immingham and Drax

2.3.17 For component specification, for the Cat.1A/1 and Cat.2 example we have used new 113A Rail (CWR) with new concrete sleepers laid on a 300mm (Cat.1A/1) & 250mm (Cat.2) layer of ballast. We note that the materials can be lower specification on Cat.5 lines compared and for the modelled renewal on Cat. 5 track we have assumed use of serviceable rail (CWR) and serviceable concrete sleepers laid on a 200mm ballast layer. We have assumed non-electrified tracks in all examples.

2.3.18 We have excluded allocation of office overhead costs relating to track renewals in both cases on the basis that these should be allocated on a basis consistent with the underlying costs, thus not affecting overall relative cost proportions. The following is a summary table of the estimated cost of a plain line track renewal as described above.

	Shared Network		FOLs
	Cat.1A/1	**Cat.2**	**Cat.5**
Manpower	£55,310	£55,310	£38,754
Materials	£87,342	£84,481	£42,951
Ballast	£29,495	£26,741	£24,684
On-Track Plant	£18,024	£18,024	£15,972
Hired Plant	£13,630	£13,630	£9,853
Portable Plant	£1,452	£1,452	£1,452
Engine Power	£22,500	£22,500	£24,000
Totals	**£227,752**	**£222,138**	**£157,665**

Figure 2.3.4 Plain Line Track Renewal Cost Estimate Summary

2.3.19 A full breakdown of these cost estimates can be found in Appendix C.

2.3.20 Comparing the cost estimates from the table above, the percentage cost of a freight only renewal appears significantly lower than that for the shared network with costs in the order of 70% of renewals for Cat 1A/1 and 2 lines. We note that there are a number of other factors which may influence relative costs such as use of high output plant on renewals on the mixed network and relative differences in possession on-costs for different routes, but believe the comparison of direct costs using comparable methods gives a good indicator of the overall relativity of costs.

2.3.21 We suggest, however, that a more detailed examination of unit costs is undertaken so that appropriate renewal methods and specifications can be considered against the range of track categories. We understand that there are also efficiencies expected from the range of track renewal methods in place and other innovative ideas being considered that will reduce the unit cost using new/enhanced track renewal methods. We recommend that these are considered also.

Track Maintenance

2.3.22 Network Rail has generated costs for track maintenance on all lines using the ICM. The ICM uses a similar process for determining costs to that used for renewals, i.e. activity volumes are estimated for each route section and unit costs are applied to these volumes to give an overall cost.

2.3.23 Within ICM activity volumes vary according to:

- Traffic volumes (EMGPTA);
- Track category and standards;
- Expected residual life (considers current condition & future degradation);
- Asset/component type;
- Assumed activity levels based on asset population size; and
- Deliverability adjustment to overall volume profiles.

2.3.24 Network Rail's approach generally appears to reflect consideration of the appropriate factors for varying activity volumes although we note some elements where volumes are driven by historical activity levels rather than specific degradation relationships. Where traffic volumes are not varying this is a reasonable assumption.

2.3.25 Unit costs for each maintenance activity are taken as network averages. Efficiency gains are assumed up to the end of CP3, with costs constant beyond this. As for renewals, we would expect unit costs for FOLs to vary from those of the mixed network. The following factors will vary on a FOL compared to the shared network:

- Possession access is generally easier and cheaper on a FOL;
- Midweek labour and plant productivity rates will be greater through better track access times and less onerous protection arrangements required than on the shared network;
- The increased productivity achieved in midweek day possessions reduces the need for midweek night and weekend possessions which attract higher labour costs; and
- The specification for track materials can be lower on lower category lines.

2.3.26 Network Rail has not attempted to capture these factors, as no reduction factor has been applied to Freight Only costs. We have again carried out a bottom up exercise to validate this and have calculated this reduction as 28%, i.e. a 72% factor. The breakdown of this reduction is shown below and is summarised and supported with more detail in the Appendix D.

Track Maintenance Activity	Base line Costs £K	Reduction %age	Weighted Average Reduction
Ultrasonic rail inspection	15,444.31	9%	0.6%
Rail changing	77,166.46	20%	6.9%
Re-sleepering	8,668.33	48%	1.9%
Plain line tamping	32,455.94	45%	6.6%
Stone blowing	8,354.86	45%	1.7%
Wet bed removal	10,809.00	58%	2.8%
S&C tamping	12,508.73	37%	2.1%
S&C unit renewal	7,908.58	12%	0.4%
Replacement of S&C bearers	2,105.85	31%	0.3%
S&C weld repairs	2,007.08	44%	0.4%
Visual inspection (patrolling)	22,545.54	9%	0.9%
Weld repair of defective rails	1,270.17	57%	0.3%
Insulated joint renewal	4,751.65	16%	0.3%
Manual correction of plain line track geometry	2,682.16	58%	0.7%
Reprofiling of ballast	8,405.76	45%	1.7%
Longitudinal timber (Maintenance)	4,323.03	20%	0.4%
Totals	**221,407.45**		**28.1%**

Figure 2.3.5 Breakdown of Reduction Factor for track maintenance

2.3.27 We propose that a more detailed examination of unit costs is undertaken so that appropriate maintenance methods and specifications can be considered against the range of factors stated above.

Civil Renewals

2.3.28 The civils costs are calculated by applying asset specific nationally averaged unit costs per structure for the given policy chose by the number of structures on a given route. These unit costs are taken from the Structures Annual Cost Profile (SACP) model. We note that there is no differentiation for asset characteristic, such as number of spans, axle loading, ease of maintenance (e.g, height of bridge) or environmental factors (e.g. coastal areas).

2.3.29 There are three Civils Renewals policies built into the model. The table below, from the ICM functional specification gives the definition of these three policies.

Policy	*Description*	*Rationale / consequences*	*Strategy*
A	Return and maintain the stock to steady state by the use of maintenance activities that will improve performance levels and the remaining life of existing assets.	Improved reliability of performance is achieved. Condition is held at a relatively higher level to minimise the risk of early or unexpected failure.	Carry out regular pro-active maintenance to control deterioration. Where renewal or major repair is required, use whole-life analysis to determine the least present-day cost option.
B	Allow structures to deteriorate until repairs or replacement are essential to maintain operational requirements. At the time of intervention, carry out works that achieve lowest long-term costs for the structure.	Intervention is delayed until performance is affected by further deterioration. Interventions are carried out on a comprehensive basis to maximise longevity of individual structures.	Evaluate essential intervention requirements using whole-life costing analysis to determine the most economic lifetime plan for individual structures.
C	Allow structures to deteriorate until intervention is essential to maintain safety standards or raise performance levels to an acceptable level.	Short-term expenditure is kept to an absolute minimum. Lower overall condition carries higher risk of performance restrictions and minor failures. Increased examination and monitoring regimes required.	Carry out work on a restricted basis to keep current expenditure to lowest possible level.

Figure 2.3.6 Description of civils asset management policies A, B and C from the ICM FS

2.3.30 Network Rail has used Policy C for freight routes within their estimates. Network Rail has apparently also run the model using Policy B for the Freight Routes. They have stated that the total costs are similar to those from Policy C. We have reviewed the model assumptions for each policy and note that the Policy C cost assumptions are consistently higher than those for Policy B. The table below provides a comparison for each type of structure over a 35 year period for each policy. This indicates a 15% increase in costs (in practice, the actual difference will be determined by the population of different structure types).

	Cost (£k) of Policy B for 35 yrs per unit	Cost (£k) of Policy C for 35 yrs per unit	Extra Cost (£k) of Policy C
Masonry Overbridges	188.4	235.7	47.3
Metal Overbridges	291.0	414.2	123.2
Concrete Overbridges	167.0	216.4	49.4
Masonry Underbridges	159.8	229.3	69.5
Metal Underbridges	486.3	741.2	254.9
Concrete Underbridges	111.1	147.5	36.4
Footbridges	378.2	646.9	268.7
Culverts	41.2	45.1	3.8
Tunnels (per km)	2007.6	2788.5	780.9
Earthworks (per km)	95.2	123.3	28.1
Retaining Walls (per km)	217.9	270.4	52.5
Coastal Defences (per km)	3994.3	4602.7	608.5

Figure 2.3.7 35 year cost of Policy choices by civil asset type

2.3.31 Network Rail justify the adoption of Policy C on the basis that it gives significantly lower short to medium term costs with the potential to reduce longer term costs by making strategic decisions regarding renewals as the need arises, with potential to avoid those costs if a business case does not support continued investment in a particular route or capability. This could result in up to half of the costs above being avoided. Figure 2.3.8 below shows the control period average annual spends estimated from the Policy C ICM profile for FOLs. The cost across the whole modelled period is equivalent to an average spend of £13.6M. Network Rail estimate that if future renewals costs are excluded (and decided on a case by case basis), the baseline expenditure would reduce to an average of £6.6M. It is noted that this lower civils estimate is not set as low as the CP4 average, as suggested in Network Rail's 20/10/06 initial estimate paper.

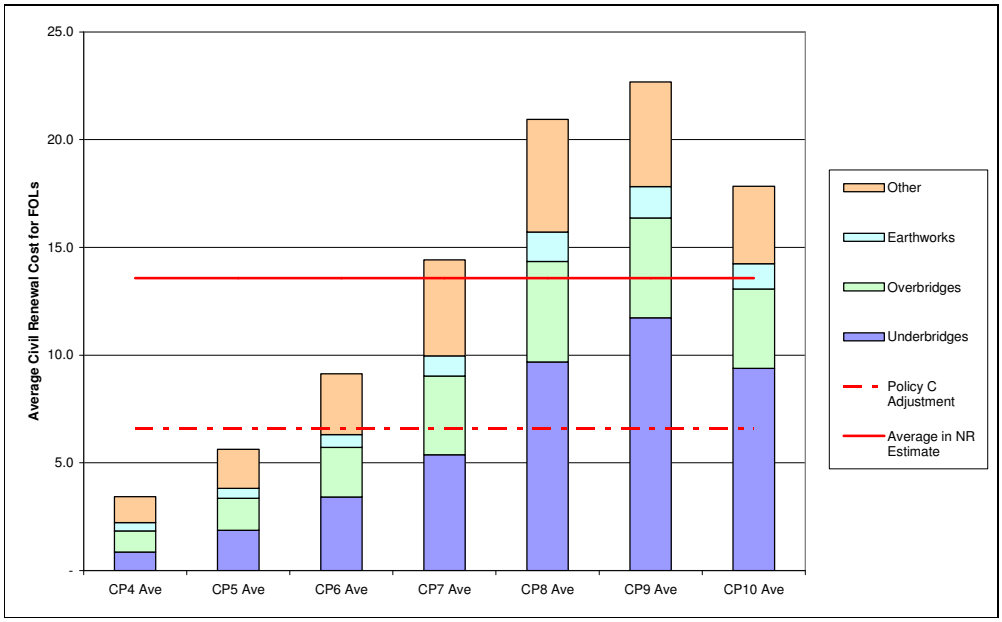

Figure 2.3.8 Yearly Average Civil Renewal cost by CP

2.3.32 As for the other asset groups, the unit costs for civil renewals for FOLs is reduced using a factor of 90% compared to the network averages taken from the SACP model. We have not had access to the underlying cost data in SACP to determine the factors included in the different unit cost build up for each policy but would expect that similar factors relating to access, productivity and labour rates identified for track asset renewals would apply to structures renewals and we would expect a greater reduction in unit rates to apply.

Signalling Renewals

2.3.33 Signalling costs have been calculated by using costs derived from signalling interlocking workbanks assessed by Network Rail's signalling engineers. We have not reviewed the cost estimate process in detail as this is completed outside of the ICM. Within ICM, costs are allocated to each SRS by equally distributing the cost of each interlocking to the SRS that it controls, for example if a there are 3 SRS then each is attributed a third of the cost.

2.3.34 Network Rail note that this is a simplified approach and intend to refine the allocation methodology. We would suggest that this is recalculated using either the number of SEUs, Route KM per SRS, or using an avoidable cost approach to identify reduced infrastructure and costs resulting from removal of an individual operator. We expect that the current approach taken will have over estimated the cost allocated to FOLs.

2.3.35 We note that the projected annual cost of £15.6M for signalling renewals for FOL is significantly higher than that projected by Brown and Root in 2000 (£0.1M in 1999/2000 rising to an average of £7.1M in CP4 in 1999 prices). We note that Network Rail have significantly improved their understanding of required signalling renewals work and its long term strategy which should give a greater confidence in the current estimates.

3 Cost Variability for Mixed Network

3.1 Network Rail's Modelling Methodology

3.1.1 Total variable costs for freight on the mixed network have been estimated by Network Rail at £86.5M. The split of these costs by expenditure type is shown in Figure 3.1.1 below.

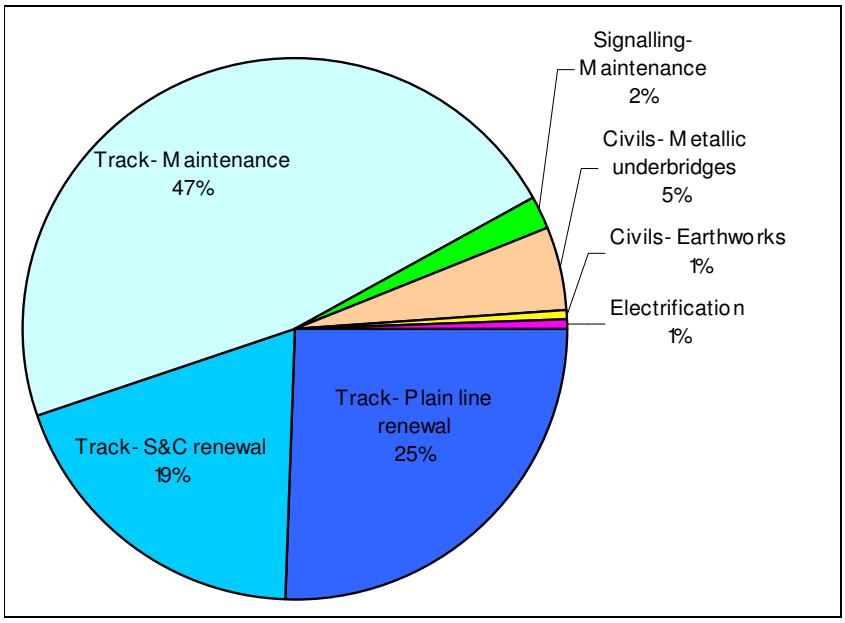

Figure 3.1.1 Split of Variable Cost

3.1.2 Network Rail has used two methods for calculating cost variability. These are:

- Use of ICM for testing sensitivity for track renewals and maintenance; and
- "Offline" calculations based on engineering judgement on activity and cost variability and costs from ICM for other disciplines.

3.1.3 Figure 3.1.1 shows that variable costs are dominated by expenditure related to track assets (c. 91% of total variable costs).

3.1.4 Network Rail's analysis indicates variable costs in the order of 31% for track maintenance, 22% for plain line track renewals and 38% for track S&C renewals. Overall, this indicates track variable costs in the order of 29%. We note that this is significantly different than previous analysis from ACR2000 and SOCC 2005.

3.1.5 For track renewals and track maintenance, variability was determined through the following process:

- A "base case" was defined relying on traffic projections to generate expected activity volumes from ICM;

- An incremental traffic case was modelled, using a 5% traffic uplift for maintenance and 10% traffic uplift (in train and GTKm) for renewals for CP4 to CP9[4] to generate incremental volumes of activities from ICM;
- Volumes were multiplied by unit rates in ICM (for track maintenance) or taken from the 2009/10 business plan (for track renewals) to generate incremental costs;
- Incremental costs were divided by gross tonne kilometres (determined from the incremental traffic) to determine a variable cost rate in £/GTKm; and
- The variable cost rate in £/GTKm was multiplied by 2005/06 estimated traffic (taken from ACTRAFF data) for freight to give total freight variable costs.

3.1.6 In the following sections we review Network Rail's methodology focussing on three main areas:

- The potential sensitivity results to changes in traffic mix (passenger/freight) and traffic assumptions;
- Track maintenance variable cost estimates; and
- Plain line track renewals variables cost estimates.

3.1.7 We note that the variability percentages used for the non-track activities are in line with the variability estimates used in the Booz Allen and Hamilton/TTCI (BAH/TTCI) review which was undertaken for ORR in 2005[5]. Within their report BAH raised concern regarding the disaggregation of Network Rail's cost estimates and the proportion of the costs that were usage related. We believe that these concerns are still valid and suggest that Network Rail should undertake further work in verifying these variability estimates.

3.2 Traffic Mix

3.2.1 The following table of traffic data by route type for the predicted traffic levels in 2009/10 was taken from the ICM:

Route Type	Million Gross Tonne km		% of Total	
	Freight	Passenger	Freight	Passenger
Primary	33,510	66,956	20%	40%
London & SE	2,420	22,109	1%	13%
Secondary	17,556	16,936	10%	10%
Rural	809	2,946	0%	2%
Freight	5,068	290	3%	0%
Total	**59,363**	**109,237**	**35%**	**65%**

Figure 3.2.1 Traffic Data by Route Class for 2009/10

3.2.2 These numbers are noticeably different then the 2005/06 figures used in the variability calculation, with the freight % increasing from 30% to 35% by 2009/10. This assumes a 24% increase in freight traffic and a 3% decrease in passenger traffic within 5 years. We have not reviewed any underlying data that supports these estimates and recommend further work is done to validate these projections.

[4] CP3 is excluded from calculations to avoid distortion of figures from inclusion of perceived backlog works.
[5] *Review of Variable Usage and Electrification Asset Usage Charges: Final Report*, Booz Allen Hamilton and TTCI (UK) Ltd., June 2005.

3.2.3 It is apparent from the table above that the London & SE and rural routes are dominated by passenger traffic while freight routes are mostly freight traffic. The ICM provides the ability to model costs for each SRS, such that the cost variability can potentially be determined to a much grater level of granularity. It is expected that variable costs will differ by both route type (relating to track category and configuration) and traffic mix. We note also that in calculating total FOL costs, the subsequent inclusion of these costs in the variable calculation can skew results. Similarly, if we are concerned only with freight variable costs on the mixed use network, the inclusion of costs for dominantly passenger routes may similarly skew results. To test this sensitivity, we have re-run the variable calculation using just the costs and MGTKm for the primary and secondary routes. This resulted in a £4m increase in variable costs for freight.

3.2.4 We recommend that further consideration is given to dis-aggregation of costs, typical route types and long term scenarios for traffic growth (rather than the basic 5% and 10% tests used for maintenance and renewals across all routes) to determine freight variable charges.

3.3 Track Maintenance Cost Variability

Modelling Approach

3.3.1 Network Rail's process for calculating the variable cost of track maintenance is based on assessing the difference in total costs generated from the ICM for a 5% uplift in traffic against the current base line from CP4. The following describes the steps in the process using analysis produced by Network Rail for CP4 Only[6].

(a) The modelled volume of track maintenance activities is multiplied by a unit cost within the ICM to generate costs against each activity, firstly for a base line scenario and then for a 5% increase in traffic expressed in GTKm. This indicates an increase of £7,699M as shown in the table below.

[6] We note that this separate analysis produced by Network Rail does not completely reconcile with data in ICM for CP4. We have highlighted significant differences where appropriate

Track Maintenance Activity	Baseline Costs £k	Plus 5% Traffic increase Costs £k	Change £k	%age increase
Ultrasonic rail inspection	15,444	15,949	504	3.3%
Rail changing	77,166	79,889	2,722	3.5%
Re-sleepering	8,668	8,702	34	0.4%
Plain line tamping	32,456	32,632	176	0.5%
Stone blowing	8,355	8,395	40	0.5%
Wet bed removal	10,809	10,810	1	0.0%
S&C tamping	12,509	12,898	390	3.1%
S&C unit renewal	7,909	7,976	67	0.8%
Replacement of S&C bearers	2,106	2,124	18	0.9%
S&C weld repairs	2,007	2,007	0	0.0%
Visual inspection (patrolling)	22,546	22,765	219	1.0%
Weld repair of defective rails	1,270	1,296	26	2.0%
Insulated joint renewal	4,752	5,031	280	5.9%
Manual correction of plain line track geometry	2,682	2,687	5	0.2%
Reprofiling of ballast	8,406	8,450	45	0.5%
Long. timber (Maintenance)	4,323	4,346	23	0.5%
Other Track	88,563	90,383	1,820	2.1%
New Measurement Train	3,378	3,378	0	0.0%
Grinding	29,237	30,543	1,306	4.5%
Other NDS Costs	1,654	1,678	24	1.4%
Ultrasonic rail exam trains	50,180	50,180	0	0.0%
Off-Track	77,428	77,428	0	0.0%
Totals	**471,847**	**479,546**	**7,699**	**1.6%**

Figure 3.3.1 Variability of Track Maintenance Activities

(b) The total of the 5% increase in the network total in MGTKm is calculated. This equates to 8,421 MGTKm (176,833 MGTKm – 168,412 MGTKm for 2009/10).

(c) The £7.699M increase in maintenance cost is then divided by the 8,421 MGTKm to get a cost (£) per thousand GTKm of 0.91.

(d) The cost of 0.91 £/KGTKm is multiplied by the GB network total KGTKm of 160,576,489 for 2005/06.

(e) This equates to £146.1M as the total variable cost of Track maintenance in 2005/06.

3.3.2 In their calculations, Network Rail have divided the total variable cost in 2005/06 by the network total annual track maintenance cost of £472M for 2009/10 to indicate that variable costs are 31% of total maintenance. We note that if the calculation is completed using CP4 traffic and total maintenance costs that variable costs are estimated at 33%.

Commentary on Modelling Approach

3.3.3 We make the following observations on Network Rail's approach.

3.3.4 The 5% incremental case in traffic across the network has been selected by Network Rail after testing a range of increases which apparently indicated a linear relationship between costs and traffic within this range. We have not reviewed the results of Network Rail's sensitivity tests and it is not apparent why a different uplift scenario of 10% is used for renewals. As noted in section 3.2 we believe further justification of the chosen level of traffic used for modelling needs to be provided, with sensitivity testing for increases of particular traffic types and on particular routes.

3.3.5 We note that there appear to be several anomalies in the projected change in costs by activity for the increase in traffic modelled. For example, a 5% increase in traffic doesn't increase S&C weld repairs at all and has a minimal impact on manual correction of plain line geometry, both of which would typically be directly related to traffic. It is also difficult to believe that the rail defect population will increase such that the (pedestrian) ultrasonic testing activity will cost 3.3% more. Existing defect growth will increase, but only a small increase in new defects will emerge which will increase testing times.

3.3.6 We note that the resultant total variable cost calculation is based on the simple metric of gross tonne kilometres while costs within ICM are driven by a number of different metrics. In particular, equivalent tonnage, which considers factors including, linespeed, track type, axle load and vehicle suspension characteristics, is a key parameter used to estimate track damage. We note that while the current charging system is based on gross tonne kilometres, further adjustment of tariffs is made to reflect these factors. It is likely that when these factors are considered the proportion of costs allocated to freight will increase.

3.3.7 We also note that other factors will drive elements of variable costs, including train kilometres, vehicle kilometres and number of trains. We recommend that Network Rail undertake a more detailed approach to analysis of variable costs drivers, particularly when applying results of modelled costs to the current traffic profile.

3.4 Plain Line Track Renewals

Network Rail Modelling Approach

3.4.1 Network Rail's process for calculating the variable cost of track renewals is similar to that used for track maintenance with the following exceptions:

- ICM is used to produce estimates of renewals volumes only. Unit costs are taken from Network Rail's Initial Strategic Business Plan (ISBP) with values for 2009/10 adopted.
- A traffic uplift of 10% is used to test variability.

3.4.2 The key difference in approach is the calculation of costs outside of ICM. The following describes the process used by Network Rail to calculate the variability for Plain Line track renewals. Network Rail adopted the same approach for S&C renewals.

(a) The volume of track renewals (in Km for ballast, sleepers and rail) is taken over CP4 to CP9, firstly for the base line and then for a 10% increase in traffic (in train and gross tonne km). The average annual values for CP4 to CP 9 are shown below:

Track Component	Baseline Renewal Volumes	10% Traffic increase (km)	Change km	%age increase
Rail	660	672	12.3	1.9%
Sleepers	615	627	11.2	1.8%
Ballast	699	716	17.0	2.4%
Totals	**1,974**	**2,014**	**40.5**	**2.1%**

Figure 3.4.1 Variability of Track Renewals Volumes

(b) Volumes of renewals are combined to give a "composite" plain track renewals volume. The difference between these two scenarios results in an average of 40.5 Km per annum.

(c) This is then multiplied by a unit cost of £191,000/km to give a total cost increase of £7.575M. This unit rate is derived from:

(i) A base cost of £187,000/km from total expenditure from the ISBP in 2009/10 divided the composite Km total of 2,589 Track Renewal Km also from the ISBP.

(ii) An increase of 2.6% to £191,000/km to remove efficiency overlays and thus reflect a pre-efficiency cost

(d) A 10% increase in the network total in MGTKm is calculated for 2005/06 which is taken as 16,000 MGT KM (i.e. approximately 10% of 160,576,489).

(e) The £7.757M renewal cost is then divided by the 16,000 MGTKm to get a cost of £0.49/ KGTKm

(f) The cost of £0.49 /KGTKm is multiplied by the GB network total KGTKm of 160,576,489. This equates to £78.7M as the total variable cost of Plain Line renewals.

3.4.3 This is then divided by the network total annual cost of £356M (the average annual renewal value from CP4 to CP10) to get an estimate of annual variable cost of 22% of total costs. We are not clear as to why Network Rail choose to use the 2005/06 traffic levels to calculate unit rates and variability. If the values for CP4 are used, the resulting variable cost calculation becomes:

(a) A 10% increase in the network total in MGTKm for CP4 equates to 16,842 MGT Km.

(b) The £7.757M renewal cost is then divided by the 16,842 MGTKm to get a cost of £0.46/KGTKm.

(c) The cost of £0.46/KGTKm is multiplied by the GB network total KGTKm for 2009/10. For the base case (of 168,412 KGTKm) this equates to £77.6M. For the 10% incremental case this equates to £81.4M.

3.4.4 This results in a similar estimate of variable costs at 22% of the total of £356M.

Commentary on Modelling Approach

3.4.5 We make the following observations on Network Rail's approach.

3.4.6 The 10% incremental case in traffic across the network has been selected by Network Rail after testing a range of increases which apparently indicated a linear relationship between costs and traffic within this range. We have not reviewed the results of Network Rail's sensitivity tests and it is not apparent why a different uplift scenario is used for maintenance. As noted in section 3.2 we believe further justification of the chosen level of traffic used for modelling is provided, with sensitivity tested for increases of particular traffic types and on particular routes.

3.4.7 It is noted that Network Rail do not have sufficient confidence in the cost calculations within ICM for renewals to base their analysis on this. We note that the use of the composite renewal rate has the potential to distort costs depending on the overall mix of activities included in the calculation. It is not clear why individual unit rates for the expected mix of work to be undertaken are not modelled.

3.4.8 As for maintenance, we note that the resultant total variable cost calculation is based on the simple metric of gross tonne kilometres while costs within ICM are driven by a number of different metrics. In particular, equivalent tonnage, which considers factors including, linespeed, track type, axle load and vehicle suspension characteristics, is a key parameter used to estimate track damage. Again, we note that while the current charging system is based on gross tonne kilometres, further adjustment of tariffs is made to reflect these factors. It is likely that when these factors are considered the proportion of costs allocated to freight will increase.

3.4.9 We note that the costs, volumes and calculated variable costs are significantly lower than previous estimates of track renewals variability. In the ACR 2001, plain line renewals costs were estimated at 36%, while in the SOCC review work completed in 2005 this was increased to 44%. We would also expect that renewal rates would be higher than those indicated above from Network Rail's analysis. This may be impacted by the following factors:

- Service life curves are not reflective of the variability of age with increased levels of traffic; and
- Renewals volumes in CP4 to CP9 are not reflective of steady state levels. The impact of backlog works completed in CP2 and CP3 which reduces the need for renewals in the modelled period of CP4 to CP9 (i.e. renewed assets in CP2 and CP3 will lead to a similar "rump" of renewals beyond CP9).

3.4.10 The figure below shows the profile of track renewal volumes projected by ICM (actual values are used from 2001/02 to 2005/06[7]). By reference to Figure 2.2.2, it is apparent that large elements of track will have a life greater than 40 years and thus the backlog of renewals completed in the period up CP4 would not be expected to be renewed until after CP9.

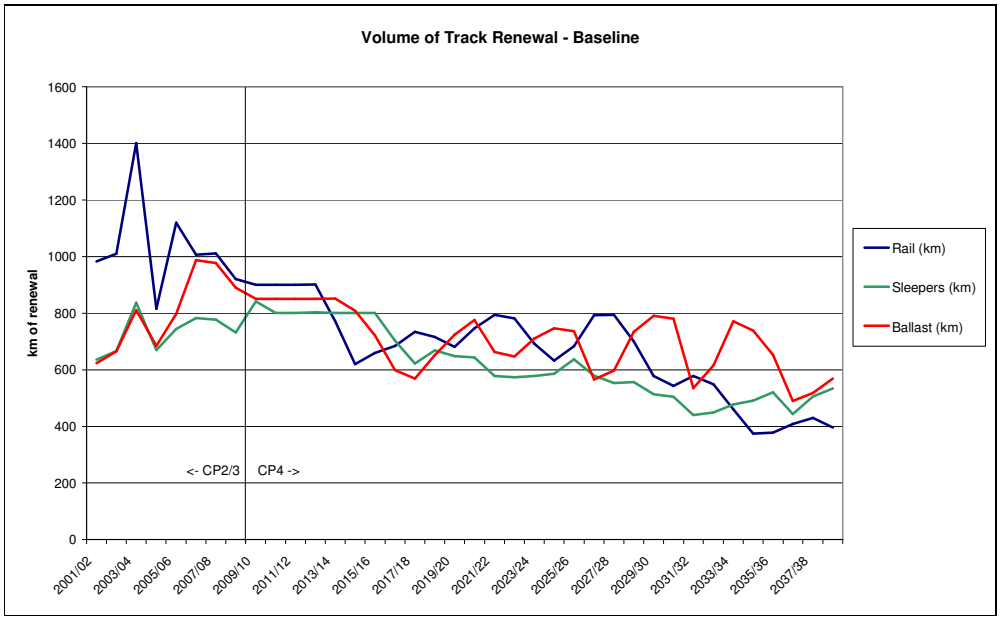

Figure 3.4.2 Volume of Track Renewal (2001/02 – 2038/39)

[7] Volumes taken from Measures M20, M21 & M22 of the 2006 Network Rail Annual Return.

4 Conclusions & Recommendations

4.1.1 We note that Network Rail's work on the ICM and specifically estimation of costs associated with freight is still under development and will evolve further. We also note that the time available for our review prevented detailed assessment of a number of factors and calculation processes used by Network Rail in determining FOL and variable costs. A number of calculations are carried out separately to the ICM and these have not yet been subject to scrutiny by AMCL (Independent Reporters for Asset Management practices).

4.1.2 We list below our recommendations for priorities for further investigation, analysis and development as appropriate.

4.1.3 General ICM Development

- Further work is necessary to validate the model service life curves and relationships included in ICM. In particular these will need to be calibrated against:
  - (i) Differences in policies for maintenance and renewals by route type and track category for service life "uplifts";
  - (ii) Understanding of actual track condition to define the current "age" or residual life of assets.
- We propose that a more detailed examination of unit costs is undertaken so that appropriate renewal methods and specifications can be considered against the range of track categories. We understand that there are also efficiencies expected from the range of track renewal methods in place and other innovative ideas being considered that will reduce the unit cost using new/enhanced track renewal methods. We recommend that these are considered also.
- Extended modelling of renewals volumes may be warranted to validate the "whole life" impacts of backlog works completed in CP2 and CP3.
- Integration of cost elements modelled outside ICM is recommended to ensure greater transparency and ensure consistency between modelled cost elements/assets.
- Treatment of allocatable, related and attributable costs apportionment should be further developed, particularly if route based charging is to be developed.

4.1.4 FOLs Cost Estimates:

- A consistent definition of "Freight Only Lines" should be agreed to ensure that analysis of route costs is consistently applied.
- For the small number of freight routes, more bespoke analysis of actual costs incurred should be undertaken to reflect:
  - (i) Differences in policies and practices for maintenance and renewals for freight only routes compared to the mixed network;
  - (ii) More detailed analysis of infrastructure profiles for freight routes, including more accurate modelling of civils assets, and potential differences in asset configuration;
  - (iii) Methods for apportioning "related" costs/infrastructure to freight only routes including weighting of route sections and/or avoidability cost analysis;
  - (iv) Analysis at a more disaggregate level of excluded and allocatable costs;
  - (v) More analysis of the unit costs incurred on freight only routes, reflecting differences in work practices, standards access costs and productivity.

4.1.5 Variable Cost Estimates:

- Network Rail should adopt a consistent approach to analysis of both maintenance and renewals variability. This should model similar scenarios for traffic variability and in assessing costs, these should be reconciled to the appropriate traffic levels.
- Further analysis should be undertaken in the sensitivity of analysis to traffic mix, linked to actual assessment of likely demand and service growth.
- Calculation of total costs should be further refined to recognise the different cost drivers, in particular:
  - (i) The different impact of different vehicles, operating speeds and axle loads on damage (as is the case with current charging);
  - (ii) Analysis of the sensitivity to cost variance from other cost drivers such as number of trains, train and/or vehicle kilometres.
- Network Rail should improve the unit cost estimates used for plain line track renewals. The current approach of using a composite renewal value derived independently from the ICM and excluding efficiency estimates does not appear to accurately reflect expected costs.

5 Appendix A: Meeting schedule

Date	Venue	Attendees
18/10/06	ORR Office	• Tim Griffiths, ORR • Peter Doran, ORR • Paul McMahon, ORR • Chris Littlewood, ORR • Michael Jamieson, Halcrow • Phil Edwards, Halcrow • Megan Gittins, Halcrow
23/10/06	AMCL's Office	• Martin Pilling, AMCL • Richard Edwards, AMCL • Russell Smith, AMCL • Michael Jamieson, Halcrow • Phil Edwards, Halcrow • Megan Gittins, Halcrow
24/10/06	Halcrow's Office	• Peter Doran, ORR • Michael Jamieson, Halcrow • Phil Edwards, Halcrow • Megan Gittins, Halcrow
25/10/06	ORR's Office	• Chris Littlewood, ORR • Megan Gittins, Halcrow
27/10/06	Network Rail's Office	• Dan Boyde, Network Rail • Chris Madden, Network Rail • Phil Edwards, Halcrow • Megan Gittins, Halcrow • Russell Smith, AMCL
30/10/06	ORR Office	• Tim Griffiths, ORR • Peter Doran, ORR • Paul McMahon, ORR • Chris Littlewood, ORR • Phil Edwards, Halcrow • Megan Gittins, Halcrow
31/10/06	Halcrow's Office	• Phil Edwards, Halcrow • Russell Smith, AMCL
01/11/06	Network Rail's Office	• Dan Boyde, Network Rail • Phil Edwards, Halcrow
06/11/06	ORR Office	• Tim Griffiths, ORR • Peter Doran, ORR • Paul McMahon, ORR • Hannah Nixon, ORR • Phil Edwards, Halcrow • Megan Gittins, Halcrow
13/11/06	Network Rail's Office	• Dan Boyde, Network Rail • Chris Madden, Network Rail • Megan Gittins, Halcrow • Russell Smith, AMCL
15/11/06	Halcrow's Office	• Ian Smith, EWS • Phil Edwards, Halcrow • Megan Gittins, Halcrow

6 Appendix B: Track service life calculations

	Track Kilometres								Units
FO SRS	**PL CWR**	**PL Jtd**	**Slab Track**	**Concrete**	**Hardwood**	**Softwood**	**Steel**	**Ballast**	**S&C**
1.16	14.04	18.78	0.00	14.12	10.54	8.16	0.00	32.82	15.00
03.14	8.03	10.39	0.00	6.04	0.13	12.20	0.00	18.42	14.00
05.10	4.69	0.55	0.00	0.00	2.03	0.95	2.25	5.23	3.00
06.08	8.28	14.25	0.00	10.55	4.53	7.43	0.00	22.50	44.00
06.09	3.78	4.20	0.00	3.39	1.80	2.79	0.00	7.98	17.00
06.10	5.82	9.68	0.00	5.05	4.16	5.74	0.54	15.50	36.00
07.04	0.12	4.25	0.00	0.48	0.05	3.65	0.18	4.37	12.00
09.08	34.01	5.03	0.00	29.01	0.26	5.93	3.81	39.04	10.00
09.09	47.77	9.19	0.00	43.84	3.41	9.65	0.00	56.96	54.00
09.10	15.45	0.52	0.00	13.38	1.24	1.36	0.00	15.97	16.00
10.13	61.54	1.32	0.00	61.76	0.25	0.86	0.00	62.87	46.00
10.14	19.48	2.14	0.00	12.59	2.09	1.39	5.48	21.62	4.00
11.15	98.01	15.17	0.00	88.32	6.73	11.33	6.79	113.18	93.00
11.17	91.79	13.79	0.00	72.15	6.99	12.05	14.44	105.64	74.00
12.14	25.77	15.90	0.00	25.90	1.02	11.75	2.84	41.67	37.00
13.23	34.88	19.04	0.05	24.39	1.41	14.74	13.30	53.92	45.00
13.24	8.66	9.89	0.00	9.35	0.34	8.07	0.79	18.55	25.00
14.14	38.64	2.77	0.13	32.49	1.33	3.06	4.41	41.41	48.00
15.02	1.12	1.21	0.00	0.68	0.01	1.20	0.44	2.34	1.00
16.05	3.80	28.02	0.00	2.99	3.45	24.00	1.37	31.82	12.00
17.17	14.59	1.60	0.00	13.86	2.12	0.21	0.00	16.19	14.00
17.21	14.81	9.15	0.00	13.74	7.92	0.87	1.43	23.96	32.00
17.22	63.91	15.64	0.00	56.29	6.50	8.21	8.55	79.55	27.00
18.13	39.06	21.73	0.00	29.72	12.12	10.17	8.76	60.79	83.00
19.11	103.87	98.45	0.00	89.08	90.97	4.28	17.99	202.32	129.00
20.20	33.46	20.82	0.00	17.67	3.75	14.97	17.77	54.28	50.00
24.10	25.19	7.12	0.00	18.29	1.77	3.85	8.40	32.37	35.00
24.11	18.99	21.70	0.00	16.72	0.98	15.41	7.53	40.69	31.00
26.13	25.82	33.62	1.70	20.76	10.30	23.37	3.32	62.20	56.00
All Lines	**865.38**	**415.92**	**1.88**	**732.62**	**188.18**	**227.62**	**130.40**	**1284.15**	**1063.00**
Service Life (Yrs) for Cat.5 Lines	70	60	55	55	50	40	50	60	50
Km Years	60,576.65	24,955.08	103.25	40,294.07	9,409.20	9,104.93	6,519.87	77,048.82	53,150.00
Ave Life (Yrs)	**66.74**			**51.08**				**60.00**	**50.00**
	Average Rail Life			**Average Sleeper Life**				**Ballast**	**S&C**

7 Appendix C: Track Renewal Costing

Shared Network Cat1 – Page 1

Example:
24 Lengths of Plain Line Relay in a 28Hr Possession (Non 3rd Rail)
The unit rates shown below are indicitive only

MANPOWER

		Rate			
Shift	**Manhours**	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
Preparation	256		£19.00	£17.00	£4,864.00
Main Works	808	£22.00			£17,776.00
Follow Up	384		£19.00		£7,296.00
Tech Staff Main Works	68	£28.00			£1,904.00
Tech Staff Follow Up	32		£25.00		£800.00
Welders Main Works	116	£60.00			£6,960.00
Welders Follow Up	64		£47.50		£3,040.00
Protection Staff - Prep	160		£21.00		£3,360.00
Protection Staff - Weekend	238	£25.00			£5,950.00
Protection Staff - Follow Up	160		£21.00		£3,360.00
				Sub-Total	£55,310.00

MATERIALS

	No.	**Unit**	**Rate**		**Cost**
Conc new sleepers	720	Each	£45.00		£32,400.00
Conc Serv Sleepers					
H/W new Sleepers					
Sgl rail new CWR	4	709ft lengths	£8,862.50		£35,450.00
Sgl rail Serv. CWR					
Exp. Sws Full Set	2	Full Set	£4,490.00		£8,980.00
Smalls	24	Pads/Nylons/Clips	£438.00		£10,512.00
Other					
				Sub-Total	£87,342.00

BALLAST

	No.	**Unit**	**Rate**		**Cost**
Stone	1735	Tonnes	£17.00		£29,495.00
Sand					
Terram					
				Sub-Total	£29,495.00

ON-TRACK PLANT

		Rate			
	Hours	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
P/L Tamper - Weekend	12	£614.13			£7,369.50
P/L Tamper - Weeknights	8		£531.75		£4,254.00
Rail Crane					
Ballast Regulator					
LWRTrain & Loco	8		£800.00		£6,400.00
				Sub-Total	£18,023.50

Shared Network Cat1 – Page 2

HIRED PLANT		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Laser Dozer	16	£100.00			£1,600.00
9Tonne Tracked Excavators	32	£50.00			£1,600.00
Road/Rail Excavators PC128	40	£90.00			£3,600.00
Road/Rail Excavators EX165	32	£90.00			£2,880.00
Rail Threader	12	£50.00			£600.00
Ballast Brush & Plough	8	£81.25			£650.00
Triple Wacker Plate Vibrator	8	£81.25			£650.00
Double Wacker Plate Vibrator	8	£56.25			£450.00
Site Lighting (Contract)	16	£100.00			£1,600.00
				Sub-Total	£13,630.00

PORTABLE PLANT		Rate			
	No.	Weekend	Weeknights	Weekdays	Cost
Bance Impact Wrench	2	£42.30			£84.60
Cembre Auger	1	£64.63			£64.63
Cembre Bush Kits	2	£23.50			£47.00
Disc Saw (14")	4	£41.13			£164.52
Chain Saw (inc.Safety Equip.)	2	£52.88			£105.76
Angle Grinder	2	£15.28			£30.56
Generators	4	£22.33			£89.32
Rail Drill	4	£63.45			£253.80
Hilti Drill	2	£25.00			£50.00
Half Set Stressing Tensors	2	£164.50			£329.00
Stressing Under Rollers	120	£0.50			£60.00
Stressing Side Rollers	120	£0.50			£60.00
Permaquip Trollies	4	£28.20			£112.80
				Sub-Total	£1,451.99

ENGINE POWER		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Material Train	20	£375.00			£7,500.00
Spoil Train	8	£375.00			£3,000.00
Spoil Train	8	£375.00			£3,000.00
Spoil & Base Ballast Train	8	£375.00			£3,000.00
Base Ballast Train	8	£375.00			£3,000.00
Hopper Train	8	£375.00			£3,000.00
				Sub-Total	£22,500.00

Grand Total =	£227,752.49

Shared Network Cat2 – Page 1

Example:
24 Lengths of Plain Line Relay in a 28Hr Possession (Non 3rd Rail)
The unit rates shown below are indicitive only

MANPOWER		**Rate**			
Shift	**Manhours**	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
Preparation	256		£19.00	£17.00	£4,864.00
Main Works	808	£22.00			£17,776.00
Follow Up	384		£19.00		£7,296.00
Tech Staff Main Works	68	£28.00			£1,904.00
Tech Staff Follow Up	32		£25.00		£800.00
Welders Main Works	116	£60.00			£6,960.00
Welders Follow Up	64		£47.50		£3,040.00
Protection Staff - Prep	160		£21.00		£3,360.00
Protection Staff - Weekend	238	£25.00			£5,950.00
Protection Staff - Follow Up	160		£21.00		£3,360.00
				Sub-Total	£55,310.00

MATERIALS					
	No.	**Unit**	**Rate**		**Cost**
Conc new sleepers	672	Each	£45.00		£30,240.00
Conc Serv Sleepers					
H/W new Sleepers					
Sgl rail new CWR	4	709ft lengths	£8,862.50		£35,450.00
Sgl rail Serv. CWR					
Exp. Sws Full Set	2	Full Set	£4,490.00		£8,980.00
Smalls	24	Pads/Nylons/Clips	£408.80		£9,811.20
Other					
				Sub-Total	£84,481.20

BALLAST					
	No.	**Unit**	**Rate**		**Cost**
Stone	1573	Tonnes	£17.00		£26,741.00
Sand					
Terram					
				Sub-Total	£26,741.00

ON-TRACK PLANT		**Rate**			
	Hours	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
P/L Tamper - Weekend	12	£614.13			£7,369.50
P/L Tamper - Weeknights	8		£531.75		£4,254.00
Rail Crane					
Ballast Regulator					
LWRTrain & Loco	8		£800.00		£6,400.00
				Sub-Total	£18,023.50

Shared Network Cat2 – Page 2

HIRED PLANT		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Laser Dozer	16	£100.00			£1,600.00
9Tonne Tracked Excavators	32	£50.00			£1,600.00
Road/Rail Excavators PC128	40	£90.00			£3,600.00
Road/Rail Excavators EX165	32	£90.00			£2,880.00
Rail Threader	12	£50.00			£600.00
Ballast Brush & Plough	8	£81.25			£650.00
Triple Wacker Plate Vibrator	8	£81.25			£650.00
Double Wacker Plate Vibrator	8	£56.25			£450.00
Site Lighting (Contract)	16	£100.00			£1,600.00
				Sub-Total	£13,630.00

PORTABLE PLANT		Rate			
	No.	Weekend	Weeknights	Weekdays	Cost
Bance Impact Wrench	2	£42.30			£84.60
Cembre Auger	1	£64.63			£64.63
Cembre Bush Kits	2	£23.50			£47.00
Disc Saw (14")	4	£41.13			£164.52
Chain Saw (inc.Safety Equip.)	2	£52.88			£105.76
Angle Grinder	2	£15.28			£30.56
Generators	4	£22.33			£89.32
Rail Drill	4	£63.45			£253.80
Hilti Drill	2	£25.00			£50.00
Half Set Stressing Tensors	2	£164.50			£329.00
Stressing Under Rollers	120	£0.50			£60.00
Stressing Side Rollers	120	£0.50			£60.00
Permaquip Trollies	4	£28.20			£112.80
				Sub-Total	£1,451.99

ENGINE POWER		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Material Train	20	£375.00			£7,500.00
Spoil Train	8	£375.00			£3,000.00
Spoil Train	8	£375.00			£3,000.00
Spoil & Base Ballast Train	8	£375.00			£3,000.00
Base Ballast Train	8	£375.00			£3,000.00
Hopper Train	8	£375.00			£3,000.00
				Sub-Total	£22,500.00

Grand Total =	£222,137.69

Freight Only Lines – Page 1

Example:
24 Lengths of Plain Line Relay in a 28Hr Possession (Non 3rd Rail)
The unit rates shown below are indicitive only.

MANPOWER

		Rate			
Shift	**Manhours**	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
Preparation	128			£17.00	£2,176.00
Main Works	780			£17.00	£13,260.00
Follow Up	384			£17.00	£6,528.00
Tech Staff Main Works	60			£25.00	£1,500.00
Tech Staff Follow Up	32			£25.00	£800.00
Welders Main Works	60			£47.50	£2,850.00
Welders Follow Up	64			£47.50	£3,040.00
Protection Staff - Prep	100			£20.00	£2,000.00
Protection Staff - Weekend	180			£20.00	£3,600.00
Protection Staff - Follow Up	150			£20.00	£3,000.00
				Sub-Total	£38,754.00

MATERIALS

	No.	**Unit**	**Rate**		**Cost**
Conc new sleepers					
Conc Serv Sleepers	672	Each	£15.00		£10,080.00
H/W new Sleepers					
Sgl rail new CWR					
Sgl rail Serv. CWR	880	Yards	£16.00		£14,080.00
Exp. Sws Full Set	2	Full Set	£4,490.00		£8,980.00
Smalls	24	Pads/Nylons/Clips	£408.80		£9,811.20
Other					
				Sub-Total	£42,951.20

BALLAST

	No.	**Unit**	**Rate**		**Cost**
Stone	1452	Tonnes	£17.00		£24,684.00
Sand					
Terram					
				Sub-Total	£24,684.00

ON-TRACK PLANT

		Rate			
	Hours	**Weekend**	**Weeknights**	**Weekdays**	**Cost**
P/L Tamper - Main Works	10			£531.75	£5,317.50
P/L Tamper - Follow Up	8			£531.75	£4,254.00
Rail Crane					
Ballast Regulator					
LWRTrain & Loco	8		£800.00		£6,400.00
				Sub-Total	£15,971.50

Freight Only Lines – Page 2

HIRED PLANT		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Laser Dozer	20			£80.00	£1,600.00
9Tonne Tracked Excavators	20			£40.00	£800.00
Road/Rail Excavators PC128	40			£72.00	£2,880.00
Road/Rail Excavators EX165	30			£72.00	£2,160.00
Rail Threader	10			£50.00	£500.00
Ballast Brush & Plough	10			£81.25	£812.50
Triple Wacker Plate Vibrator	8			£81.25	£650.00
Double Wacker Plate Vibrator	8			£56.25	£450.00
Site Lighting (Contract)	0			£100.00	£0.00
				Sub-Total	£9,852.50

PORTABLE PLANT		Rate			
	No.	Weekend	Weeknights	Weekdays	Cost
Bance Impact Wrench	2			£42.30	£84.60
Cembre Auger	1			£64.63	£64.63
Cembre Bush Kits	2			£23.50	£47.00
Disc Saw (14")	4			£41.13	£164.52
Chain Saw (inc.Safety Equip.)	2			£52.88	£105.76
Angle Grinder	2			£15.28	£30.56
Generators	4			£22.33	£89.32
Rail Drill	4			£63.45	£253.80
Hilti Drill	2			£25.00	£50.00
Half Set Stressing Tensors	2			£164.50	£329.00
Stressing Under Rollers	120			£0.50	£60.00
Stressing Side Rollers	120			£0.50	£60.00
Permaquip Trollies	4			£28.20	£112.80
				Sub-Total	£1,451.99

ENGINE POWER		Rate			
	Hours	Weekend	Weeknights	Weekdays	Cost
Material Train	16			£375.00	£6,000.00
Spoil Train	16			£375.00	£6,000.00
Spoil Train	8			£375.00	£3,000.00
Spoil & Base Ballast Train	8			£375.00	£3,000.00
Base Ballast Train	8			£375.00	£3,000.00
Hopper Train	8			£375.00	£3,000.00
				Sub-Total	£24,000.00

Grand Total =	£157,665.19

Summary

Freight Only Lines comparison with the Shared Network: Plain Line Track Renewals

		Shared Network		FO Lines
		Cat.1/1A	Cat.2	Cat.5
1	Manpower	£55,310	£55,310	£38,754
2	Materials	£87,342	£84,481	£42,951
3	Ballast	£29,495	£26,741	£24,684
4	On-Track Plant	£18,024	£18,024	£15,972
5	Hired Plant	£13,630	£13,630	£9,853
6	Portable Plant	£1,452	£1,452	£1,452
7	Engine Power	£22,500	£22,500	£24,000
	Totals	**£227,752**	**£222,138**	**£157,665**

Frieght Only/Cat 1/1A	**69%**
Frieght Only/Cat 2	**71%**

Assumptions:

1 This is based on a Cat 1/1A and Cat 2 'Excavate& Relay' Plain Line renewal carried out in a 28 hour weekend possession
2 Freight Only Lines (Cat 5) renewal is the same relay length but carried out in weekday daytime possessions
3 None of the renewals involve conductor rail or Overhead Line works and the curve radius is flatter than 400m.
4 There are no S&T resources included
5 Length of renewal = 2 Pairs of 709fts plus 60ft Ex.Switch Panel at each end (24 x 60ft lengths i.e.439m)
6 Labour Rates used are inclusive of direct overheads such as PPE, Training, Competency Assessment, Travelling Time, Vans etc.
7 Office Overheads (staff, office accomodation, IT, systems etc.) are excluded.
8 Materials are based on the following taken from NR/SP/TRK/102:

	Shared Network		FO Lines
	Cat.1/1A	Cat.2	Cat.5
Rail (CWR)	113A New	113A New	113A Serv.
Sleepers	Conc. New	Conc. New	Conc. Serv.
Fastenings	e-Clips New	e-Clips New	e-Clips New
Ballast Depth	300mm	250mm	200mm
Sleeper Spacing per 60ft	30	28	28

8 Appendix D: Track Maintenance Costing

Track Maintenance Activity	Base line Costs £K	Reduction %age	Weighted Average Reduction	Assumptions (see below for detailed explaination)
Ultrasonic rail inspection	15,444.31	9%	0.6%	U - Cat 2/Cat 5 Inspections - Not Applicable as already allowed for in ICM
Rail changing	77,166.46	20%	6.9%	M - Weeknight/day unit rates, S - Serviceable Materials, B - Possession resources
Re-sleepering	8,668.33	48%	1.9%	M - Weeknight/day unit rates, S - Serviceable Materials, B - Possession resources & P - Utilisation
Plain line tamping	32,455.94	45%	6.6%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Stone blowing	8,354.86	45%	1.7%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Wet bed removal	10,809.00	58%	2.8%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
S&C tamping	12,508.73	37%	2.1%	W - Weekend/day unit rates, B - Possession resources & P - Utilisation
S&C unit renewal	7,908.58	12%	0.4%	W - Weekend/day unit rates, B - Possession resources & P - Utilisation
Replacement of S&C bearers	2,105.85	31%	0.3%	W - Weekend/day unit rates, B - Possession resources & P - Utilisation
S&C weld repairs	2,007.08	44%	0.4%	W - Weekend/day unit rates, B - Possession resources & P - Utilisation
Visual inspection (patrolling)	22,545.54	9%	0.9%	I - Cat 2/Cat 5 Inspections - Not Applicable as already allowed for in ICM
Weld repair of defective rails	1,270.17	57%	0.3%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Insulated joint renewal	4,751.65	16%	0.3%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Manual correction of plain line track geometry	2,682.16	58%	0.7%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Reprofiling of ballast	8,405.76	45%	1.7%	M - Weeknight/day unit rates, B - Possession resources & P - Utilisation
Longitudinal timber (Maintenance)	4,323.03	20%	0.4%	W - Weekend/day unit rates, B - Possession resources & P - Utilisation
Totals	**221,407.45**		**28.1%**	

Assumptions

U - Cat 2/Cat 5 Inspections	Using Track Category 5 instead of Track category 2 reduces inspection frequency from 6 monthly to two yearly.
I - Cat 2/Cat 5 Inspections	Using Track Category 5 instead of Track category 2 reduces inspection frequency from weekly to four weekly.
M - Weeknight/day unit rates	Using Midweek Day rates as opposed to Midweek Night rates for Labour & Plant
W - Weekend/Midweek rates	Using Midweek Day rates as opposed to Weekend rates for Labour & Plant
B - Possession resources	Shared Network Possession has 4 more blockmen than a Freight Only line
P - Utilisation (Productivity)	More available working time in a weekday FO possession compared to a night possession on shared network
S - Serviceable Materials	Limited use of serviceable materials is acceptable on a Track Category 5 line as opposed to a Cat. 2 line.