6 Transport:

To appraise the losses from electricity, gas, water, waste water and telecommunications

Road disruption

OVERVIEW

This sub-section provides methodologies to estimate the potential losses due to the flooding of road networks. The Environment Agency (2024) estimates that one third (38%) of all roads are at risk from one or more sources of flooding; with about 18% of roads being at high or medium risk. Therefore, flooding has the potential to cause significant damage to roads and disruption to both travellers and businesses with the resulting losses being some of the highest non-property losses from flooding experienced.

Assessing the losses occurring from the disruption to routes is difficult and complex as it requires assessing the numbers of vehicles potentially affected and an appreciation of how their journeys may change under flooding conditions. Therefore, four approaches to the estimation of the impacts of road traffic disruption are presented. These vary in their level of complexity and therefore the appraisal resources that they require. The selection of the most appropriate method to use will depend upon the scale of the likely disruption; where losses are likely to be significant the more in-depth and detailed approaches are recommended.

LESSONS FROM EXPERIENCE

- The key factors for estimating traffic disruption costs include flood duration, the number of roads likely to be impacted and the importance of those roads affected (i.e. whether a flood causes a significant knock-on effect to other parts of the network).

- As the responsibility for roads falls between the Highways Agency, for major roads and motorways, and Local Authorities for local roads, and therefore it may be necessary to consult with these organisations when considering quantifying the potential losses from roads, depending on the types of roads affected.

- Although in general the greatest losses will occur on the roads with most traffic (i.e. motorways, or A roads). The 2012 floods highlighted the importance of connectivity and the presence of alternative routes as some roads (in particular the A361) were closed for weeks rather than hours or days.

- Adopting a proportional approach to appraisal is critical for appraising the losses emanating from the flooding of roads. It must be stressed that the first three methods highlighted below should be used to obtain an informed disruption cost which can be used to ascertain whether a more detailed analysis is required using sophisticated traffic modelling and specific, local data.

DIRECT DAMAGES TO ROAD INFRASTRUCTURE

Road reconstruction costs following flooding will vary depending upon the type and scale of damage, the type of road impacted and the location of the required repair. Unit reconstruction costs for resurfacing a local road range between approximately £15/m^2 for a quiet road to up to approximately £50 m^2 for a busier road (which require a thicker surface layer and road works may need to occur at night or off-peak and thus incurring overtime costs) (Hertfordshire County Council, undated; Conway County Borough Council, 2013).

If severe damage occurs or other road structures, such as bridges, are affected, costs may be considerably higher and will need to be evaluated on a case-by-case basis. The Highways Agency should be contacted separately for roads under their management as they will have different unit costs for repair and reconstruction.

LOSSES DUE TO ROAD TRAFFIC DISRUPTION

Estimating traffic disruption based on previous flood events is inadvisable as the severity of disruption can vary dramatically. Traffic disruption cost estimates for the summer 2007 floods, for example, highlighted a large range of between £22 and £174 million (Chatterton et al., 2010). As a percentage of direct damages, traffic disruption for the 2007 floods was approximately 10% of property damages (using the highest estimates for both), whereas for the autumn 2000 floods, this figure was nearer 2% (Penning-Rowsell et al., 2002).

The chief determining factors for traffic disruption costs include flood duration, the scale of the area affected (and therefore the number of roads) and specifically which roads are impacted (whether a flood causes significant knock-on effects to other parts of the network). Therefore, estimates based on previous events could lead to drastically over- or under-estimated figures as losses are highly location specific.

The three situations when the calculation of traffic disruption costs are most likely to be justified are when any of the following (or a combination of the following) are present:

1. When the annual probability of the flood event that causes traffic disruption is greater than 20%;
2. When a significant part of the local network is affected;
3. When the duration of the flooding is several days or even weeks/months; as happened on the A361 in Somerset in 2012.

Four approaches for appraising road traffic disruption costs will be described and the suitability of each will depend on available resources and the likely severity of the road disruption:

Method 1: The delayed-Hour Method: An average cost per hour for a delay on an average Highway's Agency road.
Method 2: The diversion-Value Method**:** The value of time based solely on the length of diversion (assuming that there is no reduction in traffic speed).
Method 3: The speed-Time Method**:** Reduced speeds are considered and a value of time applied for each diverted vehicle.
Method 4: Origin–destination matrix Method**:** Using sophisticated transport appraisal and modelling tools (e.g. SATURN/PARAMICS).

METHOD 1: THE DELAYED-HOUR METHOD

A very crude disruption cost could be ascertained using averages of Highways Agency (HA) data and Department for Transport estimate of the values associated with travellers' time.

Assuming an average speed of 100kmph (approximately 60mph), a single car delay of one hour on a motorway or trunk road will cost the UK £16.20. According to the Highways Agency National Operations Group, the average vehicle flow per hour on the strategic road network is 1,794 vehicles (see Chatterton et al., 2010). Based on this, we can estimate that the average delay of one hour on a road will cost the UK approximately £29,063.

This figure can be refined if specific data about the hourly flow rate of the particular road being appraised is available and weighted accordingly if other vehicles (e.g. LGVs and HGVs) are included. The averaged figure should only be used on Highways Agency roads (i.e. motorways and major trunk roads in England) as it will vary considerably at lower average speeds and on other road types.

A table of resource costs is available in Table 6.11 and can be used to refine the hourly cost per vehicle based on the average speed for the road(s) in question and these can then be multiplied by the calculated traffic flow for each particular road. This hourly figure will then need to be multiplied by the estimated duration of disruption. Indicative delay durations at different return periods are provided in Table 6.12. These are relatively basic estimations and local knowledge should be used to refine these where available.

The *Delayed-Hour* method is considered to be superior to the use of a percentage uplift estimate of property damages, however it will still provide a very crude estimate. More refined modelling should be undertaken where possible and if an appraiser thinks it is proportional to do so.

The following three approaches each adopt the same following basic principle: that if a road is closed; traffic will be diverted around this disruption point in the network. Essentially, Methods 2 and 3 are extensions of the same approach, but it is the level of detail which increases including how costs are attributed.

In both Methods 2 and 3 additional costs incurred due to a flood can be estimated using Equation 6T.1:

Equation 6T.1

$$CD = VD * AC * D$$

where:
CD is Estimated costs incurred during disruption (£)
VD is Number of vehicles delayed per hour
AC is Additional cost per vehicle (£)
D is Flood duration (hours)

When using this equation, it is the estimate of the total number of vehicles that will take longer to make journeys that is important. This includes not only those vehicles which have been diverted due to flooding but also will include the traffic on those roads onto which traffic is travelling to avoid the flooded roads. However, excluded from the equation are those vehicles that are travelling to or from an address that is also flooded.

When considering the traffic disruption caused by flooding, the first question is whether it is worth calculating these benefits at all. The above equation should be used to derive an initial crude estimate of the likely benefits of alleviating traffic disruption, since otherwise the costs of calculating these benefits can exceed the present value of the traffic disruption benefits is disproportionate.

METHOD 2: THE DIVERSION-VALUE METHOD

The simplest way of applying the above equation is to assume that cars will be diverted on to neighbouring roads and therefore the distance that they travel will increase; however, their speed will be unaffected. For example, suppose that 15,000 vehicles travel through the local network each hour and will have to travel on average 2 kilometres further but their average speed (40 kph) will not be reduced. In this scenario, the cost of that flood event will be equal to 15,000 * 0.52[1] * 2 for each hour of the disruption due to flooding. If the flood lasts six hours, the costs of traffic disruption amounts to £93,600. In this instance, the figure is small and therefore it is disproportionate to refine this value further using more sophisticated modelling.

METHOD 3: THE SPEED-TIME METHOD

The MCM (2005) provides a more in-depth method for calculating traffic disruption, and where possible this should still be used in conjunction with the updated figures provided here. In line with experience since 2005, we have attempted to produce a simpler and less time-consuming method which will give an adequate estimate of traffic disruption costs. More detailed modelling of local traffic conditions and driver behaviour may be the preferred option where the likelihood of road traffic disruption due to flooding is significant; for example the Somerset floods of 2012.

> Step One: Determine which roads will be disrupted by floods of different annual probabilities and the durations of closure in each case.

As an approximation, a road should be assumed to be closed when the middle of the lane is inundated and certainly when the crown of that road is flooded. Although this may be considered quite cautious it is consistent with Environment Agency advice which attempts to prevent the public driving through flood waters.

> Step Two: Estimate the volume of traffic using each road in the local network (e.g. including those roads on to which traffic is likely to be diverted in a flood).

Annual average daily traffic flows for all major and minor roads in Great Britain are available from the DfT website: https://data.gov.uk/dataset/208c0e7b-353f-4e2d-8b7a-1a7118467acc/gb-road-traffic-counts. The data are disaggregated by category of vehicle (car, LGV, HGV etc), which is relevant for calculating the different costs of travel for each vehicle type (covered in Step 5 below). An appraiser might also consult the Highways Agency and/or Local Authority who retain a large amount of data about traffic flows. It is also possible to utilise sources which provide data on 'live' traffic conditions to estimate "normal" traffic flow (e.g. Google Maps, Bing and Open Routing Service). Users should think carefully about the representativeness of any dates or times that are utilised and document the decisions which are made.

[1] (see Table 6.11 *Total Resource Costs*)

Step Three: Calculate the costs to traffic of using the local network under normal conditions.

The Department for Transport provides free flow speeds for all built-up and rural road types: https://www.gov.uk/government/collections/speeds-statistics. Free flow vehicle speeds provide information on the speeds at which drivers choose to travel and their compliance with speed limits, but should not be taken as estimates of actual average speed across the road network. Alternatively, column 1 “Free Flow speed” in the *Speed-Flow Relations* in Table 6.13, can be used for this purpose.

Step Four: For each flood event, determine the routes that diverted traffic will take.

For diversion distances, and where local expertise is absent, an online tool can be used. For example, the ‘Get directions’ feature on Google Maps provides distance information on the length of a selected stretch of road. As different traffic flow values are applicable to different types of road (single carriageway built-up roads; dual carriageway rural roads; motorways; etc) it is necessary to ensure that the diversion route is calculated using a separate distance value for each particular road type used (see Step 5). There are many assumptions that need to be made when establishing the likely routes for diversion and there is the need to concentrate primarily on diversions using major routes rather than minor roads.

Step Five: Calculate the costs to traffic of using the network under these flood conditions

The most difficult aspect here is to calculate how the non-flooded network will cope when the diverted traffic is added to it. Each road type has a free flow limit (see column 2 in Table 6.13 *Speed-Flow Relations Table*) and a capacity limit (see column 3 in Table 6.13) and when this is reached speed flows will be reduced linearly. The following equation can be used to calculate the reduced speed of vehicles on the diversion routes above the limiting capacity (QM; Table 6.13).

Equation 6T.2

$$\text{Speed} = \frac{\mathrm{VM}}{1 + \frac{\mathrm{VM}}{8\,\mathrm{DIS}} \times \left(\frac{\mathrm{F}}{\mathrm{QM}} - 1\right)}$$

Where:
DIS is the length of the road between junctions (in km);
F is the traffic volume in the pcu (per car unit) equivalents; and
VM and QM are as defined in the *Speed-Flow Relations Table* (Table 6.13)

When the reduced speed has been calculated for each diversion route, a cost per vehicle type must then be assigned using the Resource Costs Table (Table 6.11). This includes the value of time and the cost of running a vehicle (excluding indirect taxes and fuel duty etc) and is based on TAG Unit 3.5.6 (Department for Transport, 2012). It is now possible to calculate the total traffic disruption for the flood event using the equation below:

Equation 6T.3

EP = VA * L * C * D

where:
EP is Estimated potential costs of road traffic disruption (£)
VA is Number of vehicles affected (for each vehicle type)
L is Length of diversion (km)
C is Total cost of travel per km (for each vehicle type) (£)
D is Flood duration (hours)

An estimate of flood duration (in hours) for each return period is provided in the table of Indicative delay durations (Table 6.12). This should not be used as a substitute for detailed flood modelling but should be applied cautiously where no site-specific probabilities and durations are available.

METHOD 4: THE ORIGIN–DESTINATION MATRIX METHOD

The most sophisticated method of assessing road traffic disruption costs employs an origin-destination matrix and complex traffic modelling results. This would provide the most accurate of approaches. If an origin-destination traffic matrix is available for the area, then the flows on the different roads can be calculated using transport models such as SATURN (which is a general traffic assignment model) or PARAMICS (which is a more commonly-used micro-simulation model, like the old DRACULA model). Given the complexity of transport modelling, we recommend the support of a specialised transport modeller. More details can be obtained from https://www.gov.uk/transport-appraisal-and-modelling-tools.

Unless the network being modelled is small (e.g. less than 20 roads between junctions) then it is tedious to carry out an analysis without an available origin-destination matrix.

HIGH FREQUENCY EVENTS AND FLOODS WHICH AFFECT A SIGNIFICANT PART OF THE NETWORK

Roads are often the first points to flood in a floodplain, either because they run along the riverbank or because they cross the floodplain. Consequently, they may be flooded in very frequent events and perhaps be flooded several times a year. This needs to be accounted for within any calculations. However, in many cases the costs of raising the road and therefore solving flooding problems via a road engineering solution may be lower than a flood risk management option. In these circumstances it may be appropriate to cap the Present Value Damage (Pvd) due to road traffic disruption at the least cost solution of raising the road above the flooded level.

When considering floods which affect a significant part of the network, there are two sub-categories:

1. Disruption to sparse rural networks where diversion routes are long (e.g. 10 kms); and
2. Dense, heavily trafficked urban networks.

The former can be handled through the methods just described. However, the latter often involve dozens of links and, to be feasible, analysis of such networks requires the existence of an origin-destination matrix and a traffic model.

LONG DURATION FLOODS

Since traffic disruption losses are calculated on an hourly basis, the total losses from floods lasting several weeks can obviously be very significant, as experienced in Somerset during winter 2012/13.

During longer flooding events, awareness of road closures will increase and drivers will themselves begin to find alternative routes, may vary their journeys to less busy times of day, may select alternative transport options or choose not to travel and therefore traffic on the diverted routes may begin to ease. Additionally, not all diverted routes will be full to capacity at all times of day and therefore traffic speeds may vary and there is the need to ensure that the costs of traffic disruption is not severely overestimated in these circumstances.

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Rail disruption

OVERVIEW

This sub-section details a methodology for estimating the potential damages and losses caused by the flooding of railways. The Environment Agency (2024) over one third or 37% of railways are at risk from one or more sources of flooding; with, around 18% of railway lines at high or medium risk of flooding. The 2007 floods caused estimated losses of £36 million in the rail sector of which £10.5 million were direct damages to the track or other infrastructure, with the remaining £25.6 million being attributed to disruption costs. This equated to 5% of the economic losses to infrastructure.

Appraisal of the potential losses owing to the disruption of rail services are quantified in two ways: estimates of the compensation paid to Train Operating Companies (TOCs) by Network Rail following a delay in service or performance as a result of severe weather and the Value of Time (VOT) approach which quantifies the value of a delay. Each of these depends upon an estimate of the likely number of services affected and the likely duration of the flooding.

LESSONS FROM EXPERIENCE

- Site surveys are recommended in many cases as the specific circumstances of the flooding and the siting of equipment and other assets may significantly impact the losses experienced.

- Since the 2007 floods Network Rail has increased their focus on the current and future flood resilience of the rail network. This has included drainage improvements and other work to improve the resilience of assets to flooding as well as the mapping and assessment of assets at risk. Therefore, discussions with Network Rail are critical to clearly understand the potential impacts and losses of flooding on rail infrastructure.

- When appraising the benefits of schemes to reduce rail disruption owing to flooding, care is needed to calculate costs which can actually be prevented by any flood management interventions: rail service disruption may be caused simply by heavy rainfall which cannot be prevented by flood risk management investment.

- Experiences in 2012 in South-West England highlighted the importance of the specific line impacted to the losses generated and the density of the rail network and therefore alternative routes. In 2012, both of the main lines into the South- West were disrupted, thereby effectively cutting all rail travel to the region.

- The inter-dependency of the railway assets (e.g. signalling, track, buildings) means that appraisal should be considered as soon as any there is the potential of flooding on any of Network Rail's land.

TYPES OF LOSSES EXPERIENCED

Flooding of the rail track and associated infrastructure will cause some services to be cancelled and others to be delayed. The more severe the flooding the more severe will be the disruption and the larger the number of services cancelled.

Losses due to flooding can arise in the following areas:

1. Damage to assets. Network Rail incurs direct damages to infrastructure assets including track and circuits, embankments, structures and stations. There is also the potential for TOC rolling stock to be damaged although generally these losses are likely to be relatively minor.

2. Performance delay/cancellation costs. These occur as a result of delays and or cancellations in the train service and will involve costs to Network Rail for compensation to Train Operating Companies (TOCs) and to TOCs for loss of revenue and compensation to reimburse inconvenienced passengers.

3. Costs of alternative travel arrangements. When trains are cancelled owing to flooding the TOCs are under an obligation to enable passengers to continue their journey and provide alternative transport (such as replacement bus services). Although these are noted here as a separate category of loss, Network Rail's compensation to TOCs will include an element to reimburse for these losses.

ESTIMATING DIRECT DAMAGES TO RAIL ASSETS

Direct damage to rail assets is difficult to quantify as it varies considerably depending upon the circumstances of the flooding and the particular element of infrastructure affected; e.g. embankment, track, signalling etc. Therefore, to estimate potential direct damages a site survey is highly recommended along with discussions with local Network Rail engineers. However, to inform estimates the following indicative unit reconstruction values for Network Rail assets might be used: £4,000 per metre for embankments, £3,000 per metre for soil cuttings and £4,000 per metre for rock cuttings.

A METHOD OF BENEFIT ASSESSMENT FOR DISRUPTION TO THE RAIL NETWORK

The mapping of assets at risk has been improved by Network Rail's Asset Management with the development of a GIS system which is used to identify and categorise risks to assets. Network Rail has a much-improved understanding and categorisation of both the location and potential impacts of flooding on their systems and it is strongly advised that FRM project appraisers make use of this knowledge and that any significant assessment of rail damage and disruption should include a site visit and discussions with the appropriate Network Rail route engineer.

The appraisal method described below is based on, and adapted from, that described in MCM (2005) and that undertaken for the Meteorological Office (Posford Duvivier et al., 2002) and is based upon analysing the number of services or passenger journeys impacted by flooding. Two methods are presented; firstly, estimating the compensation payments made to TOCs/FOCs by Network Rail to recompense for delayed or cancelled service, whereas the second method uses a Value of Time approach accounting for how much time travellers would pay to avoid a delay. The first approach uses the total number of likely services impacted by flooding; whereas the latter utilises the number of passenger journeys impacted by flooding. If no information on the number of passenger journeys per 24 hours is available then the average number of passenger journeys per train, 182, (Burr, 2008) might be used to provide an estimated value based on the likely number of services affected.

The following steps should be used to calculate the costs of disruption:

Step One: Identify assets at risk of flooding

Obtain or create a map of the rail network running through the area at risk of flooding or the potential flood risk management benefit area. This should include the specific Train Operating Companies (TOCs) which run services on the affected part of the network. Information on the routes that each of the TOCs operate can be found on the National Rail website (http://www.nationalrail.co.uk/stations_destinations/maps.aspx).

Step Two: Determine the number of services impacted and/or the passenger journeys for the rail line at risk from flooding per 24-hour period

This information can be difficult to identify as the Office of Rail Regulation (ORR) only presents global annual passenger numbers for each of the rail companies for detailed assessment in their National Rail Trends Portal (ORR, 2013) (these averaged data are provided in Table 6.14). Therefore, it is necessary to approach each TOC operating on the rail lines within the appraisal area to refine these global passenger numbers and to identify the relative significance of the line.

Step Three: Estimate how many services will be cancelled and how many will be delayed

The Met Office research (Posford Duvivier et al., 2002) provides some benchmark data for delay and cancellation. This suggests using a 40/60 split for passenger train between delay and cancellation in this simplified algorithm.

Table 6.15 *Percentage delay/cancellation due to flooding (Posford Duvivier et al., 2002)*

Rail Service	Delay %	Cancellation %
Passenger service	40	60
Freight service	45	55

NB. This is Table 6.19 in the MCM 2013

Apply the relevant split from the table above to the number of services/passenger journeys per 24 hours which would be affected by flooding. An estimate of the likely length of a delay to a service is also required. This can be quite complex and we recommend discussions with Network Rail engineers to identify the average number of delay minutes that a service might suffer if a route is affected.

Step Four: Quantify the losses

Two methods are described below for quantifying these losses. The first relies on estimating how much compensation will be paid by Network Rail to TOCs and FOCs and therefore represents the additional costs due to flooding. The second method uses the Value of Time (VOT) approach adopted by the National Audit Office (Burr, 2008) in their investigation of rail delays.

Step Five: Convert the costs calculated per hour to annual average disruption

This requires an assessment of the depth and extent of flooding likely at different probabilities. Owing to the complexity and context-specific nature of the rail network it is preferable to undertake a site survey to understand fully the likely impacts of flooding and the likely length of a delay. Where this is undertaken, site-specific annual flooding probabilities should be applied. The inundation of areas around the track may also critically affect other assets such as signal infrastructure and affect the stability of embankments. Therefore, potential losses should be considered as soon as any Network Rail property is affected by flooding (including property assets; embankments; drainage; culverts; bridges; other crossings). These estimates can then be refined through discussion with local Network Rail route engineers.

In the absence of site-specific annual flooding probabilities (which are to be preferred) use road traffic return period disruption durations (Table 6.12). Disruption will escalate significantly as flooding becomes regional or if a key junction or station in the network is affected. Situations where widespread disruption occurs – and therefore where both rail response and repair teams and rail replacement infrastructure are stretched – are likely to have losses disproportionate to the sum of the aggregated flooding incidents. Therefore, disruption figures calculated using the approach presented here represent a minimum economic cost of disruption, relating to the separate flooding of individual floodplain areas and rail links, rather than all-region impacts.

QUANTIFYING DISRUPTION COSTS DUE TO SERVICE DELAY AND CANCELLATION

UTILISING NETWORK RAIL COMPENSATION PAYMENTS

This first method uses the compensation payments made to TOCs/FOCs by Network Rail to recompense for delayed or cancelled services. This utilises the average compensation costs that Network Rail pays to the TOCs under Schedules 4 and 8 of the Track Access Agreements. Standard costs set out in these agreements are assigned to the delay/cancellation depending on the type of route affected, the operator affected and the location of the incident; with the busiest routes allocated the highest weighting. Thus, a delay close to London in peak rush hour will be assigned a higher delay cost than, say, a delay in rural Wales. Indicative compensation values per delay minute and per cancelled service are provided in Table 6.16.

A low, medium and high value is provided for passenger services performance delays (per minute) and cancellations (per service) to account for the wide variation between TOCs and the lines impacted. These values could be used to provide a range of the potential losses due to rail disruption. Alternatively, it may be appropriate to select one of the values depending on the significance of the rail line within the assessment area. For instance, if a busy rail line (such as a main commuter route or east/west coast mainline) will be impacted the higher value should be applied. Conversely, if a less busy, rural route is within the assessment area the low value may be more appropriate.

A single indicative value for delay and cancellation for freight is provided, as these compensation values appear to be more constant. These values should be multiplied by the likely minutes of delay and estimated number of services impacted, to provide an approximation of the potential losses due to flooding.

A VALUE OF TIME APPROACH (VOT) TO QUANTIFYING THE LOSSES

Similar to the compensation approach, this method also calculates loss based on the number of delay minutes experienced. However, this approach utilises willingness-to-pay approaches presented by the New Approach to Transport Appraisal (NATA) (Department for Transport, 2011b). A monetary value is provided in Table 6.17 (based on willingness-to-pay surveys) for different types of transport user (e.g. commuter; business user and other) based on how much they would pay to avoid a travel delay.

These values can be used to approximate the costs of a delay to different passenger types and therefore to calculate the costs of travel disruption when multiplied by the length of any delay. If a local analysis is to be undertaken, data needs to be gathered on the proportions of the different types of passengers travelling per train which will vary by train line as well as the average number of passenger journeys per train (see Step 2 above).

Averaged data is available on these proportions for each TOC (Table 6.18) and a national and regional breakdown Table (6.19) by journey purpose is available here. Although these data can be used for a general assessment, specific lines and services may vary considerably in their composition and so a per railway line analysis should be undertaken where possible.

It is also possible to use average data for an approximation of the value of time costs of rail disruption. Burr (2008) utilised data from Department for Transport, Network Rail and the ORR to calculate the average number of passengers per train and an average estimation of the type of passenger split for all journeys throughout a week. This identified that an average train contained 14 business travellers, 95 commuters and 73 ‘other’ passengers. They then applied these to the VOT figures for 2007 and calculated an average value of £73.47 for every minute a train is delayed. Applying the updated VOT figures in Table 6.17 provides an updated figure of £99.93 per delayed minute of a train.

Each of the methods above provides a slightly different estimate of the potential costs of disruption. The compensation payment method provides an estimate of disruption due to the delay of a service and is broadly related to the value of the fare being paid by a passenger. The second approach provides an estimate based on the value of time and attempts to quantify the inconvenience or lost work time caused by a delay or cancellation. Combining these estimates provides an upper estimate on the value of a disruption. This arguably includes some degree of double counting as the compensation value - which if reclaimed by affected passengers – does provide some recompense for their inconvenience, however may provide a closer estimate to the true costs of the disruption of rail services.

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