Review of Possessions Cost Compensation
Final Report

A Report to Network Rail, ORR and ATOC.
17th September 2007

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Review of Possessions Cost Compensation

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1 Executive Summary

1.1 Introduction

1.1.1 This report is about the direct costs incurred by train operators when Network Rail take possession of the rail network to undertake maintenance, renewal or enhancement of the network. Currently, Network Rail compensates train operators for possessions under the provisions of Schedule 4 of the Track Access Agreement, and in some circumstances under Part G of the Network Code.

1.1.2 The Office of Rail Regulation (ORR) has decided to review the compensation mechanisms as part of Periodic Review 2008. ORR has asked the Industry Steering Group (ISG) to review the current arrangements and to propose revised ones for consultation with the industry no later than September 2007 (see http://www.rail-reg.gov.uk/upload/pdf/pr08-toc_comp.pdf).

1.1.3 As part of this workstream, Network Rail, ATOC and ORR have commissioned Faber Maunsell to undertake a review of the compensation paid to train operators for the additional costs associated with possessions. A parallel stream of work has been undertaken separately to review the revenue compensation arrangements.

1.1.4 Currently the costs incurred by Train Operators as a result of a possession are compensated through two separate channels, using similar processes but each according to slightly different criteria.

- Schedule 4, contained in most passenger Track Access Agreements, contains the provision to claim back 'direct costs' for possessions that qualify as being Significant Restrictions of Use (SRoU)[1]. Train Operators receive no compensation for costs incurred under normal Schedule 4 disruption (known from this point on as a RoU) which does not meet the SRoU thresholds.
- Alternatively, if the possession is associated with a 'Network Change' project (Part G), operators can claim their costs in all cases where they can demonstrate that such have been incurred. Whilst general principles and practices have been developed, the cost categories allowed are not stipulated contractually.

1.1.5 The ORR has requested that any proposals for a revised compensation mechanism need to take account of the following principles:

- All **compensation should be made through Schedule 4** of a Track Access Agreement;
- A **consistent approach** is taken, that is there is no differentiation between different purposes of possessions (renewal, maintenance and enhancement);
- There **may be differentiation depending on the scale** of a possession, for example different rates or approaches above or below certain thresholds;
- The **transaction costs are minimised** and that **appropriate levels of accuracy** and efficiency are adopted;
- The **correct incentives** are provided (both to Network Rail and Train Operators) to ensure that possessions and their consequences are managed efficiently;
- A **right of appeal** should be retained for Network Rail and Train Operators to seek redress if compensation is disputed;
- **Transparency of costs and benefits** should enable the risks and impacts of disruption to be anticipated;

[1] A SRoU is defined as being a Restriction of Use (RoU) that is longer than 60 hours (not including any hours of Public Holiday days), or associated with a Major Project Notice. The contract stipulates the cost categories which might be claimed as Direct Costs, for example rail replacement services, publicity, additional train planning. Claims under this mechanism are subject to a £10, 000 minimum.

- Train Operators receive an **appropriate level of compensation for reasonable costs**; and
- The new methodology can **be implemented for the start of Control Period 4**, which includes understanding the implications.

1.1.6 This Final Report contains our proposals for revised arrangements for cost compensation emerging as a result of this study. Network Rail, ATOC and ORR are intending that these proposals will then go to consultation with the industry during September 2007.

1.2 Scope of work

1.2.1 To deliver this commission Faber Maunsell has undertaken interviews with six Train Operators, and collated and analysed possession cost data from a substantial sample of possessions. The conclusions of this work are:

- Bus replacement costs form the highest proportion of costs (around 90%);
- Neither possession duration, train miles affected, or Schedule 4 revenue compensation provide an adequate direct driver of costs that could be used alone to devise a sensible mechanism for cost compensation.
- Consequently, we have developed a measure called Estimated Bus Miles (**EBMs**) that better reflects the drivers of rail replacement bus costs.
- The other costs account for around 10% of total costs, and fall into two groups:
  - Costs associated with the number of train miles operated; and
  - Other costs associated with train planning, management and publicity.

1.2.2 The Estimated Bus Miles measure has been developed to reflect the impact of the possession compared with the train service that would normally operate. It takes into account the quantity of trains operating over the section of the network affected by the possession. However, it also takes into account the level of rail replacement bus provision required, which depends on the availability of an alternative diversionary route, or the presence of an alternative parallel operator such as LUL. The definition of Estimated Bus Miles is:

Estimated Bus Miles = Length of Route Where Train Services Affected x Number of Trains x Weight

1.2.3 The weight is designed to reflect the level of rail replacement bus services provided for the length of route between which train services are affected by the possession. This provision falls into three categories:

- **Full provision** of bus services (for which we propose a weight of 1.0 is applied) where all passengers travelling over the route affected by the possession must transfer to buses.
- **No provision** of bus services (for which we propose a weight of 0.0 is applied) where all passengers use the train services which use a diversionary route, or transfer to a parallel operator such as LUL;
- **Partial provision** of bus services (for which we propose a weight of 0.5 x the proportion of trains that would normally call at intermediate stations is applied) where some passengers use the train services which use a diversionary route, or transfer to a parallel operator such as LUL, but where some buses are needed to serve intermediate stations.

1.2.4 EBMs incorporate the busyness, or intensity of track use better than possession duration. They also reflect, through the weight, the pattern of rail replacement buses provided given the availability of diversion routes or parallel services. Analysis of the relationship between EBMs and rail replacement bus costs show a reasonably good linear relationship exists. We therefore propose that EBMs form the basis of a compensation mechanism for the industry.

1.2.5 We recognise that a measure such as EBMs has some scope for ambiguity and different interpretations. We propose that the impact of a possession on the train service and hence the level of bus provision (full/none/partial) should be agreed between Network Rail and the Train Operator in advance of the compensation calculations. This would be assisted by the use of a lookup table of possession responses which would be built up from past cases. EBMs would then be used to calculate the level of compensation based on the number of trains affected by each future possession. It would then be up to the Train Operator to procure the number and type of buses that were necessary at the most commercially attractive rates.

1.2.6 Cost compensation under the current Schedule 4 and Part G mechanisms already take into account any reductions or increases in train miles. We propose that compensation is provided for the costs, or savings, of train mileage based on the net Train Miles Operated (TMO). TMO is calculated as the net difference between the train miles on the day the possession occurred against the train miles that would have run if the possession had not occurred and can be either positive or negative. It includes non-passenger stock movements.

1.2.7 A significant issue with calculating compensation for the remaining costs (publicity, train planning and miscellaneous) was that limited examples of these costs were provided for the sample possessions we examined. This could be because these costs are not significant in many cases; this was the point made by one Train Operator. However, it is more likely that these particular costs are difficult to identify and estimate.

1.2.8 We propose that the remaining costs should be swept up into a rate per Modified Train Miles (MTM). Where MTM is defined as the number of train miles which suffer alteration (compared to the normal timetable) as a result of a possession, with a positive sign always applied. Thus, both terminating trains short and additional train miles due to a diversion are counted as positive.

1.3 Proposed Compensation Mechanism

1.3.1 The conclusion of this work is to propose a compensation mechanism of the following form:

Compensation = Rail Replacement Bus Costs (rate per Estimated Bus Mile)
+ Train Mileage Costs (TOC specific rate per Train Mile Operated)
+ All Other Costs (rate per Modified Train Mile)

1.3.2 Table 1.1 shows the application of this formulation to the sample of possession costs[2] provided by Train Operators to see how the calculated compensation compares against the costs actually incurred. Train Operators currently receive compensation for SRoUs but are not compensated for RoUs.

Table 1.1 - Compensated Costs vs. Actual Costs for Sample Possessions.

	RoUs	SRoUs	All Possessions
Actual Costs (£'000s)	333	1,722	2,055
Calculated Compensation (£'000s)	547	1,509	2,056
Difference (£'000s)	+214	-213	+1

1.3.3 As expected, the calculated compensation across all possessions is very close to the actual costs incurred. We would anticipate a close overall match since the actual costs have been used to derive the calculated rates. The viability of the method depends on how convincingly

[2] Part G possession represented only 3 of our 80 sample possessions these were allocated to the relevant RoU / SRoU category based on duration and cost. Our analysis of this limited sample of Part G possessions showed that this was a reasonable assumption to make.

the formula works at a disaggregated level. For SRoUs, the formula calculates lower compensation than has actually been paid – the sample possessions suggested that costs for SRoUs are more variable and generally rail replacement bus costs are more expensive per EBM. For RoUs, for which the current regime currently does not compensate Train Operators, the formula calculates compensation above what Train Operators currently report as being incurred. However, it is likely that the costs provided by Train Operators for these smaller possessions under represent the actual costs incurred, because some costs are difficult to identify retrospectively.

1.3.4 We have examined the pattern of compensation provided by the mechanism for possessions experienced by each Train Operator. This demonstrated that the mechanism provides a reasonably accurate level of compensation for possessions for which Train Operators are currently compensated (SRoUs) by negotiation, and also provides reasonable compensation for possessions which are not currently compensated (RoUs). The mechanism does not appear to disproportionately favour or hinder a particular operator, or type of operator.

1.3.5 We have examined a sample of 80 possessions which represent around £2 million of costs. For comparison, Table 1.2 shows an estimate of the costs experienced during the same period by Train Operators provided from a study by ATOC[3]. Bearing in mind the limited sample of data which was used to derive the relationships, this estimate of costs may give an approximate upper bound on the maximum potential compensation paid to Train Operators. Further analysis on a larger dataset will be required to provide comfort to the industry about the impact of adopting this mechanism on the overall level of compensation.

Table 1.2 – Estimate of Costs Experienced by Train Operators 2006/07.

	RoUs	SRoUs	Part G	All Possessions
Estimate of Costs from ATOC (£'000s)	18,223	7,039	9,038	34,300

1.3.6 Examining a year's population of possessions, those under 8 hours accounted for 58% numerically, but only 9% of the costs. This provides strong support to the idea of a lower threshold below which compensation would not be paid, in order to reduce transaction costs associated with compensation. This threshold could be set initially at 24 hours, which would mean that only 26% of possessions would need to be processed, but that an estimated 87% of costs would be compensated.

1.3.7 However, one implication of incorporating a lower threshold is that the data points represented by these possessions should probably be excluded from the derivation of the relationships at the heart of the mechanism. Clearly an industry debate is required about both the threshold levels and the level of compensation the rates should be set to provide. For example, should the compensated costs be uplifted to take account of the uncompensated costs; and what is the possible impact of any threshold on Network Rail's possession strategy?

[3] These costs were estimated by extrapolating from the 11 Train Operators who provided detailed information to ATOC.

1.4 Conclusions and Recommendations

1.4.1 The evidence presented in this report suggests that a possession cost compensation mechanism could be devised using a formula of the form set out below. We believe this would provide a practical mechanism for calculating fair and reasonable cost compensation, in advance of a possession occurring. Most of the costs will be driven by a new measure called 'Estimated Bus Miles'.

Compensation = Rail Replacement Bus Costs (rate per Estimated Bus Mile)
+ Train Mileage Costs (TOC specific rate per Train Mile Operated)
+ All Other Costs (rate per Modified Train Mile)

1.4.2 We are recommending that this mechanism is applied to all possessions that affect Train Operators. However, a lower threshold may need to be applied, below which costs are not compensated. Whether such a threshold is needed is likely to depend on the relationship between transaction costs and the amount of compensation paid. This in turn may be driven by the level of automation or computer facilitation that can be achieved in calculating compensation for each possession.

1.4.3 Initially this lower threshold could be set at 24 hours, whilst the industry becomes familiar with the process. Over time this threshold might be reduced to 8 hours which would mean around 90% of costs would be compensated by capturing 40% of the possessions that affect Train Operators in the mechanism.

1.4.4 In addition we are proposing an upper threshold is set above which Train Operators or Network Rail could make a case for costs to be estimated on a negotiated basis. This threshold might include those possessions which would be under or over-compensated by more than £10,000, and / or those possessions that currently fall into the SRoU duration category or which fulfil the 'Larger Possession' category defined in the proposed revenue compensation mechanism. Such a threshold would:

- Provide comfort to the industry during the implementation of a new compensation mechanism; and
- Handle the fact that larger possessions may incur unusual costs not reflected in the derived compensation rates.

1.4.5 There are some residual issues around this compensation mechanism that will need industry consultation, namely:

- Whether the mechanism should be differentiated between shorter and longer possessions given the differences we observed in the relationship between rail replacement bus costs and EBMs for SRoUs and RoUs;
- Whether there needs to be a minimum cost / duration threshold, below which the compensation mechanism would not apply, to reduce overall transaction costs to the industry, and what that threshold should be; and
- Whether there needs to be a higher threshold above which compensations costs need to be negotiated individually and what this threshold could be.

1.4.6 Preliminary work examining these issues is presented within the report. The remainder of the report presents more detailed analysis and sensitivity testing of the results summarised in this Executive Summary.

1.5 Next Steps

1.5.1 The compensation mechanism is dependent upon reported cost information by Train Operators. Should it be adopted by the industry, we would recommend that further data be collected:

- In the short-term some further sample cost data should be collected to test the proposed mechanism and provide confidence to the industry. This may also help to resolve a number of outstanding issues; and
- More extensive cost data will be needed before 'live running' to derive the compensation rates. We recommend that more Train Operators are involved immediately so that, at the very least, accurate cost data can be collected for possessions occurring over the next six months.

1.5.2 In conjunction with this we recommend that system issues are investigated to test the level of automation that is feasible. This would include in the short-term:

- Development of prototype system; and
- Population of the proposed lookup table for one or more Train Operators to assess feasibility.

1.5.3 This proposed mechanism will need stakeholder review and buy-in if it is to be used effectively. Industry discussion and debate is needed on a range of policy issues outlined in Section 1.4.5. Such a debate needs to be supported and informed. We recommend that workshops are held to explain the proposals to the wider industry as soon as possible.

1.5.4 Further training of users at the ground-level would be needed in advance of implementation. This may best occur at the same time as the population of the proposed EBM lookup table for each Train Operator.

1.5.5 If the proposed approach is adopted, we recommend that a period of shadow-running is operated. This would allow the method to be tested in advance of Control Period 4, and give the industry further confidence.

2. Costs Experienced by Train Operators

2 Costs Experienced by Train Operators

2.1 Interviews With Train Operators

2.1.1 The first stage of the study involved collecting information as to the significant costs experienced by Train Operators as a result of possessions. The principal mechanism for collecting this information was through contact with six Train Operators who had agreed to participate in the study.

2.1.2 An initial interview was held with each operator to understand the significant costs they experience. The key themes and issues that emerged were:

- All Train Operators stated that the most significant costs experienced were the costs of rail replacement services;
- Publicity costs were also stated as a significant cost for major possessions as were railway planning costs, agency staff, and customer service staff.
- Half of the Train Operators stated time of year as an important driver of costs and all stated time of day and day of week.
- A few Train Operators noted that more advance notice and better planning would reduce costs.
- At least two of the Train Operators commented that they would not support the introduction of cost compensation for all possessions. This is because there are such a large number of small possessions that dealing with all of them would be very time consuming. They also broadly accepted that a level of smaller disruption is built into franchise bids and should therefore not be compensated.

2.1.3 The information gathered was used to focus our thinking and analysis on the most significant costs experienced and the factors that drive those costs. It also provided a practical understanding of the type of compensation mechanism that might be appropriate. Appendix A contains more details on the issues and themes from the interviews.

2.1.4 During the interview each operator was invited to review and suggest amendments to our proposed list of 10 to 12 example possessions they had experienced during the last two years. These example possessions were then included in our sample dataset. A limited number of substitutions were made due to the fact that data for some possessions was not available. This list was also shared with the relevant Network Rail Customer Relationship Executive (CRE) who confirmed that they were happy with the list. The purpose was to ensure that the list was representative and not biased towards either side of the contractual framework.

2.1.5 We excluded from the sample dataset one possession suggested by the Train Operators. This was the three month long blockade for renewal of Leven's Viaduct between April and July 2006. Possessions of this length are extremely infrequent and a Train Operator's response is likely to be on a different scale compared to even a week long possession. Including this case in the sample could significantly skew the results of our analysis. Such large possessions would be covered by negotiated estimates of cost compensation, rather than such a mechanism as proposed in this report.

2.1.6 All the Train Operators indicated that rail replacement buses were the most significant costs. Our analysis of the 80 sample possessions is shown below in Table 2.1[4].

Table 2.1 – Analysis of Sample Possessions by Type of Cost.

Type of Costs	RoUs % of Total Costs	SRoUs % of Total Costs
Rail replacement buses	94%	89%
Other costs	6%	11%

2.1.7 ATOC provided us with data from an exercise undertaken to investigate the scale and type of possession costs experienced by Train Operators, eleven of whom provided data. The overall split between bus costs and other costs for each category of possession in 2006/2007 is shown below in Table 2.2.

Table 2.2 – Rail Replacement Bus Costs as a Percentage of Total Costs (2006/07).

	Bus Costs (£'000s)			Total Costs (£'000s)			% Total Costs		
Operator	**RoU**	**SRoU**	**Part G**	**RoU**	**SRoU**	**Part G**	**RoU**	**SRoU**	**Part G**
1	1,040	92	365	1,040	92	365	**100%**	**100%**	**100%**
2	576	0	156	576	0	1,796	**100%**	**N/A**	**9%**
3	380	440	180	500	580	240	**76%**	**76%**	**75%**
4	1,134	1,222	0	1,134	1,811	0	**100%**	**48%**	**N/A**
5	473	358	0	473	473	0	**100%**	**76%**	**N/A**
6	295	222	8	324	350	9	**91%**	**63%**	**89%**
7	236	0	0	236	0	0	**100%**	**N/A**	**N/A**
8	1,468	558	0	1,468	584	0	**100%**	**96%**	**N/A**
9	1,660	0	1,200	1,660	0	1,500	**100%**	**N/A**	**80%**
10	1,813	97	306	2,664	184	612	**68%**	**53%**	**50%**
11	475	0	712	475	0	712	**100%**	**N/A**	**100%**
Total	**9,550**	**2,989**	**2,927**	**10,550**	**4,075**	**5,233**	**89%**	**78%**	**56%**
12[5]	492	0	0	5,900	0	0	**8%**	**N/A**	**N/A**

2.1.8 The data above confirms that rail replacement bus costs are the most significant costs to Train Operators. However, it is likely that the data overstates the proportion of total costs, since 'Schedule 4' disruption is not normally compensated for costs, except in the case of a Major Project Notice, hence costs other than buses may be difficult to identify.

2.1.9 We concluded that rail replacement bus costs should lie at the heart of any proposed cost compensation mechanism. Chapter 3 of this report describes our detailed analysis of this type of cost and our development of a compensation mechanism.

[4] Note, this ignores the impact of changes in train mileage (whether positive or negative) which in many cases were not supplied by Train Operators.
[5] An exceptional case.

2.2 Analysis of Representative Sample Possessions

2.2.1 As a result of the data collection exercise a sample set of 80 possessions was collected. This sample covered the full range of duration, mileage, days and scales of disruption. Below, Figure 2.1 shows the histogram of these possessions distributed by the total costs to Train Operators. Figure 2.2 shows the distribution by duration of possession. Figure 2.3 shows the distribution by amount of Schedule 4 revenue compensation.

Figure 2.1 – Histogram of Sample by Cost to Train Operator.

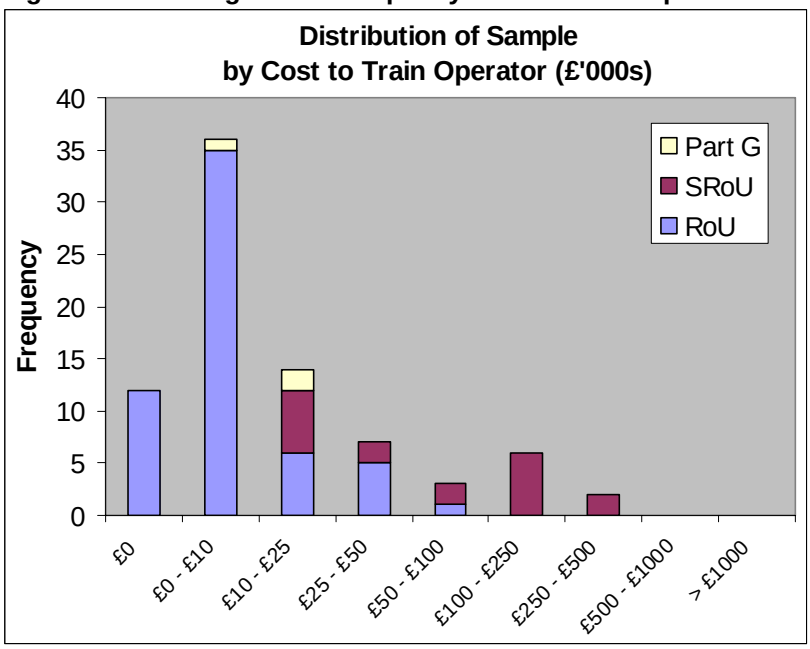


Figure 2.2 – Histogram of Sample by Duration.

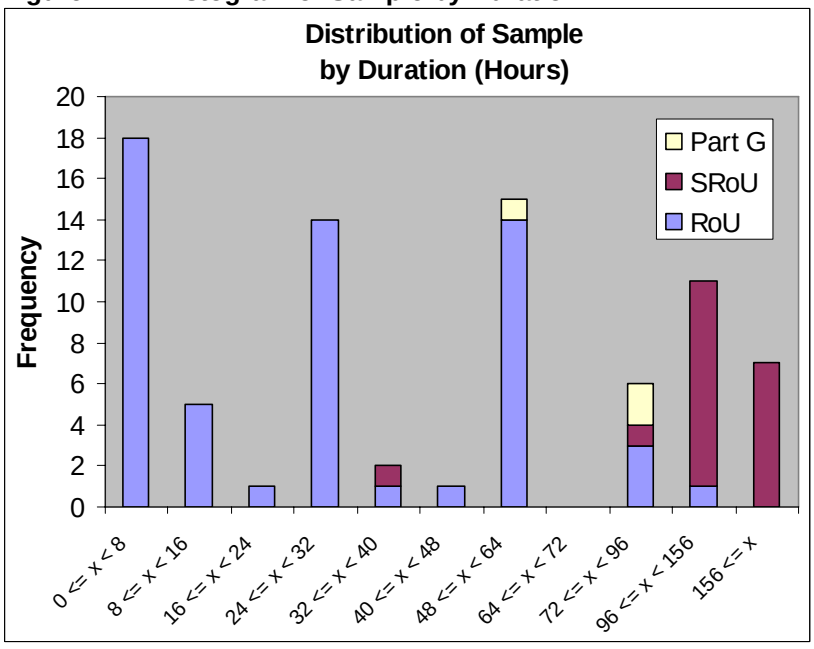
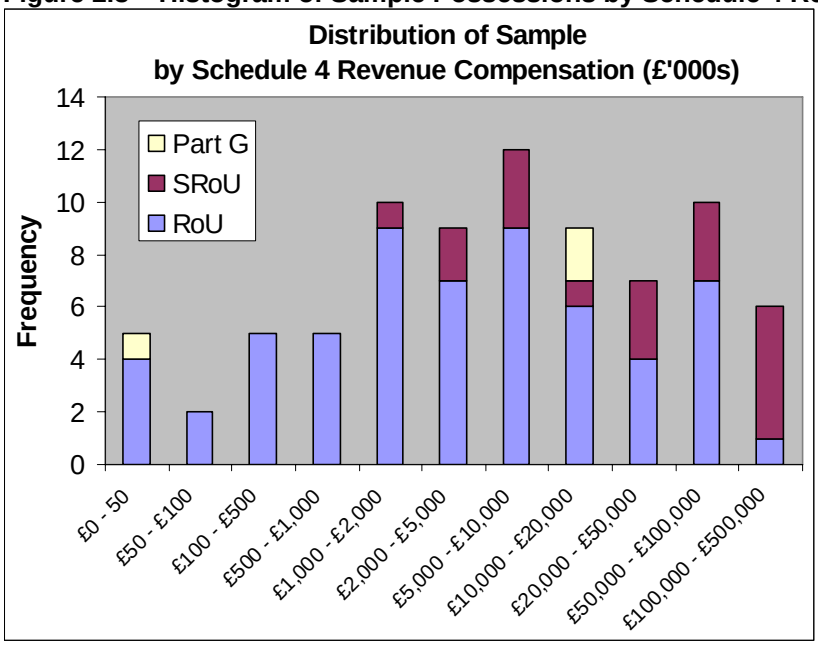


Figure 2.3 – Histogram of Sample Possessions by Schedule 4 Revenue Compensation.



2.2.2 The purpose of assembling the representative sample set was to provide a suitable dataset with which to generate and test potential compensation mechanisms, thus the sample should reflect the underlying population of possessions occurring on the network. Otherwise proposals developed using the sample might not have the expected impact when applied more generally.

2.2.3 The annual possession population was taken as the 11,432 individual possessions recorded in Network Rail's Schedule 4 Compensation System (S4CS)[6] for the financial year 2006/07. This total is calculated on the basis that every possession is counted once per Train Operator affected. Note the S4CS data had 24,691 individual records, since a possession will be recorded once for every service group and day affected.

2.2.4 The actual number of physical possessions on the network will be much higher than this for two reasons. Firstly, because S4CS only includes possessions which affect Train Operators, not those that occur in the 'white space' timetable period. Secondly, our understanding from talking to Network Rail's S4CS team is that individual possessions along the same stretch of line would be grouped together in S4CS. However, neither issue is a problem since we are only interested in possessions that actually affect services run by Train Operators, and in practice operators treat possessions as a group anyway.

2.2.5 Thus the sample size is 0.7% of the population. A significant achievement given the starting position. We would like to express our appreciation for the helpfulness of the staff that provided us with the cost information we required.

2.2.6 **Over time a larger dataset could be obtained and we would encourage the industry to consider now what information should be collected over the next few months and years in order that future reviews of compensation can be made even more robust through access to improved data.**

2.2.7 The annual possessions in S4CS for the financial year 2006/07 was analysed to test how representative the sample was of the population. Due to formatting and data consistency problems, for 21% of the records in S4CS we were unable to identify the duration of the possession. It was agreed in a conversation with Richard Wall of Network Rail on 20th August that there was no reason to think that the remaining 79% of possessions were unrepresentative of the whole population. Thus our analysis of the population is based on this 79%, uplifted to 100%. A further caveat to this dataset is that it was not possible to apply the £10,000 cost threshold to determine which possessions qualified as being a SRoU. Therefore, the distinction is purely based on the duration threshold of 60 hours (not including any hours of Public Holidays).

[6] S4CS is the system used to calculate revenue compensation for Train Operators.

2.2.8 Figures 2.4 and 2.5 shows the distribution of the population by duration of possession. They show that the sample (Figure 2.2) has the same peaks as the population for two bands of possession duration: 24 to 32 hours and 48 to 64 hours.

Figure 2.4 – Histogram of Population Possessions by Duration.

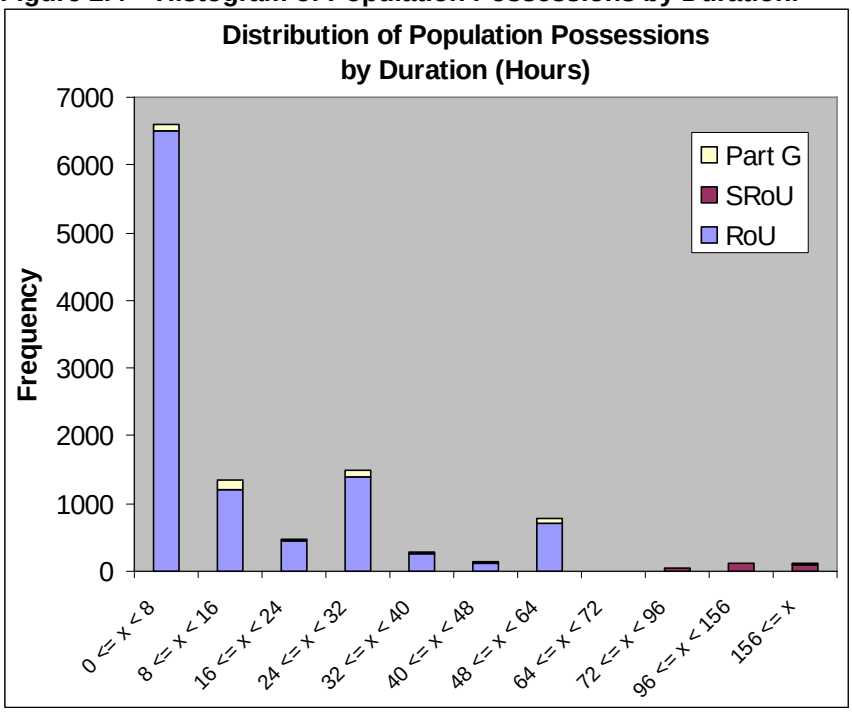
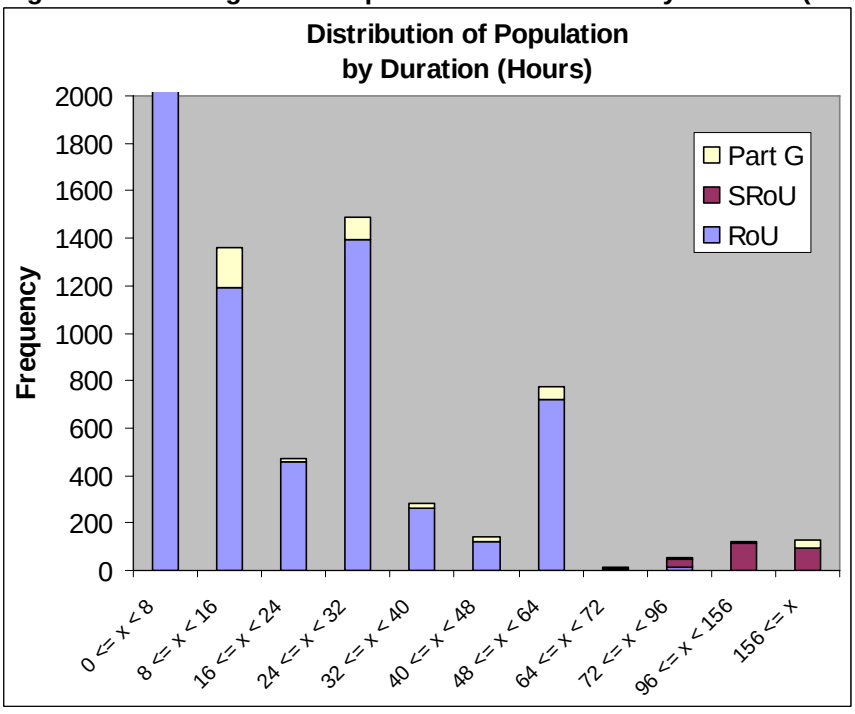


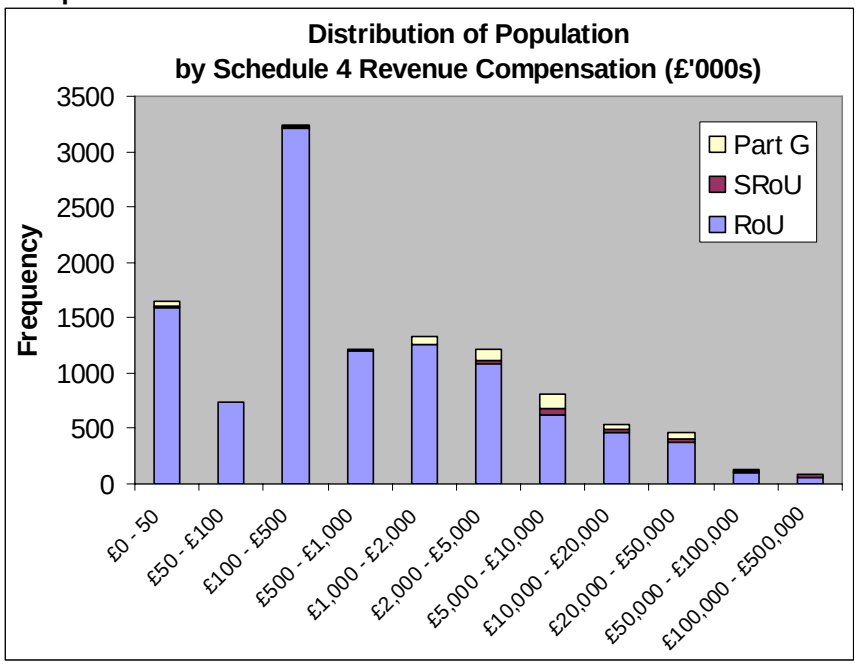
Figure 2.5 – Histogram of Population Possessions by Duration (Zoomed).



2.2.9 Figure 2.6 shows the distribution of the population by amount of Schedule 4 revenue compensation. These figures show our selected set of representative possessions do cover the full range of scales of disruption. However, it must be acknowledged that our sample set of possessions is skewed towards the larger possessions, mainly for the reason that it is difficult for Train Operators to provide data for the smaller possessions. While our set has lower numbers of very small possessions, these do incur much smaller costs (and often a high proportion of their duration is during 'white space' periods). Therefore the importance of these smaller possessions to developing potential compensation arrangements should not be

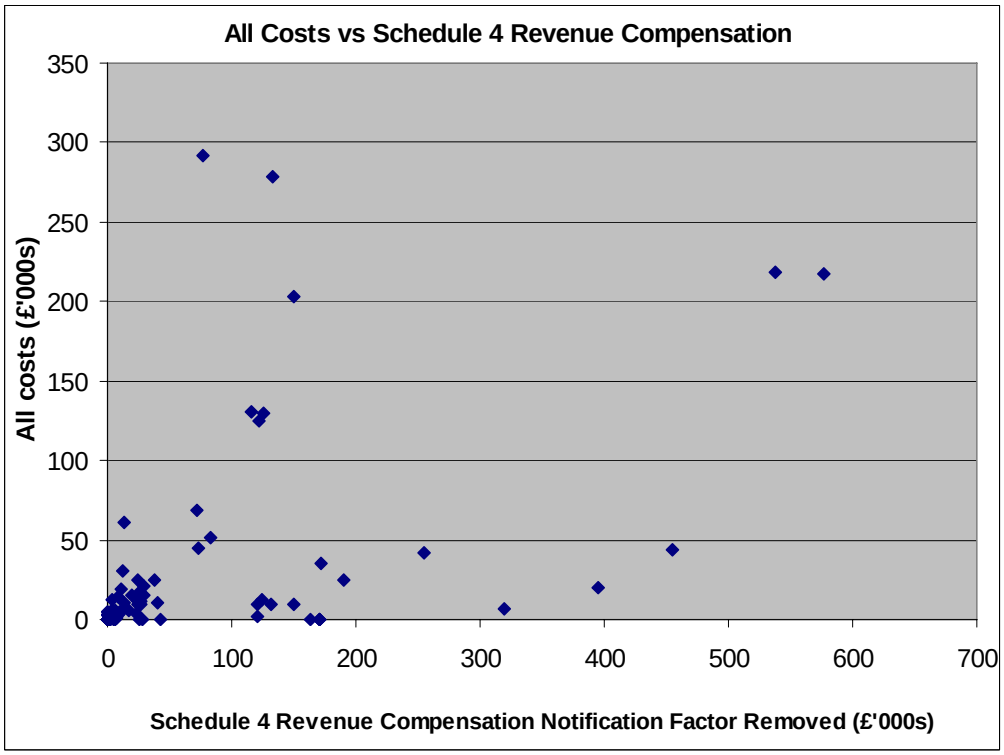
significant. This is particularly the case if as discussed in Section 4.4 the application of a lower threshold to smaller possessions means that those of less than 8 hours are excluded.

Figure 2.6 – Histogram of Population Possessions by Schedule 4 Revenue Compensation.



2.2.10 Based on our sample possessions we attempted to derive sensible relationships between total costs of possessions against a number of 'cost drivers' including Schedule 4 revenue compensation and possession duration. However, we concluded that the data did not support such a relationship. As an example, Figure 2.7 shows All Costs vs. Schedule 4 revenue compensation. Further detail of our analysis is provided in Appendix B.

Figure 2.7 - All Costs vs. Schedule 4 Revenue Compensation with Notification Factor Removed.



2.3 Other Sources of Data Used

2.3.1 As part of our data collection process we have defined and assembled a number of potential drivers of costs experienced by Train Operators. These generally came from sources external to Train Operators and are indicated below along with their source in brackets:

- Weighted Average Cancellation Minutes (S4CS);
- Extended Journey Time REJT (S4CS);
- Schedule 4 revenue compensation with Notification Factor removed (S4CS);
- Duration in hours (S4CS);
- Average notification factor (weighted by revenue) applied (S4CS);
- Average Marginal Revenue Effect (weighted by revenue) to represent the value of services disrupted (S4CS);
- Operational hours affected – Duration with 'white space' not included (Passenger timetable);
- Total trains affected (Timetable mileage data from S4CS or Passenger timetable);
- Route miles affected (Timetable mileage data from S4CS / Quail maps);
- Cut short train miles (calculated from affected trains and route miles);
- Trains diverted (Timetable mileage data from S4CS or Passenger timetable);
- Extended route miles (calculated from diverted trains and route miles); and
- Average Variable Track Access and EC4T charges per train mile by Train Operator for 2006/07 (supplied by ORR).

2.3.2 We also obtained information on the costs resulting from possessions from completed SRoU claim forms received by Network Rail's Schedule 4 teams. These were useful in providing further information with which to compare against the data provided by Train Operators.

3. Drivers of Rail Replacement Bus Costs

3 Drivers of Rail Replacement Bus Costs

3.1 Why Cost Drivers are Important

3.1.1 The planning process for engineering works on the railway, and the planning process for responding to possession, for example by operating a replacement bus service, takes place within complementary, but very different, timeframes. Decisions about engineering works to be done, and the possessions etc to be put into the Rules of the Route are made 60 plus weeks before the first week of operation of the Working Timetable. Detailed planning of replacement bus services fits round the Informed Traveller timetable revision processes, the effect of which is that planning is being undertaken 18 weeks or less before the week of actual travel.

3.1.2 If Train Operators are to receive compensation for costs incurred as a result of possessions, and those costs are to be incorporated into the budgets for the relevant engineering works, there needs to be a way by which those costs can be estimated, at the time of doing the initial engineering planning.

3.1.3 If the costs of providing a service of replacement buses correlates to other physical facts associated with a possession (e.g. length of track closed, duration of closure, numbers of trains or stations affected); and these physical facts are already known at the time of formulating the Rules of the Route (e.g. from the Sectional Appendix or the Base Timetable), then a good working estimate of the costs a Train Operator is likely to incur can be derived on the basis of a simple formula or lookup table.

3.1.4 If the correlation is close, and not biased towards or against a Train Operator, then it becomes reasonable to use that correlation as the basis to calculate not just an estimate of the costs involved, but the actual levels of compensation payments to be made. The Train Operator can then also approach the actual time of detail planning for disruption, with a clearly defined budget. It also enables Network Rail to take account of the impact of engineering decisions on the costs experienced by Train Operators.

3.1.5 It is with these thoughts in mind that we examined the relationship between replacement bus costs and all other obvious physical variables, in the hope that we would find one which, if combined with an appropriate Tariff, would give a reliable and consistent value for both cost estimates and compensation.

3.1.6 During the course of this work, we limited our analysis to looking at simple linear forms. It is possible that more sophisticated, multi-variable functional forms could have been found. However, we felt that a degree of intuition and simplicity needed to be kept with this work, and that efforts were best kept to establishing a sensible single explanatory variable which would allow a suitable linear relationship to be developed rather than undertaking multi-variable analysis.

3.2 Arriving at Estimated Bus Miles

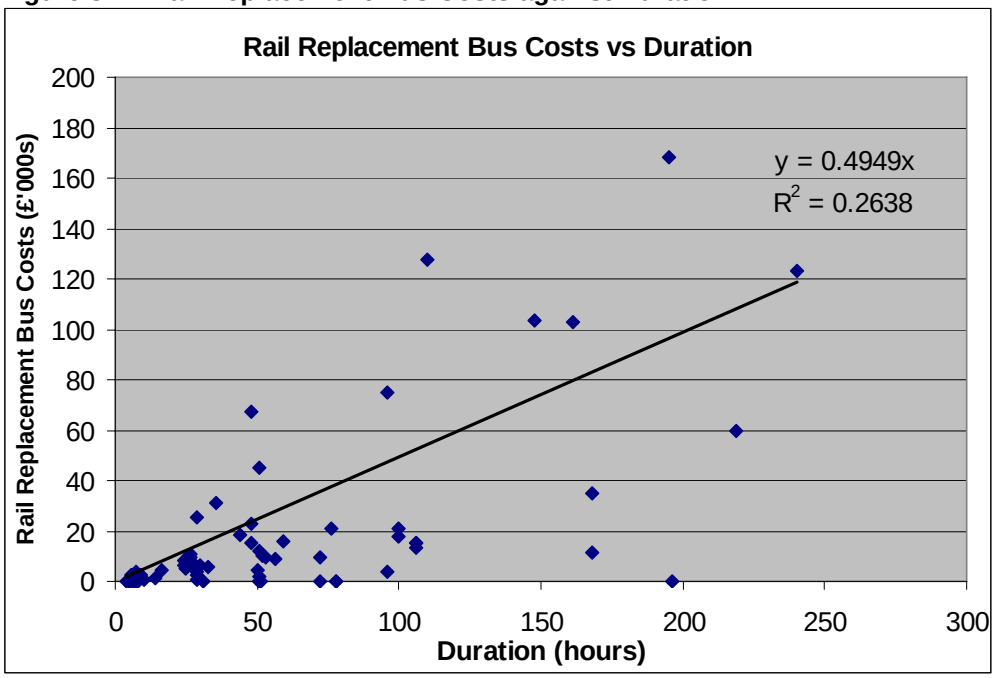
3.2.1 Based on the analysis to this point, we concluded that rail replacement buses were the most significant costs experienced by Train Operators. This section describes our attempts to derive a relationship between this cost and various cost drivers, and thus to develop a suitable compensation mechanism. For the purposes of this analysis the following costs were grouped under the heading 'rail replacement bus costs':

- The costs of hiring scheduled, standby and DDA vehicles, including the driver;
- Bus co-ordination and customer service staff at stations; and
- Taxis for train crew.

3.2.2 During the interviews some Train Operators said that factors such as time of day, day of week or season would affect these costs. We first set out to prove whether certain variables had an impact on bus costs, for example as 'economies of scale'. The analysis described in Appendix C demonstrates that the unit cost of buses per day did not vary with cost drivers, i.e. the data did not support the view that there were economies of scale. We also examined whether a pattern could be established between train loadings and the numbers of buses deployed on a particular possession. Our conclusion was that no significant relationship could be established.

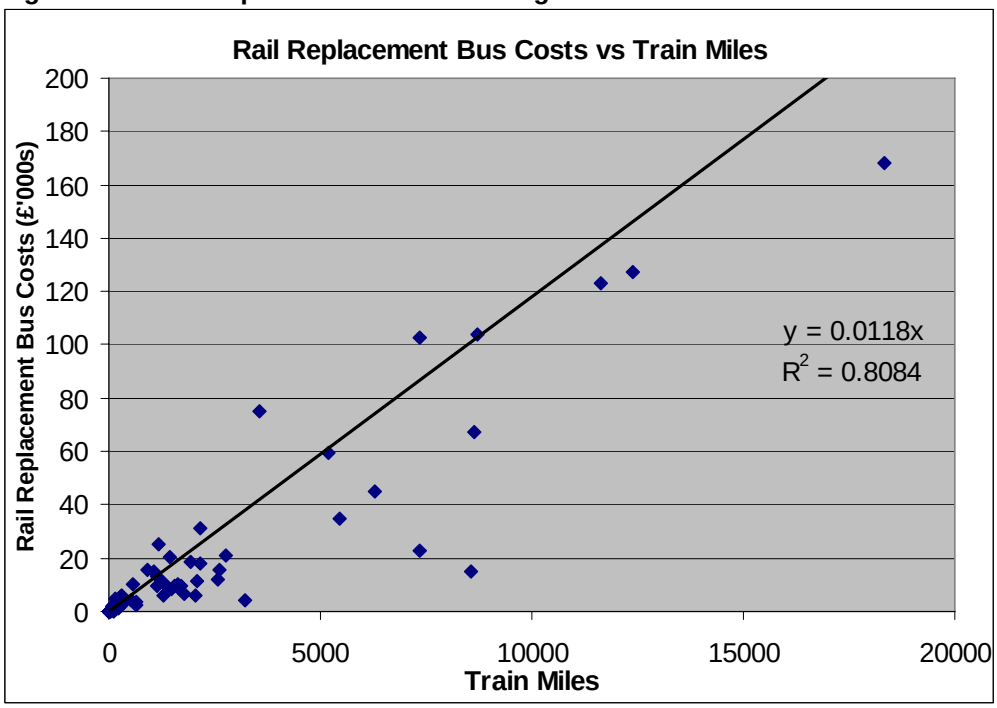
3.2.3 We then moved on to look at whether a relationship could be established between rail replacement bus costs and various potential cost drivers. As described in Appendix D, the analysis enabled us to discount there being a relationship between rail replacement bus costs and potential cost drivers such as duration, Schedule 4 revenue compensation and disruption. As an example, Figure 3.1 shows the plot of rail replacement bus costs against duration of possession in hours.

Figure 3.1 - Rail Replacement Bus Costs against Duration.



3.2.4 Having determined that rail replacement bus costs could not be directly related to existing potential cost drivers, we began to conclude that would likely be a function of the number of trains affected, duration and distance affected. During the interviews many of the Train Operators stated their 'one train one bus' policy, that is for every train disrupted by the possession a bus would be deployed. This led us to explore the relationship between rail replacement bus costs and train miles (trains x distance of possession). The regression (shown in Figure 3.2) gave a good indication of a relationship, but there were some significant outliers that needed to be explained.

Figure 3.2 - Rail Replacement Bus Costs against Train Miles.



3.2.5 During our analysis we had identified some important differences between the required level of bus provision and the 'shape' of a possession (as described in Appendix F). This meant that some sections affected by a possession would require full provision of buses, other sections partial provision (for example, when some trains could be diverted around a possession) and other sections no provision of buses (where passengers could transfer to another operator such as LUL). This led us to establish the concept of Estimated Bus Miles (EBMs) which takes account of these differences.

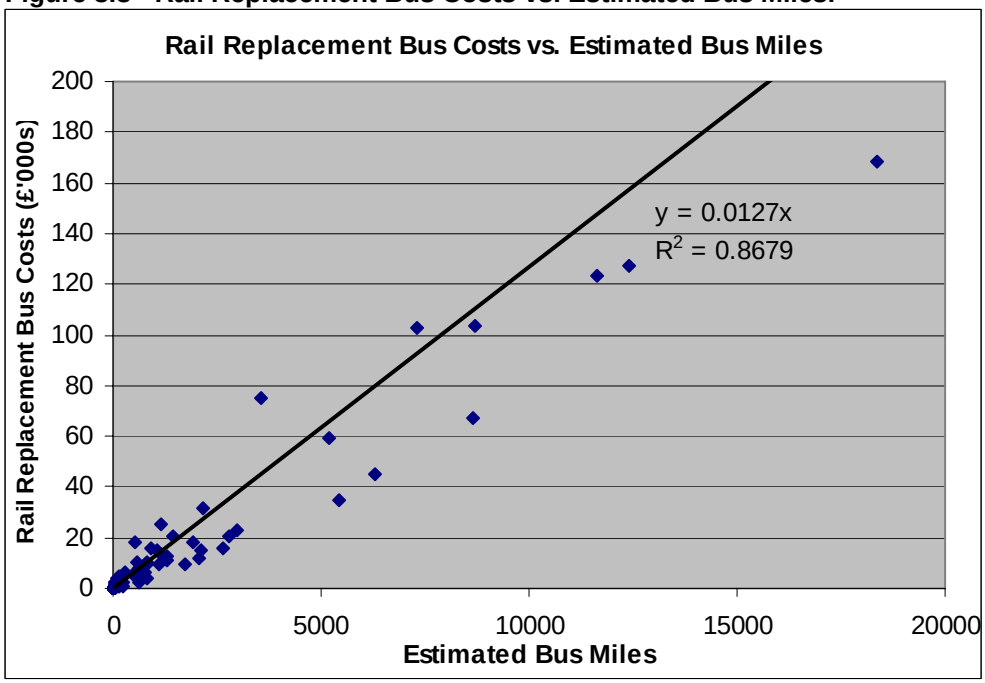
3.2.6 Estimated Bus Miles are calculated as follows (further detail is provided in Appendix G):

- If no parallel service (e.g. LUL) or diversionary route exists: Train miles = trains x miles closed;
- If there is a parallel service (e.g. LUL) or diversionary route and there are no intermediate stations missed out: Train miles = 0; and
- If there is a parallel service (e.g. LUL) or diversionary route and intermediate stations are missed out and thus required a bus service: Train miles = 50%[7] x trains stopping x trains x miles closed.

3.2.7 Figure 3.3 below shows a fitted straight line relationship between rail replacement bus costs and Estimated Bus Miles. This demonstrates a solid relationship of the form y = mx. Appendix D contains Figure D.4 which provides comments as to the outliers shown in Figure 3.3.

[7] This factor was derived by using an Excel macro to test different values of this factor in incremental steps of 5%. 50% was found to be the value that gave the best fit relationship (as measured by the maximum R squared).

Figure 3.3 - Rail Replacement Bus Costs vs. Estimated Bus Miles.



3.2.8 We concluded from this analysis that the compensation mechanism for rail replacement bus costs should take the form of a rate per EBM. Note, a number of other functional forms, including y = mx + c, were also considered at this stage. These may need to be considered further as the industry digests the proposals.

3.3 Application of Estimated Bus Miles

3.3.1 The relationship derived in the previous section between rail replacement bus costs and EBMs was applied separately to possessions falling into the categories of RoUs and SRoUs. This distinction was based solely on the duration criterion for a SRoU possession; the cost threshold of £10,000 was ignored. Also since Part G possession represented only 3 of our 80 example possessions these were allocated to the relevant RoU / SRoU category. Figures 3.4 and 3.5 show the same regression of rail replacement bus costs vs. EBMs for these two categories of possession separately. They also show the fitted line for the whole dataset.

Figure 3.4 - Rail Replacement Bus Costs vs. Estimated Bus Miles.

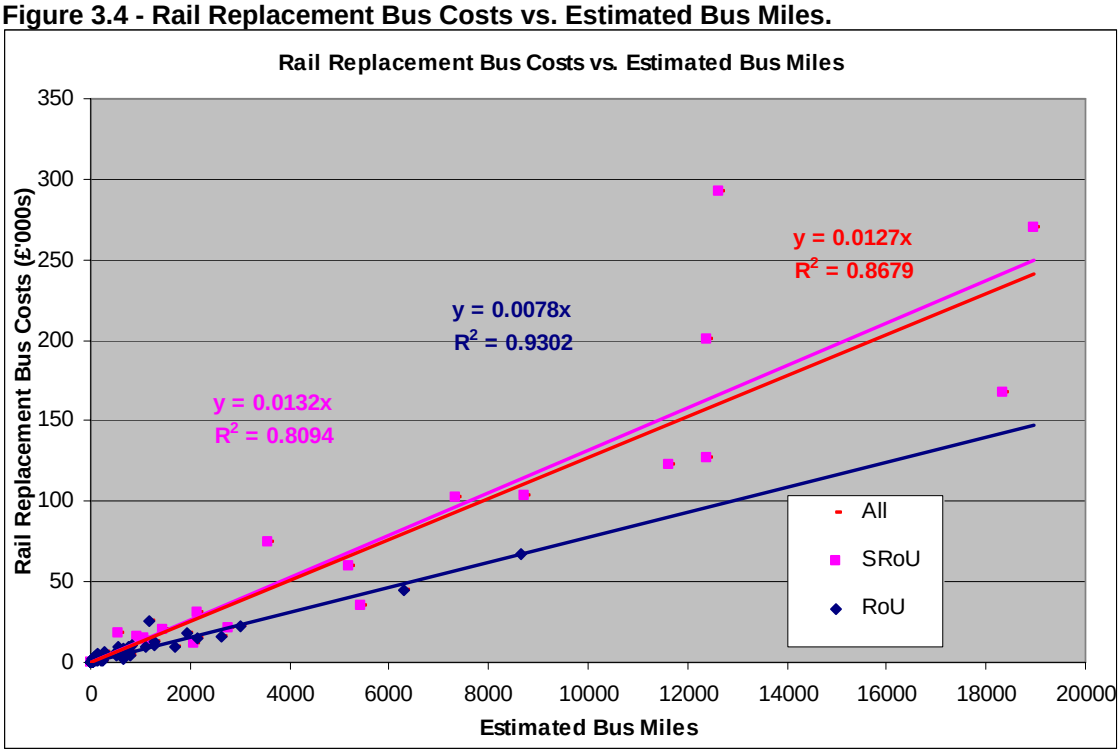
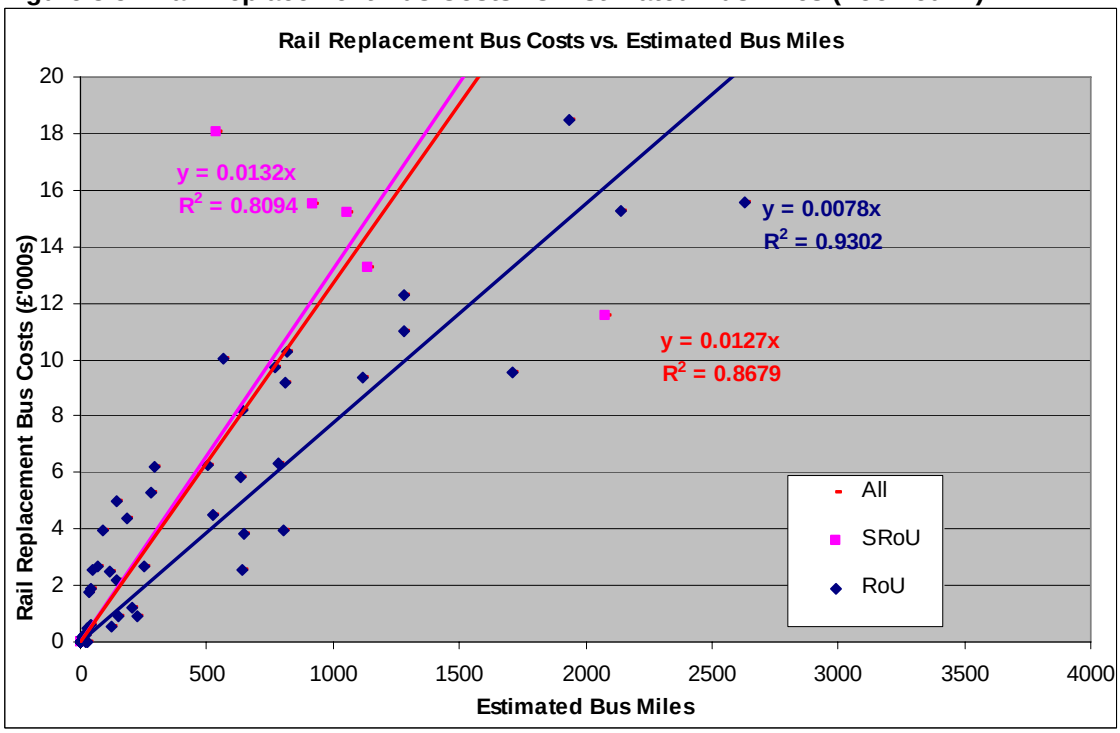


Figure 3.5 - Rail Replacement Bus Costs vs. Estimated Bus Miles (Zoomed in).



3.3.2 Figures 3.4 and 3.5 show that the error terms (the absolute difference between the actual costs and the costs predicted by the mechanism) are generally smaller for RoU possessions. This is confirmed by the fitted line for the RoUs type possessions having a higher R-squared[8]. The lower level of variation for RoU possessions might be expected since they are generally more limited in scope and scale (being of a short duration) than a SRoU possession. They are also likely to be subject to less extra-ordinary costs.

3.3.3 It is also interesting to observe that the slope of the RoU fitted line is shallower than that for SRoUs. This could be caused by a number of reasons, one of which might be the fact that SRoUs are currently compensated, whereas RoU possessions are uncompensated. As a result the RoU data points represent arguably the purer costs of Train Operators obtaining buses from the market at their own expense. Alternatively, it may be that Train Operators were unable to identify all of the costs for these possessions.

3.3.4 For the purposes of subsequent analysis in this report, we have applied the fitted line for all possessions which has the formula y = 0.0127x to our sample possession dataset. This equates to a rate of £12.70 per EBM. Table 3.1 shows the impact of applying this mechanism to the 80 possessions.

Table 3.1 – Impact of Rail Replacement Bus Cost Compensation using £12.70 per EBM.

	RoUs (x = duration in hours)				SRoUs (x = duration in hours)				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Possessions	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)	17	110	251	379	458	860	386	1704	2083
Compensated (£'000s)	17	106	409	532	293	826	516	1635	2167
% Compensated	98%	96%	163%	141%	64%	96%	134%	96%	104%

3.3.5 Table 3.1 shows that overall rail replacement buses are over slightly over compensated (104%). The mechanism provides accurate compensation (i.e. 96% of actual costs) overall for SRoU possessions (which are currently compensated). However, the degree of compensation varies by duration of the possession. This reinforces the need for a mechanism to allow redress for any of the larger possessions for which this mechanism might significantly under- or over-estimate costs.

3.3.6 The overall level of compensation for RoUs is high (141% of actual costs) and the degree of compensation varies by duration of the possession. This means that further work (based on a larger sample of possession costs collected from Train Operators) may be needed to finalise the compensation rate per EBM.

3.3.7 Appendix D contains sensitivity tests that show the impact of applying different rates per EBM. Table D.1 shows the impact of using £13.20 per EBM (taken from the fitted line on SRoUs in Figure 3.4). Table D.2 shows the impact of using £7.80 per EBM (taken from the fitted line on RoUs in Figure 3.4). This Appendix also contains details of further sensitivity tests to assess the robustness of this relationship which is at the heart of the compensation mechanism.

[8] Note, that because only a subset of the sample is used to fit these lines it is not possible to compare these R-squared figures with the results of the previous regressions which were based on the whole sample.

4. Analysis of Other Costs

4 Analysis of Other Costs

4.1 Costs Related to Changes in Train Mileage

4.1.1 This chapter considers all costs that are not related to rail replacement bus services. A significant issue was that the information provided for many of the sample possessions included limited examples of these costs. This could be because these costs are not significant in many cases; this was the point made by one Train Operator. However, it is more likely that these particular costs are difficult to identify and estimate. Other costs can be split into two types:

- Those related to changes in train mileage, for example, train miles saved due to trains not running over a section of track, or additional train miles due to a diversionary route; and
- All other costs, for example, train planning, publicity and miscellaneous.

4.1.2 The current Schedule 4 and Part G cost compensation mechanisms are already required to take into account any reductions or increases in train miles. The change in train miles is an easily calculable concept, and not compensating this aspect could have an impact on Train Operators plans to respond to possessions, for example, by discouraging the use of diversionary routes. Therefore, we concluded that this element should be included in the compensation mechanism.

4.1.3 The costs (or savings) of changes to mileage are made up of a number of elements including Variable Track Access Charges, EC4T, Capacity Charge and fuel (diesel trains). In order to make calculation simpler and quicker, our proposal is that an average compensation rate per train mile for each Train Operator should be applied. This average rate would include implicit assumptions about the type of stock, length of track, and routes operated by the Train Operator.

4.1.4 We derived a single rate to include Variable Track Access Charges, EC4T and Capacity Charge for each Train Operator based on financial and train miles data for the financial year 2006/07 provided by ORR. In order to take account of the fuel costs of diesel trains we requested costs per mile from the relevant Train Operators. Further analysis (on more reliable cost data) would be required to derive robust figures for every Train Operator.

4.1.5 Compensation is calculated by multiplying the rate per mile for the Train Operator by the change in Train Miles Operated (TMO). TMO is calculated as the net difference between the train miles on the day the possession occurred against the train miles that would have run if the possession had not occurred.

4.1.6 The compensation estimates were applied to the sample possessions, whether or not this cost (or saving) had been declared by the Train Operator. For many of the possessions the actual cost was adjusted to take account of the change in train mileage we had estimated. Our process was subject to some inaccuracy since it did not include the impact of the possession on empty stock movement. In reality, the compensation mechanism when applied should include these non-passenger train miles. For illustration Table 4.1 shows the proportion of this type of cost against all costs for each Train Operator, for the representative set of possessions.

Table 4.1 - Costs of Changes in Train Miles Operated for each Train Operator.

Train Operator	Rail Replacement Bus Costs (£'000s)	Costs due to decreases in train mileage (£'000s)	Costs due to increases in train mileage (£'000s)	All Other Costs (£'000s)	Total (£'000s)
1	247	-66	10	49	240
2	85	-12	0	3	77
3	40	-19	27	6	53
4	825	-107	0	151	868
5	233	-70	30	24	217
6	653	-68	0	14	599
Total	**2,083**	**-342**	**67**	**247**	**2,055**

4.2 All Other Costs

4.2.1 In order to perform more detailed analysis, the 'other costs' were allocated into three categories:

- Publicity costs;
- Train planning costs; and
- Miscellaneous costs.

4.2.2 Appendix D describes our analysis of these other costs based on the 34 possessions in our sample for which data was provided. As a result we concluded that the data did not support a simple relationship between costs and cost drivers. We also looked at whether a relationship could be found between 'other costs' and rail replacement bus costs (which account for the other 90% of costs). If this were the case then 'other costs' could be accounted for simply by uplifting the rate for rail replacement bus costs. However, the data did not support such a relationship.

4.2.3 However, many of these 'other costs' would be expected to be related to the degree of operational disruption faced by the Train Operator, for example, the train planning involved in responding to the possession. Some of the plots supported this hypothesis, or at least did not discount it. We therefore concluded that compensation should be provided for these costs at a fixed rate per Modified Train Mile (MTM). Where MTM is defined as the number of train miles which suffer alteration (compared to the normal timetable) as a result of a possession, with a positive sign always applied. Thus, both terminating trains short and additional train miles due to a diversion are counted as positive.

4.2.4 Therefore, in addition to a mechanism to compensate for the change in train mileage we propose a further element of compensation for disruption based on a rate per MTM. This would sweep up all three categories of costs (publicity, train planning and miscellaneous costs). A rate of £0.873 per MTM was calculated from the 80 sample possessions as shown below in Table 4.1.

Table 4.1 – Calculation of Rate per Modified Train Mile.

Possessions	Total Other Costs (£'000s)	Total Modified Train Miles ('000s)	Rate per MTM (£)
80	163	283	0.58

5. Testing of Proposed Compensation Mechanism

5 Testing of Proposed Compensation Mechanism

5.1 Application to Sample Dataset

5.1.1 We have tested our proposed compensation mechanism on the sample set of possessions using the following rates:

Compensation = **Rail Replacement Bus Costs (£12.70 per Estimated Bus Mile)**
+ Train Mileage Costs (TOC specific rate per Train Mile Operated)
+ All Other Costs (£0.90 per Modified Train Mile)

5.1.2 Table 5.1 shows the result of applying the mechanism individually to each of the 80 possessions, and then aggregating the overall impact. Note, the actual costs reported here take into account the changes in train miles operated, whether or not these were declared by Train Operators who provided the data.

Table 5.1 – Application of Compensation Mechanism to Sample Set.

	Restrictions of Use (x = duration in hours)				Significant Restrictions of Use (x = duration in hours)				All
	0>x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Number in sample	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)									
Total	15	102	243	360	442	922	360	1724	2084
Rail Replacement Bus Costs	17	110	251	379	458	860	386	1704	2083
Train Mileage Costs[9]	-2.5	-17	-25	-45	-27	-96	-78	-201	-245
Other Costs	0.5	8	17	26	11	158	53	221	247
Compensated (£'000s)									
Total	17	112	462	591	291	785	473	1549	2140
Rail Replacement Bus Costs	17	106	409	532	293	826	516	1635	2167
Train Mileage Costs	-2.4	-18	-52	-71	-27	-98	-78	-203	-274
Other Costs	2.7	24	104	130	24	57	35	117	247
Uncompensated (£'000s)									
Total	-2.0	-10	-219	-231	150	138	-113	175	-56

5.1.3 The impact is shown split by possession band duration in hours, with the major split between RoUs and SRoU applied. Table 5.1 shows that the Rail Replacement Bus Costs mechanism provides reasonable compensation for possessions that fall within the RoU threshold. It works

[9] Where the cost for train mileage was supplied by a Train Operator we used that figure in our analysis of a possession. If a figure was not supplied, we estimated the actual costs or savings based on the compensation rate.

less well for the very small possessions (less than 8 hours) which are over-compensated and for the larger possessions that fall within the SRoU duration which are under-compensated. The Other Costs mechanism works less well for possessions that fall within the RoU threshold, however, it could be argued that this is because other costs associated with these possessions are difficult to identify.

5.1.4 In Figures 5.1, 5.2 and 5.3 the results of applying the mechanism individually to each possession are shown for each of the six Train Operators separately. The purpose was to examine whether the mechanism might disproportionately favour or hinder a particular operator, or type of operator. The data supporting these charts is provided Table H.1 in Appendix H.

5.1.5 These figures show some minor variation in the proportion of actual costs being compensated for each operator. Figure 5.1 demonstrates that the overall compensation for all possessions is reasonable. Figure 5.2 shows which are not currently compensated (RoUs) are generally over-compensated. Figure 5.3 demonstrates that the mechanism provides a reasonably accurate level of compensation for possessions for which Train Operators are currently compensated by negotiation (SRoUs).

Figure 5.1 – Application of Compensation by Train Operator for All Possessions.

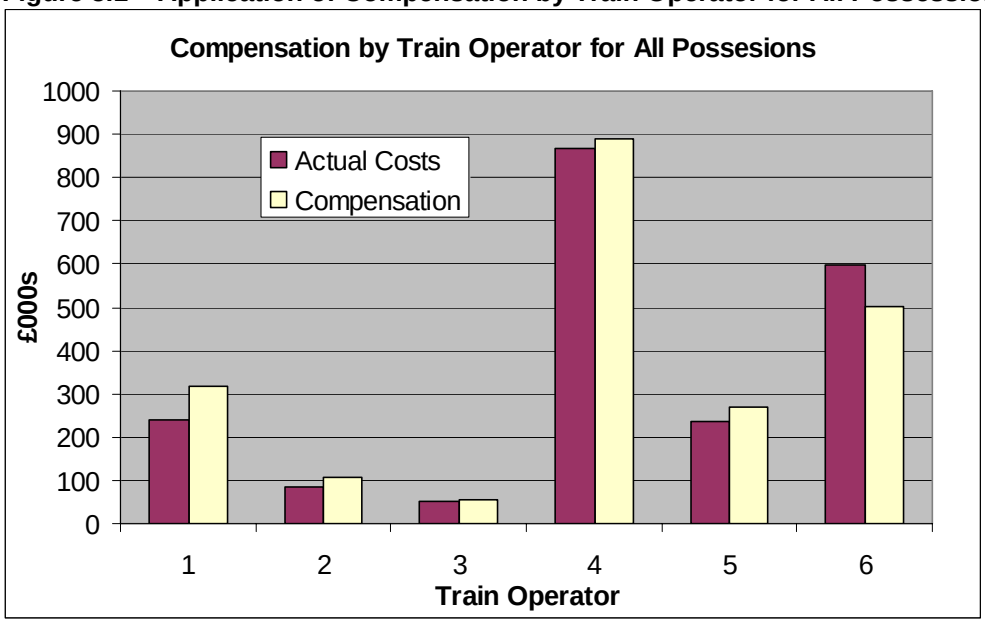


Figure 5.2 – Application of Compensation by Train Operator for RoUs.

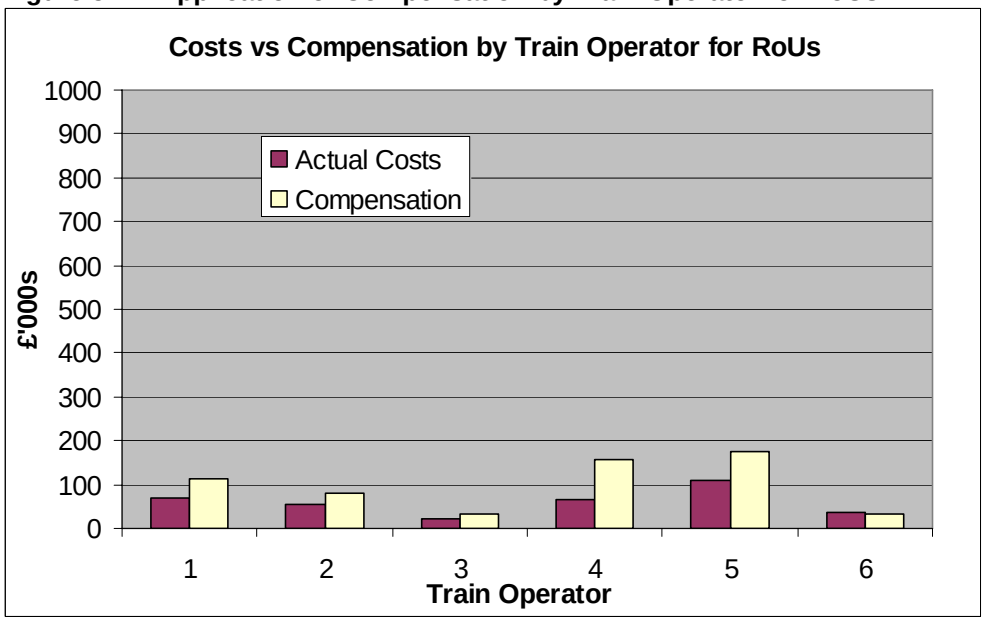
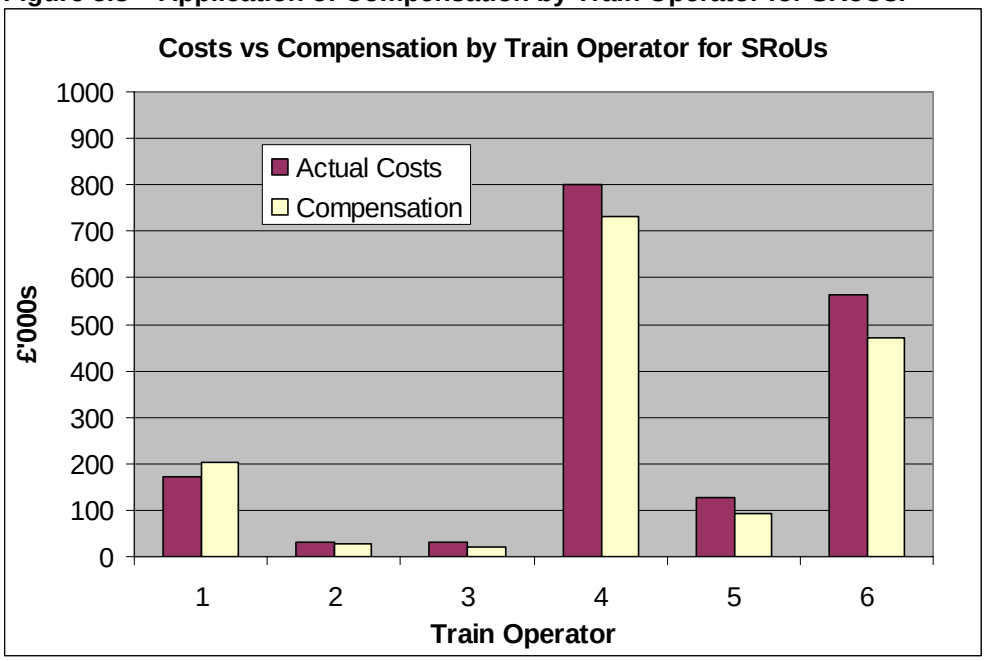


Figure 5.3 – Application of Compensation by Train Operator for SRoUs.

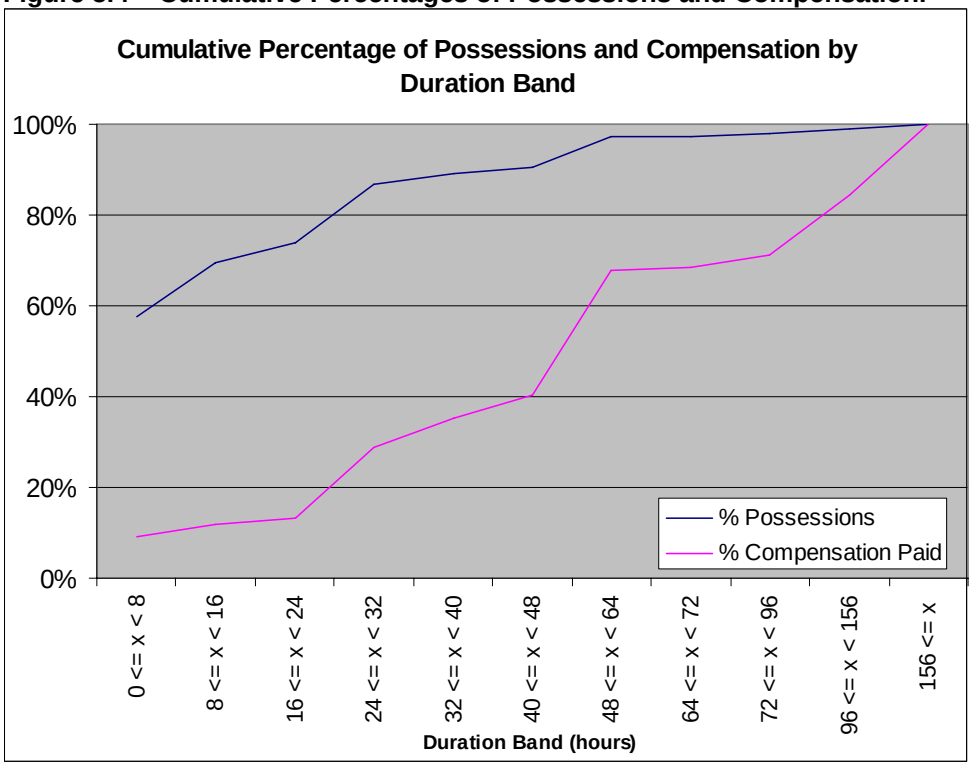


5.1.6 None of the Train Operators appear to be significantly disadvantaged given the number of possessions in the sample. There also does not appear to be consistent variation in the level of compensation between different types of operator (Commuter, Intercity or Regional).

5.1.7 One of the interesting things to note in applying the mechanism to the sample population is the number of possessions falling into bands of duration[10]. For example, for the population of possessions those under 8 hours accounted for 58% numerically, but only 9% of the compensation. This is demonstrated more clearly in Figure 5.4 which shows the percentage of possessions and compensation in each duration band.

[10] Estimated by calculating the average amount of compensation paid for sample possessions in each duration band. This was then applied to the population possessions in each duration band to calculate the overall compensation. This should only be taken as a very approximate estimate, since earlier in Section 3.2 we demonstrated a poor relationship between duration and possessions cost.

Figure 5.4 – Cumulative Percentages of Possessions and Compensation.



5.1.8 In order to reduce transaction costs associated with administering the compensation mechanism, we propose that a lower threshold is set below which costs are not compensated. This threshold could be set initially at 24 hours, which would mean that only 26% of possessions would be included, but that an estimated 87% of costs would be paid.

5.1.9 As the process became more embedded, we propose that this threshold could be progressively reduced to 8 hours so that the cost implications of more possessions were captured. This would encourage Network Rail to take account of the costs of more possessions in its decision making process. However, we believe that the volume of possessions lasting less than 8 hours means that reducing the threshold further work add significantly to transaction costs, without benefiting the industry. It was interesting to note that at least two of the Train Operators commented during the interviews that they would not support the introduction of cost compensation for all possessions. This is because there are such a large number of small possessions that dealing with all of them would be very time consuming.

5.1.10 However, one implication of incorporating a lower threshold is that the data points represented by these possessions should probably be excluded from the derivation of the relationships at the heart of the mechanism. Clearly an industry debate is required about both the threshold levels and the level of compensation the rates should be set to provide. For example, should the compensated costs be uplifted to take account of the uncompensated costs; and what is the possible impact of any threshold on Network Rail's possession strategy?

5.2 Application to Larger Possessions

5.2.1 A cost compensation mechanism which is based on using a formula for the majority of cases needs some ability to adjust the output of the mechanism to take account of special circumstances. However, as far as possible, there should be a clear boundary that defines the scope of ordinary circumstances, and special circumstances would normally only be admissible outside that boundary

5.2.2 As part of the review of Schedule 4 revenue compensation three categories of possessions are being proposed:

- 'Typical Possessions' being calculated according to a (revised) Schedule 4 algorithm;
- 'Larger Possessions', beyond a defined threshold, would by default have compensation calculated using the Schedule 4 algorithm, but there would be scope to use alternative methods should the Train Operator produce prima facie evidence that the algorithm was likely to underestimate the level of revenue loss; and
- 'Largest Possessions', beyond a second threshold, would have compensation calculated using bespoke methods (although the Schedule 4 algorithm would be calculated by default, and would form a "floor" to the level of compensation).

5.2.3 The proposed boundaries between these categories might be:

- 'Larger Possessions' defined as those where a given service group is affected by possessions in a particular location with a cumulative duration of 300 hours over any consecutive three rail periods. Or an individual possession with a minimum duration of 120 hours (i.e. five full days, clearly encroaching into the working week)
- 'Largest' Possessions' defined as those where a given service group is affected in a particular location by possessions with a cumulative duration of 700 hours over any consecutive 7 rail periods.

5.2.4 We support the general concepts in these categories. Grouping smaller possessions to consider the cumulative effect on a given service group at a particular location is helpful for dealing with the longer-term impact of repeated short disruption. However, we believe that the duration thresholds above which an individual possession moves into the 'Larger Possession' category might be too high to deal with the variations in the costs caused by possessions.

5.2.5 This is based on two pieces of evidence. Firstly, the fitted lines of Rail Replacement Bus Costs against EBMs (Figures 3.4 and 3.5) show more variation in the scale and slope of possessions classed as being SRoUs than RoUs. Secondly, Table 5.2 below shows the number of possessions in our sample set of 80 that are under or over compensated. The choice of the SRoU threshold would mean that all possessions that are under compensated by more than £10,000 would be included. While 8 of the over-compensated possessions are not SRoUs, the scale of over-compensation is much smaller than under-compensation.

Table 5.2 – Sample Possessions that are Under or Over-Compensated by the Proposed Mechanism.

Possessions under-compensated by amount below	Number of possessions that are SRoUs	Number of possessions that are RoUs	Average amount of under-compensation per possession (£'000s)
> £10,000	7	0	-52
< £10,000	5	21	-2
Possessions over-compensated by amount below	Number of possessions that are SRoUs	Number of possessions that are RoUs	Average amount of over-compensation per possession (£'000s)
< £10,000	2	28	3
> £10,000	6	8	24

5.2.6 The analysis based on our sample possessions suggests that the mechanism provides fair compensation on average. However, given the limited number of larger possessions on the network, it is possible that a Train Operator, who is significantly out of pocket due to one large possession, might not receive equivalent over-compensation for a number of years. We are

therefore proposing a right of appeal might be given to either party if they can demonstrate that costs exceed a threshold of £10,000 above or below the calculated level of costs. This would help provide comfort to both Train Operators and Network Rail about the impact of the process on compensation.

5.2.7 It remains to be determined whether this right of appeal should be applied to all possessions, or only those above an upper threshold. It might be that this right of appeal only applies to possessions that either currently fall into the SRoU duration threshold of 60 hours (not including Bank Holidays), or which fulfil the 'Larger Possession' category defined in the proposed revenue compensation mechanism (i.e. the cumulative effect of repeated short disruption). Alternatively, the right of appeal might be available for all those possessions which would be under or over-compensated by more than £10,000 if either party could demonstrate that this was the case.

6. Implementation Issues

6 Implementation Issues

6.1 The Concept of Estimated Bus Miles

6.1.1 For a compensation mechanism to provide incentives to industry parties with respect to possession planning and execution, it needs to comply with the following principles:

- Be predictable and calculable by reference to simply stated rules;
- Input data should be either invariable or available at the time that compensation needs to be calculated; and
- Any mechanism should be structured, and endorsed by the industry, such that the only areas of probable dispute are in respect of the application of rules, and not at the level of principle.

6.1.2 The most complex variable in the proposed mechanism is Estimated Bus Miles. This section explores some of the practical issues as to the implementation of the mechanism driven by EBMs.

6.1.3 In order to test whether the methodology of calculating EBMs could be understood, we circulated a paper containing a number of example calculations to a number of colleagues. This identified a number of issues and ambiguities in the instructions that were provided. As a result the instructions were improved by means of a flow chart, as shown in Appendix G.

6.1.4 We also discussed the concept of EBM's and their practicality with one Track Access Manager and received the following comment:

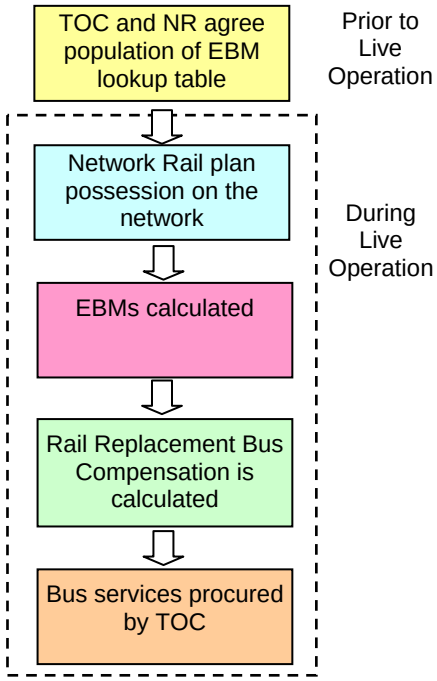
> *"As a method of compensating train operators for the costs of operating rail replacement services the Estimated Bus Miles would appear to be a worthwhile method of calculating the cost of possessions to TOC."*

6.1.5 The Track Access Manager expressed a number of concerns relating to the potential risks of adopting a compensation mechanism based on a formulaic approach. We are proposing that an upper-threshold should be applied, above which the Train Operator or Network Rail could make a case for costs to be negotiated. This should provide comfort to both parties where there are "*large additional costs not accounted for by the Estimated Bus Miles mechanism."*

6.1.6 In addition, the Track Access Manager stressed the importance of relating costs back to the disruption to train service rather than the possession activity, i.e. the site of actual engineering work. This refers to whether the EBMs calculation should be based simply on the length of the network subject to engineering activity, or the wider length of the network over which train services are in someway affected by the possession. The evidence from talking to Train Operators is that the costs they experience are closely related to the overall impact on the train service. It is this impact that the concept of Estimated Bus Miles is designed to reflect.

6.1.7 Figure 6.1 outlines our proposals for how this calculation process might operate. Prior to live running, Network Rail and the Train Operator would agree what the response to a possession on any particular route would look like. This response would then be captured in the form of a lookup table containing the EBM weights that would apply along that route.

Figure 6.1 – Process for Calculating Compensation.



6.1.8 Table 6.1 below shows an example of such a lookup table. For each section on the network the normal response to a possession on that section would be recorded in terms of where each EBM weight would be applied. For example, the table would show over which miles of the route the Train Operator would run buses, use a diversionary route, or do a combination of the two.

Table 6.1 – Example Lookup Table for EBM Weights.

Route Section	FULL rail replacement bus service **weight = 1.0**	NO rail replacement bus service **weight = 0.0**	PARTIAL rail replacement bus service **weight = 0.5 x % trains stopping**	
			Section	% trains stopping at intermediate stations
London Fenchurch Street to Shoeburyness	Pitsea to Shoeburyness	Fenchurch Street to Upminster	Upminster to Pitsea	75%
Huddersfield to Manchester Airport	Manchester Piccadilly to Manchester Airport	-	Huddersfield to Manchester Piccadilly	25%

6.1.9 The weight for partial rail replacement includes a factor for the percentage of trains calling at intermediate stations on that section. This could be calculated on an individual basis for each possession from the Base Timetable, giving a more accurate compensation figure. However, the industry may decide that the necessary level of accuracy would be retained by calculating this figure at the beginning of the Control Period, from the current timetable, and storing it in the relevant record in the lookup table. This would prevent the (potentially time consuming) task of calculating this percentage individually for each possession.

6.1.10 Populating the lookup table would include dealing with any ‘special cases’. For example, two Train Operators told us that if there is a possession affecting services to an airport, buses will run over a longer distance than operationally necessary. The purpose being to avoid hindering passengers with heavy luggage by forcing them to change twice between train and bus. This means that in populating the lookup table there may be some debate between Network Rail (who would want to calculate EBMs on the actual section of railway that is closed) and the Train Operator (who would want to calculate EBMs over the whole section to the airport). However,

by populating the lookup table in advance, the scope for dispute once the mechanism becomes operational is much reduced.

6.1.11 We anticipate that once operation begins, Train Operators and Network Rail may wish to make a case for changes to be made to particular records in the lookup tables. However, we propose that the onus should be on parties to provide good evidence for such changes and that they should be by mutual agreement only.

6.1.12 In addition, we suggest that changes during the Control Period should be restricted to updating the lookup tables for future possessions, rather than to retrospectively correct individual cases. Such changes would reflect either a better understanding of the possession response, or a change in the actual response a Train Operator makes. We are suggesting that individual cases which might be considered to be poorly treated should not be retrospectively adjusted by such changes. This is because the analysis so far supports the view that the mechanism provides reasonable compensation on average, not accurate compensation in every individual case. Secondly, we are proposing an upper-threshold, above which costs could be negotiated to deal with the really large exceptions.

6.1.13 As explained above, the lookup tables would be populated in advance of live running. Once the arrangements became operational, the process of calculating compensation would proceed as follows:

- Network Rail decide to take a possession over a specified section of network;
- The EBM weights for this section are identified in the lookup table;
- These weights are then combined with other data needed to calculate EBMs which would be known at 'T-60': lengths of route and the number of trains affected (from the Base Timetable or Draft Timetable); and
- Compensation is calculated from the EBMs and the rate per EBM.

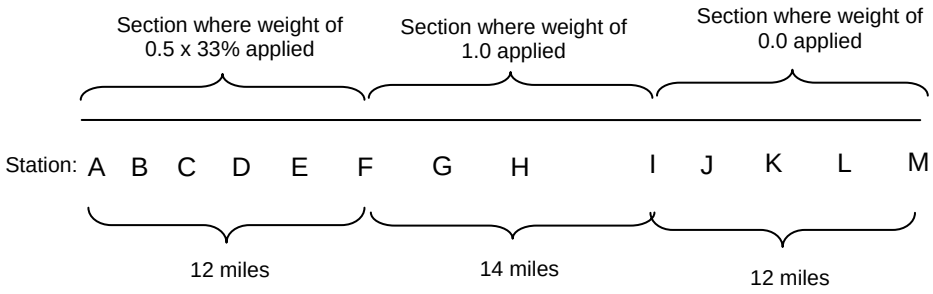
6.1.14 Below we demonstrate how this approach applies to an illustrative example, a line between stations A to M, with the following characteristics:

- If the line is blocked between A and F, there is a second diversionary route which, does not serve the intermediate stations B, C, D and E; a replacement bus service would be required to serve intermediate stations B to E;
- If the line is blocked between F and I, there is no diversionary route (or alternative parallel operator) and a replacement bus service would be required; and
- If the line is blocked between stations I and M then there is the option of diverting passengers to a parallel line of route (e.g. LUL, or Metrolink, or further Network Rail line without physical connections to the main route) between stations I and M.

6.1.15 Figure 6.2 shows the population of the lookup table for this route. As explained above, this would be prepared in advance. Based on the agreed response to a possession the table specifies the EBM weights on the route section between A and M, including the calculation of the factor for the % trains stopping at intermediate stations between A and F (from the current timetable). This setup would also include recording the relevant distances involved.

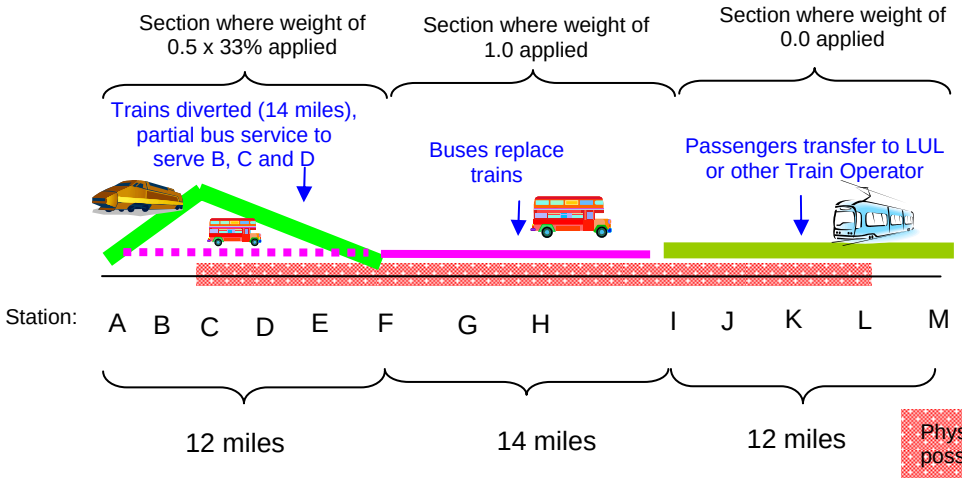
Figure 6.2 – Preparatory Setup of Lookup Table for Section from Station A to Station M.

Route Section	FULL rail replacement bus service **weight = 1.0**	NO rail replacement bus service **weight = 0.0**	PARTIAL rail replacement bus service **weight = 0.5 x % trains stopping**	
			Section	% trains stopping at intermediate stations
Stations A - M	Stations F - I	Stations I - M	Stations A - F	33%



6.1.16 Figure 6.3 shows how the example specified in Figure 6.2 applies to calculating compensation for an individual possession that is planned by Network Rail. The possession involves engineering activity between Stations C and L, with train services affected between Stations A and M. During the period of the possession (29 hours) the Base Timetable shows that the Train Operator is scheduled in the Base Timetable to operate 15 trains in each direction between stations A and M, and that of these trains only 5 (33.3%) in each direction stop at stations B to E.

Figure 6.3 – Application of Mechanism to Example Possession.



Rail Replacement Bus Costs:
= £12.70 x EBMs = £12.70 x **(**12 miles x 0.5 x 0.33 + 14 miles x 1.0 + 12 miles x 0.0) x 30 trains
= £6,088

Train Mileage Costs:
= £2 x TMOs = £2 x (14 miles x 30 trains – (12 miles + 14 miles + 12 miles) x 30 trains)
= -£1,440

All Other Costs:
= £0.58 x MTMs = £0.58 x (14 miles x 30 trains + (12 miles + 14 miles + 12 miles) x 30 trains)
= £905

Total Compensation:
= £5.553

6.1.17 Calculation of EBMs will involve the application of the lookup table and distances to the number of trains affected by this individual possession. Thus the calculation of EBMs for this possession between C to L as illustrated, the EBMs would be the sum of:

- Possession between A and F, trains able to run over alternative route to A to F. Replacement buses necessary to serve intermediate stations B, C, D and E. Weight for this section = 0.5 x % trains stopping (33%) = 0.17. Therefore EBMs = 30 x 12 x.0.167 = 59.4;
- Possession between I and M. Trains terminate at M. No replacement buses as passengers are diverted to parallel operator. Weight for this section = 0.0. Therefore, EBMs = 0.0; and
- Possession between F and I. No alternative to running a replacement bus service between F and I. Weight for this section = 1.0 and EBMs = 30 x 14 x 1.0 = 420.

6.1.18 If the proposed mechanism was implemented, we recognise that examples of 'special cases' are likely to be encountered. These will require further investigation to ensure the process can cope with the range of situations across the network. We envisage that the numbers and types of 'special cases' will need to be catalogued during the data collection and set-up process described later in Section 6.2. This will allow Network Rail, ATOC and ORR the opportunity to review such cases prior to implementation, and satisfy themselves that all such special cases are dealt with equitably.

6.1.19 The variables other than EBMs that are used in the proposed compensation mechanism are Train Miles Operated and Modified Train Miles. These are more straightforward and rely on the existing industry concept of train miles. We believe this could probably be derived from data in TSDB or other timetable systems. Further discussions with Network Rail would be needed to confirm this.

6.1.20 Calculating these variables would involve comparing the train miles in the timetable that would have been operated with the train miles in the timetable operated on day of possession (Applicable Timetable or First Working Timetable). A representative calculation could be made of these figures derived from the Base Timetable. This could be effective for budgeting purposes, but might well not capture ancillary movements. If the industry view is that such an approximation would not be appropriate, then a more accurate figure could be derived (at a much later date) by drawing on comparisons made between First Working Timetable or Corresponding Day Timetable and Applicable Timetable.

6.2 Outstanding Issues

6.2.1 Our analysis on the sample possessions suggests that a mechanism of the form presented here could provide the industry with a practical means for calculating fair and reasonable cost compensation. However, at this stage a number of issues remain which will need to be resolved before such a mechanism could be implemented. These can be grouped into the following three categories:

- Data and validation / calibration of the compensation relationships;
- Development of the process for calculating compensation, including system issues; and
- Policy issues – to be determined by the industry.

6.2.2 There is the requirement for further data from Train Operators as to the costs they experience as a result of individual possessions. We suggest that this might occur in two stages.

6.2.3 In the short-term a further set of sample data should be obtained, either from other Train Operators, or fresh data from the original six Train Operators. The purpose would be to carry out further 'blind-testing' of the mechanism and compensation rates calculated so far. The compensation calculations could be undertaken in conjunction with Train Operator staff. This would have the advantage of transparency, as well as enabling feedback on how the mechanism was working from future users.

6.2.4 The purpose of this testing would be primarily to assess the validity of the EBMs relationship proposed here. If the relationship works well for an independent dataset, this would give confidence to the industry. If the relationship did not work as well, further work would be required to refine the proposals.

6.2.5 This testing would give further clarity and confidence as to whether the mechanism, if implemented, would provide fair and reasonable cost compensation. One issue we would stress is the need for Train Operators to provide detailed information as to the pattern of bus operation during the possession, which is used to determine the EBM weights that are applied. Clarity here would help remove ambiguities and ensure that a fair test was undertaken.

6.2.6 We anticipate that the question will be asked by the industry as to whether a different rate should apply to each Train Operator or type of operator. The analysis in Section 5.1 showed that based on the same rate per EBM, none of the Train Operators appeared to be significantly disadvantaged. Given the data currently available, it would be difficult to justify something other than a single rate. Further sample data would help provide further clarity and confirmation on this issue.

6.2.7 A second stage of more detailed and in-depth data collection would be required in advance of implementation, to derive the actual rates applied during CP4. This would involve further cost data for specific possessions from a wider group of Train Operators. We recommend that Train Operators are involved immediately so that, at the very least, accurate data can be collected for possessions occurring over the next six months.

6.2.8 There is a need to ensure the rates used in the mechanism reflect the efficient costs to Train Operators of, for example, procuring bus services. Section 3.3 showed that proportionately higher costs were observed in the sample dataset for SRoUs compared to RoUs. This could be caused by a number of factors, one of which is that RoU possessions are currently uncompensated. Thus the RoU data points may represent more efficient costs of procuring bus services, since they are a direct cost to the Train Operator. However, the costs of RoUs may be under-estimated because Train Operators keep limited records of them. We suggest that further benchmarking could occur, perhaps using data sources from outside the industry.

6.2.9 We propose that the rate per train mile for Train Mileage Costs should be derived from the annual variable access charge paid by each Train Operator, and the train miles run by that operator. This would include the following costs train mileage: Variable Track Access Charges, EC4T and Capacity Charge. A further element would be needed to take account of the fuel costs of diesel trains. We propose that this could be derived either by requesting the annual amount spent on diesel fuel from each Train Operator, or by the use of benchmark fuel costs per train mile.

6.2.10 There are also a number of issues around the development of the compensation process:

- Population of the Estimated Bus Miles lookup tables;
- Development of a 'semi-automatic' system along the lines of S4CS; and
- Briefing and training of those involved in the process.

6.2.11 As described in Section 6.1 the lookup tables would record the expected response of an individual Train Operator to a possession on a particular route section in terms of the effect on the train service operated. Our proposal is that these tables would have a record for each combination of Train Operator and Constant Traffic Section[11] (CTS).

6.2.12 The boundaries between CTSs (where traffic changes) represent the most likely place for trains affected by a possession to terminate / re-start, or be diverted. Thus CTSs represent the very smallest level at which response to a possession would normally be planned and operated. In reality, many adjoining CTSs will be treated in the same way when a possession occurs. The sum of all CTSs operated over by all Train Operators is approximately 4,900 (counting an Up CTS and an equivalent Down CTS as one). This gives an estimate of the maximum number of entries that would need to be populated in such a table.

6.2.13 We anticipate that population would involve a number of sessions for each Train Operator, involving both the Track Access Manager and the relevant Network Rail Customer Relationship Executive. The purpose would be to agree for each CTS that the Train Operator ran services over, what the appropriate response (in terms of EBM weights) was to a possession. This could be based on past possessions and other sources of data such as contingency plans.

6.2.14 Further thought needs to be given as to the dimensions of the lookup table. For example, should the pattern of response by TOCs vary by weekend / weekday / time of day etc? In addition, possessions across multiple adjacent CTSs may be responded to in a different way. Some of the issues may only be resolved as part of the population process. It is also likely that there would be some ongoing iterative development, by mutual agreement, during any phase of shadow-running.

6.2.15 The use of a lookup table approach would mean that it is likely that a system could be developed to calculate the compensation for each possession. This would work at a similar level of semi-automation to the S4CS revenue compensation system, which requires some user intervention at the beginning of the process. Initially we had suggested that the cost compensation should be incorporated into S4CS. However, revenue compensation occurs after a possession has occurred. In order to be useful the cost compensation process needs to be carried out well in advance of a possession. This points to use of a different system, even if this functions in a similar way and uses the same inputs as S4CS.

6.2.16 We propose that in the short-term, a prototype system should be developed in Microsoft Access. This would test the feasibility of automating stages of the calculation, as well as highlighting any technical and data issues. A large number of possessions occur annually on the network. Hence, it is important for ISG to have confidence that the mechanism will actually reduce transaction costs (one of the criteria set out by ORR). Should such a prototype be successful, it could then be adapted to form part of an operational system.

6.2.17 We also recommend that ISG should run a number of briefing sessions to inform the wider industry about the proposals. This is likely to occur at a relatively senior level, and would involve an explanation of the proposed mechanism. These sessions would result in a more informed consultation process, and hopefully achieve more industry acceptance of the proposals. They would also lead to identification of any issues that need further consideration.

6.2.18 Further on in the implementation process, training sessions would be required to brief those tasked with operating and interfacing with the proposed compensation mechanism.

[11] Constant Traffic Sections were defined by Network Rail for use in their Infrastructure Cost Model. These segments of the network represent sections where there is relatively constant volume, type and speed of traffic. For example, three CTS are: Kings Cross to Finsbury Park; Finsbury Park to Alexander Palace; Alexander Palace to Welwyn Garden City.

6.2.19 As described in the body of this report, a number of policy issues remain unresolved, which are likely to require further industry discussion and consultation.

6.2.20 Firstly, should a lower threshold be applied, below which costs are not compensated? This is likely to depend on the relationship between transaction costs and the amount of compensation paid. This may be driven by the level of automation or computer facilitation that can be achieved in calculating compensation for each possession. (Hence, our recommendation that a prototype system should be developed). As stated above, ISG need confidence that implementing the proposed mechanism will actually reduce overall industry transaction costs.

6.2.21 Secondly, should a higher threshold above which Train Operators and Network Rail could make a case for costs to be estimated on a negotiated basis be implemented? If so, should larger possessions above the threshold be excluded from the calculation of compensation rates?

6.2.22 Thirdly, whether a process for handling real anomalies should be applied to all possessions, or only those above an upper threshold?

6.2.23 Finally, should the mechanism include simply the Rail Replacement Bus Costs component (which accounts for approximately 90% of costs) or all three elements? We suggest that as a minimum the Train Mileage Costs element also needs to be included. Without this element an incentive may be introduced that encourages Train Operators to run rail replacement buses (for which they would be compensated) rather than use diversionary routes (for which they would not be compensated).

7. Conclusions and Recommendations

7 Conclusions and Recommendations

7.1 Conclusions

7.1.1 The evidence presented in this report suggests that a possession cost compensation mechanism could be devised using a formula of the form set out below. We believe this would provide a practical mechanism for calculating fair and reasonable cost compensation, in advance of a possession occurring. Most of the costs will be driven by a new measure called 'Estimated Bus Miles'.

Compensation =	**Rail Replacement Bus Costs (rate per Estimated Bus Mile)**
	+ Train Mileage Costs (TOC specific rate per Train Mile Operated)
	+ All Other Costs (rate per Modified Train Mile)

7.1.2 We are recommending that this mechanism is applied to all possessions that affect Train Operators. However, a lower threshold may need to be applied, below which costs are not compensated. Whether such a threshold is needed is likely to depend on the relationship between transaction costs and the amount of compensation paid. This in turn may be driven by the level of automation or computer facilitation that can be achieved in calculating compensation for each possession.

7.1.3 Initially this lower threshold could be set at 24 hours, whilst the industry becomes familiar with the process. Over time this threshold might be reduced to 8 hours which would mean around 90% of costs would be compensated by capturing 40% of the possessions that affect Train Operators in the mechanism.

7.1.4 In addition we are proposing an upper threshold is set above which Train Operators or Network Rail could make a case for costs to be estimated on a negotiated basis. This threshold might include those possessions which would be under or over-compensated by more than £10,000, and / or those possessions that currently fall into the SRoU duration category or which fulfil the 'Larger Possession' category defined in the proposed revenue compensation mechanism. Such a threshold would:

- Provide comfort to the industry during the implementation of a new compensation mechanism; and
- Handle the fact that larger possessions may incur unusual costs not reflected in the derived compensation rates.

7.1.5 There are some residual issues around this compensation mechanism that will need industry consultation, namely:

- Whether the mechanism should be differentiated between shorter and longer possessions given the differences we observed in the relationship between rail replacement bus costs and EBMs for SRoUs and RoUs;
- Whether there needs to be a minimum cost / duration threshold, below which the compensation mechanism would not apply, to reduce overall transaction costs to the industry, and what that threshold should be; and
- Whether there needs to be a higher threshold above which compensations costs need to be negotiated individually and what this threshold could be.

7.1.6 Below in Table 7.1 we assess these proposals for a revised compensation mechanism against the principles set out in ORR's letter of 5th January 2007 to the Industry Steering Group.

Table 7.1 – Assessment of Proposed Compensation Mechanism vs. ORR Criteria.

Criteria	Assessment of Proposed Mechanism
All compensation should be made through Schedule 4 of a Track Access Agreement.	Mechanism can be incorporated into Schedule 4 alongside revenue compensation.
A consistent approach is taken, that is there is no differentiation between different purposes of possessions (renewal, maintenance and enhancement).	Possessions are treated on a consistent basis using objective variables that do not change by possession purpose.
There may be differentiation depending on the scale of a possession, for example different rates or approaches above or below certain thresholds.	Proposed lower duration threshold applied, below which compensation is not paid. Upper threshold above which Train Operators are able to claim for costs which are significantly under compensated by this mechanism. Further industry debate needed on these issues.
The transaction costs are minimised and that appropriate levels of accuracy and efficiency are adopted.	Likely to depend on the degree of automation that can be achieved and whether a lower threshold is applied below which compensation is not paid.
The correct incentives are provided (both to Network Rail and Train Operators) to ensure that possessions and their consequences are managed efficiently.	Network Rail is provided with incentives as to the costs implications of engineering planning on Train Operators. Train Operators are incentivised to minimise costs of engineering response because compensation is pre-determined.
A right of appeal should be retained for Network Rail and Train Operators to seek redress if compensation is disputed.	Above upper threshold costs to be compensated on a negotiated basis. Both Train Operators and Network Rail have right of appeal.
Transparency of costs and benefits should enable the risks and impacts of disruption to be anticipated.	Compensation mechanism can be calculated in advance allowing the implications of decisions to be determined.
Train Operators receive an appropriate level of compensation for reasonable costs.	See Chapter 5 of Report.
The new methodology can be implemented for the start of Control Period 4, which includes understanding the implications.	See Chapter 6 of Report.

7.2 Recommended Next Steps

7.2.1 The compensation mechanism is dependent upon reported cost information by Train Operators. Should it be adopted by the industry, we would recommend that further data be collected:

- In the short-term some further sample cost data should be collected to test the proposed mechanism and provide confidence to the industry. This may also help to resolve a number of outstanding issues; and
- More extensive cost data will be needed before 'live running' to derive the compensation rates. We recommend that more Train Operators are involved immediately so that, at the very least, accurate cost data can be collected for possessions occurring over the next six months.

7.2.2 In conjunction with this we recommend that system issues are investigated to test the level of automation that is feasible. This would include in the short-term:

- Development of prototype system; and
- Population of the proposed lookup table for one or more Train Operators to assess feasibility.

7.2.3 This proposed mechanism will need stakeholder review and buy-in if it is to be used effectively. Industry discussion and debate is needed on a range of policy issues outlined in Section 7.1.5. Such a debate needs to be supported and informed. We recommend that workshops are held to explain the proposals to the wider industry as soon as possible.

7.2.4 Further training of users at the ground-level would be needed in advance of implementation. This may best occur at the same time as the population of the proposed EBM lookup table for each Train Operator.

7.2.5 If the proposed approach is adopted, we recommend that a period of shadow-running is operated. This would allow the method to be tested in advance of Control Period 4, and give the industry further confidence.

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Appendix A: Train Operator Interviews

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This Appendix summarises the key themes and issues that emerged from the interviews with the six Train Operators. The information has been useful in focussing our thinking and analysis into the costs experienced and the factors that drive those costs. It has also given us a practical understanding of the type of compensation mechanism that might be appropriate.

Costs Experienced by Train Operators

Five of the Train Operators stated that there are normally no additional fleet costs associated with possessions as diversion services are run using current stock. This may often lead to running shorter-formed services than is ideal due to the inherent inefficiency of the amended timetable. None of the Train Operators noted any significant increases in mileage or crew costs associated with possessions. Station operating costs were also not perceived to increase significantly by any of the Train Operators unless a road substitute is required. Half of the Train Operators stated that they had standard diversion routes for which route knowledge is generally maintained, therefore there is often no specific cost per possession.

All but one of the operators stated that they use one agent or supplier to procure bus services. The agent will also provide staff to manage rail replacement operations. All Train Operators stated that taxis are generally only used to move crew and passengers who are unable to use rail replacement services. Standby coaches are used to cater for busier trains.

One Train Operator pointed out that the type of rail replacement vehicle used will differ by Train Operator. On some routes passengers will expect a higher quality of service therefore coaches may be used. On others single or double-decker buses will suffice. It was not clear as to whether there were any ownership issues when a franchisee and bus supplier have common ownership or where the latter is owned by a rival. However, we did note that First Buses and National Express Rail Replacement were used by the majority of the Train Operators we had consulted.

Most Train Operators stated that they do not compensate other train operators or LUL when they carry their passengers during possessions.

We presented the Train Operators with the list of costs below in Table A.1.

Table A.1 – List of Costs Experienced by Train Operators.

Increased costs of operating services that would otherwise run:	increases to fleet, ownership costs, additional train mileage, fuel, staff hours, access charges , traction training , route learning, route conductors, station operating costs, extended operating hours
Costs associated with the provision of alternatives:	running trains over an alternative route (see above costs), running substitute bus services/taxis, crew taxi costs, DDA vehicles, standby coaches, supervision/management costs
Other costs:	additional policing, publicity costs

A number of additional costs which we had not included were highlighted (not all applied to all the interviewed Train Operators):

Use of alternative depots, ancillary movement costs, train cleaning, train / station security, signage, vehicle removal and recovery, office hire, loss of car parking revenue when station car

park is used as a worksite, disposing of waste from Controlled Emissions Toilets when cut off from maintenance facilities; transferring people from inaccessible stations on diversion routes; clauses in maintenance contracts which are fouled by the impact of disruption; diesel-haulage of electric stock over un-wired lines to reach maintenance facilities; use of alternative termini (though one Train Operator said there would be no costs associated with this); re-programming automated customer information systems.

All Train Operators stated that the most significant costs experienced were the costs of rail replacement services. Publicity costs were also stated as a significant cost for major possessions as were railway planning costs, agency staff, and customer service staff.

Section 4.2.2.1 of Network Rail's Commercial Manual ("Schedule 4 – Significant Restrictions of Use) lists the categories of Direct Costs associated with possessions for which Network Rail will compensate Train Operators. Table A.2 uses this manual to allocate each of the costs discussed with operators into one of these five categories or into a sixth category of uncompensated costs.

Table A.2 – Categories of Cost Experienced by Train Operators.

Direct Cost Category	Costs Included
1. Bus and taxi hire costs	Running substitute buses, crew taxi costs, DDA vehicles, standby coaches
2. Publicity costs	Publicity costs
3. Additional train planning and diagramming costs	Train planning
4. Costs directly related to the organisation and management of the train operator's response to an RoU	Bus supervision costs, new route learning, increased staff costs, additional train cleaning, station signage
5. Increase in costs resulting from increases in train mileage	Additional train mileage, access charges, fuel
6. Costs not mentioned (uncompensated)	Increases to fleet, ownership costs, traction training, station operating costs, additional policing, use of alternative depots, ancillary movement costs, vehicle removal and recovery, loss of car parking revenue, re-programming automated customer information systems, office hire[12], disposing of waste from CETs, clauses in maintenance contracts which are fouled by the impact of disruption, diesel-haulage of electric stock over un-wired lines.

Drivers of Costs

Half of the Train Operators stated time of year as an important driver of costs and all stated time of day and day of week. On weekdays/Sunday afternoons there are more passengers and journey times are usually longer on the roads. Possessions on a weekday night can incur significant rail replacement costs for the small number of passengers displaced. Some Train Operators stated that the hire rate will change at certain times of the year. For example, in the school holidays there are more buses generally available which lead to lower hire costs. Three of the Train Operators also stated that the location of a possession is a significant driver of cost. There was no agreement between Train Operators over whether repetition is a driver of cost.

The Train Operators had different strategies for working with other operators. In some cases, one Train Operator will procure the services and the remaining Train Operators will reimburse. In other cases Train Operators will jointly agree a response plan, but procure bus services separately.

The Current Compensation Mechanism

All but one Train Operator are currently compensated on an emerging costs basis for Significant Restrictions of Use.

Most Train Operators agreed that the incentives of Network Rail and Train Operators do not completely align. Network Rail is interested in completing engineering works to time and cost, whereas Train Operators are interested in minimising the impact on their passengers.

[12] Due to the need to relocate staff to manage a possession.

Two Train Operators suggested a better mechanism would be a free period when Network Rail has access to the railway. This would incentivise the Train Operators to manage costs and improve the service provision when a possession is on. It would also incentivise Network Rail to manage within the envelope. However, Network Rail could be encouraged to take possessions irrespective of whether it actually needed them. A free possessions allowance has been applied in the past and this is something which has been moved away from.

A few Train Operators noted that more advance notice and better planning would reduce costs. One Train Operator commented that it would be more effective if Network Rail could give a planned maintenance and renewals strategy to Train Operators when they take on the franchise. This would reduce costs, improve planning, and reduce the overall impact of possessions. Another commented that at present the pattern of possessions is not regular. It changes week on week making management and planning very difficult. Some Train Operators said that the detail of a particular possession often is not available until the last minute.

At least two of the Train Operators commented that use of binding estimates may encourage Train Operators to load everything with risk therefore leading to possession cost inflation.

At least two of the Train Operators commented that they would not support the introduction of cost compensation for all possessions. This is because there are such a large number of small possessions that dealing with all of them would be very time consuming. They are also broadly supportive of the idea that a level of smaller disruption is built into franchise bids and should therefore not be compensated. Thus Train Operators were not supportive of creating a large bureaucracy to achieve cost compensation for small possessions.

Estimating Costs

Very few of the operators had standard unit costs for the hiring of rail replacement vehicles. Most said that they vary depending on time of year, week, and the amount of notice given. Costs are therefore calculated on a possession by possession basis.

The number of replacement vehicles required is generally estimated based on past experience. Some Train Operators put on one bus per train with additional vehicles as required. One Train Operator stated that they provide enough bus capacity to cater for the number of rail passengers who would be travelling in the absence of a possession, regardless of whether they would be displaced by the disruption.

Appendix B: Plots of Costs vs. Cost Drivers

Appendix B: Plots of Costs vs. Cost Drivers

This Appendix shows further plots of total costs experienced by Train Operators against various cost drivers. As a result of these plots we concluded that the data did not support a simple relationship between costs and cost drivers.

- Figure B.1 shows All costs vs. the Schedule 4 measures of disruption Weighted Average Cancellation Minutes and Extended Journey Time (WACM + REJT); and
- Figure B.2 shows the ratio: All costs / Schedule 4 revenue compensation (adjusted) vs. possession duration.

Figure B.1 - All Costs vs. WACM + REJT.

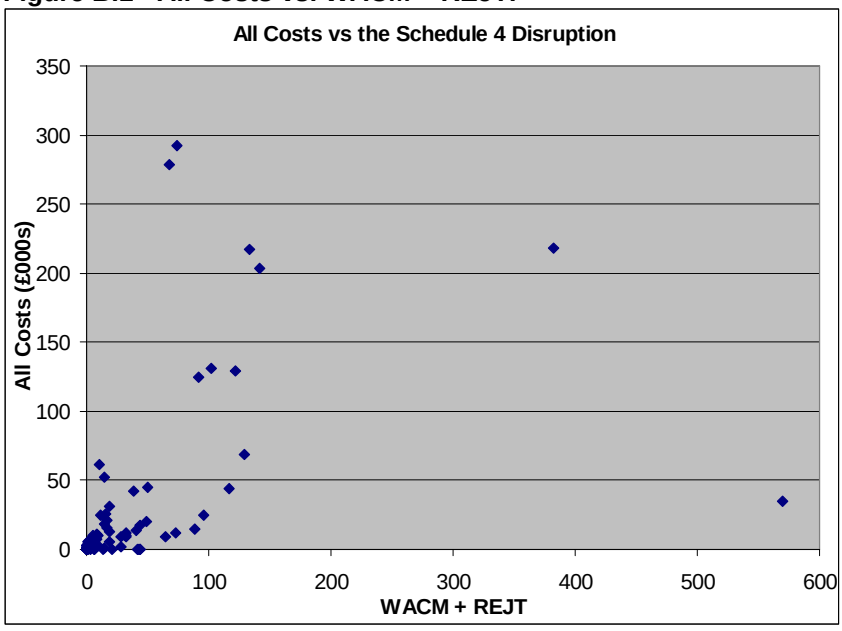
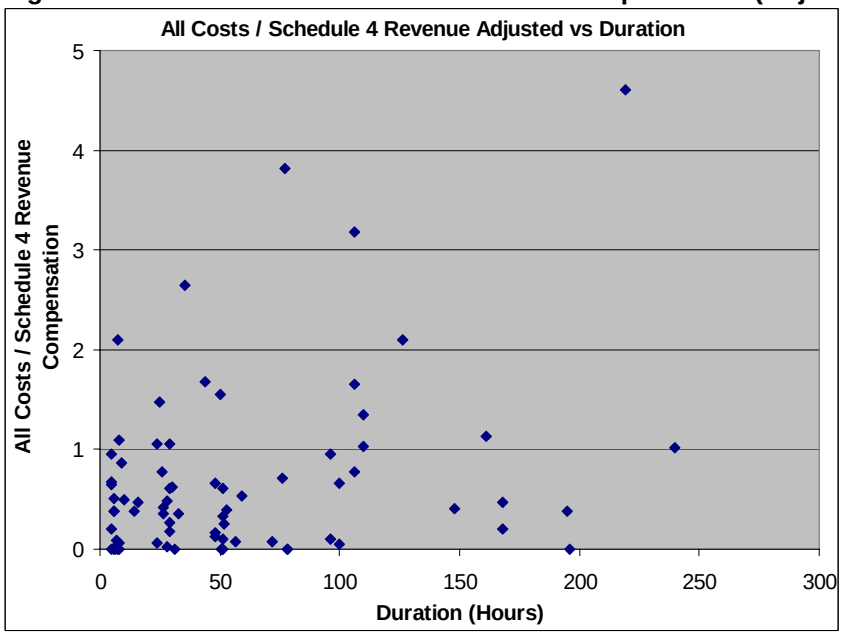


Figure B.2 - All Costs / Schedule 4 Revenue Compensation (Adjusted) vs. Duration.



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Appendix C: Factors Affecting Rail Replacement Bus Unit Costs

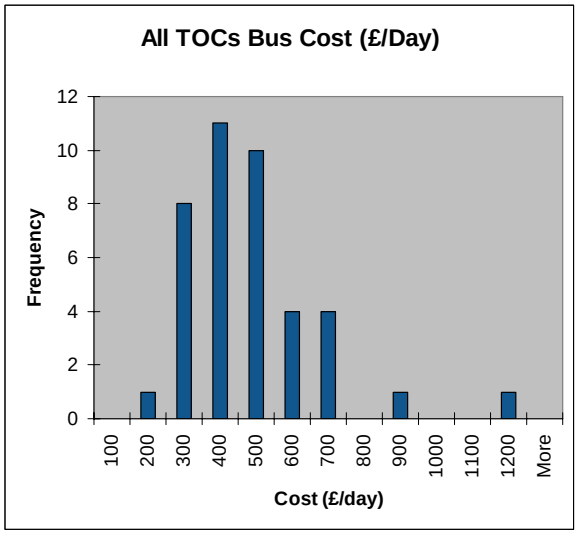
Appendix C: Factors Affecting Rail Replacement Bus Unit Costs

This Appendix contains detail of our analysis of the factors that affect rail replacement bus costs. During the interview with Train Operators the view was posited that factors such as time of day, day of week or season would affect these costs. We first set out to prove whether certain variables had an impact on bus costs, for example as 'economies of scale'. We also examined whether a pattern can be established between train loadings and the numbers of buses deployed on a particular possession. Our conclusion was that no significant relationship could be established.

Investigation of Economies of Scale

Figure 4.1 is a histogram showing the distribution of bus costs per day across the 80 representative possessions. These costs include bus hire and driver costs but do not include the costs of bus co-ordination staff.

Figure C.1 – Unit Bus Costs (£/hour).



As shown in Figure 4.1, over two thirds of possessions had bus costs per hour of between £200 and £500. Changes in bus unit costs may be due to a variety of factors including the length of a possession and the number of buses required. During the interviews Train Operators stated that a number of factors affected the costs of hiring buses for rail replacement bus services:

- Half stated time of year as an important driver;
- All stated time of day and day of week as important - for example, on weekdays and Sunday afternoons there are more passengers and journey times are usually longer on the roads;
- Possessions on a weekday night can incur significant rail replacement costs for the small number of passengers displaced;
- Some stated that the hire rate will change at certain times of the year, such as during school holiday periods when more buses are available;
- Three stated that the location of a possession is a significant driver of cost; and
- There was no agreement as to whether repetition is a driver of cost.

We undertook some analysis to verify whether these factors do have an impact on costs. *We have investigated a series of potential drivers of a change in bus costs. For example, Figure C.2 shows the plot of hiring a bus per day against the duration of possession. The plot does not support the idea of 'economies of scale' with increasing duration of possession.*

Further plots are shown below in Figures C.3 to C.8. These demonstrate no relationship between these cost drivers and the unit cost. Therefore we concluded that bus unit costs appear independent of all of these variables and there are no economies of scale or density.

Figure C.2 – Bus Unit Cost (£/day) vs. Duration (hours).

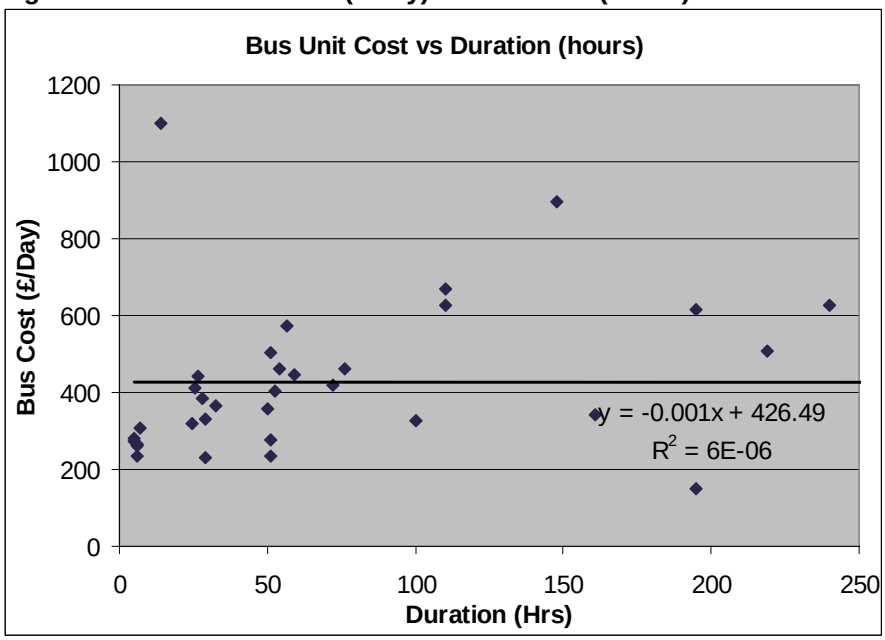


Figure C.3 – Bus Unit Cost vs. Length of Possession.

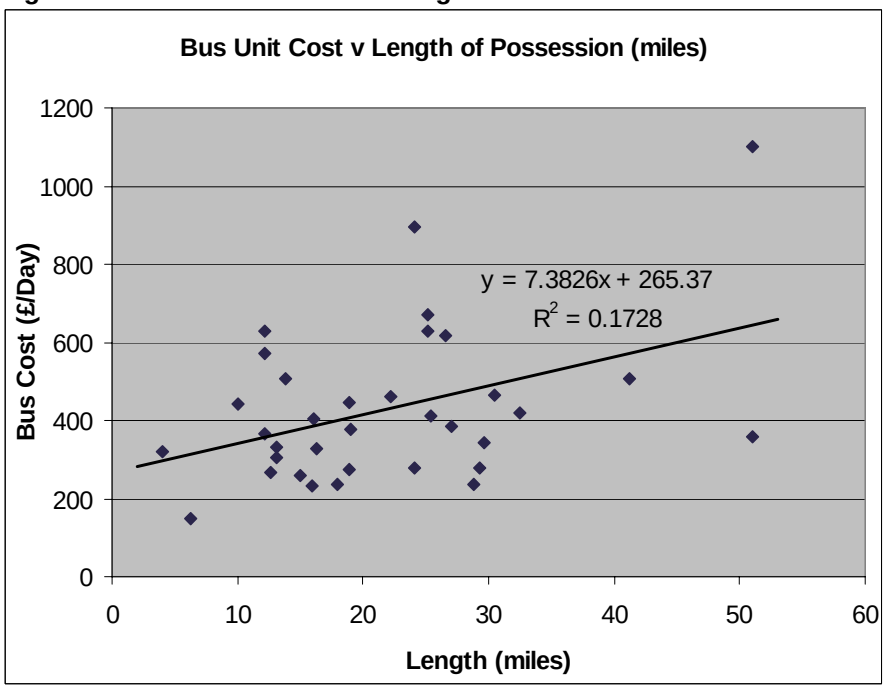


Figure C.4 – Bus Unit Cost vs. Weighted Average Cancellation Minutes.

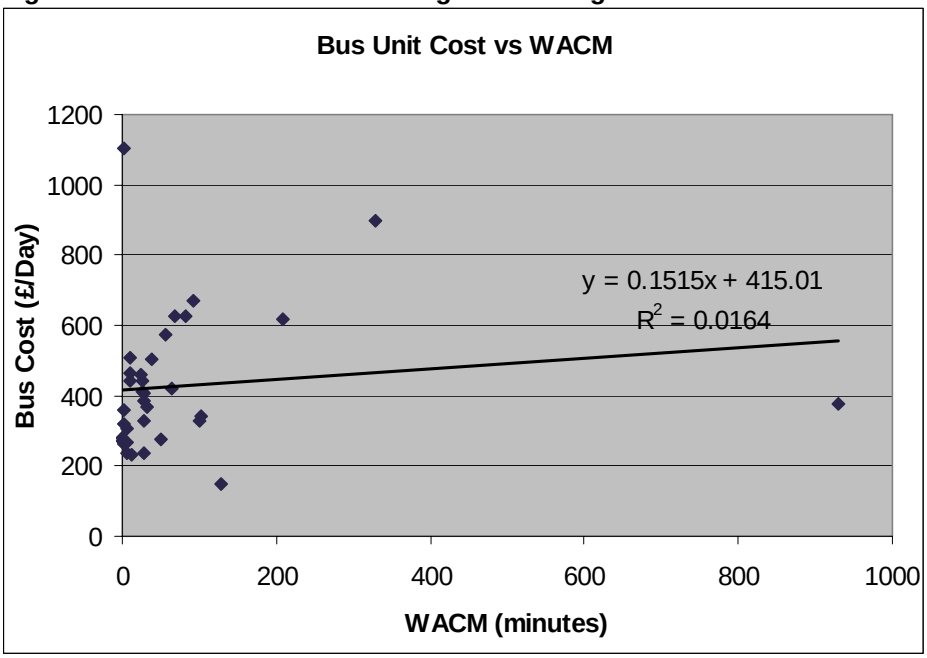


Figure C.5 – Bus Unit Cost vs. Extended Journey Time.

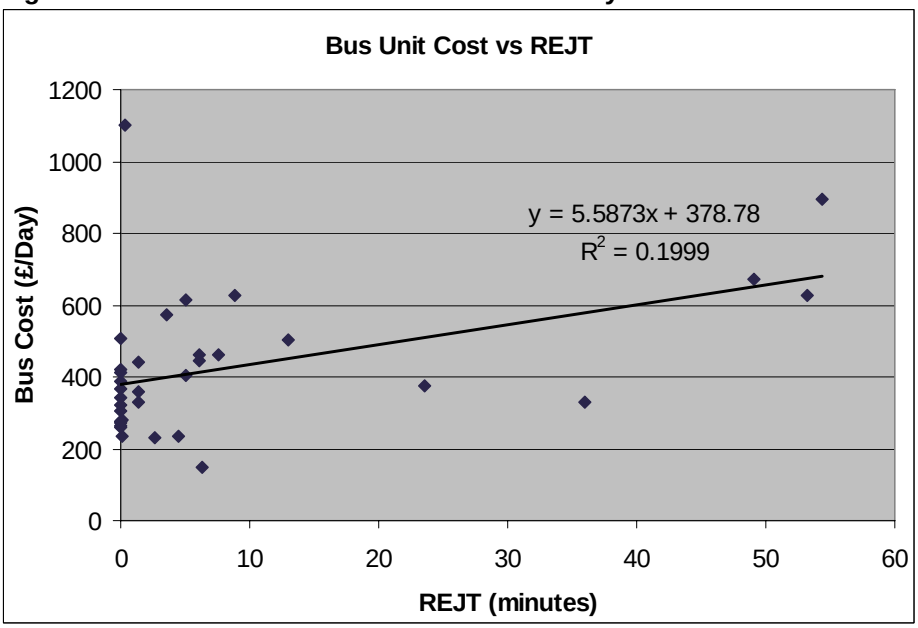


Figure C.6 – Bus Unit Cost vs. WACM + REJT.

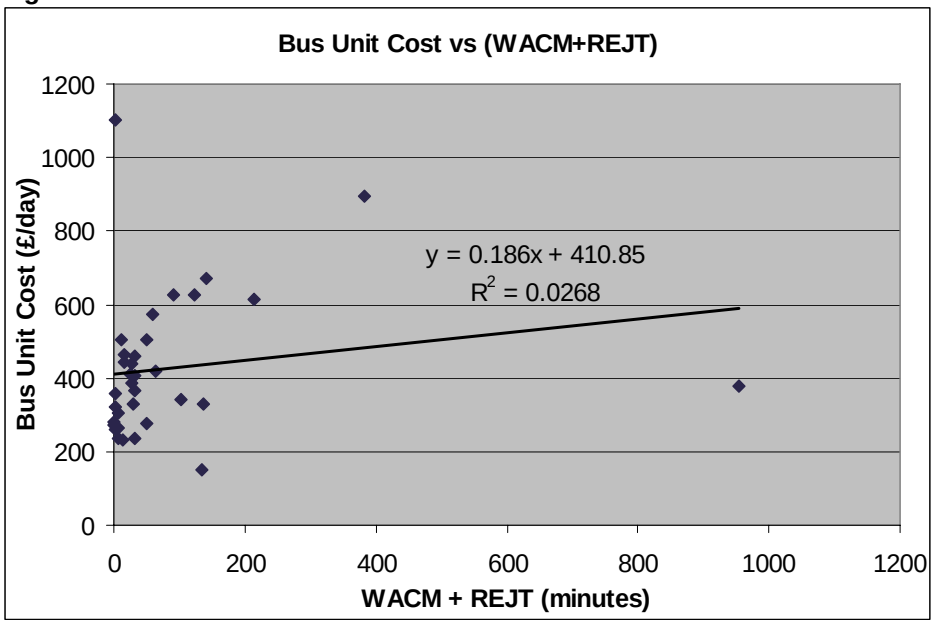


Figure C.7 – Bus Unit Cost vs. Notification Factor.

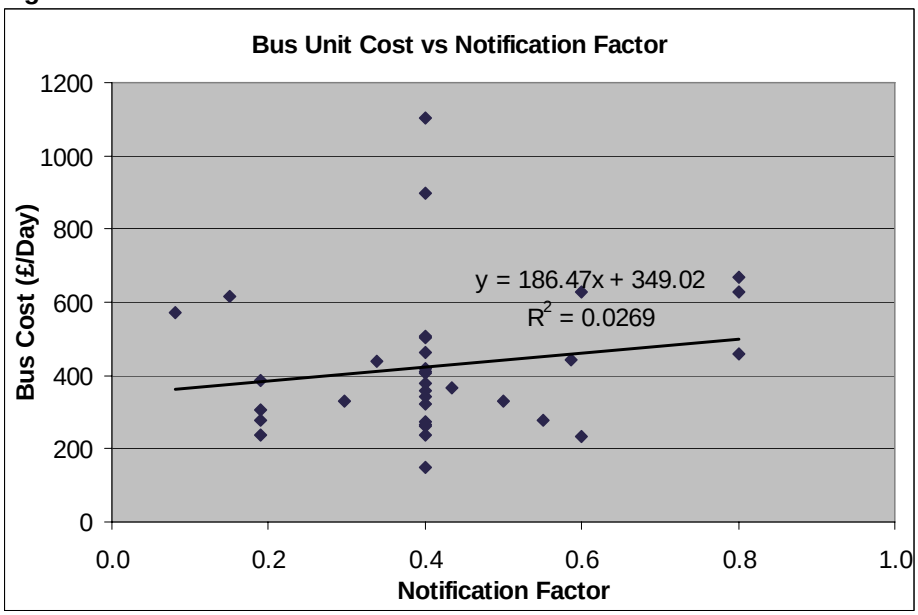
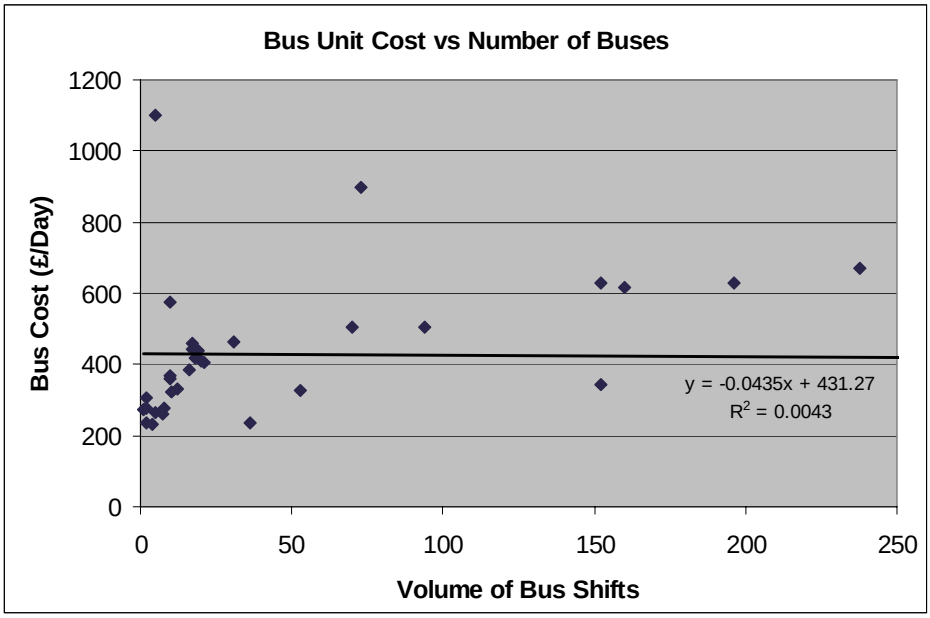


Figure C.8 – Bus Unit Cost vs. Number of Buses Deployed.



We also examined the variation in bus unit costs (£/day) by day of week and time of year, the results of which are shown in Table C.2. There is little difference in costs between weekdays and weekends. Costs do appear to be slightly higher at Christmas and lower in the summer although this may be a result of the small sample size for these categories. However, given the small sample size, and the difficulties in generalising across Train Operators this impact was not developed further.

Table C.2 – Variation of Rail Replacement Bus Unit Costs with Day / Season.

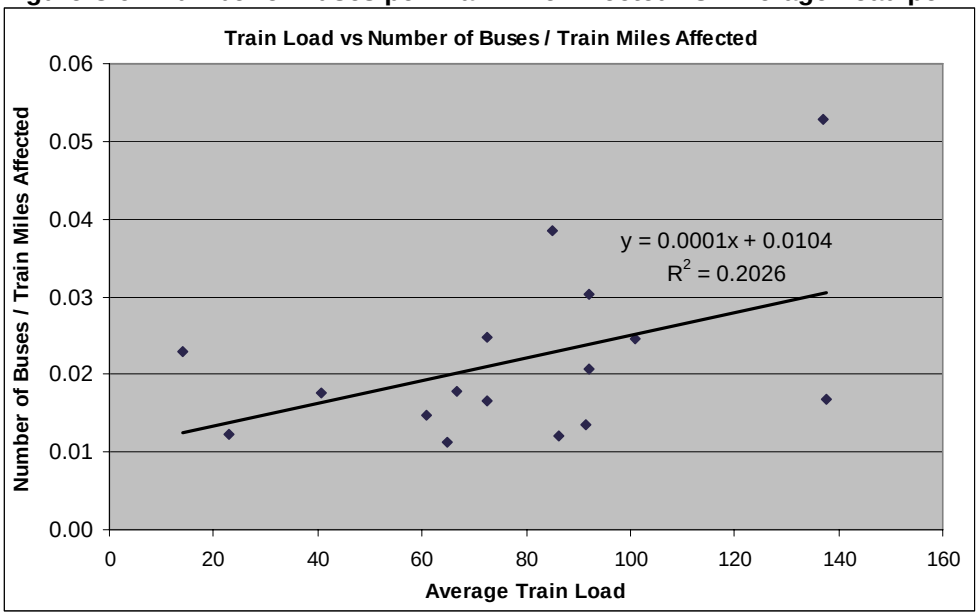
	Average	Minimum	Maximum	Number
Weekday	398	237	897	15
Weekend	449	149	1102	19
Christmas	554	149	897	3
Summer	384	329	419	3
Rest of Year	417	232	1102	28
Overall	***429***	***149***	***1102***	34

For an individual possession, the bus capacity required could be expected to depend on the number of rail passengers using services under normal operation. The majority of Train Operators in their interviews stated that they will try to put on at least one bus for every train cancelled, with more buses where required for busy trains. However, the level of provision will also be affected by the impact of the possession on demand.

Establishing whether a relationship can be derived between train loadings and the numbers of buses deployed on a particular possession, is important given the variation in scale of provision between different possessions. Based on loadings data for one Train Operator we investigated the relationship between average train loads on a section of track effected by a possession and the number of rail replacement buses used. However, as in the plot in Appendix C shows, no relationship was found between the number of buses and train loadings.

Figure C.9 shows the variation in the number of buses per train mile affected with the average load per train. The train miles affected is calculated from the number of trains operating over the section covered by the possession multiplied by the miles between the stations at which train services stop and restart. It might be expected that train miles would be proportional to the number of buses deployed if one bus were used to cover each train. This plot does not confirm a relationship between the volume of buses deployed and the loads on each train.

Figure C.9 - Number of Buses per Train Mile Affected vs. Average Load per Train.



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Appendix D: Rail Replacement Bus Costs

Appendix D: Rail Replacement Bus Costs

This Appendix contains further detail of our analysis of the factors that affect rail replacement bus costs. Figures D.1 to D.2 examine whether a relationship could be established between total rail replacement bus costs and various cost drivers. They enabled us to discount there such a relationship existing in favour of adopting Estimated Bus Miles.

Figure D.1 – Rail Replacement Bus Costs vs. Schedule 4 Revenue Compensation.

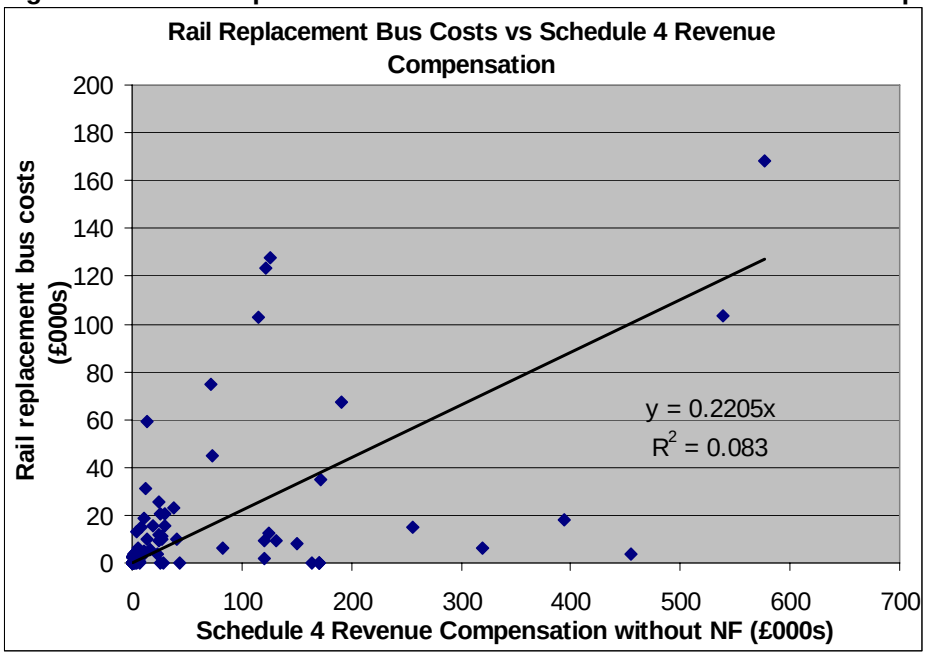
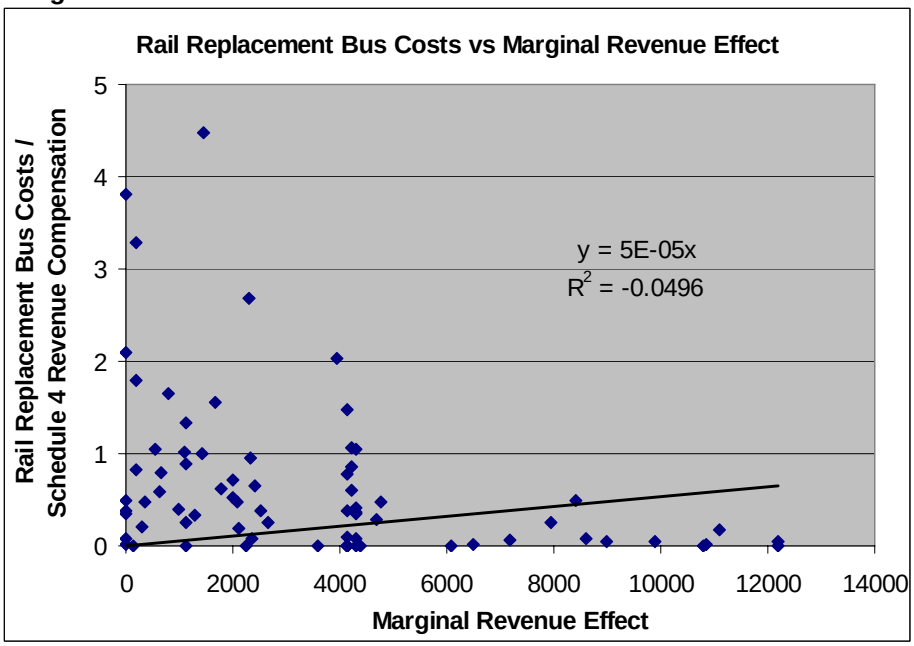


Figure D.2 – Ratio Rail Replacement Bus Costs / Schedule 4 Revenue Compensation vs. Marginal Revenue Effect.



Below we show the results of sensitivity tests that show the impact of applying different rates per EBM. Table D.1 shows the impact of using £13.20 per EBM (taken from the fitted line on SRoUs in Figure 3.4). Table D.2 shows the impact of using £7.80 per EBM (taken from the fitted line on RoUs in Figure 3.4).

Table D.1 – Impact of Rail Replacement Bus Cost Compensation using £13.20 per EBM.

	RoUs (x = duration in hours)				SRoUs (x = duration in hours)				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Possessions	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)	17	110	251	379	458	860	386	1704	2,083
Compensated (£'000s)	18	110	426	553	305	858	536	1699	2,252
% Compensated	102%	100%	170%	146%	67%	100%	139%	100%	108%

Table D.2– Impact of Rail Replacement Bus Cost Compensation using £7.80 per EBM.

	RoUs (x = duration in hours)				SRoUs (x = duration in hours)				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Possessions	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)	17	110	251	379	458	860	386	1704	2,083
Compensated (£'000s)	10	65	252	327	180	507	317	1004	1,331
% Compensated	60%	59%	100%	86%	39%	59%	82%	59%	64%

As a further test we also applied the upper and lower 95% confidence limits from the fitted line on all possessions. The results are shown below in Tables D.3 and D.4.

Table D.3– Impact of Rail Replacement Bus Cost Compensation using £11.70 per EBM.

	RoUs (x = duration in hours)				SRoUs (x = duration in hours)				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Possessions	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)	17	110	251	379	458	860	386	1704	2,083
Compensated (£'000s)	16	97	377	490	270	761	475	1506	1,996
% Compensated	90%	88%	150%	129%	59%	88%	123%	88%	96%

Table D.4– Impact of Rail Replacement Bus Cost Compensation using £13.69 per EBM.

	RoUs (x = duration in hours)				SRoUs (x = duration in hours)				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Possessions	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)	17	110	251	379	458	860	386	1704	2,083
Compensated (£'000s)	18	114	441	574	316	890	556	1762	2,336
% Compensated	106%	103%	176%	151%	69%	103%	144%	103%	112%

Given the sensitivity of rail replacement bus cost compensation to variation in the rate per EBM (which is derived from the fitted regression line) we carried out some further tests to assess the robustness of this regression. Below Figure D.3 shows the fitted line derived based on two subsets of the sample possession dataset. Set 1 included possessions cost data received up until the point of the mid-point meeting with the Client Group. Set 2 included possessions cost data received subsequently. The purpose in carrying out this test was to assess whether the relationship derived between rail replacement bus costs and EBMs using set 1, still held true for set 2. Figure shows variation in the fit and slope of the two relationships derived from the two sets of data. However, this was caused by the fact that set 2 possessions were mainly from two operators who had a different pattern of possessions to the other four Train Operators.

Figure D.3 - Fitted Line Derived from Subsets of the Sample Possessions.

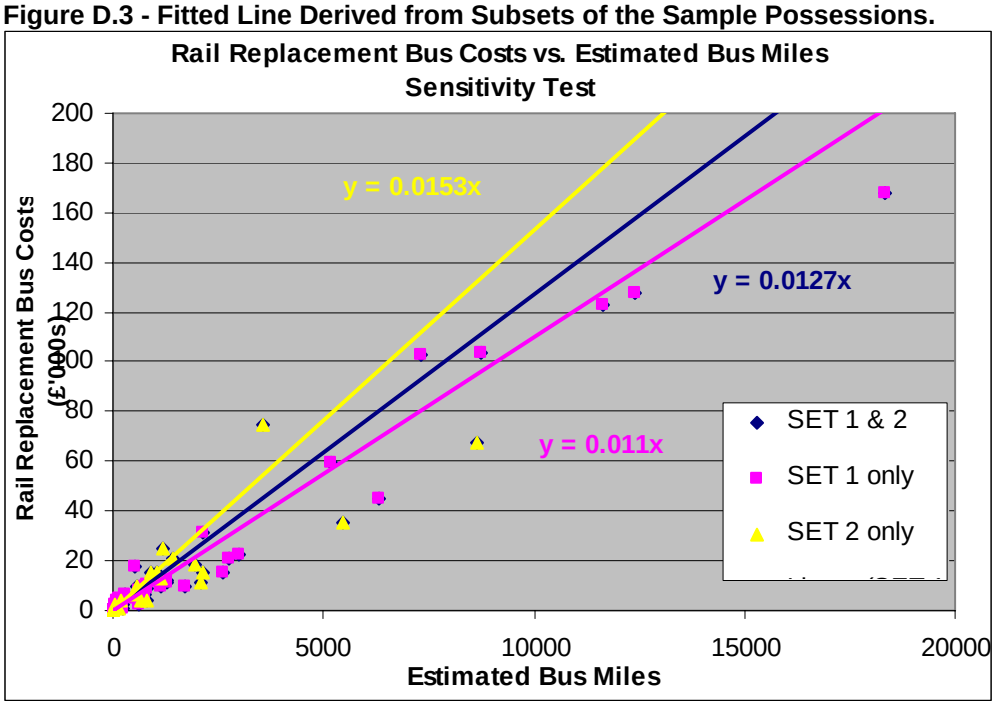
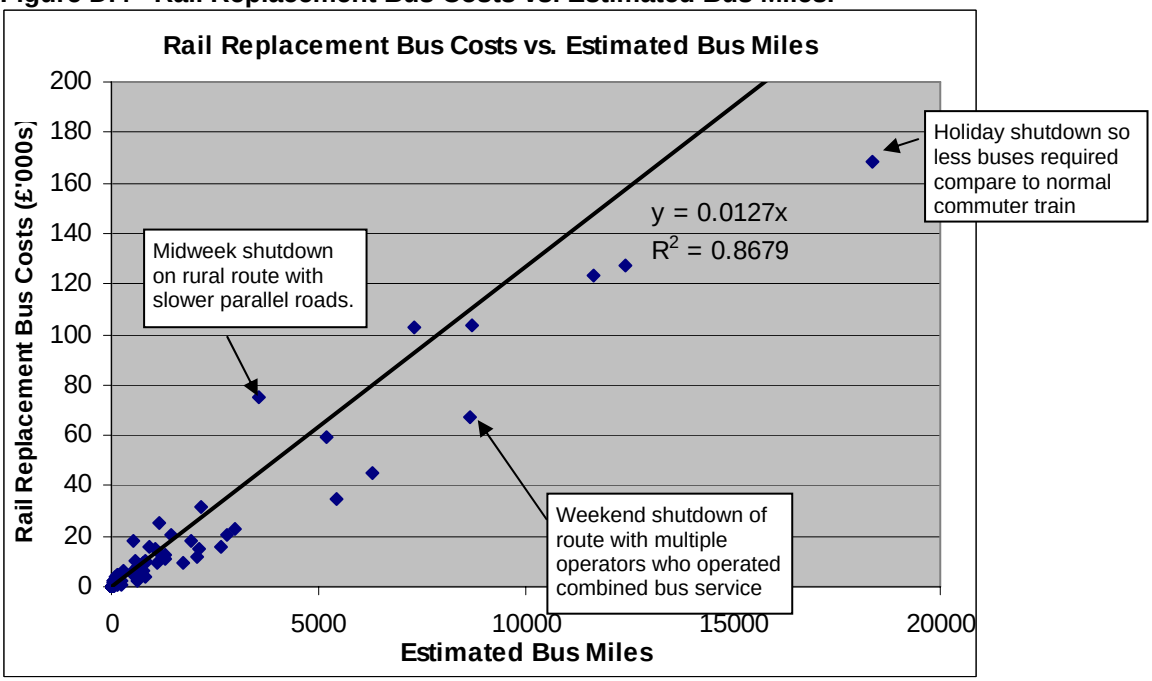


Figure D.4 which provides comments as to some of the outliers shown in Figure 3.3. Given the limited information available to Train Operators as to the costs of individual possessions it is difficult to be certain as to the exact cause of the variation.

Figure D.4 - Rail Replacement Bus Costs vs. Estimated Bus Miles.



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Appendix E: Analysis of Other Costs

Appendix E: Analysis of Other Costs

This Appendix shows further analysis of other costs experienced by Train Operators against various cost drivers, in an attempt to derive relationships. As a result of these plots we concluded that the data did not support a simple relationship between costs and cost drivers

Table E.1 below shows the distribution of 'other costs' for the 34 example possessions that included entries under this type of cost. It shows that for the possessions which fell under the SRoU duration threshold, other costs were in all cases less than £2,000. However, this may be due to the fact that for these possessions costs can only be claimed under Part G, hence operators may not have access to detailed cost records. Table E.1 also shows that all of the possessions with 'other costs' higher than £10,000 have a long duration (over 128 hours). However this is not the rule, as some of the lengthier possessions had 'other costs' of less than £10,000.

Table E.1 - Distribution of 'Other Costs' for 34 Example Possessions.

		Duration (hours)					
		0<x<24	24<x<48	48<x<60	60<x<72	72<x<128	x>128
Total Other Costs	>£0	4	5				
	>250	3					
	>£500		1	1		3	
	>£750		1				
	>£1,000	1	1				2
	>£2,000					3	
	>£5,000				2	2	
	>£10,000						5

Figure E.1 suggests that while duration might have some bearing on the possible range of 'other costs' for a particular possession, it does not have a direct relationship with the 'other costs' experienced.

Figure E.1 - 'Other Costs' vs. Possession Duration.

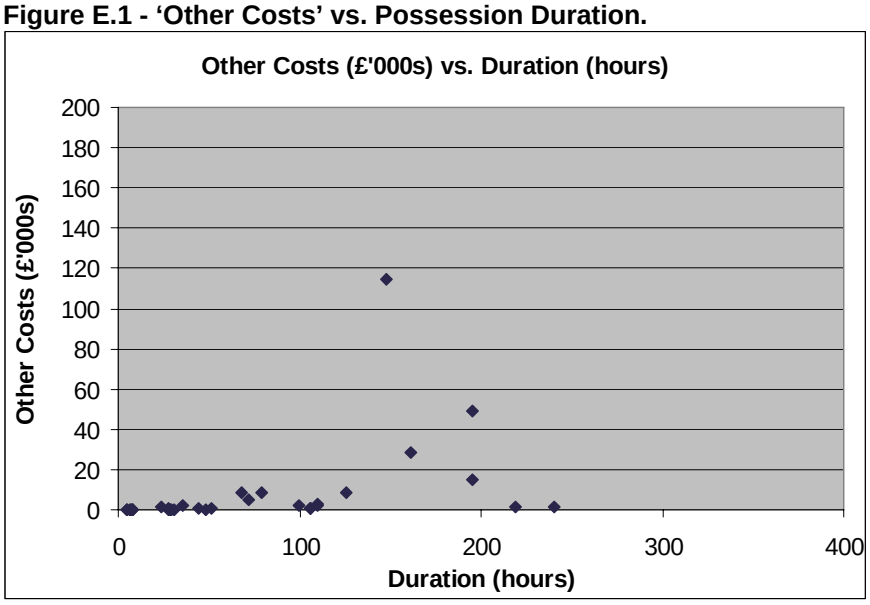
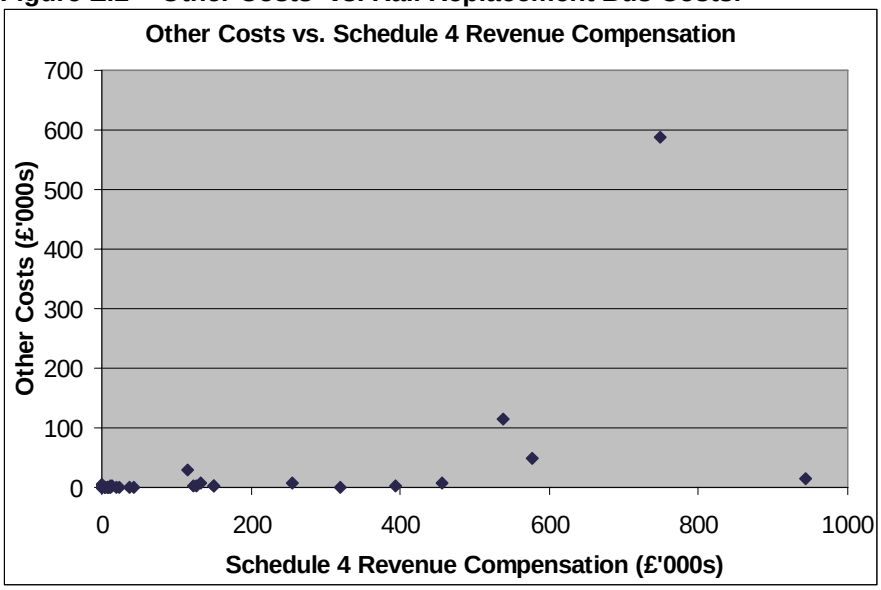


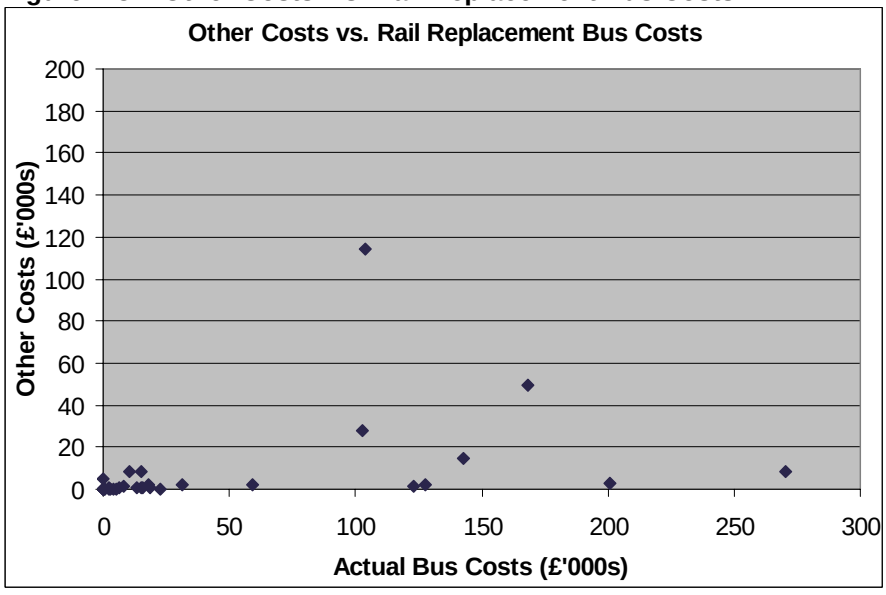
Figure E.2 shows the plot of 'other costs against Schedule 4 revenue compensation with the Notification Factor removed.

Figure E.2 - 'Other Costs' vs. Rail Replacement Bus Costs.



We also looked at whether a relationship could be found between 'other costs' and rail replacement bus costs (which account for the other 90% of costs) as shown in Figure E.3. If this were the case then 'other costs' could be accounted for simply by uplifting the rate for rail replacement bus costs. However, the data did not support such a relationship.

Figure E.3 - 'Other Costs' vs. Rail Replacement Bus Costs.

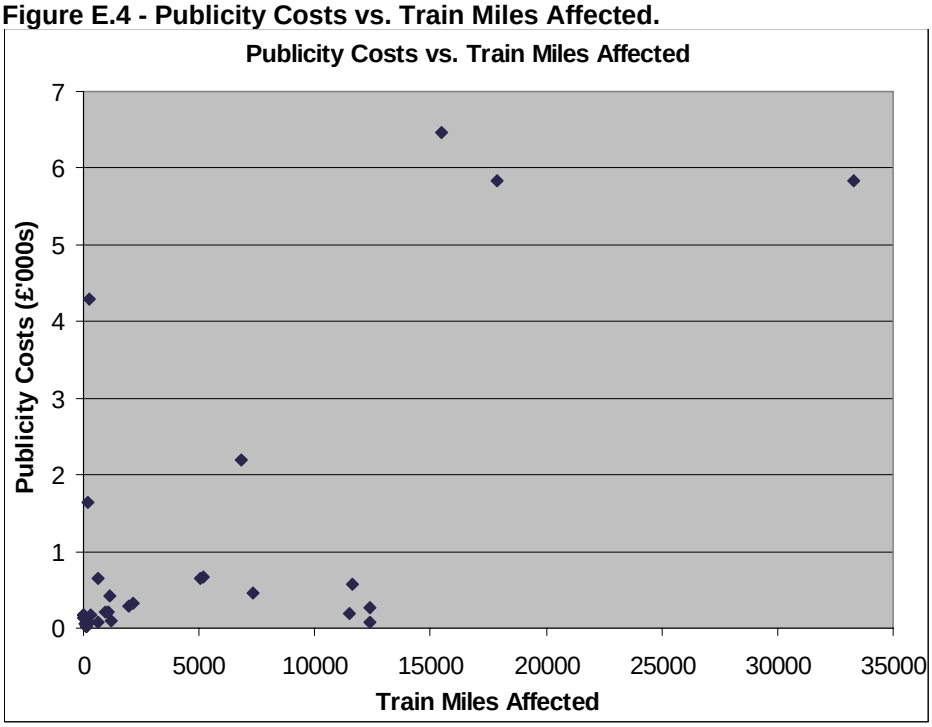


Below further analysis of the individual categories of cost are shown.

Publicity Costs

Of the example possessions that quoted publicity costs separately, 80% were below £750 and 87% were below £2,200. Publicity costs ranged between £13 and £6,470. There are no apparent relationships between publicity costs and duration, train miles affected or bus costs. Plots of these relationships are shown in the Appendix. Figure E.4 shows the plot of publicity costs against Train Miles Affected.

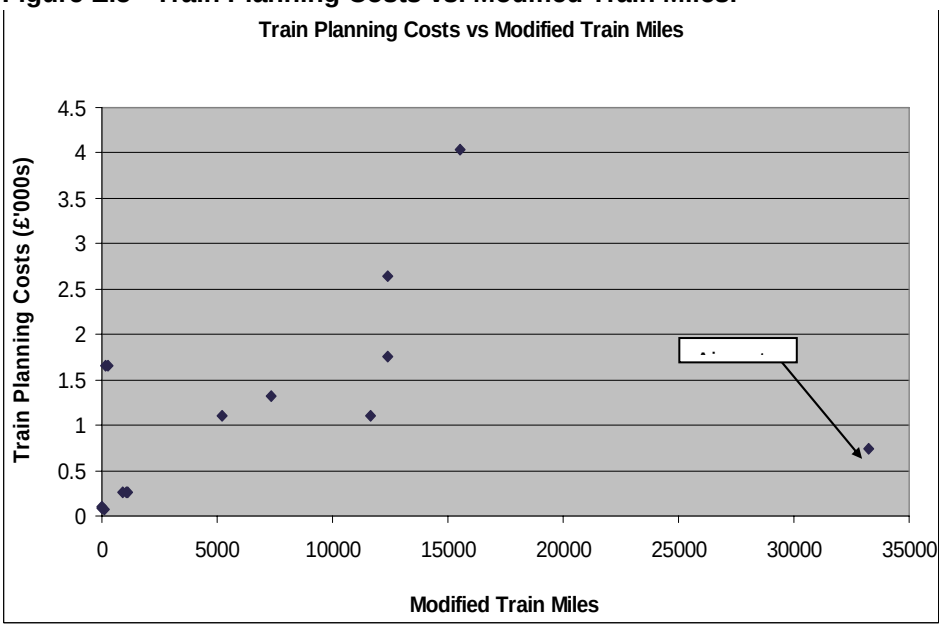
Figure E.4 - Publicity Costs vs. Train Miles Affected.



Train Planning Costs

Of the example possessions that quoted train planning costs separately, 87% were below £1,800. Train Planning Costs ranged between £72 and £4,032. Figure E.5 shows the plot of train planning costs against Modified Train Miles.

Figure E.5 - Train Planning Costs vs. Modified Train Miles.



This plot shows that some sort of linear relationship can be observed (with the exception of a couple of outliers, one of which can be explained by the fact that it is a frequent airport service,

and therefore due to the simple nature of their timetable, less train planning time will be required). There are no apparent relationships between train planning costs and duration, Schedule 4 revenue compensation or bus costs.

Miscellaneous Costs

Of the example possessions that quoted other 'miscellaneous' costs separately, 64% were below £6,000. Miscellaneous costs ranged between £72 and £589k. These costs might include staff training or temporary maintenance facilities. Figures E.6 and E.7 show plots of miscellaneous costs against duration and against Schedule 4 revenue compensation. These values appear good indicators of when miscellaneous costs become more variable, but poor indicators of the value of these costs.

Figure E.6 - Miscellaneous Costs vs. Possession Duration.

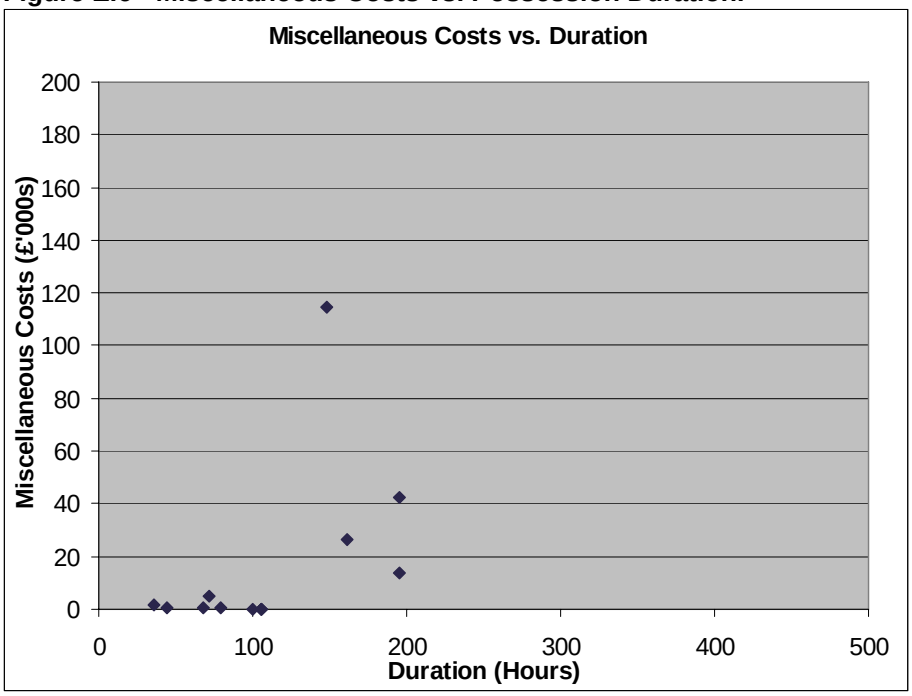
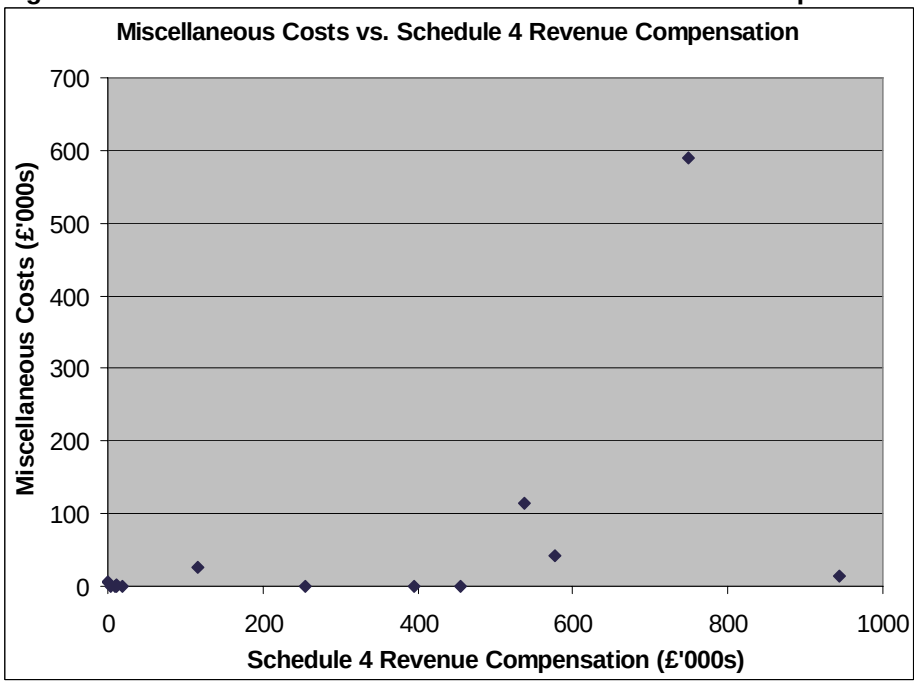


Figure E.7 - Miscellaneous Costs vs. Schedule 4 Revenue Compensation.



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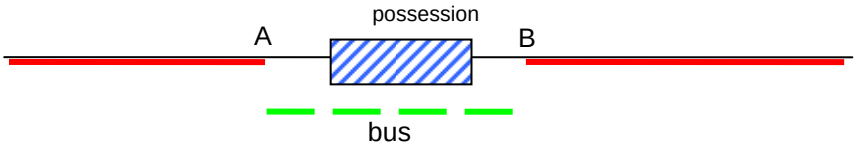
Appendix F: Possession Types

Appendix F: Possession Types

This Appendix lists the different types of possessions that were identified during the study.

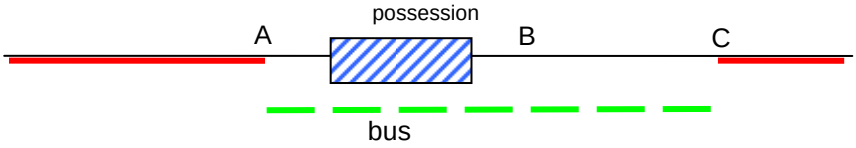
Possession Type 1:
Possession between A and B with train-bus-train replacement between A and B. (Note, A and B are stations at which trains normally stop and which have the facility for trains to terminate).

Example: Possession between Leicester and Peterborough, Central Trains ran bus services between Leicester and Peterborough.



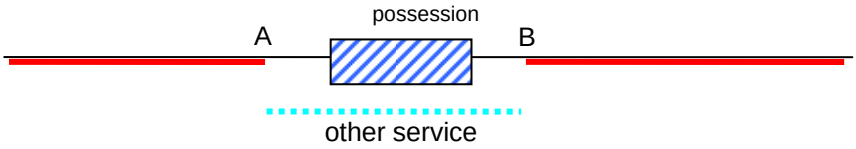
Possession Type 2:
Possession between A and B; with train-bus-train replacement between A and C.

Example: Possession between Peterborough and Cambridge, Central Trains ran bus services from Peterborough to Stansted.



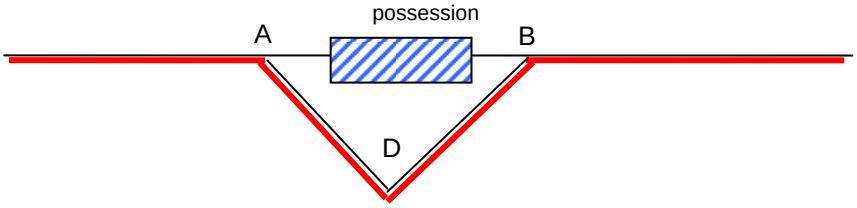
Possession Type 3:
Possession between A and B; with parallel service (e.g. LUL or another Train Operator) between A and B.

Example: Possession between St Pancras and West Hampstead; Midland Mainline trains ran north of Luton, with passengers transferring to First Capital Connect services between Luton and London.



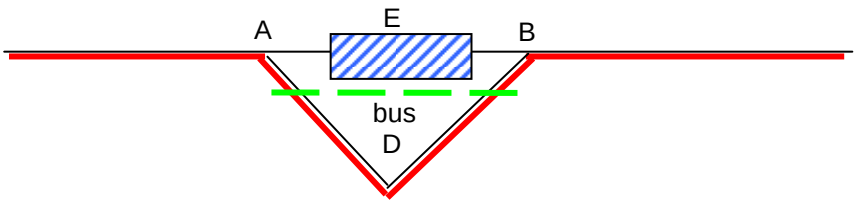
Possession Type 4:
Possession between A and B; with diversionary parallel route via D and either no intermediate stations between A and B, or with a parallel service available.

Example: Possession between Barking and Upminster; C2C trains ran via Rainham with passengers to Upminster using LUL.



Possession Type 5:
Possession between A and B; with diversionary parallel route via D and with bus service to service intermediate station E between A and B.

Example: Possession between Kettering and Bedford with fast lines blocked; Midland Mainline trains ran via slow line, not calling at Wellingborough; buses ran Kettering – Wellingborough - Bedford.



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Appendix G: Estimated Bus Miles

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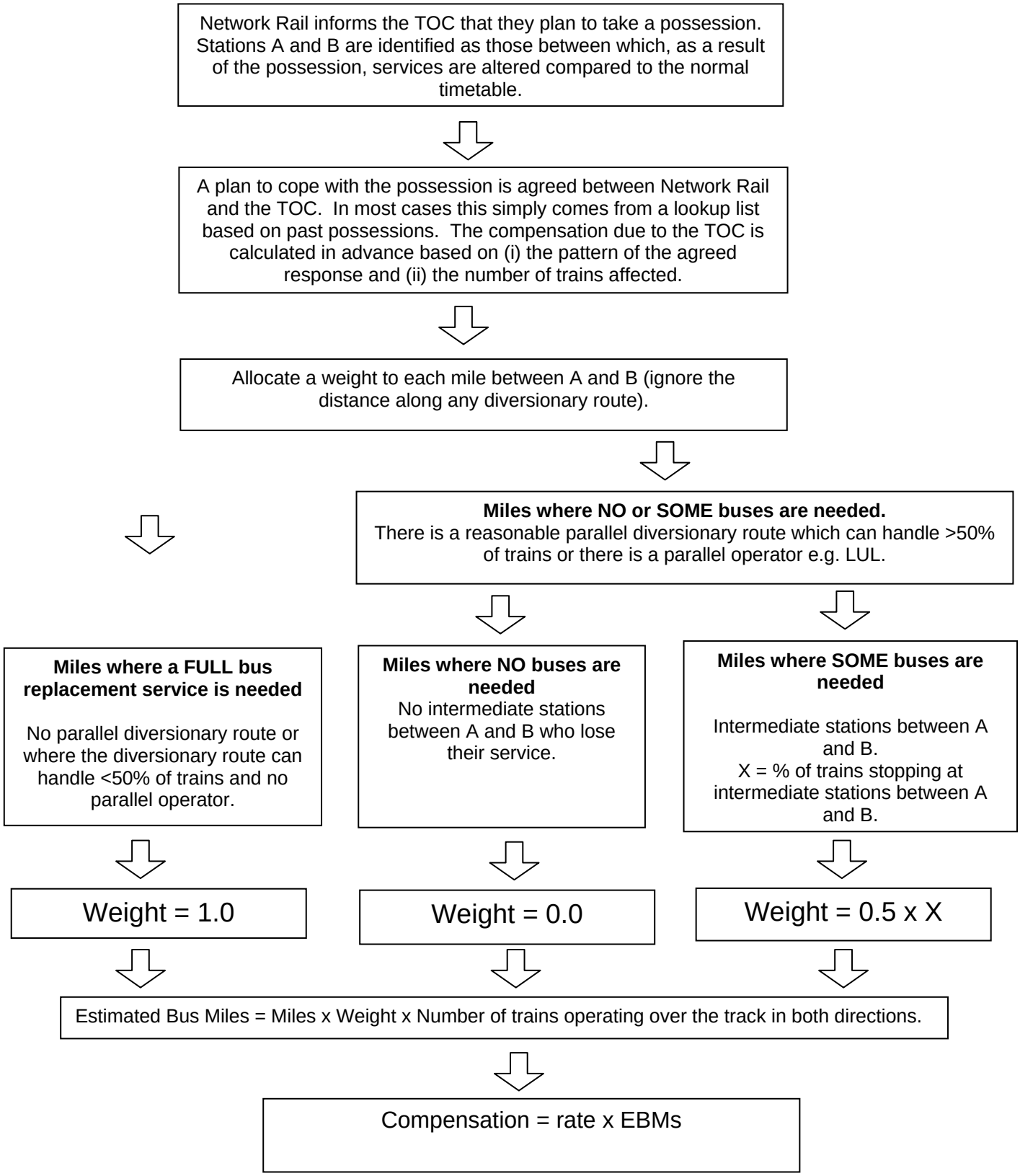
As described in Chapter 3, the rail replacement bus compensation relies on Estimated Bus Miles. This Appendix demonstrates how this value would be calculated in practice.



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Appendix H: Further Testing of Compensation Mechanism

Appendix H: Further Testing of Compensation Mechanism

This Appendix provides further information to support the testing carried out on the proposed compensation mechanism. Table H.1 refers to the application of the mechanism to the sample possessions. Table H.2 provides the detailed results from applying the mechanism to each Train Operator separately. Figure H.3 shows the level of compensation by Duration Band for the Sample Possessions – this was used as the basis for extrapolating the sample results to the population.

Table H.1 - Application of Compensation Mechanism to Sample Possessions.

	Restrictions of Use				Significant Restrictions of Use				All
	0>=x>8	8>=x>32	x>=32	All	x<104	104>=x>168	x>=168	All	
Number in sample	18	20	22	60	7	9	4	20	80
Actual Costs (£'000s)									
Total	15	102	243	360	442	922	360	1724	2084
Rail Replacement Bus Costs	17	110	251	379	458	860	386	1704	2083
Train Mileage Costs	-2.5	-17	-25	-45	-27	-96	-78	-201	-245
Other Costs	0.5	8.1	17	26	11	158	53	221	247
Compensated (£'000s)									
Total	17	112	462	591	291	785	473	1549	2140
Rail Replacement Bus Costs	17	106	409	532	293	826	516	1635	2167
Per Possession	0.9	5.3	19	9	42	92	129	82	27
%	98%	96%	163%	141%	64%	96%	134%	96%	104%
Train Mileage Costs	-2.4	-18	-52	-71	-27	-98	-78	-203	-274
Per Possession	-0.1	-0.9	-2.3	-1.2	-3.8	-11	-20	-10	-3.4
Other Costs	2.7	24	104	130	24	57	35	117	247
Per Possession	0.2	1.2	4.7	2.2	3.5	6.3	8.9	5.8	3.1
Uncompensated (£'000s)									
Total	-2.0	-10.2	-219	-231	150	138	-113	175	-56
Per Possession	-0.1	-0.5	-9.9	-3.8	21	15	-28	8.8	-0.7
%	-13%	-10%	-90%	-64%	34%	15%	-31%	10%	-3%

Table H.2 - Application of Compensation Mechanism by Train Operator.

Train Operator	Restrictions of Use				Significant Restrictions of Use			
	Number	All Costs (£000s)	Compensation (£000s)	%	Number	All Costs (£000s)	Compensation (£000s)	%
1	19	69	113	164%	1	172	204	119%
2	7	55	81	147%	1	31	26	84%
3	8	23	32	142%	1	31	22	71%
4	11	67	156	232%	7	801	733	91%
5	7	109	177	162%	5	127	94	74%
6	8	37	31	85%	5	562	471	84%
Total	**60**	**360**	**591**	**164%**	**20**	**1724**	**1549**	**90%**

Figure H.1 – Compensation by Duration Band for Sample Possessions.