Risk Based Performance Measurement in the Fire and Rescue Services

Final Report

Fire Research Series 10/2008
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The findings and recommendations in this report are those of the authors and do not necessarily represent the views of the Department for Communities and Local Government.
Risk Based Performance Measurement in the Fire and Rescue Service – an Introduction

This research was commissioned by the Department for Communities and Local Government (CLG) as part of work to consider options for revised national targets in the context of the 2007 Comprehensive Spending Review (CSR07). Spending Review 2004 had introduced Public Service Agreement (PSA3) national targets for the Fire and Rescue Service in England to reduce the number of accidental fire deaths and deliberate fires. CSR07 incorporated a full review of PSA targets and consideration was given to potential options either revising or supplementing the existing targets for the Fire and Rescue Service. Government opted to consolidate and reduce the overall number of PSA targets for CSR07, and as PSA3 had achieved its objective of providing a national focus for the work of the Fire and Rescue Service, new or revised PSA targets for the Service were not incorporated in the CSR07 set. Instead it was determined that what had been achieved by the Service in response to PSA3 would be built upon through the adoption of a broader Departmental Strategic Objective (DSO6) for CLG:

“Ensuring safer communities by providing the framework for the Fire and Rescue Service and other agencies to prevent and respond to emergencies.”

DSO 6 incorporates appropriate measures of the performance of the Fire and Rescue Service, outcomes for communities and delivery of the Fire and Resilience Programme which is intended to deliver an enhanced national response capability for the Service.

The initial work for this research project was therefore used to (i) help inform consideration of relevant performance indicators within the national set for local government; and (ii) developed further to help provide the basis of a “toolkit” (published February 2008) to assist Fire and Rescue Authorities in working with Local Strategic Partnerships in the development of Local Area Agreements (LAAs). As such it provided some of the underpinning research to support guidance in the toolkit on a range of potential local approaches to target setting, either for fire targets adopted within LAAs, or to provide context and measures of success for programmes of activity by Fire and Rescue Authorities in support of wider LAA targets.
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Abstract

A study into the formulation of future performance measures for the Fire and Rescue Services is undertaken, with the emphasis on the adoption of risk based and outcome focused measures. Three candidate areas are identified as suitable for the application of measures, namely dwellings fires, deliberate fires, and a composite fire index consisting of the consequential costs due to fatalities, injuries and property loss as a result of accidental and deliberate dwelling, other buildings and vehicle fires. In addition, areas in which the FRS may contribute to other (non FRS) targets are investigated with a view to identifying where FRS contribution can be highlighted and measured.

Detailed analyses, in terms of assessing the viability and effectiveness of potential measures are presented. In particular, the potential for the target measures to promote a reduction in inequality between local areas is considered, alongside the headline objective to measure FRS performance.

A strong association between deprivation and other social factors with the incidence of fire is identified, and target metrics, at both local and national level, are suggested for each of the candidate areas. The fire rate is suggested as the most suitable target measure for dwelling fires, since this provides the least volatile measure for FRSs. Fire rate is also proposed at local level for the deliberate fire measure, while the national measure is based on the total number of deliberate fires. The cost of fire index, which is based on a value per head of population, is shown to be robust at local level and the target measures are presented as a reduction in the index.
Executive Summary

This document provides a detailed commentary on a study undertaken into the scope for the formulation of future performance measures for the Fire and Rescue Services (FRS), with the emphasis on the adoption of risk based and outcome focused measures.

As such, three candidate areas are developed in terms of investigating their feasibility as measures, namely:

- Dwellings fires
- A ‘composite’ fire index
- Deliberate fires.

Following the identification of a number of areas in which performance measures could be applied, detailed analyses in terms of assessing the viability and effectiveness of potential measures are undertaken. In particular, the potential for the target metrics to promote a reduction in inequality between local areas is considered, alongside the headline objective to measure FRS performance.

In addition, areas in which the FRS may contribute to other (non FRS) targets have been investigated with a view to identifying where the FRS contribution towards meeting these targets can be highlighted and measured.

Since the publication of the Progress Report (Ref. 2) for this project in November 2006, the proposed approach to be taken by Communities and Local Government towards future policy has undergone further development. This report takes due cognisance of this revised approach and seeks to place the candidate targets within the proposed policy framework for the Department.

Dwellings fire measure

The results of the analysis reveal that dwelling fire rates (as opposed to fire deaths or injuries) provides the least volatile measure for FRSs of any size. If there is a requirement for a single measure to be applied to FRSs the rate of dwelling fire could be the preferred measure. If there is flexibility in performance measurement (such as in the context of IRMPs), a more flexible use of these measures (eg larger FRSs to use rate of fatalities and/or injuries as well as rate of fire) could be proposed.
It is concluded that the method of calculating dwelling fire metrics for each FRS (based on socio-demographic make-up of each FRS) produces measurable targets that are linked to inequality in the incidence of fire. Further conclusions drawn include:

- There is a strong association between deprivation and other social factors with the incidence of fire
- There is a four fold variation in the rate of dwelling fire, associated with deprivation and other social factors
- Dwelling risk target metrics can be related to relative levels of deprivation/socio-demographic risk, with more stringent metrics for higher risk areas
- Dwelling risk target metrics can be aligned with FSEC risk categories – thereby providing linkage to a tool that enables assessment at smaller areas and possibly Local Area Agreements.

Wiltshire is used in part as a test of the application of targets to areas analogous in size to Local Area Agreements (LAAs). The results suggest that dwelling fire rates are the least volatile measure to apply to smaller LAAs.

The review of past experience and other government targets indicates that a measure of 50 per cent reduction in dwelling risk in higher risk areas over a five or ten year period is a credible target.

**Composite fire index measure**

The analysis concludes that an index based upon fatalities, injuries and property damage incurred as a result of deliberate and accidental fires for dwellings, non-domestic premises and vehicles is a feasible performance measure which is robust at local area levels. This measure would be reflective of the broader role of the Fire and Rescue Service in protecting the community from fire, and aligns well with developments in integrated risk management planning. The metric is also shown to demonstrate good correlation with the risk of social deprivation and crime.

It is proposed that the composite cost of fire measure is best presented as a value per head of population. This is primarily to aid in the dissemination of the metric to LAA level in allowing relative performance to be gauged with a view to risk targeted measures that are proportional to existing FRS performance.

At National level, it is suggested that a target metric based on the percentage reduction in the overall cost of fire index over a ten year period would be suitable. At local level, a variable metric is suggested for each FRS/LAA, with the aim of promoting a reduction in inequality between local areas. The local metric is in the form of a percentage reduction in the three year average cost of fire index over a ten year period, with the target metric...
itself being directly proportional to the index at the outset of the target period. As such, those areas with a higher index are assigned more stringent metrics. The level of the target metrics is assigned based on an analysis of current performance trends at National level.

Deliberate fires measure

A metric based upon the total number of fires, or fire rate, is identified as a suitable candidate for a deliberate fires measure. This provides consistency with an existing target area as well as providing robust data to local areas. Such a metric would align with tackling deprivation and potential crime rate targets set by the Home Office.

At National level, it is suggested that a target measure based on the percentage reduction in the three year average number of deliberate fires over a ten year period would be suitable. At local level, a variable metric based on the deliberate fire rate (per population) is suggested for each FRS/LAA, with the aim of promoting a reduction in inequality (and crime rate/deprivation) between local areas.

FRS contribution to other measures

The review of FRS contribution to other (non FRS) target areas concludes that there may be scope to measure performance at Road Traffic Collisions and in terms of Environmental Impact with a view to future metrics. It is suggested that Ethnicity should be part of a broad range of measures to ensure that public services are representative of the communities that they serve.
1 Introduction

1.1 Performance measurement in the Fire and Rescue Services

The FRS currently has in place a number of Public Service Agreement (PSA) targets that were defined at SR2004. Briefly these are:

- To reduce the number of accidental fire-related deaths in the home by 20 per cent, averaged over the eleven-year period to 31 March 2010.
- No local fire and rescue authority having a fatality rate, from accidental fires in the home, more than 1.25 times the national average by 2010.
- To achieve a 10 per cent reduction in deliberate fires by 31 March 2010 to 94,000 from the 2001/02 baseline of 104,500.

The current targets have performed an effective role in focusing FRS activities on to the core activities of reducing loss of life in the home and reducing the number of deliberate fires. As such, future performance measures within the FRS should pay due regard to the success of the targets while noting that there are a number of issues with the current targets that may be addressed with the application of new measures, including:

- As significant progress has been made towards achieving the current targets, they will play a diminishing role henceforth in stimulating improvement in FRS performance.
- The rate of fire death target is volatile and difficult to measure at the level of Local Area Agreements (LAA).
- The range of FRS statutory responsibilities has increased with the advent of the 2004 Fire and Rescue Services Act (Ref. 4). As such, the current PSA3 targets do not capture the full range of FRS core activities.
- Some stakeholders have expressed concern that the FRS, although justified, focus on public safety needs to be balanced by a proportionate focus on the economic and other impacts of fire.
- The FRS role in Civil Contingencies has developed with the advent of new dimensions and the Civil Contingencies Act (Ref. 8).
Therefore, in terms of the definition of future performance measurement in the FRS, the following should be given consideration:

- Current targets could be ‘stretched’ to encourage further performance improvement
- The scope of the targets could be broadened, particularly to encompass new areas of statutory responsibility
- Targets can be developed that are less volatile, specifically at the level of Local Area Agreements
- The FRS’s role in achieving external (ie non fire-specific) Government targets can be addressed

1.2 Project summary

Two previous reports (Refs. 2 & 3) have been issued during the course of this task, namely a Progress Report (Ref. 2) and an Interim Report (Ref. 3). Although this report is intended as a standalone document, further information and detail regarding the work undertaken may be found in the previously issued documents, and reference is made to these reports where necessary. The following provides a summary of the content of the two reports.

1.2.1 Progress Report

The Progress Report, Ref. 2, documented the early phase of the project, which sought to provide an initial assessment of the potential for risk based performance measures for the FRS, including a review of the current PSA3 targets and the use of similar measures in other Government departments and the commercial sector. In addition, the applicability of the various categories of risk based performance measures was assessed, and used as part of the analysis of the feasibility of such measures to the FRS.

A review of a risk based approach to performance measurement was undertaken (reported in full in Appendix F), both in terms of the general approach and a study of the process as applied to other Government sectors. The review encompassed a number of measurement methods, including:

- Key risk-focused measures
- Outcome measures
- Risk weighted measures
- Added value

It was found that a risk based approach in general offered significant potential for application to performance measurement in the FRS, particularly in terms of the likely broadening in scope of such measures. Current PSA3 targets align closely with the study of those targets which focus on key risks, such as the NHS and the DfT headline targets, and offer scope to develop the measures through a ‘stretching’ of the target.
Measures that are specifically matched to outcomes are considered to be particularly applicable to the FRS, with the requirement towards risk based, outcome focused measures. The review noted that current application of this approach is not limited to ‘end-events’, eg an incident resulting in casualties, and measures can be applied to intermediate events which may contribute to the prevention, or a reduction in severity, of the incident.

The review also noted that areas identified as potentially suitable for performance measurement should not require additional data to be collected (in the spirit of Ref. 1, which calls for a radical reduction in data collection).

Risk-weighted measures were identified as a likely candidate to address the social deprivation issues as applicable to fire risk in dwellings. Added Values measures also offer a tool to address the socio-demographic factors, in terms of the possibility of measuring the extent to which an FRS can reduce the rate of fire relative to a baseline associated with their local socio-demographic profile level and deprivation level.

At the same time, a review of the new areas for which the FRS has statutory and corporate social responsibility was carried out, including those set out in the Fire and Rescue Service Act 2004 and the Civil Contingencies Act. This review also included an assessment of the potential areas where FRS jurisdiction contributes towards other outcomes, such as extrication from RTCs.

Following the review of available information, a risk based identification of areas suitable for performance measurement was undertaken. The review was based on the new areas of FRS statutory and corporate social responsibility, including those areas identified as measurable contributions to ‘non-FRS’ performance measures. As part of the review, consideration of the possibility of disseminating the candidate measures down to FRS and LAA level was also addressed. A total of six candidate areas were identified for further analysis:

- Dwellings (including the possibility of a target based on socio-demographic risk)
- Fires in other buildings
- Deliberate fires
- Vehicle fires
- Rescues at RTCs
- Community safety – other special services rescues

Following the identification of the candidate areas a consolidation exercise concluded that the following performance measures could be used as a basis for refinement and testing during the next phase of the task.
1. A dwelling fire death and casualty measure, possibly with a deprivation weighting in recognition of the need to reduce social inequality in fire risk.

2. A composite measure of the economic and social cost of fire in domestic and non-domestic premises (incorporating consideration of fatalities, casualties and property damage in dwellings and other buildings).

3. A deliberate fires measure.

It was noted that there could be potential to combine candidate measures 2 and 3 above into a single measure which could incorporate the consequential cost of both accidental and deliberate fires in premises within a single measure. Also, the initial analysis considered whether the assumptions, exclusions etc. in any cost of fire model would make the total cost an arbitrary value, such that the composite cost of fire measure could be expressed as a "cost of fire index" rather than as a monetary value.

In addition, the following were identified as candidate measurable contributions to other areas of performance measurement reflecting the FRSs revised statutory role in road safety and community safety.

- Extracting casualties from road traffic accidents and accidental vehicle fires
- Reducing traffic delays by dealing with road traffic accidents
- Tackling crime through arson reduction
- Addressing inequality, social exclusion and social cohesion by a reduction in inequality rates and impact of fire between deprived and affluent sections of the community.

1.2.2 Interim Report

The Interim Report (Ref. 3) documented progress made towards the development of risk based performance measures for the FRS. The analyses presented built upon the initial research undertaken and conclusions drawn which were published in the Progress Report (Ref. 2).

As such, three candidate areas were developed further to investigate their feasibility as measures, namely:

- A dwellings fires measure
- A ‘composite’ fire index measure
- A deliberate fires measure
The analyses presented in the report included the following as applicable to each candidate measure:

- A detailed review of the measures, including the potential for application at LAA level
- Definitions of approaches which could be taken to generate suitable metrics based on the measure
- Outlines of the types of metrics that could be set based on the above.

In addition, areas in which the FRS may contribute to other areas of performance measurement were investigated with a view to identifying where the FRS contribution towards meeting these metrics could be highlighted and measured.

**Dwellings fire measure**

The results revealed that dwelling fire rates (as opposed to fire deaths or injuries) provide the least volatile measure for FRSs of all sizes, and that the rate of dwelling fire could be the preferred candidate for a single measure. The report also stated that a more flexible use of the measures (eg larger FRSs could use the rate of fatalities and/or injuries as well as the rate of fire), could be proposed.

It was concluded that the method of calculating dwelling fire measures for each FRS (based on the socio-demographic make-up of each FRS) produces measurable targets that are linked to inequality in the incidence of fire. Further conclusions drawn included:

- There is a strong association between deprivation and other social factors with the incidence of fire
- There is a four fold variation in the rate of dwelling fire, associated with deprivation and other social factors
- Dwelling risk measures can be related to relative levels of deprivation/socio-demographic risk, with more stringent targets for higher risk areas
- Dwelling risk measures can be aligned with FSEC risk categories – thereby providing linkage to a tool that enables assessment at smaller areas and possibly Local Area Agreements.

This phase of the work involved the development of a metric for a dwelling risk measure and illustrated how such a metric could be defined. Suggestions were made as to how actual measures could be set but alternative rationale for the level at which metrics could be set or the time period over which the metrics could be applied were not explored at this stage.
**Composite fire index measure**
Ref. 3 presented a discussion on the development of a composite fire index, and an investigation into its suitability in terms of a risk based performance measure. Analysis concluded that an index based upon fatalities, injuries and property damage incurred as a result of deliberate and accidental fires for dwellings, non-domestic premises and vehicles was a feasible performance measure which is robust at local area levels. This measure would be reflective of the broader role of the Fire and Rescue Service in protecting the community from fire, and aligns well with developments in integrated risk management planning. The metric was also shown to demonstrate good correlation with the risk of social deprivation and crime.

Metrics considered to be suitable for the composite fire index included a national reduction in index value measure, or risk-based measures in which areas with a relatively high index value are set higher target metrics than those where the relative index value is already low.

It was proposed that the composite cost of fire measure is best presented as a value per head of population. This is primarily to aid in the dissemination of the metric to LAA level in allowing relative performance to be gauged with a view to risk targeted measures that are proportional to existing FRS performance.

**Deliberate fires measure**
A metric based upon the total number of fires, or fire rate, was identified as a suitable candidate for a deliberate fires measure. This provides consistency with an existing target area as well as providing robust data to local areas. Such a metric would align with tackling deprivation and potential crime rate targets set by the Home Office.

Metrics proposed included a reduction in the number of deliberate fires nationally over a period of time and a risk based measure; an example of this being those areas with the highest deliberate fire rates could receive more stringent metrics than other areas.

**FRS contribution to other measures**
The review of FRS contribution to other areas of performance measurement concluded that there may be scope to measure performance at *Road Traffic Collisions* and in terms of *Environmental Impact* with a view to future metrics. It was suggested that ethnicity should be part of a broad range of measures to ensure that public services are representative of the communities that they serve.
1.3 Scope of this report

The report aims to provide a complete, standalone commentary on the Risk Based Performance Measurement in the Fire and Rescue Services task. As such, relevant content from the earlier reports (section 1.2) is retained and expanded upon where necessary. In particular the technical content from the Interim Report (Ref. 3) is included in order to provide a complete discussion of the measures, from initial formulation through testing and definition of potential target measures and levels.

This report includes a discussion on the final phase of the task, namely the definition of the target measures proposed during the interim phase. The analyses undertaken during the final phase of the task, contained within this report, have sought to:

- Review the proposed measures identified during the previous phase and assess their suitability at local and national levels.
- Define and review a selection of metric mechanisms, including an assessment of the potential to reduce inequality.
- Conduct an assessment of the current trends with regards to the measures, and formulate new metrics for consideration by Communities and Local Government based on the trends.
2 Developments in Performance Measurement

2.1 Policy

The following are key themes identified by Communities and Local Government which will be reflected in future policy development:

- Equalities
- Tackling deprivation and disadvantage
- Community cohesion
- Housing supply
- Place-based economic growth and disparity

The role of future performance measurement within the FRS has been considered in the context of these themes and is presented as such herein.

The ‘deprivation and disadvantage’ theme potentially provides the strongest angle with which to portray FRS metrics because there is a recognised relationship between the incidence of fire and areas of deprivation. This theme is understood to be being developed based around ensuring that the service provided by the FRS should have a clear focus on reaching deprived or disadvantaged groups within society, and that these groups should be targeted in a similar fashion to the way in which Health Service and crime targets are addressed.

The theme for equalities is understood to have two dimensions which could be relevant to the Fire Service, namely:

- the equality in terms of the social groups within the service – the diversity of the workforce
- ensuring that the FRS provides a service that meets the needs of minority groups within society

The community/social cohesion theme links to Communities and Local Government’s expectations of tackling issues such as the community’s links to terrorism, feelings of exclusion from society etc. This is a developing area which has come to prominence in recent months and this is a very sensitive and challenging issue. This theme is less likely to be directly relevant to the role of the FRS although it is noted that individuals employed by

\(^1\) Note that this is a provisional list and is not, at the time of writing, being circulated beyond PSA target related projects.
the Fire and Rescue Services, for example as wholetime or retained firefighters, would be expected to feel a sense of responsibility for the safety of the Community which they serve. This in turn could improve community cohesion, noting an interface with the equalities theme (in terms of making the FRS more reflective of the community it serves) discussed earlier. In addition, the impact of fire on the wider community (in terms of loss of amenity, fear of arson, etc) could be considered under this theme.

The themes tackling housing supply and economic growth are less likely to be themes to which Fire Service measures could contribute to directly.

There are understood to be further possible themes which could be defined which may consider:

- Local services
- Counter-terrorism.

In addition, there are likely to be Community Safety and/or Crime Prevention targets set by the Home Office. Counter-terrorism themes are likely to be about capacity rather than outcomes; for the FRS it would be likely to be concerned with fire control etc.

### 2.2 Impact on potential metrics

The following sections, in which appropriate measures are developed and defined, include a commentary on how these metrics are likely to best interface with the themes outlined in Section 2.1.
3 Dwelling Fire Risk

3.1 Introduction

The purpose of this section of the report is to develop a set of recommendations which could be used to base future FRS dwelling performance measures. These metrics aim to draw on previous work by Greenstreet Berman (Ref. 16) on the influence of socio-demographic factors in fires. This work highlights the role of socio-demographic factors such as being single and deprived in the incidence of fire and the high level of socially related inequality in the incidence of fire. The current PSA3 target states that FRSs rate of dwelling fire deaths should not be 1.25 times the national average. However, some FRSs may be several times the national average due to their socio-demographic make-up. Accordingly this section first explores the nature and extent of deprivation related incidence of fire and then explores how a dwelling fire risk metric could be related to socio-demographic risk. After developing some initial ideas their practical application is tested by retrospectively applying potential metrics to a sample of FRSs.

The potential new metrics can be termed either:

- Socio-demographic risk weighted dwelling risk metrics; or
- Deprivation related dwelling risk metrics.

3.2 Deprivation and dwelling fire risk

A series of studies have indicated that there is an association between deprivation and dwelling fire risk, as well as some other socio-demographic factors, particularly being single. For example:

A recent large scale multiple regression analysis (Ref. 16) of the census, the Indices of Multiple Deprivation and the incidence of dwelling fires and injuries found that:

- The Indices of Multiple Deprivation (IMD) when regressed against the incidence of dwelling fire accounts for 60 per cent of the variance – which is a strong statistical model.
- The census when regressed against the incidence of dwelling fire accounts for 69 per cent of the variance – which is stronger than the IMD. The census variables identified in the regression are Lone parent with dependent child (ren); Caribbean/African and other black; Never worked; Single adult household; Age 70+.

The latter work also found similar associations between these socio-demographic factors and the incidence of dwelling fire casualty.
Figure 3.1 illustrates (using data for 353 English local and unitary authorities) the strength of the association between, in this example, lone parents and the incidence of fire. The proportion of lone parents is the single strongest predictor of the incidence of dwelling fire.

Multiple regression reduces the number of explanatory variables to a minimum, after controlling for interactions between factors. In this case lone parents are associated with many other ‘deprivation’ related factors. Figure 3.2 provides as an example a plot of the proportion of lone parents and the rate of unemployed, (using data for 353 English local and unitary authorities), and gives the R2 value of 0.75, indicating strong association. Thus, whilst lone parents are the strongest single socio-demographic factor, this is indicative of other deprivation related factors such as unemployment.
Caribbean/African and other black has a positive bi-variate correlation with the rate of fire when examined in isolation. However, it should be noted that Caribbean/African and other black is associated with fewer fires once you have controlled for factors such as never worked and single parents families. Thus, it is the higher levels of deprivation and disadvantage amongst Caribbean/African and other black that is associated with fire risk, not ethnicity per se.

The latter recent results are similar to those of a 2001 study completed as part of the development of the Fire Service Emergency Cover toolkit (Ref. 17). The work found that single parent families were the single most powerful indicator of the rate of dwelling fires, accounting for 63.7 per cent of the variance. This research also concluded that percentage of rented homes, percentage of homes with lone pensioners, people with long term limiting illness and the rate of fire were all good indicators of rate of fire casualties accounting for 49.3 per cent of the variance.
In 2004, completed as part of the development of the Fire Service Emergency Cover toolkit, Greenstreet Berman explored risk measures for potential use in the FRS funding formula (Ref. 18). The study used national geocoded fire data for a single year (2002) and found that Household type (children and pensioners), ethnicity, occupation and work status were good indicators of the rate of dwelling fires.

Thus, there does appear to be a clear association between measures of deprivation/disadvantage and the incidence of dwelling fire risk (measured as a rate per million population). Figure 3.3 shows a plot of the reported number of fires in each English FRS using 2002-2004 fire data and the number of fires predicted by the census regression model developed in 2006. It shows a close association between the identified socio-demographic factors and reported incidence of fires.

![Figure 3.3: Predicted versus reported dwelling fire (English FRSs)](image)

When the rate of fire is compared against the national average it is clear that there are significant inequalities in the rate of dwelling fire associated with the aforementioned socio-demographic factors. Figure 3.4 presents the relative rate of dwelling fire, drawing on the 2006 study. All reported (using 2002-2004 data) and predicted (using the census regression model) rates of fire are presented as a fraction of the average rate of fire in England. The figure plots rates for 46 English FRSs. The figure shows that there is a four fold variation in the rate of predicted and the rate of reported dwelling fires. The highest reported rate is twice the national average whilst the lowest reported rate is less than half the national average. A similar range is found using the predicted rates of fire, indicating
that the range in the rate of fire is associated with the socio-demographic profile of the population within each FRS.

**Figure 3.4: Relative rates of dwelling fire**

<table>
<thead>
<tr>
<th>Predicted fires</th>
<th>Reported fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

3.3 Deprivation related dwelling (Socio-Demographic) risk metrics

The recognition of the association between deprivation and the incidence of dwelling fire and fire casualties and the wide range in the incidence of fire raises the option of a ‘risk’ or ‘deprivation’ weighted set of dwelling fire metrics.

The concept could be to set more ‘stretching metrics’ for FRSs (and/or local authorities) where the dwelling fire risk is higher than the national average than in areas where the risk is lower. This would serve the purpose of reducing the level of inequality in the incidence of fire experienced by the more deprived and disadvantaged sections of the community.

The concept of socio-demographic risk weighted metrics, or what could be termed deprivation weighted metrics, is illustrated in Figure 3.5. The figure uses hypothetical data for four FRSs. The four FRSs have different rates of dwelling fire in the period 2000-2004. FRS A with the highest rate of dwelling fire is given a metric to (say) reduce the rate of fire by half, FRS B (with the second highest rate) has metric to reduce rate of fire by (say)
40 per cent, FRS C with a lower rate of fire has a metric of ~17 per cent and the FRS D with the lowest rate of fire has a metric to reduce the rate of fire by ~6 per cent. The hypothetical example applies the metric over a ten year period, at the end of which the ‘inequality’ in the rate of fire is far less than at the base line year.

**Figure 3.5: Illustration of concept of deprivation weighted dwelling risk metrics**

How might the metrics be set?

There are a number of options regarding how to set metrics related to socio-demographic risk, including:

- By professional judgement – with comparison against the national average
- By comparison with the FSEC dwelling risk categories.

Both options would provide socio-demographic risk weighted metrics that would seek a reduction in the inequality in the incidence of fire.

**Option 1: Professional judgement**

The concept is illustrated in Table 3.1 where the targeted reduction is higher for FRSs with higher relative rates of dwelling fire. The metrics (assumed to be over a five year period) are based on two judgements, one being that it is possible to reduce the rate of fire by ~5 per cent per year and the other being that the aim is to reduce higher rates of fire to the average in the base line year.
### Table 3.1: Hypothetical judgment based metrics

<table>
<thead>
<tr>
<th>Current rate of fire</th>
<th>Metric based on judgement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 25% above national average</td>
<td>25</td>
</tr>
<tr>
<td>In region of 100% to 125% of the national average</td>
<td>12.5</td>
</tr>
<tr>
<td>In region 99% to 75% of national average</td>
<td>6</td>
</tr>
<tr>
<td>Less than 75% of the national average</td>
<td>3</td>
</tr>
</tbody>
</table>

### Option 2: Link to FSEC risk categories

FSEC categorises the rate of dwelling fire death into five categories, as per Table 3.2. Figure 3.6 places the FSEC risk categories onto the relative rate of dwelling fire. The metrics could be developed on the basis that FRSs and areas within FRSs (such as those covered by Local Area Agreements) should reduce risk to a medium level with lesser metrics for areas of lower risk. Thus, an area whose risk is in a region ‘Well above average’ should reduce risk by at least 50 per cent.

This option offers a number of advantages, including:

- FSEC models risk at the level of Output Areas and groups of Output Areas. Therefore, it should be possible to apply the metrics to geographic areas that are covered by Local Area Agreements.
- The FSEC risk categories are based on an assessment of the tolerability of dwelling risk as well as the relative risk in the UK. Hence, the metrics would be founded in societal values.

### Table 3.2: FSEC dwelling risk categories

<table>
<thead>
<tr>
<th>Fatalities per ‘n’ people</th>
<th>Fatalities per million population</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;50000</td>
<td>Above 20 pmp</td>
<td>Well above average</td>
</tr>
<tr>
<td>100000 to 50000</td>
<td>Between 10 pmp and 20 pmp</td>
<td>Above average</td>
</tr>
<tr>
<td>150,000 to 100,000</td>
<td>Between 10 pmp and 6.6 pmp</td>
<td>Medium</td>
</tr>
<tr>
<td>200,000 to 150,000</td>
<td>Between 6.6 pmp and 5 pmp</td>
<td>Below average</td>
</tr>
<tr>
<td>&lt;200,000</td>
<td>Less than 5 pmp</td>
<td>Well below average</td>
</tr>
</tbody>
</table>
3.4 Derivation of specific metrics for FRS and/or sub-areas

Metrics can be set:

- Against FRSs placed into quartiles or quintiles, such as FRSs with rates of fire in the top quartile having a metric of (say) 50 per cent; and
- By application of a mathematical function based on the relative rate of fire.

The former option has the advantage of simplicity. However, it has the disadvantage of imprecision and FRSs that have very similar rates of fire that fall just either side of a quartile receiving very different metrics.

The advantage of a more precise approach to setting metrics is that it avoids the crudity of assigning metrics to quartiles or quintiles.

The concept of developing measures using a function is shown in Figure 3.6. The vertical axis indicates a metric (% reduction in the rate of fire). The metric is linked to the relative risk shown on the horizontal axis. For example, a FRS whose rate of dwelling fire is 1.5 the average receives a target metric of 40 per cent reduction. The line from the bottom left point of origin to the top right shows the conjunction of the relative risk and target metric. The metrics are based on the following assumptions:

- FRSs whose relative risk is double the medium level should aim to half their risk
- The target level of reduction should decline proportionately to the relative risk using the relative risk of 2 as a base point— for example, if the relative risk is 1 the target metric is 25 instead of 50 per cent.
The latter logic achieves the aim of reducing above average rates to the medium level, with diminishing metrics for areas at or below the medium level.

Examination of the per cent change in rates of dwelling fire in the period 1999 to 2005 suggests values in the range of 0 to ~9 per cent per annum, with most in the range of 3 to 8 per cent per year. Thus, a target metric of 50 per cent reduction would be practical, using these historical examples, in a period of six to ten years.
3.5 Examples of other target measures

The latter framework would suggest a range of target metrics for the annual decline in fire measures. The ‘face validity’ of such metrics can be reviewed by comparison with other targets set by the government to reduce various events. For example:

- The Department for Transport has set a ten year target to reduce casualty rates by 2010. The targets for this ten year period include:
  - reducing the number of people killed or seriously injured on UK roads by 40 per cent
  - reducing the number of children killed or seriously injured on UK roads by 50 per cent
  - initial results indicate that they are on course to reach these targets
- Other targets set by government include a 50 per cent reduction in the number of teenage pregnancies over a ten year period
- A 30 per cent reduction in the level of car crime from 1999-2004
- A reduction in the number of deaths from heart disease and stroke related disease in people aged under 75 years by 40 per cent
- The Home Office has a five year plan to reduce the overall level of crime by 15 per cent – however, by June 2006 crime had been reduced by 10.7 per cent indicating that there was still work to do to reduce this figure by a further 4.3 per cent.

Thus, there are examples of targets seeking a 3 to 5 per cent reduction per annum, which is at the lower end of the target measures suggested by the latter framework.

3.6 Review of past experience

It is also possible to review the face validity of the latter target metrics by examining the rate of decline in the fire measures in a sample of FRS. The following pages summarise the rate of change in the various measures of dwelling fire risk.

3.6.1 Weighted fire data

The average weighted reduction of fires across all FRSs from 1997 to 2005 is 2.85 per cent for annual fire data and 1.6 per cent for three year rolling average data. Looking specifically at annual fire data the range of percentage change across FRSs is from +1.9 per cent for the Isle of Wight to -5.2 per cent for Nottinghamshire. The percentage change range for the three year rolling average was from +2.5 to -2.8 per cent for the Isle of Wight and Nottinghamshire respectively.
From looking at Figure 3.8 it is apparent that for a couple of FRSs their weighted (combined fires/injuries and deaths) rate of fire fell by up to 50 per cent over a nine year period, ie close to 5 per cent per year. For the majority of FRSs their weighted rate of fire fell by about 30 per cent to 35 per cent over the nine year period. There were exceptions to this rule however; Isle of Wight’s rate of weighted fires rose over the period. The average overall reduction in weighted rate of fire across the 14 FRSs is −24.8 per cent. However this number is lower when three year rolling average data, −11.3 per cent including London the average is −4.8 per cent, excluding London the percentage reduction increases to −11.9 per cent.
Further analysis of the percentage change of dwelling fire has revealed interesting results for the weighted fire data. The results (presented in Figure 3.9) reveal that it was not until 2003 that there started to be a decrease in the weighted rate of fires. Prior to this date the rate of weighted fires had risen across the majority of FRSs.
3.6.2 Dwelling fire data

The results reveal that the average fall in the rate of dwelling fires from 1997 to 2005 was 4 per cent across FRSs when looking at annual fire data. The range of decline in dwelling fires for annual data varied from –0.5 per cent (Wiltshire) to –6.7 per cent (Nottinghamshire). The range of decline in dwelling fires for the three year rolling average data varied from –0.8 per cent (Wiltshire) to –6.6 per cent (Isle of Wight).
Figure 3.10: Average percentage change of rate of dwelling fires from 1997 to 2005

Figure 3.11: Overall percentage change in the rate of dwelling fires over a nine year period from 1997-2005. The range in the decline of dwelling fires is from –4.4 per cent (Wiltshire) to –60.2 per cent (Nottinghamshire). The overall average percentage change in dwelling fires using annual fire data was –35 per cent and using three year rolling average data was –22 per cent.
Further analysis of the percentage change in the rate of dwelling fires has revealed that there was a greater decline in the rate of dwelling fires from 2003 to 2005 than there was 2000-2002. This is displayed in Figure 3.12.

**Figure 3.12: Percentage change in the rate of dwelling fires within 2000-2002 and within 2003-2005**

3.6.3 Dwelling fire injuries

The average percentage change in dwelling fire injuries was –1.6 per cent for annual fire data and –1.9 per cent for three year rolling average fire data. The range of percentage change in dwelling fire injuries for annual data varied from +7.3 per cent (Isle of Wight) to –5.3 per cent (Merseyside). The range of percentage change in dwelling fire injuries for the three year rolling average data varied from +9 per cent (Isle of Wight) to –6.3 per cent (Merseyside).
The rate of dwelling fire injuries declined in most FRSs between 1997 and 2005. However, the Isle of Wight did not report a lower rate of dwelling fire injuries. However, this may be due to the volatile nature of dwelling fire injury data. The average percentage change (excluding the Isle of Wight) in the rate of dwelling fire injuries is -20.7 per cent using annual fire data and -19.2 per cent when using three year rolling average data. The range of percentage change in dwelling fire injuries is from +65.6 per cent (Isle of Wight) to -42. One per cent (Nottinghamshire) for annual fire data. The range of percentage change in dwelling fire injuries using three year rolling average data is +62.7 per cent (Isle of Wight) to -44.4 per cent (Merseyside).
Percentage change in the rate of dwelling fire injuries within 2000-2002 and within 2003-2005 is presented in Figure 3.15. The results reveal that unlike dwelling fires and dwelling fire weighted there is more variation in the results and it is unclear from the graph if there is a pattern in terms of if there was more reduction in injuries in 2000-2002 or 2003-2005.

**Figure 3.15: Percentage change in the rate of dwelling fire injuries within 2000-2002 and within 2003-2005**

3.6.4 Dwelling fire deaths
The average percentage change over a nine year period in rate of dwelling fire deaths is –3 per cent for annual fire data and three year rolling average data. The range of percentage change is from –1 to –8.5 per cent when looking at annual fire data. The range in percentage change for three year rolling average data is –0.9 to –6.1 per cent.

**Figure 3.16: Average percentage change in dwelling fire deaths from 1997-2005**
From looking at Figure 3.17 it is apparent that some FRSs rate of dwelling fire deaths declined by over 60 per cent including Wiltshire, Manchester and Berkshire. The overall percentage change in rate of dwelling fire deaths for annual fire data is −25.9 per cent and for three year rolling average data −20.7 per cent. The range in percentage change of rate of dwelling fire deaths using annual fire data is 44.6 per cent (Tyne and Wear) to −63.5 per cent (Cleveland). The range in percentage change of rate of dwelling fire deaths using three year rolling average data is from 6.2 to −54.2 per cent.

Further analysis of the percentage change in the rate of dwelling fire deaths looked at the percentage change from 2000 to 2002 and also 2003 to 2005. The results are presented in Figure 3.18 and suggest that the general trend is that there was a greater reduction in rate of dwelling fires from 2003 to 2005 as opposed to 2000 to 2002. This indicates that the majority of reductions in dwelling fire deaths have taken place in the last three to four years rather than from previous years.
3.6.5 Summary

The application of the risk criteria from within FSEC would suggest a range of target measures for reduction in rates of dwelling fire from over 50 per cent (for higher risk areas) to less than 5 per cent (for lower risk areas). From looking at other targets set by government and from looking at actual declines in rate of dwelling fires, injuries and deaths that have taken place over the last nine years setting target measures for FRSs a reduction of up to 50% over a ten year period appears to be a reasonable target.

However, the greatest reductions in dwelling fires occurred from 2003 to 2005 compared with 2000 to 2002. This can clearly be shown in Figure 3.12. This indicates that generally, the majority of dwelling fire decline has taken place from 2003 onwards rather than the years preceding this, ie the rate of decline exceeds 10 per cent per year in recent years in some FRSs. This does suggest that the option of applying a shorter time period of (say) five years to achieve a 50 per cent reduction (for higher risk areas) is credible, ie a 10 per cent per year target measure.
3.7 Measurement Issues

3.7.1 Introduction
There is a series of issues regarding the practical application of dwelling fire risk performance measures, including:

- What measures are used – fire deaths, injuries and/or fires – or a composite of the three?
- Should you use annual fire data or a rolling three year average?

In assessing these, it is necessary to consider:

- Volatility – would the measure be volatile due to low numbers (can they be applied to small areas)?
- Reliability – would the measures be subject to reporting inconsistencies?

Even a cursory examination of dwelling fires indicates that there is a high level of volatility in the number and rate of dwelling fire deaths in FRSs, especially but not exclusively in smaller FRSs. Given that there are approximately 20 times more fire casualties than fatalities and approximately 100 times more dwelling fires than fatalities, this raises the question of which measure(s) can best be used to measure performance and set target metrics.

These options have been explored by using examples of actual dwelling fire data from FRSs, using a large metropolitan, a moderately sized non-metropolitan and a small non-metropolitan FRS. In each case the socio-demographic risk weighted performance measures have been applied retrospectively as a ‘test’ of their practical application.

3.7.2 Approach
There were two types of data used to develop the performance measures for dwelling fires. Firstly, the annual fire data from FRSs was used to calculate the rate of fire per million people. Secondly, a three year rolling average was calculated.

During analysis of the actual fire data the steps in the analysis were as follows:

- The actual data was used to calculate the rate of fire per million people
- The predicted vs. National average as well as the average taken from 1999-2001 was used to calculate the metric based on a function (as shown in Figure 3.6)
- The function $y=25x$ (where $y$ is the % reduction target and $x =$ relative risk) was calculated as derived from Figure 3.6
- Upper and lower confidence Intervals were calculated.

During analysis of the three year rolling average fire data the steps in the analysis were as follows:
The three year rolling average was calculated using the actual rate of fire. The predicted vs. national average as well as the average taken from 1999-2001 was used to calculate the new target based on a function. The same function was used to derive percentage target metric. Upper and Lower Confidence Intervals were calculated.

Analysis was repeated for rate of dwelling fires, rate of dwelling fire injuries, rate of dwelling fire deaths and a weighted combination of the three. The weighted dwelling fire risk measure applied the following weights:

- Fatality = 1
- Injury = 0.1
- Fire = 0.01

Note that the equivalent weightings used as part of the composite cost of fire analysis (Section 4), were based on the ‘costs’ attributed to fatalities/injuries in the Highways Agency paper (Ref. 14) and were as follows:

- Fatality = 1
- Injury (serious) = 0.11

The three FRSs that have been presented in this report as examples are Berkshire, Merseyside and Wiltshire. Merseyside was chosen to represent the large Metropolitans, Berkshire was chosen to represent the medium sized FRSs and Wiltshire was chosen as a representative of the smaller FRSs.

3.7.3 Type of data used
The results revealed that the type of data used in terms of whether it was fire data, injury data or fire death data had an impact on the result. Data taken from the rate of fatalities per million people was highly volatile, data from dwelling fire injuries was relatively volatile; however, this was less volatile than fatalities.

There is an issue concerned with reporting when using injury data; some FRSs report those people who are sent to hospital for a check up as injuries, rather than only people who have been visibly injured during a dwelling fire. Therefore some of the injury data may be inconsistent and may not be an accurate representation of the true rate of injury within that FRS.

Therefore this report looked at all the types of data in order to identify any differences.

The full set of examples is shown in Appendices B – E.
3.8 Retrospective test of alternative measures

The four alternative dwelling risk measures were tested by retrospectively applying target metrics to three FRSs, as outlined below.

3.8.1 Fatal dwelling fire data

As noted above, the fatal fire data was very volatile. Therefore a three year rolling average was developed as well as the annual fatality rate. However, the level of volatility was not reduced by much through use of the three year rolling average. Smaller FRS’s targets tended to be within the 5 per cent confidence intervals (CI). If the rate of fatalities is below the target metric but within the CI, one cannot assume that they have met their targets. Therefore, using fatality data for small FRSs may not be the most practical method of applying a metric. For more medium sized FRSs such as Berkshire, the target still falls within the CI when using annual data, however, the three year rolling average has reduced volatility within the data set and placed the target metric outside the CI.

The examples also revealed that:

- The target metric for smaller FRSs was within the CI when using annual data (see Figure 3.19). However, it falls outside the CI when using the three year rolling average (see Figure 3.20)

- For both sets of data used for medium sized FRSs, the target metric is within the CI, indicating that if the FRS meets their target, one cannot be confident that the result is significant.

Therefore, it may be less practical to apply fatality data for smaller and medium sized FRSs since data volatility often results in target measures within the CI. The results for the larger Metropolitans revealed that the fatality data could be used to set target metrics for the FRSs because the target is below the CI. However, the data is still volatile.
Figure 3.19: Target rate of fatalities for Wiltshire FRS using annual fire data

Figure 3.20: Target rate of fatalities for Wiltshire FRS using three year rolling average
3.8.2 Injury fire data

The results indicate that the injury rate is still fairly volatile for the smaller and medium sized FRSs. The injury data produces smaller confidence intervals than the fatal fire data. As with the fatal fire data the target measure falls within the confidence intervals for the smaller and medium sized FRSs when using the annual fire data (see Figure 3.21).

Figure 3.21 displays the target for Berkshire FRS using annual fire data. The example suggests that in 2005 Berkshire did not meet their (hypothetical) target metric; however, in 2004 it looks as though they met their target comfortably. This indicates that the data is too volatile to use at this level for some FRSs. The target metric moves outside the confidence interval when using three year rolling average (see Figure 3.22), and it looks as though the FRS met their target in 2005. Both Figure 3.21 and Figure 3.22 display how the injury rate is slightly less volatile than the fatality rate and that the CIs are narrower than that of the fatality rate.
3.8.3 Dwelling fire data
The examples indicate that dwelling fire rates are less volatile and the CIs are narrower than either the fatal fire data or the injury fire data. Therefore more confidence can be placed in this data set. For all types of FRS (small, medium and large), the target measures fall outside the CI for annual fire data and the three year rolling average. Therefore the dwelling fire data could be used to set the metrics for all types of FRS. Figure 3.23 and Figure 3.24 present the target dwelling fire rate for Wiltshire. The results reveal that in both graphs (using annual data and three year rolling average) the target measures fall outside of the CI and that in both cases Wiltshire were above their metric.
Figure 3.23: Target rate of fire for Wiltshire FRS using annual fire data

Figure 3.24: Target rate of fire for Wiltshire FRS using three year rolling average
3.8.4 Weighted fire set

The results reveal the data is relatively more volatile when using weighted data composed of all three fire variables (fires/injuries/fatalities). The results also reveal that when using the weighted fire data, the target measure falls inside the CI for annual fire data for the smaller and medium sized FRS. This then falls below the CI when using the three year rolling average. This is displayed in Figure 3.25 and Figure 3.26. Figure 3.25 presents the target rate of fire for Wiltshire FRS; the graph includes the actual weighted rate of fire with the CI. This graph indicates that as with the fatal fire and the injury fire the data is volatile, and the target falls within the CI. This means that if this FRS meets this target metric, then due to the target being within the CI one cannot be confident that the FRS have truly met their target.

Figure 3.26 presents the target rate of fire (weighted) for Wiltshire using the three year rolling average. The results reveal that the data is less volatile using the three year rolling average and the target measure has now fallen outside of the CI. This suggests that the weighted data using three year rolling average could be used to set target measures for smaller FRSs.

Figure 3.25: Target rate of fires (weighted) for Wiltshire FRS using annual fire data

![Graph showing target rate of fires for Wiltshire FRS using annual fire data.](image-url)
3.9 Summary

The results have revealed that dwelling fire rates (as opposed to fire deaths or injuries) provides the least volatile measure for FRSs of all sizes. If there is a requirement for a single measure to be applied to FRSs, such as in support of risk based performance measures the rate of dwelling fire could be the preferred metric.

However, if there is flexibility in performance measurement, such as in the context of IRMPS, guidance could advise on a more flexible use of these measures. For example, larger FRSs may make use of the rate of fatalities and injuries in addition to the rate of fire, where the absolute number of incidents provides a more robust measure of fire deaths. Smaller and medium sized FRSs may opt to place more importance on the rate of fire where the relatively low number of fatalities renders the trends volatile. Smaller FRS may also opt for a weighted composite of the three fire variables and make more use of the three year rolling average data.

In summary, the method of calculating dwelling fire performance metrics for each FRS outlined here (based on socio-demographic make-up of each FRS) produces measurable targets that are linked to inequality in the incidence of fire.
Wiltshire was used in part as a test of the application of targets to areas analogous in size to Local Area Agreements (LAAs). Hence, this indicates that dwelling fire rates are the least volatile measure to apply to smaller LAAs.

The application of FSEC, which models risk at the level of Output Areas, would support the identification of higher risk areas within FRSs and LAA, and hence could support the identification of areas for purposes of setting metrics.

The review of past experience and other government targets indicates that a target measure of 50 per cent reduction in dwelling risk in higher risk areas over a five or ten year period is credible.
4 Composite Cost of Fire Model

4.1 Outline of measure

This metric seeks to provide a measure of the overall impact of fire on communities to allow performance measures to be defined which will contribute to driving further improvements in these areas. This measure is intended to be reflective of the broader fire related activities of the FRS by including the following attributes:

- Dwelling fires
- Non-domestic buildings fires
- Vehicle fires.

The potential for further contributors to this measure, such as from outdoor fires or secondary fires was discussed in the Progress Report (Ref. 2) but was discounted at that stage because of the relatively low individual risk from such events and difficulties in obtaining appropriate data to allow the costs of such fires to be estimated.

In order to ensure that this measure is as broad as possible, this composite model includes:

- Accidental fires
- Deliberate (malicious) fires.

To be reflective of the wider impacts of fire on society, this measure includes consideration of the following within the single metric:

- Fatalities
- Casualties (serious and slight)\(^2\)
- Property damage.

In order to allow these three outcomes to be combined into a single composite measure, a monetary value is ascribed to fatalities and casualties using a standard approach (see Section 4.2.2).

It is considered that this measure is linked most strongly to the Communities and Local Government ‘community cohesion’ theme. This is because this measure takes a holistic view of the impact of fire on a community by considering a range of fire outcomes such as fatalities and injuries as well as domestic and non-domestic property damage. Property damage included in this measure would encompass, for example, damage to public

\(^2\) Using the method used by Ref. 6 to determine serious and minor casualties
buildings such as schools and hospitals as well as individual dwellings. Incorporation of vehicle fires and accidental and deliberate fires generally allows this composite index to be a broad-based measure of the impact of fire on communities.

This index, through inclusion of a range of FRS related risks, is also representative of the philosophy behind Integrated Risk Management whereby FRSs seek to identify and manage risks within their areas through risk-based planning and decision making. This metric therefore allows for a measure of the broader impact of fire on an area to allow strategic planning to concentrate on improving service delivery over a range of outcomes rather than through focussing upon a single incident type.

4.2 Sources of data

4.2.1 Fire incidents
Data relating to fire incidents is collected via FDR1 forms and is available for analysis based on FRS area, incident type, fatalities or casualties and whether the fire was accidental or deliberate. FDR1 data does not include estimates of the property damage costs associated with the fire (although data relating to the area of burn is collected). For the purposes of researching and defining this measure, appropriate data was available on the Office for National Statistics (ONS) website.

4.2.2 Fatalities and casualties
Data for fire related fatalities and casualties are available from FDR1 data. The use of such casualty data may, however, be subject to the following issues:

- Variation in reporting practices (e.g. what constitutes a slight/serious injury and variances in reporting precautionary check-ups)
- Introduction of future measures to record statistics which could skew future data compared to the existing data
- Approaches taken to, for example, record a fire as accidental, deliberate or unknown could skew data.

Monetary values for the cost of fatalities, casualties and minor casualties are published annually by the Department for Transport (DfT) in Highways Economic Note 1 (Ref. 14). These values are revised annually based on the GDP per capita and have therefore shown a year-on-year increase throughout their period of publication.

As is discussed below for the property loss financial model, the impact of this increasing value on life/injury each year would tend to mask improvements in FRS performance in reducing fatalities and casualties through the increasing ‘costs’ assigned to fatalities and injuries each year. It is therefore proposed to utilise a ‘fixed’ cost for fatalities, casualties and minor injuries based on a three year average for the published values for 2002 to 2004.
(Ref. 15). The methodology used in the calculation of the Cost of Fire 2004 report (Ref. 6) is used to distinguish major from minor casualties. This [briefly] assesses serious injuries as burns/scalds, a combination of burns/scalds and asphyxiation, and a discrete fraction (25%) of asphyxiation only. All other injuries are assessed as minor.

The average values used in the calculations are:

- Fatalities: £1,315,390
- Serious injuries: £147,811
- Slight injuries £11,397.

### 4.2.3 Property damage

The Association of British Insurers (ABI) publishes annual data relating to fire damage in Great Britain. As part of the research undertaken for this report, the ABI were contacted regarding these figures and were able to supply data for the period 1995 to 2005. This data was reviewed to determine its suitability as a source of information for the definition of a performance measure.

Figure 4.1 and Figure 4.2 below show the values of ABI claims settled per year for domestic and non-domestic premises respectively together with the total number of fires recorded each year. The following issues are of note:

- The general decline in the number of fires per year recorded in domestic and non domestic premises is not reflected in the ABI data which, in both cases shows an increase in the total cost of claims settled over the period of the data
- The ABI data shows greater volatility in numbers than the total fire incidents each year
- The non domestic ABI data shows particular volatility.
Figure 4.1: ABI domestic claims and total number of domestic fires

Figure 4.2: ABI non-domestic claims and total number of non-domestic fires
There are further issues with the ABI data which is considered to impact its direct use in defining performance measures. These include:

- The ABI does not publish data broken down by local areas; this would not allow for the accurate dissemination of target measures based on ABI data to local areas.
- The ABI data does not provide data which allows for the specific identification of accidental and deliberate fires claims.
- ABI members do not provide full coverage of the insurance market and, hence, if an estimate of the actual cost was required (as would be the case for an ‘actual’ cost of fire metric), assumptions would need to be made regarding the extent of ABI coverage of the insurance market.
- The ABI data does not provide for damage to uninsured properties; hence it would tend not to account fully for deprived areas where it may be expected that the proportion of uninsured properties would be highest.
- Fire insurance claims could be expected to rise in line with inflation, GDP, economic growth, house prices etc and hence would tend to rise year on year with the effect of masking improvements made with regards to FRS performance.
- There is no visibility of how the ABI calculate their values as this is third party data.
- Published ABI figures equate to claims settled within a specific year and not to fires which occurred within that year and hence there can be a ‘lag’ in the data, particularly for non domestic fire claims where the timescales for the settling of claims can be longer than for domestic premises.

**4.3 Approach taken**

In order to allow for a metric which was based on all fires but reflective of the costs of property damage it was decided that the best way to resolve these issues was to use the ABI data combined with the number of recorded fires data for Great Britain (FDR1 data). The data was combined in order to determine an average cost of domestic and non-domestic fires. This yielded the following values, based on an average of data available for 2002 to 2004 to allow for the effects of variations in the data to be minimised:

- Domestic fires £8,201
- Non-domestic fires £20,789.

The benefits of this approach are that it allows for costs to be ‘fixed’ at a particular value which discounts inflationary effects which would tend to show rising property loss costs even where the fire rate is shown to be falling. This is considered to be more beneficial from the perspective of demonstrating continuous performance improvement by the

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3 The ABI have stated that the estimate they provided for the 2004 model is still valid (domestic coverage only)
Fire and Rescue Service. This approach also allows for the dissemination of target measures to a local level; data is available at individual FRS level for the numbers of fires and would be expected to be made available at LAA level in future if required.

The following are noted as potential downsides of such an approach although in these cases data is not available to refine these assumptions further:

- Accidental and deliberate fires are assumed to have the same average cost
- The average cost of a fire is assumed to be the same throughout the country.

Although not considered at this stage due to data not being available, the property loss part of the index has the potential for expansion to include, for example, weighting factors which could be applied to particular property fires in much the same way as the FSEC Toolkit uses values (such as multipliers applied for heritage loss, single suppliers etc). Similarly, particular types of non-domestic premises could have their property loss values weighted based on, for example, stakeholder preference. In this way, the model could be ‘tuned’ to take into account community impact, such as preferentially weighting fires in Hospitals or Schools compared to other fires, although this has not been developed further in this study.

Data is available from the ABI for business disruption costs although this has not been included at present since the model is focused on the direct consequential costs of fire.

Detailed flowcharts showing the approach taken to calculate this measure are presented in Appendix A.

**4.3.1 Composite measure application at a local level**

At national level, the cost of fire can be presented as a single figure (either as a financial value or as an index value). Changes in this measure over time can therefore be taken as an indication of improvements in service delivery at national level. However, when considering dissemination of targets to LAA level, potential risk-based target measures for improvement using this metric can become problematic because larger areas (with higher populations) will tend to have higher composite measure values than areas with smaller populations.

In order to allow for comparison of areas on a relative basis it is proposed to present the results as a value per head of population in an area rather than as a single overall figure. This has the advantage of allowing relative performance to be observed and opens the door to potential risk based target measures whereby the areas with a higher composite level are assigned greater improvement targets than those where the level is already relatively low.

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4 Assumption also made in Ref. 6
The use of area population as part of this measure has been investigated, particularly in terms of application to vehicle fires and non-domestic premises fires. In terms of vehicle fire rates this makes the implicit assumption that the number of people per vehicle is broadly the same throughout all regions of England and that local effects will not make a significant contribution. Similarly, the assumption is made that the number of non-domestic buildings is approximately proportional to the population of an area. This has been investigated using population data for FRS areas and ‘other building’ Valuation Office data counts for England. Figure 4.3 below highlights that this is a reasonable assumption and could therefore form the basis of the composite model, especially where an index is considered rather than an absolute monetary value. Using a single easily obtained metric, such as area population, also has the advantage of ensuring the model does not become too complex or introduce unrepresentative skews into the model.

**Figure 4.3: Number of ‘other buildings’ versus area population (FRS areas)**

4.3.2 Composite cost of fire index

By employing the ‘fixed costs’ approach to developing this composite fire model, the financial costs assigned to the outcomes of fire essentially become weighting factors to allow a selection of various factors to be combined together into a single value.
This ‘fixed costs’ approach moves away from the calculation of an ‘actual’ cost of fire each year and it is considered that the link to monetary values is broken by presenting the output of this model as a ‘cost of fire index’ rather than as a financial value.

For presentational purposes, the results presented in this report have been indexed to be 1,000 per head of population, this being the average value of the index for England between 2002 and 2004. This approach allows a clear comparison to be made between areas; for example those areas with an index of above 1,000 will have a higher composite cost of fire per head of population than those with an index value of below 1,000, with the magnitude of the variance from this value being a measure of how well, or poorly, this area compares to the national average.

4.4 Results

The following sections present a discussion on the results based on the model described above.

4.4.1 Cost of fire index for England

The overall cost of fire index for England, as a sum of contributors based on fire type, is presented in Figure 4.4. It can be seen that there has been a decline in the value of the index between 2000 and 2004 (noting there was a slight rise in 2003), suggesting that the index would be suitable as a basis for a performance measure. Accidental domestic fires are the main contributor, accounting for almost half of the total index and are also the main driver in terms of the trend during the period shown.

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5 Research undertaken for this project indicates that there is sufficient data present for an actual cost of fire per year to be estimated if required
This is further demonstrated in Figure 4.5, in which the overall cost of fire index value is shown to align closely with the number of accidental domestic fires. In terms of a risk based measure, this could conceivably be interpreted in one of two ways:

- The continued application of resource in this area will ensure the overall cost of fire continues to decline
- The scope for further reducing the number of accidental domestic fires is declining and is offset against the need for increased resource to achieve the same reduction; this may be better applied to other areas which are less mature in terms of integrated risk management.
Figure 4.5: Fire index vs. number of accidental dwelling fires

Figure 4.6 illustrates the relationship between the contributors to the index, in terms of the value associated with the type of fire and the number of fires. It can be seen that vehicle fires, particularly deliberate vehicle fires, account for a significantly disproportionate fraction of the index in that they account for almost half the number of fires but contribute approximately 10 per cent of the cost of fire index. This is primarily driven by the relatively low numbers of fatalities and casualties (and hence risk), and property loss resulting from vehicle fires and demonstrates how the weighting approach to defining the index operates in practice.

Reducing the number of vehicle fires would tend to reduce the value of the cost of fire index although the index will not be particularly sensitive to this. Notwithstanding this, the application of resource to tackling deliberate vehicle fires may offer an opportunity to measure the FRS contribution to Home Office crime targets (Section 5) through a proposed
target measure focused specifically on deliberate fires. In addition, the reduction of the number of deliberate vehicle fires may offer secondary, non-measurable, benefits in terms of community cohesion, particularly to deprived areas.

Figure 4.7 presents the cost of fire index by its constituent categories, namely costs attributed to property damage, fatalities and casualties. This demonstrates that property damage accounts for over half of the costs associated with the consequences of fire, with the remainder roughly equally distributed between fatalities and serious injuries. Slight injuries account for approximately 5 per cent of the cost of fire index. It can also be seen that fatalities are the main driver in terms of volatility in the model, with the sharp increase in fatalities in 2003 resulting in an overall increase in the cost of fire for that year. Property damage (and hence number of fires) for the same period showed a gradual decline.

A breakdown of the four contributory categories by fire type is shown in Figure 4.8 a-d. In terms of the cost index due to property (Figure 4.8a), previously shown to account for around half of the total index (Figure 4.7), the main contributors are accidental domestic fires, and both accidental and deliberate non-domestic fires. For domestic fires, the high contribution to the property loss index is attributable to the relatively high number of fires, while for the non-domestic fires, the contribution is dominated by the relatively high consequential property loss indices.
Figure 4.8b presents the fatalities contribution to the cost of fire index broken down by fire type. The volatility in the measure is immediately obvious, noting that the number of fires during the time period shows a year on year decrease (Figure 4.6). The dominant contributor to the fatalities index is accidental domestic fires, which account for around two thirds of the total figure. Other significant contributions are from deliberate domestic fires and accidental vehicle fires, the latter of which it is suggested the FRS have limited influence over. It can be seen that the volatility in the measure is also driven by the accidental domestic contributor, noting that the overall volatility in the fatalities measure has been shown to be the primary source of volatility in the index overall (Figure 4.7). It is noted that a measure based on fatalities alone would therefore tend to be volatile and this would be exacerbated when considering data at LAA level. It is also noted that volatility is reduced when fatalities are considered alongside other outcome measures.

Serious and slight injuries (Figure 4.8 c/d) demonstrate a similar breakdown in terms of fire type. It can be seen that the volatility seen for fatalities is not present, since the sampled data is one to two orders of magnitude greater (Figure 4.9). Hence both measures demonstrate a smooth downward trend during the time period, mirroring the trend seen in the total number of fires.
4.4.2 Cost of fire index at FRS/LAA level

The possibility of disseminating potential performance measures based on the cost of fire index down to LAA level has been investigated. Since fire and other data at LAA level was not available, the study was based on the applicability of the measures at FRS level, with the assumption that target measures identified could be read-across to LAAs.

Figure 4.10 presents the cost of fire index as applied to each FRS, alongside the overall index for England (i.e. the national average). In general, the index shows a downward trend consistent with the national average which suggests that the measure may be suitable at this level. Levels of volatility appear generally tolerable, particularly for those areas with an index above the national average. In addition, it is apparent that the use of a composite measure is advantageous at this level in reducing the impact of individual events such as fatalities, for which an individual target metric would be impractical. Assigning a performance measure based on a three year rolling average, or similar, would also serve to further reduce the impact of individual, unpredictable events. A particular trend to note is the fact that all the metropolitan counties, aside from Greater London, have an index significantly above the national average.
Figure 4.10: Cost of fire index by FRS

FRS Cost of Fire Index (A-E – Non Met)

FRS Cost of Fire Index (G-O – Non Met)
Figure 4.10: Cost of fire index by FRS

FRS Cost of Fire Index (S-W – Non Met)

Index

2000 2001 2002 2003 2004

Shropshire
Somerset
Staffordshire
Suffolk
Surrey
Warwickshire
West Sussex
Wiltshire
ENGLAND

FRS Cost of Fire Index (Met)

Index

2000 2001 2002 2003 2004

Greater Manchester
Merseyside
South Yorkshire
Tyne & Wear
West Midlands
West Yorkshire
Greater London
ENGLAND
It is apparent that the FRSs demonstrating the highest cost of fire index in Figure 4.10 are those associated with similarly high levels of crime/deprivation etc (Figure 4.11). This is shown in Table 4.3, in which FRSs are ranked based on a three-year average of the total cost of fire index.

<table>
<thead>
<tr>
<th>FRS</th>
<th>Cost of Fire Index (England = 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Manchester</td>
<td>1702.5</td>
</tr>
<tr>
<td>Lancashire</td>
<td>1488.1</td>
</tr>
<tr>
<td>Merseyside</td>
<td>1427.3</td>
</tr>
<tr>
<td>Tyne &amp; Wear</td>
<td>1319.5</td>
</tr>
<tr>
<td>Cleveland</td>
<td>1301.2</td>
</tr>
<tr>
<td>West Yorkshire</td>
<td>1234.9</td>
</tr>
<tr>
<td>Humberside</td>
<td>1213.0</td>
</tr>
<tr>
<td>West Midlands</td>
<td>1154.9</td>
</tr>
<tr>
<td>Cumbria</td>
<td>1142.0</td>
</tr>
<tr>
<td>East Sussex</td>
<td>1094.9</td>
</tr>
<tr>
<td>Durham</td>
<td>1094.2</td>
</tr>
<tr>
<td>South Yorkshire</td>
<td>1090.5</td>
</tr>
<tr>
<td>Northumberland</td>
<td>1059.7</td>
</tr>
<tr>
<td>Nottinghamshire</td>
<td>1059.3</td>
</tr>
<tr>
<td>West Sussex</td>
<td>996.0</td>
</tr>
<tr>
<td>Cheshire</td>
<td>986.6</td>
</tr>
<tr>
<td>Greater London</td>
<td>965.0</td>
</tr>
<tr>
<td>Shropshire</td>
<td>960.3</td>
</tr>
<tr>
<td>Northamptonshire</td>
<td>943.0</td>
</tr>
<tr>
<td>Derbyshire</td>
<td>930.2</td>
</tr>
<tr>
<td>Lincolnshire</td>
<td>913.4</td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>912.5</td>
</tr>
<tr>
<td>Somerset</td>
<td>911.0</td>
</tr>
<tr>
<td>Gloucestershire</td>
<td>897.6</td>
</tr>
<tr>
<td>Buckinghamshire</td>
<td>878.5</td>
</tr>
<tr>
<td>Avon</td>
<td>874.1</td>
</tr>
<tr>
<td>Devon</td>
<td>865.0</td>
</tr>
</tbody>
</table>
Table 4.3: FRS ranked by average cost of fire index 2002 – 04 (continued)

<table>
<thead>
<tr>
<th>FRS</th>
<th>Cost of Fire Index (England = 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxfordshire</td>
<td>833.8</td>
</tr>
<tr>
<td>Bedfordshire</td>
<td>821.2</td>
</tr>
<tr>
<td>Dorset</td>
<td>817.9</td>
</tr>
<tr>
<td>Leicestershire</td>
<td>806.4</td>
</tr>
<tr>
<td>Berkshire</td>
<td>800.4</td>
</tr>
<tr>
<td>Surrey</td>
<td>792.1</td>
</tr>
<tr>
<td>Cornwall</td>
<td>791.5</td>
</tr>
<tr>
<td>North Yorkshire</td>
<td>791.3</td>
</tr>
<tr>
<td>Isle of Wight</td>
<td>766.0</td>
</tr>
<tr>
<td>Staffordshire</td>
<td>765.9</td>
</tr>
<tr>
<td>Wiltshire</td>
<td>763.8</td>
</tr>
<tr>
<td>Essex</td>
<td>752.9</td>
</tr>
<tr>
<td>Hampshire</td>
<td>726.3</td>
</tr>
<tr>
<td>Warwickshire</td>
<td>719.8</td>
</tr>
<tr>
<td>Kent</td>
<td>715.4</td>
</tr>
<tr>
<td>Suffolk</td>
<td>711.8</td>
</tr>
<tr>
<td>Hereford &amp; Worcester</td>
<td>700.6</td>
</tr>
<tr>
<td>Norfolk</td>
<td>699.9</td>
</tr>
<tr>
<td>Hertfordshire</td>
<td>680.0</td>
</tr>
</tbody>
</table>

As previously stated, those FRS areas that have a high cost of fire index are closely aligned with those areas associated with high rates of crime and social deprivation (Figure 4.11). Hence a performance measure based on the cost of fire index, proportional to deviation from the national average for example, would provide the basis for a risk based target metric aimed at disadvantaged areas.
Note that the index of deprivation (Figure 4.11) is taken as the mean value of the various indexes of areas in each FRS and is included only to illustrate the correlation.

In addition, in order to correlate the cost of fire index with the measure of deprivation based on the Census Regression Model used during the dwellings fire target analysis (section 3 and Ref. 16), Figure 4.12 presents the relative fire risk measure based on the Census Regression Model against the cost of fire index for each FRS. It can be seen that there exists good correlation between the two metrics.
In order to examine the contributing factors influencing the cost of fire index at FRS level a study of a subset of FRSs was undertaken. Figure 4.13 presents a graphical breakdown of the contributing factors to the cost of fire index for a sample of FRSs.
Figure 4.13: Cost of fire index breakdown by FRS

ENGLAND (Index = 1000)

Greater Manchester (Index = 1702)
Merseyside (Index = 1427)
Cleveland (Index = 1301)

Greater London (Index = 965)
Warwickshire (Index = 720)
Shropshire (Index = 960)
It can be seen that the national average breakdown is reflected broadly throughout the sample, with the domination of accidental domestic fires a consistent theme. However, there are certain deviances from this trend.

The Metropolitan Counties show a broad similarity with the national average breakdown, noting that the costs of fire index values are significantly higher than the national average with the exception of Greater London. Accidental domestic fires are slightly more dominant than the national average, with the deviation increasing for Greater Manchester and Greater London. This suggests that the dominance of accidental domestic fires increases with population or population density.

Cleveland, which along with Lancashire is the highest ranked non-metropolitan FRS, has a cost of fire index on a par with the Metropolitan Counties but that is significantly less dominated by accidental dwelling fires, around 30 per cent lower than Greater London. This difference is directly attributable to deliberate fires, both in buildings and vehicles, and highlights the benefits of a composite cost of fire target in highlighting areas in which resources should be allocated.

Warwickshire and Shropshire are two lower ranked counties for which accidental dwelling fires contribute significantly less than the national average. It can be seen that this is primarily due to a disproportionate cost index attributable to accidental vehicle fires. Further investigation revealed that two fatalities annually in these areas was sufficient to cause this deviation, noting that the fatalities do not significantly affect the overall cost index. It should be noted however, that there exists potential for individual events to influence the breakdown of the index at this level, particularly for smaller FRS areas (or smaller LAAs). This should be borne in mind when interpreting the results of the index with a view to the allocation of resource.

4.4.3 Development of the cost of fire model

The Composite Cost of Fire Model was constructed as detailed at Appendix A. It was considered that, for the purpose of the development of a risk based performance measure, a cost of fire index, based on arbitrary costs and normalised against population and a defined national average would be developed alongside the original model. As the task developed the index was used more prominently and the results presented herein are almost exclusively based on the index.

However, the cost based model has been maintained alongside the index and is available for the formulation of cost based target metrics and/or further development as required. A sample output from the model is shown in Figure 4.14, representing the overall cost of fire for the UK during the period 2000 – 2004. Note that the cost is fixed at 2004 prices (a model based on actual costs is also available) and shows a decline of almost £500m during the period.
During the development of the model further consequential losses have been identified which may be added to the model as required. Two examples are given below:

- Business interruption data has been obtained from the ABI which may be used to predict losses following fires in commercial buildings
- Multipliers may be included for ‘high value’ buildings, e.g. heritage properties or sole suppliers.

### 4.4.4 Summary

It has been demonstrated that a composite cost of fire index is a feasible approach for measuring FRS performance, at both local and national level. This model has the following advantages:

- A composite measure is representative of a range of risks faced by the FRS and is hence reflective of the philosophy of integrated risk management
- The composite nature of the model would ensure that potential target measures would give discretion to FRSs and FRAs regarding how to meet their targets (through, for example, their IRMP process)
- Analysis has shown correlation of the index value with areas of deprivation and high crime rate and hence it can be identified with Communities and Local Government themes
• Inclusion of a range of incident types and outcomes makes the index reflective of the impact of fire on a community rather than solely through individual risk

• Analysis of results at FRS level indicates that the measure would be suitable for application at LAA level

• The composite nature of the model encapsulates a range of high frequency input parameters; as such the model is less susceptible to ‘noise’ from individual events

• The proposed model utilises readily available data which does not require additional data to be measured

• The model could be ‘tuned’ (for example by weighting some property fires higher than others) or through addition of further measures (eg business disruption costs or cost of attending false alarms). Deliberate fires could be excluded to give an accidental fires model only

• By incorporating a metric which is proportional to the number of fires attended (property loss) this measure can give credit to an overall reduction in the incidence of fire (ie prevention activities).

The following are identified as potential disadvantages which should be considered when reviewing this model:

• The composite cost of fire index would be a new measure and would not therefore be immediately understood by stakeholders; this would perhaps render targets set against such a metric as requiring further explanation compared to more familiar measures

• The model necessarily requires assumptions and simplifications to be applied to data although these are not considered to be significant in terms of the output from the model

• By including a range of fire service activities within one measure there may be an impression of not targeting ‘key topics’ such as the number dwelling fatalities; this would be solved by including a (complementary) composite target measure alongside specific key area metrics

• The allocation of resource based on the results of the model requires individual analysis at FRS level; however, it is envisaged that this may be included as part of existing IRMP strategy.

The following sections present a discussion on the development of performance measures based on the index.
4.5 Development of performance measures

4.5.1 National level
The cost of fire index allows for a single national target to be set for improvement using the index for England as a whole. This is similar in style to the current PSA3 targets where an overall improvement target is set to be reached by a certain date. This target metric is measured by the overall performance of the individual FRSs who contribute to this index. The Integrated Risk Management Planning process provides flexibility to individual FRSs in terms of how they wish to tackle the composite index reduction requirements for their area based upon their particular local risks. In terms of determining a suitable level for the measure, a trend analysis was carried out. This is discussed in the following section.

(i) Trend analysis
The magnitude of the performance measures was determined via a study of the trends for each of the constituent components of the Cost of Fire Index at national level. This was not carried out locally since the individual components of the model are volatile at this level and difficult to predict. The trends were extrapolated to 2014 and the cost of fire index model reconstructed year on year to produce an estimate of the index value over the period. An example is given in Figure 4.15; the trends are defined for accidental dwelling serious injuries and accidental non-domestic fires and extrapolated to 2010 (the trends were extrapolated to 2014 for the purposes of the analysis). Note that simple linear trendlines were used where applicable although exponential trends were applied where the linear degradation approached zero during the period.

![Figure 4.15: Trend analysis for England](image)

Based on the analysis discussed above, a projected estimate of the national cost of fire index was constructed for the period 2004 – 2014. This is shown in Figure 4.16 and demonstrates that, based on current performance trends, the cost of fire index for England can be expected to decrease by around 43 per cent to the period ending 2014.
In addition, the possible ‘plateauing’ of performance improvement was considered through the application of performance ‘loss factors’ to the predicted continued improvements at current rates. This was undertaken since it can be reasonably expected that the linear trends assumed during the analysis (Figure 4.15) are a best case scenario and that, realistically, an exponential distribution of performance can be expected (e.g. the linear distribution in Figure 4.15 predicts that serious injuries due to accidental dwelling fires will be zero by around 2020, suggesting that current rates of improvement cannot be sustained). This is based on the fact that the potential for performance improvement reduces as the improvements are realised, and that more work is required to achieve a given increment in performance. An example of this is in the current drive to promote the installation of smoke detectors in the home; as the proportion of homes with detectors increases further preventative work in other areas, possibly with less benefit, is required to continue the reduction in casualties. It should be noted that individual FRSs will be at different stages with regards to the maturity of prevention measures and that FRSs with higher indices can be expected to have more potential for improvement. This is reflected in the more stringent target measures proposed for these areas at local level, Section 4.6.

Note that research was undertaken to locate evidence of plateauing, including a review of current IRMPs, and none was found; this is not thought to be symptomatic of a continued improvement in performance at current rates, rather that the data was not available in the sources used.

The predicted national cost of fire index is shown in Figure 4.17 complete with performance ‘loss factors’ of 5 and 20 per cent (year on year decrease in performance improvement). It can be reasonably assumed that actual performance will lie between the ‘no improvement’ and the best case ‘index’ lines, and that a loss factor of between 5 and 20 per cent can be expected (circled).
(ii) Proposed target measures

It is suggested that any performance measure based on the cost of fire index at national level should lie between the predicted index with a loss factor of 5 and 20 per cent applied, over a ten year period. In addition, the predicted index without a loss factor could be used as the basis for a ‘stretch’ target to measure best case performance. The targets are summarised below:

*It is suggested that a target measure in the range 15 – 35 per cent, based on a percentage reduction in the cost of fire index over a ten year period, would be suitable.*

*If a ‘stretch’ target is required, it is suggested that a level of 45 per cent is suitable, based on a percentage reduction in the cost of fire index over a ten year period.*

4.6 Local level

An alternative (or complementary) approach would be to set more demanding target measures for those areas where the composite index is higher than the national average and smaller measures where the composite measure was already low compared to the national average (i.e., a risk weighted measure). The following presents a summary of the investigation and analysis undertaken towards the development of local risk weighted measures.
For the purposes of developing the composite model, FRS areas have been used as being representative of LAAs in terms of demonstrating the applicability of such measures to small areas. It is noted that a composite index value could be attributed to any area and that the combination of factors together within a single measure would make such an index less volatile at a local area level than, say, measuring dwelling fatalities only. In addition, all analyses presented at local level are based on a three year average measure, since the greater volatility present at this level is offset to a degree by such a method.

*Note that a three year ‘retrospective’ average (i.e. the index for 2002 is based on an average of 2000, 2001 and 2002) has been used throughout these analyses since it is envisaged that the measure will be required in the same year to which it applies. However, were this not the case then a three year ‘rolling’ average may be the preferred measure.*

A total of six ‘metrics’ were investigated, each of which was designed to promote a reduction in the inequality between individual FRSs over a nominal ten year period from 2004 – 2014, as well as a general improvement in the performance of the FRS. Note that this timeframe is arbitrary. It is reasoned that the ten year timescale on the performance measures affords opportunity to align projected targets with IRMPs, from which new initiatives etc. may require a period of ‘bedding in’ before the benefits are realised and can contribute to achieving the target measures.

The investigation involved an assessment of the relative merits of each metric, with a view to identifying which provided the most suitable basis for a target measure. The six metrics are listed below, followed by a discussion on the development and assessment of each metric:

- Metric 1 – Proportional to cost of fire index (1)
- Metric 2 – Quartiles
- Metric 3 – Deviation from moving national index (1)
- Metric 4 – Deviation from moving national index (2)
- Metric 5 – Proportional to cost of fire index (2)
- Metric 6 – Banding.

**4.6.1 Metric 1 – Proportional to cost of fire index (1)**

The first metric involved a percentage reduction in the cost of fire index over a ten year period, determined based on a fixed-proportion of the index at the outset. An example of such a metric is given in Figure 4.18.
A general function for the metric is given in equation 4.01;

\[ y = mx \]  \hspace{1cm} (4.01)

Where \( y \) = Target metric as a percentage reduction over 10 years

\( m \) = General factor depending on magnitude of target metric

\( x \) = 3 year average cost of fire index

It can be seen that the metric is directly proportional to the index and as such is weighted towards those areas with the highest risk in terms of the cost of fire (noting the correlation with areas of social deprivation and high crime rate). This metric offers a relatively simplistic method of determining a risk based measure that is a function of the cost of fire index.

### 4.6.2 Metric 2 – Quartiles

The FRSs were ranked based on the cost index at 2004 and sub-divided into quartiles with each assigned a different target measure. The target itself was again a percentage reduction over a ten year period. An example of such a target is shown in Figure 4.19.
It can be seen that the target metric is highest for those FRSs in the upper quartile (ie those with the highest cost of fire index) and as such addresses inequality in the risk due to cost of fire. The division of the FRSs into quartiles (or quintiles etc) offers the simplest method from which to derive risk-weighted measures.

4.6.3 Metric 3 – Deviation from moving national index (1)

This metric is dynamic in that it is redefined year on year based on the national [three year average] index. As a result, each FRS’s target measure is a function of the performance of all FRSs throughout the target period. In addition, the metric is sympathetic to the influence of external factors at national level. For example, a particularly arid summer may yield higher consequential costs as a result of accidental fires. This would impact on the following year’s measures at local level in that they would be less stringent, noting that the target metrics are based on a three year average and would hence include the previous years indices. An example of the metric is shown in Figure 4.20.
A general function for the metric is given in equation 4.02:

\[ y = m(x + d) \]  

(4.02)

Where \( y \) = Target measure as a percentage reduction year on year

\( m \) = General factor depending on magnitude of metric

\( x \) = Deviation from national three year average cost of fire index

\( d \) = Deviation from National Index that yields a ‘zero’ target metric

Although a relatively complex method of determining a performance measurement, it can be seen that areas with the highest risk in terms of cost of fire index are allotted more stringent target metrics. In addition, the dynamic nature of the measure is such that good performance from the majority of areas will result in an increase in the ‘stretch’ targets for those areas not achieving similar performance, thus ensuring that the target metrics continue to promote a reduction in the inequality.

4.6.4 Metric 4 – Deviation from moving national index (2)

This metric is identical to metric 3 with the exception that the national index is baselined every three years as opposed to annually. As a result the local areas are allocated target measures over a three year period, at the end of which the targets are redefined based on national performance over the period. This measure was introduced in order to combine the benefits of a longer term static metric with the reactive nature of a dynamic measure.
4.6.5 Metric 5 – Proportional to cost of fire index (2)

A second ten year performance measure was derived based on a proportional relationship between the target metric and the cost of fire index. In contrast to metric 1 however, the relationship was exponential rather than directly proportional, allowing for an additional degree of ‘skewing’ of the target metric towards those areas with a higher initial cost of fire index. This measure was derived to allow greater flexibility in terms of the refinement of the relative magnitude of the local target metrics and the degree to which the inequality can be addressed. An example of such a metric is shown in Figure 4.21.

A general function for the metric is given in equation 4.03:

\[ y = me^{\frac{x}{d}} \]  (4.03)

Where \( y \) = Target metric as a percentage reduction over 10 years

\( m \) = General factor depending on magnitude of target

\( x \) = 3 year average cost of fire index

\( d \) = General factor that determines the ‘skew’ of the metric towards areas with higher index

The figure demonstrates that the function allows for a relatively relaxed target measure for those areas with a low index and conversely the metric can be set to rise sharply as the index increases. As such, it is envisaged that such a measure may be useful in aiding decisions regarding, for example, the allocation of resource between local areas, where a directly proportionate distribution may not adequately address inequality.
4.6.6 Metric 6 – Banding
This metric was developed as a more refined version of metric 2, which divided the FRS areas into quartiles. The obvious disadvantage with quartiles is the fact that adjacent areas in terms of ranking may have very similar index values but may fall into different quartiles and hence be allocated different target metrics, which may be construed as imbalanced. This is discussed further later in this section.

Hence, the FRSs were ranked by Cost of Fire Index and then grouped into bands with other areas with a similar index value, based on judgement. This process is illustrated in Figure 4.22, in which the FRSs are grouped into bands A-H depending on their Cost of Fire Index.

Once grouped into bands, each band was assigned a performance metric, again a percentage reduction over a ten year period. This is illustrated in Figure 4.23 and demonstrates how the inequality is addressed through the increase in the target measures for those FRSs in the higher bands. The method of banding the FRSs retains the simplicity of the quartile measure (target 2) while reducing the potential of FRSs with similar index values being assigned different metrics. In addition, the greater resolution in terms of the variance in the targets across FRSs offers potential for improved control over the reduction of inequality.
4.6.7 Trend analysis

The predicted national cost of fire index (Figure 4.16) was used as a basis in deriving reasonable target measures as applicable to individual FRSs. Note that, for metrics at local level, the predicted three year average index was used. In the first instance, the six metrics (discussed above) were defined such as to ensure that the overall national index would reflect the predicted index (Figure 4.16), assuming that the target metrics are met. An assessment was then made of the impact of the metrics as applicable to individual FRSs and whether there was scope, or indeed whether it was necessary, to further ‘stretch’ the target metrics to drive performance improvement over current trends.

In addition, the possible ‘plateauing’ of performance was considered through the application of performance ‘loss factors’ to the predicted continued improvements at current rates. This process is discussed further in section 4.5.1(i).

The predicted national three year average cost of fire index is shown in Figure 4.24 complete with performance ‘loss factors’ of 5 per cent, 10 per cent and 20 per cent (year on year decrease in performance improvement). It can be reasonably assumed that actual performance will lie between the ‘no improvement’ and the best case ‘index’ lines, and that a loss factor of between 5 and 20 per cent can be expected (circled).
An example of the process undertaken to define the magnitude of the target measures is given below.

**Setting the target metrics – example**

*Note that the following is based on metric 1 (section 4.6.1) although a similar process was carried out for each of the six metrics.*

Figure 4.25 shows the effect of having zero target metric, i.e., performance levels are constant throughout the period 2004 – 2014, at both national level and for a range of sample FRSs.

The target metric is of the form $y=mx$ where $m$ is the variable term (section 4.6.1) and is equal to zero in Figure 4.25. The effect of increasing $m$ is indicated by the arrows on the charts.
In defining a reasonable magnitude for the target metrics the variable $m$ was iterated at local level until the effect at national level was such as to match the index predicted during the trend analysis. The end result of this process is shown in Figure 4.26.
Following the iteration of the variable $m$ to match the predicted trends nationally the exercise was repeated to account for the ‘loss factors’ discussed herein. The range of values for $m$ that produced a cost index equivalent to the national trend with loss factors of between 5 and 20 per cent (Figure 4.24) was established; this can be seen in Figure 4.27.

The end result of the application of this method is to generate target metrics at local level that will have the effect of matching the more robust trends seen nationally. It should be reiterated that the analyses are based on the assumption that the targets are met.

In order to further establish the validity of the target metrics at local level a trend analysis, similar to that undertaken at national level, was carried out for a subset of FRSs and the results compared with the defined metrics. An example of this is shown in Figure 4.28, for Buckinghamshire, Cleveland and Nottinghamshire FRS. It can be seem that, based on current performance, Buckinghamshire is on course to exceed its target and Cleveland, despite a trend for strong improvement, is predicted to miss its baseline target though it will meet its target based on the 5 per cent loss factor. Nottinghamshire is showing a trend for diminishing performance and will not meet the 20 per cent loss factor target.
Figure 4.28: Predicted index vs. metric 1

[predicted] 3 Year Average Cost of Fire Index – Buckinghamshire

[predicted] 3 Year Average Cost of Fire Index – Cleveland

[predicted] 3 Year Average Cost of Fire Index – Nottinghamshire
4.6.8 Setting target metrics
The following presents a discussion on the magnitude and applicability of the six metrics at local level, set based on the discussion in section 4.6.7. For each target metric, values are based on the national trend with and without the 5 and 20 per cent loss factors discussed and for clarity, the metrics are applied to a representative subset of FRSs.

As discussed previously, all metrics have been defined based on an analysis of the trends of each component of the cost of fire index at national level, including a 5 and 20 per cent loss factor. Figure 4.29 illustrates the predicted cost of fire index at national level, assuming the target measures are met locally. It can be seen that each metric aligns closely with the national index (blue line) predicted during the trend analysis (section 4.6.7), suggesting that all the metrics are reasonable at this level.

Note that metric 4 is not shown on the figures since, in terms of the predicted outcome, it is essentially the same as metric 3.

Figure 4.29: National cost of fire index assuming each metric is met at local level

(i) Metric comparison
The metrics can be compared in terms of the extent to which they promote a reduction in inequality between FRS areas. This is illustrated in Figure 4.30, which shows the difference between the highest and lowest sample FRS areas in terms of the cost of fire index as a percentage of the national value at the end of the target period (2014), noting that the difference at the start of the period (2004) was 67 per cent.
It can be seen that metric 2 appears to provide the greatest reduction in inequality between FRS areas over the period, followed by metrics 1 and 3. As such, noting that all metrics ultimately achieve the same reduction in the overall national cost of fire index (Figure 4.29), this suggests that metrics 2 is possibly the preferred measure. However, as was noted in the discussion on the development of the metrics (section 4.6.2), the division of local areas into quartiles can result in disproportionate performance measures.

This is illustrated in Figure 4.31, where it is demonstrated that the source of the increase in the reduction in inequality for metric 2 is achieved via a less ambitious target for Wiltshire, noting that the Merseyside target is essentially the same. This occurs due to the fact that, when the FRSs are ranked by index and split into quartiles (target 2), Wiltshire is placed high in the fourth quartile and as such is allocated a less severe target metric than its ranking suggests. Hence the apparent greater reduction in inequality for metric 2 occurs as a result of the particular sampled subset of FRSs and would not be seen when looking at all FRSs. In addition, the disproportionate target levels allocated via the quartiles/banding methods are not seen for other metrics.
The disproportionate target metrics allocated for the quartiles/banding methods may be manifested in terms of targets that can, if achieved, alter the ranking of FRSs. An example of this is given in Figure 4.32, where the predicted index for Wiltshire (high quartile 4) and Somerset (low quartile 2) is seen to alter the ranking during the period, which can be perceived as an unfair metric.
This is further illustrated in Figure 4.33, in which the predicted indices for all FRSs based on achieving metrics 1 and 2 are plotted. It can be seen that, for metric 1, the rankings at the end of the target period are unaffected and therefore FRSs are not required to ‘outperform’ one another. This is not the case for metric 2, where it can be seen that the rankings for all but the highest ranked FRSs are altered during the course of the target period. In addition, Figure 4.33 demonstrates the previous point that overall reduction in inequality is greater for target 1 than target 2.

In terms of the other metrics, metric 6 has the same deficiencies that have been demonstrated for metric 2. In addition, it is reasoned that the outcome from metrics 3 and 5 is sufficiently similar to that of metric 1 such as to not warrant the increased complexity of the target metric, noting that they offer more scope in terms of the potential for refining the distribution of inequality were this required. The shorter term timescales for metrics 3 and 4 may be preferable although it should be noted that the ten year timescale is arbitrary and may be altered as required.

(ii) The effect of loss factor
As discussed in section 4.6.7, the loss factor is applied based on the assumption that current rates of performance improvement predicted by the trend analysis cannot be sustained over the long term. The distinction between actual rates of improvement and that predicted by the trend analysis should be reiterated, given that the analysis was based on limited data and largely assumed a linear distribution. As such, the loss factor aims to better model the actual rate of improvement, and it is suggested in section 4.6.7 that a loss factor of between 5 and 20 per cent applied to the index predicted by the trend analysis will model the likely trend to 2014.

The effect of the loss factor at FRS level for target 1 is shown in Figure 4.34. The cost of fire index trend based on achieving metric 1 is shown for each FRS, for loss factors of 0 per cent, 5 and 20 per cent.
It can be seen that the loss factor has a significant effect on the reduction in inequality achieved. The assumption that the actual projected improvement will fall between loss factors of 5 and 20 per cent seems reasonable given the data in Figure 4.34. The projections with zero loss factor show the highest ranked FRS in terms of cost of fire index (Greater Manchester) having an index value at 2014 which is significantly less that the lowest ranked FRS in 2004 (Hertfordshire). This appears extremely unlikely and supports the use of the loss factor; the 5 per cent loss factor results in Greater Manchester having a 2014 index 30 per cent higher than Hertfordshire in 2004 and the 20 per cent loss factor results in a 90 per cent higher index (the 2004 Greater Manchester index is 250% higher).

### 4.6.9 Proposed target metrics

The investigation into the validity and magnitude of the proposed measures, as detailed in sections 4.6.7 and 4.6.8, concluded that all performance metrics suggested would be suitable in terms of reducing the cost of fire index at national level. It was found that metrics 1 and 3 were preferable in terms of a reduction in inequality at local level, and that the simplicity of metric 1 was advantageous. Further, the trend analysis, at both local and national level, and a qualitative comparison of the predicted indices at local level, led to the conclusion that the metric should be set based on a loss factor of 5 – 20 per cent applied to the index at national level.
Metric 1 is of the form \( y = mx \) (Figure 4.18), where \( y \) is the target metric in terms of a percentage reduction of the cost of fire index over ten years and \( x \) is the value of the index for a given FRS (or local area) at the outset of the target period. Hence, it is proposed that the variable \( m \) is within the range of values such that the combined national index from all local areas based on achieving metric 1 is within the range predicted by the trend analysis with loss factors of 5% and 20%. The result is that the value \( m \) for the proposed metric should lie between 0.014 and 0.03, Figure 4.35.

![Figure 4.35: Proposed cost of fire index target metric range](image)

The corresponding target metric ranges, in terms of a percentage reduction in the cost of fire index over a ten year period are presented in Table 4.4.

<table>
<thead>
<tr>
<th>FRS</th>
<th>Metric (5% LF) (values %)</th>
<th>Metric (20% LF) (values %)</th>
<th>FRS</th>
<th>Metric (5% LF) (values %)</th>
<th>Metric (20% LF) (values %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon</td>
<td>26</td>
<td>12</td>
<td>Leicestershire</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>Bedfordshire</td>
<td>25</td>
<td>12</td>
<td>Lincolnshire</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>Berkshire</td>
<td>24</td>
<td>11</td>
<td>Norfolk</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>Buckinghamshire</td>
<td>26</td>
<td>12</td>
<td>North Yorkshire</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>27</td>
<td>13</td>
<td>Northamptonshire</td>
<td>28</td>
<td>13</td>
</tr>
<tr>
<td>Cheshire</td>
<td>30</td>
<td>14</td>
<td>Northumberland</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>Cleveland</td>
<td>39</td>
<td>18</td>
<td>Nottinghamshire</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>Cornwall</td>
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<td>11</td>
<td>Oxfordshire</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Cumbria</td>
<td>34</td>
<td>16</td>
<td>Shropshire</td>
<td>29</td>
<td>13</td>
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## Table 4.4: Proposed performance measures for individual FRSs (continued)

<table>
<thead>
<tr>
<th>FRS</th>
<th>Metric (5% LF) values %</th>
<th>Metric (20% LF) values %</th>
<th>FRS</th>
<th>Metric (5% LF) values %</th>
<th>Metric (20% LF) values %</th>
</tr>
</thead>
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<td>Warwickshire</td>
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<td>West Sussex</td>
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<td>Wiltshire</td>
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<td>10</td>
<td>Greater Manchester</td>
<td>51</td>
<td>24</td>
</tr>
<tr>
<td>Hereford &amp; Worcester</td>
<td>21</td>
<td>10</td>
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<td>43</td>
<td>20</td>
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<tr>
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<td>10</td>
<td>South Yorkshire</td>
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<td>Humberside</td>
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<td>Greater London</td>
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</table>
5 Deliberate Fires

5.1 Outline of measure

Three potential measures for deliberate fires were considered during the task. These are:

- Total number of deliberate fires
- Numbers of fatalities and injuries in deliberate fires
- Composite measure for deliberate fires.

The first of these measures is similar to an existing PSA3 target which sets a level of reduction in the number of deliberate fires by a particular date. The second measure is proposed to give a more ‘outcome focussed’ measure than numbers of fires attended. The third candidate is essentially a subset of the composite index model proposed in Section 4 which would provide an overall measure of the impact of deliberate fires in a community.

Note that the definition of deliberate fires is based on the statistics published by Communities and Local Government (Ref. 5). In terms of the total number of deliberate fires metric (section 5.2.1), all deliberate primary fires, as defined in Ref. 5 are used. For the fatalities/injuries and the composite measure (sections 5.2.2 & 5.2.3), the metric is limited to deliberate vehicle and building fires (Ref. 13) in order to maintain alignment with the overall cost of fire model.

This candidate metric area can be considered to be related to the following potential Communities and Local Government PSA3 themes:

- Tackling deprivation and disadvantage
- Community cohesion.

In addition, a deliberate fires performance measure is likely to be strongly linked to any Home Office targets relating to a reduction in crime rate.

The deliberate fires measure is linked to deprivation and disadvantage themes because it is well known that the rate of arson is linked to areas of social deprivation. Similarly, an arson measure is linked to community cohesion, particularly where a composite measure is considered as this provides a measure of the overall impact of arson on a community by including a range of fire types and outcome measures.

As highlighted in Figure 5.4, the rate of deliberate fires in an area is correlated to the reported crime rate in an area and therefore a metric to reduce arson would be likely to make a significant impact on the overall crime rate for an area.
5.2 Results

5.2.1 Number of fires metric
A study was undertaken into the number of deliberate fires and specifically the possibility of using this as a measure with a view to a continuing, or ‘stretched’ FRS target. Figure 5.1 shows the number of deliberate fires (dwellings) plotted against FRS area population. It can be seen that, although there is a general proportionate relationship between the two there are a significant number of areas (circled) which have a higher number of deliberate fires per population than average. It is these higher risk areas on which a risk based performance measure could be focused.

Figure 5.1: Deliberate fires variance with population

The overall number of deliberate primary fires in England is shown in Figure 5.2. Following a period of increase prior to 2002, the number of deliberate fires has shown a steady downwards trend. The large number of deliberate fires combined with the lack of volatility in this measure would appear to make a metric based upon the number of deliberate fires a likely candidate for a robust measure; indeed an existing PSA target is based on this metric. The relatively high number of deliberate fires is advantageous in terms of the dissemination of such a measure to FRS and LAA level.
In examining the possibility of a metric aimed at addressing the areas of highest risk, the number of deliberate primary fires per head of population was assessed for each FRS. The FRSs were then ranked based on deviation from the national average. The results of this analysis are presented in Table 5.1.

**Figure 5.2: Deliberate primary fires in England**

![Deliberate Primary Fires in England](image)

<table>
<thead>
<tr>
<th>Rank</th>
<th>FRS</th>
<th>Fire Rate (/m)</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>Mean Dev</th>
</tr>
</thead>
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<td>1</td>
<td>Cleveland</td>
<td></td>
<td>3695</td>
<td>4350</td>
<td>4777</td>
<td>4053</td>
<td>3095</td>
<td>114.2%</td>
</tr>
<tr>
<td>2</td>
<td>Merseyside</td>
<td></td>
<td>3911</td>
<td>4093</td>
<td>4084</td>
<td>4082</td>
<td>3411</td>
<td>111.7%</td>
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<tr>
<td>3</td>
<td>Greater Manchester</td>
<td></td>
<td>3486</td>
<td>4121</td>
<td>3605</td>
<td>3305</td>
<td>2563</td>
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<tr>
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<td></td>
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<td>3831</td>
<td>3980</td>
<td>3493</td>
<td>2439</td>
<td>79.6%</td>
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<td>3473</td>
<td>4167</td>
<td>3646</td>
<td>2761</td>
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</tr>
<tr>
<td>6</td>
<td>Tyne &amp; Wear</td>
<td></td>
<td>3037</td>
<td>3477</td>
<td>3520</td>
<td>3247</td>
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<td></td>
<td>2341</td>
<td>2646</td>
<td>3242</td>
<td>3331</td>
<td>2567</td>
<td>52.8%</td>
</tr>
<tr>
<td>8</td>
<td>Humberside</td>
<td></td>
<td>2116</td>
<td>2518</td>
<td>3030</td>
<td>3431</td>
<td>2771</td>
<td>50.7%</td>
</tr>
<tr>
<td>9</td>
<td>Avon</td>
<td></td>
<td>2638</td>
<td>3210</td>
<td>2856</td>
<td>2609</td>
<td>2134</td>
<td>44.5%</td>
</tr>
<tr>
<td>10</td>
<td>West Midlands</td>
<td></td>
<td>2688</td>
<td>2911</td>
<td>2802</td>
<td>2622</td>
<td>2036</td>
<td>40.4%</td>
</tr>
<tr>
<td>11</td>
<td>Northamptonshire</td>
<td></td>
<td>2094</td>
<td>2206</td>
<td>2439</td>
<td>2415</td>
<td>1896</td>
<td>19.3%</td>
</tr>
<tr>
<td>12</td>
<td>Durham</td>
<td></td>
<td>2181</td>
<td>2334</td>
<td>2314</td>
<td>2214</td>
<td>1725</td>
<td>15.9%</td>
</tr>
<tr>
<td>13</td>
<td>Bedfordshire</td>
<td></td>
<td>2185</td>
<td>1982</td>
<td>2343</td>
<td>1826</td>
<td>1425</td>
<td>4.8%</td>
</tr>
<tr>
<td>14</td>
<td>Northumberland</td>
<td></td>
<td>1831</td>
<td>1991</td>
<td>1975</td>
<td>2085</td>
<td>1503</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Table 5.1: FRS ranked by deliberate fire rate
<table>
<thead>
<tr>
<th>Rank</th>
<th>FRS</th>
<th>Fire Rate (/m)</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>Mean Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Lancashire</td>
<td></td>
<td>1759</td>
<td>1969</td>
<td>1879</td>
<td>1950</td>
<td>1588</td>
<td>-1.2%</td>
</tr>
<tr>
<td>16</td>
<td>Buckinghamshire</td>
<td></td>
<td>1800</td>
<td>2036</td>
<td>1823</td>
<td>1896</td>
<td>1464</td>
<td>-2.9%</td>
</tr>
<tr>
<td>17</td>
<td>Kent</td>
<td></td>
<td>1893</td>
<td>1854</td>
<td>1746</td>
<td>1681</td>
<td>1419</td>
<td>-7.2%</td>
</tr>
<tr>
<td>18</td>
<td>Cambridgeshire</td>
<td></td>
<td>1727</td>
<td>1602</td>
<td>1878</td>
<td>1853</td>
<td>1481</td>
<td>-7.6%</td>
</tr>
<tr>
<td>19</td>
<td>Leicestershire</td>
<td></td>
<td>1744</td>
<td>1969</td>
<td>1944</td>
<td>1627</td>
<td>1237</td>
<td>-8.7%</td>
</tr>
<tr>
<td>20</td>
<td>East Sussex</td>
<td></td>
<td>1786</td>
<td>1898</td>
<td>1737</td>
<td>1659</td>
<td>1369</td>
<td>-8.9%</td>
</tr>
<tr>
<td>21</td>
<td>Cheshire</td>
<td></td>
<td>1341</td>
<td>1636</td>
<td>1746</td>
<td>1657</td>
<td>1621</td>
<td>-13.0%</td>
</tr>
<tr>
<td>22</td>
<td>Staffordshire</td>
<td></td>
<td>1460</td>
<td>1653</td>
<td>1612</td>
<td>1612</td>
<td>1354</td>
<td>-16.9%</td>
</tr>
<tr>
<td>23</td>
<td>Shropshire</td>
<td></td>
<td>1540</td>
<td>1882</td>
<td>1651</td>
<td>1449</td>
<td>1203</td>
<td>-17.1%</td>
</tr>
<tr>
<td>24</td>
<td>Warwickshire</td>
<td></td>
<td>1363</td>
<td>1438</td>
<td>1667</td>
<td>1624</td>
<td>1401</td>
<td>-18.8%</td>
</tr>
<tr>
<td>25</td>
<td>Somerset</td>
<td></td>
<td>1253</td>
<td>1571</td>
<td>1780</td>
<td>1544</td>
<td>1080</td>
<td>-22.6%</td>
</tr>
<tr>
<td>26</td>
<td>Essex</td>
<td></td>
<td>1388</td>
<td>1522</td>
<td>1448</td>
<td>1370</td>
<td>1019</td>
<td>-27.6%</td>
</tr>
<tr>
<td>27</td>
<td>Derbyshire</td>
<td></td>
<td>1248</td>
<td>1396</td>
<td>1585</td>
<td>1476</td>
<td>1010</td>
<td>-28.0%</td>
</tr>
<tr>
<td>28</td>
<td>Gloucestershire</td>
<td></td>
<td>1107</td>
<td>1180</td>
<td>1432</td>
<td>1490</td>
<td>1377</td>
<td>-28.2%</td>
</tr>
<tr>
<td>29</td>
<td>Norfolk</td>
<td></td>
<td>1342</td>
<td>1377</td>
<td>1436</td>
<td>1426</td>
<td>1056</td>
<td>-28.5%</td>
</tr>
<tr>
<td>30</td>
<td>Oxfordshire</td>
<td></td>
<td>1531</td>
<td>1255</td>
<td>1335</td>
<td>1255</td>
<td>1077</td>
<td>-30.1%</td>
</tr>
<tr>
<td>31</td>
<td>Cumbria</td>
<td></td>
<td>1311</td>
<td>1353</td>
<td>1295</td>
<td>1325</td>
<td>1135</td>
<td>-30.5%</td>
</tr>
<tr>
<td>32</td>
<td>Berkshire</td>
<td></td>
<td>1421</td>
<td>1510</td>
<td>1326</td>
<td>1166</td>
<td>1001</td>
<td>-30.9%</td>
</tr>
<tr>
<td>33</td>
<td>Lincolnshire</td>
<td></td>
<td>1090</td>
<td>1260</td>
<td>1360</td>
<td>1345</td>
<td>1168</td>
<td>-32.6%</td>
</tr>
<tr>
<td>34</td>
<td>Hertfordshire</td>
<td></td>
<td>1217</td>
<td>1243</td>
<td>1235</td>
<td>1207</td>
<td>958</td>
<td>-36.8%</td>
</tr>
<tr>
<td>35</td>
<td>Dorset</td>
<td></td>
<td>1176</td>
<td>1398</td>
<td>1194</td>
<td>1188</td>
<td>902</td>
<td>-37.1%</td>
</tr>
<tr>
<td>36</td>
<td>Greater London</td>
<td></td>
<td>1254</td>
<td>1366</td>
<td>1192</td>
<td>1124</td>
<td>900</td>
<td>-37.3%</td>
</tr>
<tr>
<td>37</td>
<td>West Sussex</td>
<td></td>
<td>1039</td>
<td>1289</td>
<td>1141</td>
<td>1190</td>
<td>999</td>
<td>-38.9%</td>
</tr>
<tr>
<td>38</td>
<td>North Yorkshire</td>
<td></td>
<td>964</td>
<td>1162</td>
<td>1257</td>
<td>1090</td>
<td>844</td>
<td>-42.9%</td>
</tr>
<tr>
<td>39</td>
<td>Hereford &amp; Worcester</td>
<td></td>
<td>977</td>
<td>1131</td>
<td>1086</td>
<td>903</td>
<td>871</td>
<td>-46.4%</td>
</tr>
<tr>
<td>40</td>
<td>Devon</td>
<td></td>
<td>853</td>
<td>997</td>
<td>1076</td>
<td>1019</td>
<td>926</td>
<td>-47.2%</td>
</tr>
<tr>
<td>41</td>
<td>Cornwall</td>
<td></td>
<td>821</td>
<td>1028</td>
<td>1022</td>
<td>1009</td>
<td>908</td>
<td>-48.1%</td>
</tr>
<tr>
<td>42</td>
<td>Suffolk</td>
<td></td>
<td>867</td>
<td>1014</td>
<td>941</td>
<td>985</td>
<td>873</td>
<td>-49.3%</td>
</tr>
<tr>
<td>43</td>
<td>Surrey</td>
<td></td>
<td>827</td>
<td>855</td>
<td>937</td>
<td>992</td>
<td>806</td>
<td>-52.1%</td>
</tr>
<tr>
<td>44</td>
<td>Hampshire</td>
<td></td>
<td>818</td>
<td>874</td>
<td>828</td>
<td>820</td>
<td>667</td>
<td>-56.8%</td>
</tr>
</tbody>
</table>
Table 5.1: FRS ranked by deliberate fire rate (continued)

<table>
<thead>
<tr>
<th>Rank</th>
<th>FRS</th>
<th>Fire Rate (/m)</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>Mean Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>Wiltshire</td>
<td></td>
<td>817</td>
<td>845</td>
<td>796</td>
<td>774</td>
<td>666</td>
<td>-57.9%</td>
</tr>
<tr>
<td>46</td>
<td>Isle of Wight</td>
<td></td>
<td>600</td>
<td>893</td>
<td>650</td>
<td>686</td>
<td>507</td>
<td>-64.3%</td>
</tr>
<tr>
<td>47</td>
<td>Isles of Scilly</td>
<td></td>
<td>0</td>
<td>479</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-95.3%</td>
</tr>
</tbody>
</table>

The FRSs in Table 5.1 have been grouped into quartiles and it can be seen that those in the first quartile are dominant in terms of positive deviation from the national average. Indeed, it is shown in Figure 5.3 that the first quartile is the only one with a mean fire rate above the national average and that this is a factor of four greater than the fire rate for the fourth quartile. As such, it can be seen that the national fire rate for deliberate fires is being driven by a small number of high risk areas and that a risk targeted measure would enable these areas to be addressed.

Figure 5.3: Deliberate fire rate by FRS

In addition it is noted that the risk of deliberate fires demonstrates close correlation with crime rate and social deprivation (Figure 5.4). Consequently a risk based performance measure proportional to the deliberate fire rate could have repercussions in terms of both crime and deprivation issues.
Note that the index of deprivation (Figure 5.4) is taken as the mean value of the various indexes of areas in each FRS and is included only to illustrate the correlation.

In essence a risk based target measure can be formulated that is less stringent for less deprived/disadvantaged areas. This could be based on a number of metrics:

1. Deliberate Fire rate for each FRS.
2. Ranked FRSs spilt into quartiles/quintiles, each with a different target measure.
3. Reducing the number of FRSs that have a fire rate x% above the national average.

5.2.2 Fatalities and casualties
The second potential metric investigated concerns the numbers of fatalities, serious injuries and slight injuries incurred as a result of deliberate fires. Fatalities and injuries are combined together to allow for increased robustness in the measure, particularly when considering decomposition of target metrics to LAA sized areas. In order to combine the results, costs of fatalities and injuries are used which have been obtained from Ref. 13, averaged for the years 2002 to 2004.

This cost index is presented in Figure 5.5, based on a normalised index of 1,000 being the national average for the period 2002-04. This has been combined into a single measure since the individual contributors, notably fatalities, are seen to be volatile and it was reasoned that the combination of the three metrics would serve to increase the frequency and hence reduce the volatility of the sampled data. In addition, the fatalities and injuries data is available at local level and hence relative risk target metrics may be viable.
Figure 5.5 infers that there may be excess volatility in the metric, even at national level. It can be seen that the fatalities contribution is erratic when compared to the number of deliberate fires (Figure 5.2), particularly during the period 2000-02. This is exacerbated by the low frequency of the fatalities contribution (79 in the Year 2000) and the fact that the contribution from fatalities ‘costs’ accounts for approximately half of the total index.

The inherent volatility in the model is amplified when assessing the metric at FRS level. Ranking the FRSs based on the index value produces the five highest ranked FRSs as shown in Table 5.2. Both Cambridgeshire and Derbyshire are disproportionately high when compared with the equivalent rankings by Composite Cost of Fire (Table 4.3 – Cambridgeshire 22nd, Derbyshire 20th) and deliberate fire rate (Table 5.1 – Cambridgeshire 17th, Derbyshire 29th), indicating that the metric shows little potential for correlation with risk categories and could be unduly influenced by single events.
Table 5.2: Top 5 FRSs by deliberate fires fatality/casualty index

<table>
<thead>
<tr>
<th>FRS</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridgeshire</td>
<td>2136.0</td>
</tr>
<tr>
<td>West Yorkshire</td>
<td>1911.9</td>
</tr>
<tr>
<td>Cleveland</td>
<td>1879.7</td>
</tr>
<tr>
<td>Derbyshire</td>
<td>1692.0</td>
</tr>
<tr>
<td>Greater Manchester</td>
<td>1547.0</td>
</tr>
</tbody>
</table>

In terms of examining the source of the volatility, particularly at FRS level, a subset of sample FRSs was analysed. The cost index for the subset is shown in Figure 5.6.

The erratic nature of the index is driven primarily by the occurrence of isolated fatalities, which have a large impact on the magnitude of the measure, particularly for non-Metropolitan Counties for which a fatality is an exceptional event. An extreme example is the case of Cleveland; during 2003 three fatalities occurred as a result of a single deliberate dwelling fire and three as a result of deliberate vehicle fires, causing the index to increase by an order of magnitude on the previous year (Figure 5.6). Hence, it is apparent that the metric is highly volatile and is probably unsuitable as the basis for a performance measure.
5.2.3 Fatalities/casualties and property damage

The final option in terms of potential metrics for a deliberate fires target measure was an arson-specific version of the Composite Cost of Fire metric, section 4. Essentially this involved the addition of property damage to the fatalities/casualties index described in section 5.2.2 which was concluded to be impractical as a discrete measure due to its volatility.

As for previous indices, the baseline is normalised based on a value of 1,000 for the three year average for England for the period 2002-04. Figure 5.7 shows a breakdown of the index by category. It can be seen that, compared to the combined index for accidental and deliberate fires (Figure 4.4), the property damage component dominates the index to a greater extent (around 15 per cent more than the composite cost of fire model).

Further investigation was carried out into the suitability of the composite metric at LAA, and specifically FRS level. The index is plotted for a subset of sample FRSs in Figure 5.8. The corresponding values for the fatalities/casualties index are shown in Figure 5.6.
The figure demonstrates that the volatility present due to the sporadic nature of fatalities is present in the revised index, which is particularly apparent for Cleveland and Somerset. For this reason, in combination with the fact that fatalities and casualties have a diminished role compared with the overall composite cost of fire index, it is concluded that the property contribution of this index would be the most practical measure upon which to base a risk based target measure.

However, since the property damage contribution to the index is directly proportional to the number of deliberate fires (since the cost of property damage is calculated using the numbers of fires and a representative cost) and hence the fire rate, the fire rate target as discussed in section 5.2.1 is considered the most appropriate measure for any deliberate fires target measure. This also has the advantage of being consistent with an existing PSA3 target metric.

5.2.4 Summary
The analysis presented in this section has concluded that a performance measure based on the total number of deliberate fires would be the most suitable metric in this area, at both local and national level. This metric is considered to have the following advantages:

- The number of deliberate fires is an easily understood and communicated measure
- Requires no additional data collection
• Links to other potential targets for crime reduction, disadvantage/deprivation and community safety
• Robustness of numbers makes dissemination of targets to LAA/FRS areas feasible
• Risk focussed target measures are possible
• Consistency with an existing PSA3 target area.

The following is highlighted as a possible disadvantage of this approach:

• Using a metric based on the total number of deliberate fires ‘weights’ all such fires the same; in other words there is no bias towards different outcomes whereby targets could be focussed on those deliberate fires with more significant outcomes for individuals or society.

The following sections present a discussion on the development and definition of performance measures based on the number of deliberate fires.

5.3 Development of performance measures

The interim report (Ref. 3) concluded that a performance measure based on the overall number of deliberate fires is the most appropriate measure, and that target metrics set could involve:

• A reduction in the number of deliberate fires nationally over a period of time (this would be complementary to an existing PSA3 target and could be in the form of a stretch target to highlight continued improvement)
• A risk targeted measure; those areas with the highest deliberate fire rates could receive more stringent target metrics than other areas.

5.3.1 National level

A national metric based on reducing the number of deliberate fires within a defined period would reflect the existing PSA3 sub-target 3 to achieve a 10 per cent reduction in the number of deliberate fires by 2010 from the 2001/02 baseline. The Integrated Risk Management Planning process would give flexibility to individual FRSs in terms of how they wish to tackle the reduction requirements for their area based upon their particular local risks. In terms of defining a suitable level for the measure, a trend analysis was carried out, discussed in the following section.

(i) Trend analysis

In determining the magnitude of the metric, a study of the trend for the number of deliberate fires at national level was undertaken. The trend was extrapolated to 2014 and the three year average number of fires model constructed for the period. The model is
shown in Figure 5.9, demonstrating that, based on current performance, the national three year average number of deliberate fires can be expected to decrease by around 40 per cent to the period ending 2014.

**Figure 5.9: Three Year average predicted number of deliberate fires**

In addition to the trend analysis at national level the exercise was repeated for a number of individual FRSs, to ascertain further whether the trend at national level was reasonable. Two typical examples are given in Figure 5.10, and it can be seen that the national trend is broadly representative of those at local level. It is also apparent that current trends appear more sustainable in the near future than those observed in a similar study for the cost of fire index, reported in section 4.6.7, for which the linear trend for a number of the contributing factors reached or approached zero during the target period.

**Figure 5.10: Deliberate fire trends for Merseyside and Buckinghamshire**

The trend analysis undertaken for the cost of fire index suggested that a ‘loss factor’, ie a year on year reduction in performance improvement, of between 5 and 20 per cent should be applied to the predicted trend to account for the assumptions made. The equivalent loss factor for the number of deliberate fires measure is shown in Figure 5.11.
It is suggested that the loss factor applied to the number of deliberate fires measure should be at the lower end of the band (ie 5%) as it is reasoned that the current trends are largely sustainable over the target period. This is due to the fact that, as stated, the linear trends can be extrapolated to 2014 and do not approach zero during the period. In addition, the variation in \textit{deliberate fire rate} is large across FRSSs (eg Merseyside is over five times greater than Wiltshire) suggesting that there is large scope for continued improvement.

(ii) Proposed target measures

It is suggested that a metric based on the number of deliberate fires at national level should lie between the predicted number of fires with a loss factor of 5 and 20 per cent applied, over a ten year period. In addition, the predicted number of deliberate fires without a loss factor could be used as the basis for a ‘stretch’ target metric to measure best case performance. The targets are summarised below:

\textit{It is suggested that a target measure in the range 15 – 30 per cent, based on a percentage reduction in the [three year average] number of deliberate fires over a ten year period, would be suitable.}

\textit{If a ‘stretch’ target is required, it is suggested that a level of 40 per cent is suitable, based on a percentage reduction in the [three year average] number of deliberate fires over a ten year period.}

It is suggested that the current trend in terms of a reducing number of deliberate fires is sustainable over the period and that the metric may be reasonably positioned at the more severe end of the range.
5.3.2 Local level
For the purposes of developing a realistic target measure at local level, FRS areas have been used as being representative of LAAs in terms of demonstrating the applicability of such measures to small areas. It is noted that a deliberate fire rate could be attributed to any area. In addition, all analyses presented at local level are based on a three year average measure, since the greater volatility present at this level is offset to a degree by such a method.

In order to align with the Cost of Fire Index metrics (section 4.6), the same six models were investigated concurrently, each of which was designed to promote a reduction in the inequality (noting the alignment with crime and deprivation, Figure 5.4) between individual FRSs over a nominal ten year period from 2004 – 2014, as well as a general improvement in the performance of the FRS. Note that the timeframe is arbitrary and was chosen based on the fact that data was available up until 2004 and consideration of the current PSA3 targets. It is reasoned that the ten year timescale on the targets affords opportunity to align projected targets with IRMPs, from which new initiatives etc may require a period of ‘bedding in’ before the benefits are realised and can contribute to achieving the measures.

The six models assessed as part of the investigation are listed below and are discussed in detail as part of the Cost of fire Index target development, section 4.6.

- Metric 1 – Proportional to Deliberate Fire Rate (1)
- Metric 2 – Quartiles
- Metric 3 – Deviation from Moving National Deliberate Fire Rate (1)
- Metric 4 – Deviation from Moving National Deliberate Fire Rate (2)
- Metric 5 – Proportional to Deliberate Fire Rate (2)
- Metric 6 – Banding.

All metrics were based on a measure of deliberate fire rate (per 1,000,000 population). Metric 1 was identified as being the most suitable for the same reasons as discussed during the review of the cost of fire index metrics, section 4.6, and the following analysis is presented for metric 1 only.

(i) Trend analysis
In determining the magnitude of the metrics at local level the study of the trend for the number of deliberate fires at national level (section 5.3.1(i)) was expanded to include the fire rate. The trend was extrapolated to 2014 and the three year average fire rate model constructed for the period. Both the trend and the model are shown in Figure 5.12, demonstrating that, based on current performance, the national three year average deliberate fire rate can be expected to decrease by around 40% to the period ending 2014.
The trend analysis undertaken for the cost of fire index suggested that a ‘loss factor’, ie a year on year reduction in performance improvement, of between 5 and 20 per cent should be applied to the predicted trend to account for the assumptions made. The equivalent loss factor for the deliberate fire rate measure is shown in Figure 5.13.

Similarly to the loss factor as applied to the number of deliberate fires measure (section 5.3.1(i)), it is suggested that the loss factor applied to the deliberate fire rate measure should be at the lower end of the band (ie 5%) as it is reasoned that the current trends are largely sustainable over the target period. This is discussed further in section 5.3.1(i).
Hence, the local metrics were derived based on the more robust trend predicted at national level, including the addition of loss factors of 5 and 20 per cent. A similar process was carried out for the cost of fire index metric and is discussed in detail in section 4.6.7. The target metric was iterated to predict the trends seen nationally and can be seen in Figure 5.14. It should be reiterated that the analyses are based on the assumption that the metrics are met.

**Figure 5.14: Metric 1 matched to national fire rate including loss factor**

![Graph showing the relationship between 3 Year Average Fire Rate and Target metric (% reduction) for Metric 1, 5% LF, and 20% LF.]

In order to further establish the validity of the measures at local level a trend analysis, similar to that undertaken at national level, was carried out for a subset of FRSs and the results compared with the defined targets. An example of this is shown in Figure 5.15, for Buckinghamshire, Cleveland and Nottinghamshire FRS. It can be seen that, based on current performance, Buckinghamshire is on course to exceed its target. Cleveland and Nottinghamshire, despite trends for strong improvement are predicted to miss both the baseline target and the 5 per cent loss factor target though they are predicted to achieve the 20 per cent loss factor target. Nonetheless, the magnitude of the targets appears reasonable and, in the case of Cleveland and Nottinghamshire, the 5 per cent loss factor targets form ‘stretch’ targets that require an increase in current rates of performance improvement in order to further reduce inequality.
Figure 5.15: Predicted deliberate fire rate vs. metric 1

[predicted] 3 Year Average Deliberate Fire Rate – Buckinghamshire

[predicted] 3 Year Average Deliberate Fire Rate – Cleveland

[predicted] 3 Year Average Deliberate Fire Rate – Nottinghamshire
(ii) **The effect of loss factor**

As discussed in section 5.3.2(i), the loss factor is applied based on the assumption that current rates of performance improvement *predicted by the trend analysis* cannot be sustained. The distinction between actual rates of improvement and that predicted by the trend analysis should be reiterated, given that the analysis was based on limited data and largely assumed a linear distribution. As such, the loss factor aims to better model the actual rate of improvement, and it is suggested in section 5.3.2(i) that a loss factor of around 5 – 20 per cent applied to the fire rate predicted by the trend analysis will model the likely trend to 2014.

The effect of the loss factor at FRS level for target 1 is shown in Figure 5.16. The deliberate fire rate based on achieving metric 1 is shown for each FRS, for loss factors of 0 and 5 per cent.

![Figure 5.16: FRS fire rate based on metric 1 including 5 per cent loss factor](image_url)

The loss factor is shown to have a significant effect on the reduction in inequality achieved assuming that the metrics are met. The assumption that the actual projected improvement will occur at a loss factor of around 5 – 20 per cent seems reasonable given that, for a 0 per cent loss factor, the highest ranked FRSs (Merseyside, Cleveland) are predicted to have a fire rate in 2014 comparable to Dorset and Devon in 2004. This would seem to be an unrealistic target. The 5 per cent loss factor results in the highest ranked FRSs having a fire rate of around 1900 in 2014, equivalent to Lancashire and Northumberland in 2004. This would seem to be a more practical target. There is also an additional beneficial property of the loss factor, in that at a level of 0 per cent disproportionate targets require FRSs to outperform one another (circled in Figure 5.16). This would require a ‘tweaking’ of the metrics for higher ranked FRSs and it can be seen that this effect is eliminated when the metric is set based on the 5 per cent loss factor.
5.4 Proposed target metrics

The investigation into the validity and magnitude of the proposed metrics was carried out in conjunction with the cost of fire index target and similar conclusions were drawn in terms of the suitability of the six metrics (section 4.6). It was found that metric 1 was the most suitable in terms of reducing the rate of deliberate fires, as well as a reduction in the inequality at local level. In addition, the simplicity of metric 1 was an advantage over other metrics. Further, the trend analysis, at both local and national level, and a qualitative comparison of the predicted fire rates at local level, led to the conclusion that the metric should be set based on a loss factor of around 5 – 20 per cent applied to the fire rate at national level. In addition, the sustainability of the current trends led to the recommendation that the more severe end of the target range (i.e. the 5 per cent loss factor target) be applied.

Metric 1 is of the form $y=mx$, where $y$ is the target measure in terms of a percentage reduction in the [three year average] deliberate fire rate (per 1,000,000 population) over ten years and $x$ is the value of the [three year average] deliberate fire rate for a given FRS (or local area) at the outset of the target period. Hence, it is proposed that the variable $m$ is set such that the combined national deliberate fire rate from all local areas based on achieving metric 1 is within the range predicted by the trend analysis with a loss factor between 5 and 20 per cent. The result is that the value $m$ for the proposed metric should be between 0.007 and 0.013 (Figure 5.17).

![Figure 5.17: Proposed deliberate fire rate metric](image)

The corresponding target metrics, in terms of a percentage reduction in the [three year average] deliberate fire rate over a ten year period are presented in Table 5.3. It should be reiterated that, based on the sustainability of the current trends, it is proposed that the more severe end of the target range (i.e. the 5 per cent loss factor target) be applied.
Table 5.3: Proposed target measures for individual FRSs

<table>
<thead>
<tr>
<th>FRS</th>
<th>Metric (5% LF) (values %)</th>
<th>Metric (20% LF) (values %)</th>
<th>FRS</th>
<th>Metric (5% LF) (values %)</th>
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</table>
6 Contribution to Other Measures

6.1 Road traffic collisions

6.1.1 Introduction

The Fire Services Act 2004 (Ref. 4) defines an FRS statutory duty to prepare for rescuing people from Road Traffic Collisions (RTCs). In 2005 there were 3,201 road deaths and 271,000 casualties in 199,000 accidents overall in Great Britain (Ref. 12).

Attendance at RTC incidents overlaps with an existing PSA target<sup>6</sup> defined by the Department for Transport to reduce the number of people killed or seriously injured in Great Britain in road accidents by 40 per cent and the number of children killed or seriously injured by 50 per cent. In addition, FRS participation at the scene of a RTC can be a factor in reducing traffic delays by allowing the road to be reopened sooner than would otherwise have been the case. This may link in with DfT targets to reduce congestion on the roads and also carries benefits in terms of business/social disruption and consequential cost. Attendance at other special services incidents (eg extrications) may form part of achieving Community safety targets.

Communities and Local Government data suggests that the FRS attends over 35,000 RTCs each year, in which there are around 18,000 casualties, and assist with the extrication of over 4,000 persons each year. In terms of life risk, the rescue of casualties from RTCs dominates FRS ‘Special Services’ activities with over 700 fatalities per year at such incidents attended by the FRS.

Through attendance at RTCs the FRS:

- Contribute to improvements in outcomes for persons involved in RTCs through:
  - achieving access to casualties (enabling on-scene care by other attendees)
  - assisting with extraction of casualties (using back boards etc to prevent additional injury)
  - enable timely despatch to hospital for emergency care.
- Contribute to reducing road congestion by assisting with operations to allow the road to be re-opened where necessary
- Contribute to the reduction of the consequences of any ‘secondary’ impacts of RTCs such as:
  - vehicle fires as the result of the RTC
  - clearance of dangerous accident debris
  - prevention or reduction of environmental impacts such as fuel spillages.

<sup>6</sup> Details of revised PSA targets for DfT not available at time of writing
The above suggests that the role played by the FRS in such incidents should be considered for possible inclusion as a PSA3 target in its own right or, more likely, as a contributor to a road safety target(s) in other areas. This is because:

- The FRS is not the lead organisation in terms of road safety or accident prevention so has less influence over incident rates than for, say, dwellings fire rates.
- Rescue and treatment of casualties in RTCs is a multi-agency issue of which the FRS is just one part.
- The FRS attend a minority of RTC incidents.

The following sections discuss the possible approaches which could be considered in measuring this contribution.

### 6.1.2 Reduction in fatalities

Application of the response time-fatality rates developed by Communities and Local Government as part of the FSEC Toolkit RTA module would suggest that a ten minute delay in FRS response times to RTCs would lead to an increase in RTC fatalities of approximately 1,250 per year. This demonstrates that the FRS plays a major role in reducing the number of deaths in road accidents each year.

The fatality rate from RTCs is a multi-agency issue which would be expected to include contributions from:

- Police (attendance at incidents and prevention work)
- Ambulance Service (response time, treatment protocols etc)
- Hospital Accident and Emergency Departments (initial treatment, co-ordination with Ambulance Service)
- Hospital care (treatment, surgical intervention)
- Highways Agency
- Department for Transport (vehicle safety standards, legislation [eg compulsory seatbelt wearing])
- Local Councils (eg road design, maintenance, lighting, gritting etc).

Since the FRS do not attend all RTCs this, combined with the above multi-agency issues, could make the measurement of the contribution made by the FRS to the survival of persons trapped following RTCs difficult.

---

7 Research indicated that some FRSs are starting to take an active interest in road safety and accident prevention strategies within their areas.
Research has been undertaken for this project which has sought to identify potential data sources to allow for measurement of this contribution. At present there appears to be little in the way of measurable data for use, although information on data known to be available and other issues has been obtained from stakeholders such as the DfT, Police and Health Services.

Information obtained suggests that the FRS is often not on the ‘critical path’ in terms of survivability (this is linked to Ambulance service treatment protocols whereby the casualty may be required to be extricated rapidly [eg in the case of severe bleeding] or may be stabilised at the scene by attending paramedics before extrication is attempted [eg spinal injuries]). In addition, the FRS may not be called immediately to an incident. This would make an FRS RTC attendance time metric unsuitable to measure this contribution\(^8\). Additionally, using a metric to measure for example, the period of time taken for the FRS to extricate a trapped casualty from a crashed vehicle would be unsuitable as this is not an effective outcome measure; indeed, rapid inappropriate extrication could make the extent of a casualty’s injuries worse, particularly in the case of neck or spinal injuries. It is also unlikely that this data would be collectable at the scene of an accident.

There is potential, however, to measure the impact of action of the FRS through analysis of the survival rate of casualties extricated by the FRS at RTCs. This could perhaps look at the ratio of fatalities to casualties in RTCs and use this as a metric for performance measurement. The FRS measures such data as part of their special services incident recording system.

There are known to be variations in the quality of data and recording practices for such data across the country for Special Services data, which may make it unsuitable for use at this time but maintains the possibility of such data being the basis of a contributory target in future.

A more refined target could be based in future on the survival rate (or other metric) for casualties with particular levels of injury. This could be based upon the Injury Severity Score (ISS), or other injury severity scale, estimated for the casualty at the scene of the accident. The ISS can be correlated with the risk of mortality for different age ranges and considers:

- Injuries are assigned to five body regions:
  - General
  - Head & neck
  - Chest
  - Abdominal
  - Extremities and pelvis.

\(^8\) There is a known relationship, however, between FRS attendance time and survival rates at RTCs and this form the basis of response time data used in the FSEC Toolkit.
Each type of injury encountered is assigned a value from 1 to 5, in accordance with the Abbreviated Injury Scale (AIS) with:

- Minor injury
- Moderate injury
- Severe but not life-threatening injury
- Life-threatening but survival likely
- Critical with uncertain survival.

The ISS for a casualty is calculated as the sum of the squares of the three highest area scores. This system could be used to calculate survival rates for injury severities (using bands of ISS scores) where the FRS is in active attendance. Research undertaken for this study was unable to locate a source of information which linked FRS action to ISS scores and survival rates. It is suggested that should such data be available in future that this should be investigated as a potential means for measuring FRS performance at RTC attendance.

6.1.3 Reduction in road congestion

Action taken by the FRS, at the scene of an RTC which has caused a road to be closed or traffic flow severely restricted, can ensure that the road can be re-opened more rapidly than would otherwise have been the case. Where the affected road is a motorway or major A-road the costs to the economy at large of traffic delays resulting from an RTC could be significant. Research has been undertaken into whether the actions of the FRS in re-opening roads could be used as a performance metric for the FRS attendance at RTC incidents. This has links to an existing DfT PSA target to make journeys more reliable on the strategic road network.

This research has made initial contact with the Highways Agency's Safety Standards and Research (SSR) directorate who develop policy through research for the Agency's Traffic Incident Management (TIM) programme. A number of research projects in TIM are understood to interface with FRS involvement in their specific roles and their contribution to the recovery process. Although not reviewed at the time of writing it is understood that the Highways Agency are able to provide details for the costs to the economy of road delays, particularly for major incidents. Research is ongoing at the Highways Agency although the role of the FRS in reducing congestion has not yet been quantified. There exists potential for collaborative research between the Highways Agency and the FRS in this area.

It is noted that, should data relating FRS involvement to cost of traffic delays be available that it may not be a suitable metric because:

- The FRS may not be on the critical path in terms of reopening the road (for example road clearance may be by other agencies such as recovery organisations or the road may remain closed for accident investigation purposes)
- Data may not be available in terms of time taken for closed roads to be reopened.
6.2 Environmental impact

As part of the research undertaken for this project, initial discussions were held with the Environment Agency about the feasibility of measuring the FRS contribution towards environmental protection. Ways in which the FRS may assist with environmental protection include:

- Extinguishing fires emitting toxic or highly polluting chemicals
- Clearing or containing chemical spills
- Controlling contaminated water from fire fighting.

The EA contact was enthusiastic about the fire service contribution to the prevention of environmental damage through their work. As an example it was indicated that the number of calls the EA are required to attend reduces by 39 per cent when the FRS are in attendance. The EA also have a cost model which may be of use in determining such costs and it is proposed that this could be investigated further as a part of a future performance metric.

The following example was presented by the EA to highlight the value of the work undertaken by the FRS.

- Incident on the M62 where 20,000 litres of oil was contained by the attending FRS using £50 worth of Environment Agency equipment. This action:
  - prevented a major pollution incident
  - protected public safety
  - ensured significant cost savings in environmental remediation costs.

6.3 Ethnicity

The discussion in Section 2 regarding the applicability of the Communities and Local Government proposed PSA themes to Fire Service activities identified the possibility of addressing equality and community cohesion aspects through increasing the representation of minority groups and women in the Fire Service.

It is suggested that any future targets in this area should be part of a broad range of measures to ensure that public services are representative of the communities which they serve and that such targets should be set in regard to staff turnover.
7 Conclusions

A detailed study into the scope for the formulation of future performance measures for the Fire and Rescue Services has been undertaken, with the emphasis on the adoption of risk based and outcome focused measures. Following the identification of a number of areas in which performance measures could be adopted, detailed analyses in terms of assessing the viability and effectiveness of potential measures were undertaken. In particular, the potential for the target metrics to promote a reduction in inequality between FRSs was considered, alongside the headline objective to measure FRS performance. Once suitable measures had been proposed, specific target levels were defined based on analysis of current trends at both local and national level.

Specifically, metrics were defined for the following areas:

- Dwellings fires
- A composite measure of the economic and social cost of fire
- Deliberate fires.

In addition, specific areas in which the FRS may contribute to other [non FRS] targets have been investigated with a view to identifying where the FRS contribution towards meeting the targets can be highlighted and measured.

The following presents a review of the conclusions drawn during the task, including, where applicable, a summary of the proposed metrics as defined in the relevant sections.

7.1 Dwellings fire measure

The conclusions regarding dwelling fire risk measures include:

- There is a strong association between deprivation and other social factors with the incidence of fire
- There is a four fold variation in the rate of dwelling fire, associated with deprivation and other social factors
- Dwelling risk measures can be related to relative levels of deprivation/socio-demographic risk, with more stringent target metrics for higher risk areas
- Dwelling risk targets can be aligned with FSEC risk categories – thereby providing linkage to a tool that enables assessment at smaller areas and possibly Local Areas Agreements.
The results have revealed that dwelling fire rates (as opposed to fire deaths or injuries) provides the least volatile measure for FRSs (small, medium and large). If there is a requirement for a single measure to be applied to FRSs, the rate of dwelling fire could be the preferred measure. If there is flexibility in performance measurement (such as in the context of IRMPs), a more flexible use of these measures, e.g. larger FRSs to use rate of fatalities/injuries as well as rate of fire, could be proposed.

The method of calculating dwelling fire metrics for each FRS (based on socio-demographic make-up of each FRS) produces measurable target metrics that are linked to inequality in the incidence of fire.

Wiltshire was used in part as a test of the application of the metrics to areas analogous in size to Local Area Agreements (LAAs). This indicates that dwelling fire rates are the least volatile measure to apply to smaller LAAs.

The application of FSEC, which models risk at the level of Output Areas, would support the identification of higher risk areas within FRSs and LAA, and hence could support the identification of areas for purposes of assigning measures.

The review of past experience and other government targets indicates that a measure of 50% reduction in dwelling risk in higher risk areas over a five or ten year period is a credible target.

7.2 Composite cost of fire measure

It is proposed that the composite cost of fire measure is best presented as a value per head of population. This is primarily to aid in the dissemination of the metric to LAA level in allowing relative performance to be gauged with a view to risk targeted measures that are proportional to existing FRS performance.

In addition, it is proposed that the cost of fire be applied as an index rather than a cost, since the inherent assumptions necessary in constructing the model weaken the link between the model and the true monetary cost of fire. Note that the method used to normalise the index is arbitrary at this stage and will be discussed with stakeholders if the metric is selected for further development.

Hence, based on investigation and analyses contained within this report, it is concluded that a composite index based upon fatalities, injuries and property damage incurred as a result of deliberate and accidental fires for dwellings, non-domestic premises and vehicles is a feasible performance measure which is robust at LAA level. This measure would be reflective of the broader role of the Fire and Rescue Service in protecting the community from fire and aligns well with developments in integrated risk management planning. The metric also demonstrates good correlation with the risk of social deprivation and crime.
At national level, it is proposed that a target metric based on a percentage reduction in the overall cost of fire index over a ten year period be applied. At local level, a variable measure is proposed for each FRS/LAA, with the aim of promoting a reduction in inequality between local areas. It is proposed that the local metric, in the form of a percentage reduction in the three year average cost of fire index, is directly proportional to the value of the index for the particular area at the outset of the target period, with those areas with a higher index being assigned more stringent target metrics.

The level of the proposed target measures, at both local and national level, was set based on analysis of current performance trends at national level. The trend for the cost of fire index was predicted and extrapolated over the duration of the target period, with performance ‘loss factors’ applied to account for the limitations of the trend analysis and the plateauing of performance. The target metrics were then set based on these performance predictions. A summary of the proposed target metrics is given below:

**National level**

It is suggested that a target measure in the range **15 – 35 per cent**, based on a percentage reduction in the cost of fire index over a ten year period, would be suitable.

If a ‘stretch’ target is required, it is suggested that a level of **45 per cent** is suitable, based on a percentage reduction in the cost of fire index over a ten year period.

**Local level**

The suggested form of the target measure for each FRS/LAA is given below:

\[
\text{target percentage reduction in three year average cost of fire index over a ten year period} = m \times \text{three year average cost of fire index at outset of target period}
\]

It is suggested that ‘m’ should be in the range 0.013 – 0.03.

### 7.3 Deliberate fires target

It is concluded that the analysis undertaken has demonstrated that a performance metric based on the overall number of deliberate fires is the most appropriate measure. This is due to the fact that fatalities, and to a lesser extent serious injuries, are infrequent events at LAA level and susceptible to volatility. The number of fires, and the fire rate, constitutes a robust measure at LAA level. In addition, the deliberate fire rate demonstrates close alignment with deprivation and crime rates and could potentially link in with other targets in such areas.

At national level, it is proposed that a target measure based on a percentage reduction in the three year average number of deliberate fires over a ten year period be applied. At local level, a variable measure based on the deliberate fire rate (per population) is proposed
for each FRS/LAA, with the aim of promoting a reduction in inequality (and crime rate/deprivation) between local areas. It is proposed that the local metric, in the form of a percentage reduction in the three year average deliberate fire rate, is directly proportional to the deliberate fire rate for the particular area at the outset of the target period, with those areas with a higher rate being assigned more stringent target metrics.

Similarly to the cost of fire index measure, the level of the proposed target metrics, at both local and national level, was set based on analysis of current performance trends at national level. The trend for the number of deliberate fires was predicted and extrapolated over the duration of the target period, with performance ‘loss factors’ applied to account for the limitations of the trend analysis and the plateauing of performance. The metrics were then set based on these performance predictions. A summary of the proposed target metrics is given below:

**National level**

*It is suggested that a target measure in the range **15 – 30 per cent**, based on a percentage reduction in the [three year average] number of deliberate fires over a ten year period, would be suitable.*

*If a 'stretch' target is required, it is suggested that a level of **40 per cent** is suitable, based on a percentage reduction in the [three year average] number of deliberate fires over a ten year period.*

*It is suggested that the current trend in terms of a reducing number of deliberate fires is sustainable over the period and that the metric may be reasonably positioned at the more severe end of the range.*

**Local level**

The suggested form of the target measure for each FRS/LAA is given below:

\[
[\text{target percentage reduction in three year average deliberate fire rate (per million population) over a ten year period}] = m \times [\text{three year average deliberate fire rate (per million population) at outset of target period}].
\]

*It is suggested that ‘m’ should be in the range **0.007 – 0.013**.*

*It is suggested that the current trend in terms of a reducing number of deliberate fires is sustainable over the period and that the metric may be reasonably positioned at the more severe end of the range.*
7.4 Contribution to other measures

A review of the FRS contribution to other measures, specifically in the areas of Road Traffic Collisions, Environmental Impact and Ethnicity was undertaken. The following conclusions were drawn:

There is potential to measure the impact of the FRS at RTCs through analysis of the survival rate of casualties extricated by the FRS. This could possibly examine the ratio of fatalities to casualties in RTCs and use this as a metric for performance measurement. It is noted that the quality of data available at this time may make such a measure impractical though it is suggested that should such data become available in future, this should be investigated as a potential means for measuring FRS performance at RTCs.

It is understood that the Highways Agency are able to provide details of the costs to the economy of road delays, particularly for major incidents. However, it is noted that, should data relating to FRS involvement in RTCs be available it may not be a suitable metric since:

- The FRS may not be on the critical path in terms of reopening the road (for example road clearance may be by other agencies such as recovery organisations or the road may remain closed for accident investigation purposes)
- Data may not be available in terms of time taken for closed roads to be reopened.

In terms of environmental impact, the EA have a cost model which may aid in identifying and measuring FRS contribution towards the prevention of environmental damage. This could be investigated as part of a future performance metric.

It is suggested that any future targets regarding ethnicity should be part of a broad range of measures to ensure that public services are representative of the communities that they serve. Such targets should be set in regard to staff turnover.
8 References

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11. Road Casualties Great Britain 2005, Department for Transport


15. Communities and Local Government Revision of PSA3 Progress Meeting Minutes, 231490/03/A, 23rd November 2006

17. Wright, M Antonelli A and Marsden S. *Development of the Fire Service Emergency Cover Planning Methodology*, 2003, report to ODPM

Appendix A

Composite cost of fire index flow charts

The following flowcharts illustrate the method used in constructing the composite cost of fire model. Note that the values represent actual costs based on prices for the given year.
A.1 Domestic Property Damage

Data regarding the percentage of domestic insurance services provided by the ABI, and the estimated fraction of insured households was provided by the ABI.

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<th>Claim (£m)</th>
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<td>2004</td>
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<tr>
<td>2005</td>
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Calculate total cost of insured market (ABI Claim/0.94)

Add value of uninsured loss (Total/0.7)

Divide by no. of domestic fires to get property loss

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<tr>
<td>2002</td>
<td>£7,395</td>
</tr>
<tr>
<td>2003</td>
<td>£8,214</td>
</tr>
<tr>
<td>2004</td>
<td>£8,294</td>
</tr>
<tr>
<td>2005</td>
<td>-</td>
</tr>
</tbody>
</table>
A.2 Commercial Property Damage

Data regarding the percentage of uninsured commercial properties was not available from the ABI and was read-across from the Economic Cost of Fire 2004 model (Ref. 6). The estimate for the percentage of commercial insurance services provided by the ABI was obtained from the ABI.


<table>
<thead>
<tr>
<th>Year</th>
<th>Personal</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>77.5</td>
<td>886.6</td>
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<tr>
<td>2001</td>
<td>82.4</td>
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</tr>
<tr>
<td>2002</td>
<td>86.3</td>
<td>926.7</td>
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<tr>
<td>2003</td>
<td>90.7</td>
<td>976.6</td>
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<tr>
<td>2004</td>
<td>96.2</td>
<td>1009.1</td>
</tr>
<tr>
<td>2005</td>
<td>100</td>
<td>1035.7</td>
</tr>
</tbody>
</table>

Calculate total value of property stock:

$\text{Personal (ex. Dwellings)} = \text{CIWG} - \text{CIWV}$

$\text{Capital: Commercial} = \text{CIXH} + \text{CIXI}$

Calculate total cost of insured market:

$\text{Claim} \times 0.80$

Divide by no. of commercial fires to get property loss

<table>
<thead>
<tr>
<th>Year</th>
<th>Prop Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>£15,925</td>
</tr>
<tr>
<td>2001</td>
<td>£19,893</td>
</tr>
<tr>
<td>2002</td>
<td>£23,454</td>
</tr>
<tr>
<td>2003</td>
<td>£20,858</td>
</tr>
<tr>
<td>2004</td>
<td>£16,538</td>
</tr>
<tr>
<td>2005</td>
<td>-</td>
</tr>
</tbody>
</table>

Percentage of commercial insurance services in UK provided by ABI 80
A.3 Vehicle Property Damage

Note that the value of £77m for the cost of claims due to deliberate car fires was based on 1997 figures. Since deliberate fire data was not available for this period the average ratio of deliberate/total vehicle fires for the period 2000 – 05 (77%) was applied to the total number of vehicle fires in 1997 (69,508) giving an estimated total of 53,500 deliberate vehicle fires in 1997.


<table>
<thead>
<tr>
<th>Year</th>
<th>DoCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>105</td>
</tr>
<tr>
<td>1988</td>
<td>111.1</td>
</tr>
<tr>
<td>1989</td>
<td>115.1</td>
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<td>1990</td>
<td>117.4</td>
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<tr>
<td>1991</td>
<td>123.1</td>
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<tr>
<td>1992</td>
<td>129.4</td>
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<td>2004</td>
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<td>2005</td>
<td>109.2</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Relative Price</th>
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</thead>
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<td>0.743</td>
</tr>
<tr>
<td>1988</td>
<td>0.786</td>
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<td>1989</td>
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<td>1990</td>
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<td>1991</td>
<td>0.871</td>
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<td>1993</td>
<td>0.907</td>
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<tr>
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<td>1995</td>
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<td>1996</td>
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<td>1997</td>
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<td>2001</td>
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<td>2002</td>
<td>0.866</td>
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<tr>
<td>2003</td>
<td>0.841</td>
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<tr>
<td>2004</td>
<td>0.815</td>
</tr>
<tr>
<td>2005</td>
<td>0.773</td>
</tr>
</tbody>
</table>

DOCS - RPI: Motoring Expenditure: Purchase of Motor Vehicles (Jan 1987 = 100)
Not Seasonally Adjusted
Appendix B

Fatalities

B.1 Annual Data
B.2 Three Year Rolling Average

Target rate of fatalities for Wiltshire FRS (3 year rolling average)

Target rate of fatalities for Berkshire (3 year average)
Fatalities

Target rate of fatalities for Merseyside FRS (3 year average)

- Rate of fatalities
- Target based on function
- Upper CI
- Lower CI
- England rate for 2000

Year | Rate of fatalities | Target based on function | Rate of fatalities | Upper CI | Lower CI | England rate for 2000
---|-------------------|--------------------------|-------------------|---------|---------|---------------------
1997 |                  |                          |                   |         |         |                     
1998 |                  |                          |                   |         |         |                     
1999 |                  |                          |                   |         |         |                     
2000 |                  |                          |                   |         |         |                     
2001 |                  |                          |                   |         |         |                     
2002 |                  |                          |                   |         |         |                     
2003 |                  |                          |                   |         |         |                     
2004 |                  |                          |                   |         |         |                     
2005 |                  |                          |                   |         |         |                     

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0

- Rate of fatalities
- Target based on function
- Upper CI
- Lower CI
- England rate for 2000
Appendix C

Injuries

C.1 Annual Data

![Graph showing target rate of injuries for Wiltshire FRS compared to actual rate of injuries with confidence intervals and comparison to England. The graph includes data from 1997 to 2005.](image-url)
C.2 Three Year Rolling Average

Target rate of fire for Wiltshire FRS (3 year average)

Target rate of injury for Berkshire (3 year Average)
Target rate of fire for Merseyside FRS (3 year average)

Year

Rate of fire
Upper CI Lower CI England

Target based on function Rate of fire
Appendix D

Fire Data

D.1 Annual Data
D.2 Three Year Rolling Average

**Target rate of fire for Wiltshire FRS (3 yr average)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate of fire</th>
<th>Target based on function</th>
<th>Rate of fires</th>
<th>Upper CI</th>
<th>Lower CI</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
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</table>

**Target rate of fires for Berkshire FRS (3 yr average)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate of fire</th>
<th>Target based on function</th>
<th>Rate of fires</th>
<th>Upper CI</th>
<th>Lower CI</th>
<th>England</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>
Target rate of fire for Merseyside FRS

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate of fire</th>
<th>Upper CI</th>
<th>Lower CI</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
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<td>2005</td>
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</tr>
</tbody>
</table>
Appendix E

Weighted Data

E.1 Annual Data
### E.2 Three Year Rolling Average

#### Target rate of fires for Wiltshire FRS (weighted)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate of Fire</th>
<th>Target based on function</th>
<th>Upper CI</th>
<th>Lower CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>20</td>
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<td>1998</td>
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<tr>
<td>2005</td>
<td>20</td>
<td>20</td>
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<td></td>
</tr>
</tbody>
</table>

#### Target rate of fire for Berkshire FRS (weighted)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate of Fire</th>
<th>Target based on function</th>
<th>Upper CI</th>
<th>Lower CI</th>
</tr>
</thead>
<tbody>
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<td>1997</td>
<td>25</td>
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<td>2005</td>
<td>25</td>
<td>25</td>
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</tr>
</tbody>
</table>
Target rate of fire for Merseyside FRS (weighted)

Rate of fire vs Year

- Target based on function
- Rate of fire
- Upper CI
- Lower CI
Appendix F

Review of ‘non-FRS’ PSA Targets
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
</table>
| Home Office   | • Reduce crime by 15%, and further in high crime areas, by 2007-08.  
• Reassure the public, reducing the fear of crime and anti-social behaviour, and building confidence in the Criminal Justice System without compromising fairness.  
• Improve the delivery of justice by increasing the number of crimes for which an offender is brought to justice to 1.25 million by 2007-08.  
• Increase voluntary and community engagement, especially amongst those at risk of social exclusion.  
• Reduce race inequalities and build community cohesion.                                                                                                                                                                                                                   | Reduce Crime  
Reassure the public, reduce fear of crime and anti-social behaviour  
Increase voluntary and community engagement  
Reduce race inequalities & build community cohesion                                                                                                                                                                                                                     | FRS can help reduce crime through:  
1. Arson prevention and investigation.  
2. Working closer with local communities, promotions and educational activities.  
3. Through increasing their voluntary arm in the community and through incorporating a greater racial diversity they can affect community spirit and cohesion.                                                                                                                                                      |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
</table>
| Department for Transport/Highways Agency | - By 2007-08, make journeys more reliable on the strategic road network.  
- Improve punctuality and reliability of rail services to at least 85% by 2006, with further improvements by 2008.  
- By 2010, increase the use of public transport (bus and light rail) by more than 12% in England compared with 2000 levels, with growth in every region.  
- By 2010-11, the ten largest urban areas will meet the congestion targets set in their Local Transport Plan relating to movement on main roads into city centres.  
- Reduce the number of people killed or seriously injured in Great Britain in road accidents by 40% and the number of children killed or seriously injured by 50%, by 2010 compared with the average for 1994-98, tackling the significantly higher incidence in disadvantaged communities.  
- Improve air quality by meeting the Air Quality Strategy targets for carbon monoxide, lead, nitrogen dioxide, particles, sulphur dioxide, benzene and 1,3 butadiene.  
- To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including energy efficiency and renewables. | Reduce the number of people/children killed or seriously injured in traffic accidents | FRS can aid in reducing the fatality rate of traffic incidents through timely arrival at incidents to safely extricate casualties, enable at scene pre-hospital care and enable swift despatch to hospital, and hence improving survival rates. |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
</table>
| Environment Agency      | • Enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands – there is a requirement for nearly all inland and coastal waters to achieve ‘good status’ by 2015;  
• Promote the sustainable use of water;  
• Reduce pollution of water, especially by ‘priority’ and ‘priority hazardous’ substances; lessen the effects of floods and droughts;  
• Rationalise and update existing water legislation and introduce a co-ordinated approach to water management based on the concept of river basin planning.  
• Provide relevant information held by the Agency to local authorities  
• Provide advice to local authorities on identifying and dealing with pollution of controlled waters  
• Provide advice to local authorities on the remediation of contaminated land  
• Ensure remediation of ‘Special’ Sites  
• Prepare a national report on the state of contaminated land  
• Maintain a public register of regulatory action for Special Sites | Reduction in impact of chemical spills.  
Reduction in contaminated fire water run off | Minimisation of contaminated fire water runoff, esp from chemical fires.  
Rapid clean up of chemical spills. |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
</table>
| Department for Environment, Food and Rural Affairs | Sustainable development, which means a better quality life for everyone, now and for generations to come, including:  
  - a better environment at home and internationally, and sustainable use of natural resources;  
  - thriving economies and communities in rural areas and a countryside for all to enjoy.  
  To promote sustainable development across government and in the UK and internationally, as measured by:  
  - the achievement of positive trends in the Government’s headline indicators of sustainable development;  
  - To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including energy efficiency and renewables.  
  Care for our natural heritage, make the countryside attractive and enjoyable for all and preserve biological diversity by:  
  - reversing the long-term decline in the number of farmland birds by 2020, as measured annually against underlying trends; and  
  - bringing into favourable condition, by 2010, 95% of all nationally important wildlife sites. | Reducing greenhouse gas emissions.  
Caring for natural heritage and biodiversity. | FRS can aid in reducing greenhouse gas emissions through measuring and comparing times for extinguishing fires in:  
  - extinguish wildfires (forest moorland etc)s  
  - control of major petrochemical plant fires.  
FRS can help maintain heritage through fire prevention and response to heritages sites, response to chemical spills that threaten the environment and control of contaminated fire water run off. |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
</table>
| **Department for Environment, Food and Rural Affairs (continued)** | Reduce the gap in productivity between the least well performing quartile of rural areas and the English median by 2008, demonstrating progress by 2006, and improve the accessibility of services for people in rural areas. Enable at least 25% of household waste to be recycled or composted by 2005-06, with further improvements by 2008. Eliminate fuel poverty in vulnerable households in England by 2010 in line with the Government’s Fuel Poverty Strategy objective. Improve air quality by meeting the Air Quality Strategy targets for carbon monoxide, lead, nitrogen dioxide, particles, sulphur dioxide, benzene and 1,3 butadiene. To improve the health and welfare of kept animals, and protect society from the impact of animal diseases, through sharing the management of risk with industry, including:  
  - a reduction of 40% in the prevalence of scrapie infection (from 0.33% to 0.20%) by 2010;  
  - a reduction in the number of cases of BSE detected by both passive and active surveillance to less than 60 in 2006, with the disease being eradicated by 2010; and  
  - a reduction in the spread of Bovine TB to new parishes to below the incremental trend of 17.5 confirmed new incidents per annum by the end of 2008. | | |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Summary of their targets</th>
<th>Target FRS may impact</th>
<th>How FRS may impact target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department for Communities and Local Government</td>
<td>Tackling disadvantage by reviving the most deprived neighbourhoods, reducing social exclusion and supporting society’s most vulnerable groups. Tackle social exclusion and deliver neighbourhood renewal, working with departments to help them meet their PSA floor targets, in particular narrowing the gap in health, education, crime, worklessness, housing and liveability outcomes between the most deprived areas and the rest of England, with measurable improvement by 2010. Promoting the development of the English regions by improving their economic performance so that all are able to reach their full potential, and developing an effective framework for regional governance taking account of the public’s view of what’s best for their area. Make sustainable improvements in the economic performance of all English regions by 2008, and over the long term reduce the persistent gap in growth rates between the regions, demonstrating progress by 2006. Promoting high quality, customer-focused local services and ensuring that adequate, stable resources are available to local government; and By 2010, reduce the number of accidental fire-related deaths in the home by 20% and the number of deliberate fires by 10%. By 2008, improve the effectiveness and efficiency of local government in leading and delivering services to all communities.</td>
<td>Tackling disadvantage by reviving the most deprived neighbourhoods, reducing social exclusion and supporting society’s most vulnerable groups. Promoting the development of English regions Promote high quality customer-focused local services Reduce number of accidental fire related deaths Improve effectiveness of delivering local services to communities Lead the delivery of cleaner, safer and greener public spaces</td>
<td>FRS can help improve community cohesion and interaction by reducing social inequality in fire, promoting safer communities and social inclusion (e.g. enabling vulnerable people to remain in their homes safely). Helping to support, offer guidance and advice to vulnerable groups, offering free preventative measures, such as fire alarms, smoke detectors, fire extinguishers, educational and promotional materials Offering a community facing service, interacting and building social and communal cohesion. Raising awareness of FRS in the community and increasing activities.</td>
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<td>Department for Communities and Local Government (continued)</td>
<td>Delivering a better balance between housing supply and demand by supporting sustainable growth, reviving markets and tackling abandonment. Achieve a better balance between housing availability and the demand for housing, including improving affordability, in all English regions while protecting valuable countryside around our towns, cities and in the green belt and the sustainability of towns and cities. Lead the delivery of cleaner, safer and greener public spaces and improvement of the quality of the built environment in deprived areas and across the country, with measurable improvement by 2008.</td>
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<td>Offering training and education on fires, fire prevention and extermination can help reduce the number of accidental fires and therefore accidental deaths, improve the effectiveness of the FRS and subsequently lead to a cleaner and safer community.</td>
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| Medical Certification and Advice            | **Delivery Targets:**  
In at least 96% of incidents, decide on the Search and Rescue response within 5 minutes of being alerted.  
Deliver our programme of planned ship inspections.  
Carry out 95% of mandatory expanded inspections.  
Work with UK ship-owners so that no more than 3% of UK ships inspected under global Port State Control arrangements are detained, and the UK Shipping Register maintains a position on the Paris MOU White List which is comparable to registers of a similar size and reputation.  
Reduce the proportion of vessels suffering machinery failures (commercial ships and leisure craft) in the UK, by increasing prevention activities, working with other relevant organisations.  
Strengthen our evidence base by analysing all fatal incidents and serious maritime accidents, to inform our assessment of maritime safety risks and prioritise these to assist with future regulatory policy and planning, including the allocation of costs and resources to activities.  
As a Category 1 Responder, meet the provisions of the Civil Contingencies Act 2004 on behalf of the Secretary of State, in so far as his functions include responsibilities to maritime and coastal emergencies (excluding the investigation of accidents). |
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| Medical Certification and Advice (continued) | **Development Targets**  
Prepare for a review in 2007-08 of the implementation, effectiveness and impact of the comprehensive prevention strategy, using evidence based information to check the Agency’s direction in this area.  
Work with other responders and providers to contribute to improvement of joined up approaches to civil resilience matters, and specifically develop with the Ministry of Defence a harmonised provision for search and rescue helicopters from 2012. | | |
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| Department of Health   | The Department’s overall aim is to improve the health and well-being of the people of England. The distinctive roles of the Department include:  
  - developing strategy and direction for the health and social care system – including not for profit and private providers – while maintaining the integrity of the system and its values;  
  - providing the legislative framework;  
  - building capability and capacity;  
  - setting some standards and ensuring others are set;  
  - securing and allocating resources and ensuring that their usage provides value for money; and,  
  - ensuring accountability to the public and Parliament.  
Reduction in the death rate from accidents by at least 20 per cent by 2010, from a baseline of 15.9 per 100,000 populations for the three years 1995 to 1997.  
Reduction in the rate of hospital admission for serious accidental injury by at least 10 per cent by 2010, from a revised baseline estimate of 315.9 admissions per 100,000 populations for the financial year 1995–96.  
Ensure everyone with suspected cancer is able to see a specialist within two weeks of their GP deciding they need to be seen urgently and requesting an appointment for: all patients with suspected breast cancer from April 1999; and, for all other cases of suspected cancer by 2000. | Improve the health and well-being of people in England  
Reduction in death rates  
Reduction in rate of hospital admission  
Improve the health of the population – helping to increase life expectancy  
Reduce health inequalities as measured by infant mortality and life expectancy at birth  
Tackle the underlying determinants of health and health inequalities by:  
Reducing adult smoking rates to 21 per cent or less by 2010, with a reduction in prevalence among routine and manual groups to 26 per cent or less.  
To improve health outcomes for people with long-term conditions by offering a personalized care plan for vulnerable people most at risk. | Through community fire safety educational activities, the FRS can help to protect the health and well-being of the nation. Education and community inclusion will help reduce the death rate, the rate of hospital admissions  
Fire is related to deprivation and disability. By reducing inequality in fire risk the FRS can assist with reducing health inequalities. Offering personalised help, support and packages for the sick and elderly, fire alarms, routine inspections of fire alarms and other devices. |
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<td>Department of Health (continued)</td>
<td>As part of the new Framework for Managing Human Resources in the NHS, targets for managing sickness absence have been set consistent with the Cabinet Office recommendations of a reduction of 20 per cent by April 2000. Performance improvement targets will also be set for NHS trusts on Managing Violence to Staff in the NHS aimed at reducing the levels of absence due to sickness or injury caused by violence. Reduce the maximum wait for an outpatient appointment to three months and the maximum wait for in-patient treatment to six months by the end of 2005; and to achieve progressive further cuts with the aim of reducing the maximum in-patient and day case waiting time to three months by 2008. Value for money in the NHS and personal social services will improve by at least two percent per annum, with annual improvements of one per cent in both cost efficiency and service effectiveness. Improve the health of the population. By 2010, increase life expectancy at birth in England to 78.6 years for men and to 82.5 years for women. Substantially reduce mortality rates by 2010: • from heart disease and stroke and related diseases by at least 40 per cent in people under-75, with a 40 per cent reduction in the inequalities gap between the fifth of areas with the worst health and deprivation indicators (the spearhead group) and the population as a whole;</td>
<td>Improve the quality of life and independence of vulnerable older people by supporting them to live in their own homes where possible</td>
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| Department of Health (continued) | • from cancer by at least 20 per cent in people under-75 with at least a reduction in the inequalities gap of at least 6 per cent between the fifth of areas with the worst health and deprivation indicators (the spearhead group) and the population as a whole; from suicide and undetermined injury by at least 20 per cent.  
Reduce health inequalities by 10 per cent by 2010 as measured by infant mortality and life expectancy at birth.  
Tackle the underlying determinants of health and health inequalities by:  
Reducing adult smoking rates to 21 per cent or less by 2010, with a reduction in prevalence among routine and manual groups to 26 per cent or less.  
Halting the year-on-year rise in obesity among children under-11 by 2010, in the context of a broader strategy to tackle obesity in the population as a whole (joint target with the Department for Education and Skills and the Department for Culture, Media and Sport).  
Reducing the under-18 conception rate by 50 per cent by 2010, as part of a broader strategy to improve sexual health (joint target with the Department for Education and Skills).  
To improve health outcomes for people with long-term conditions by offering a personalized care plan for vulnerable people most at risk; and to reduce emergency bed days by five per cent by 2008, through improved care in primary care and community settings for people with long-term conditions. |                        |                           |
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<td><strong>Department of Health (continued)</strong></td>
<td>To ensure that by 2008 no one waits more than 18 weeks from GP referral to hospital treatment. Increase the participation of problem drug users in drug treatment programmes by 100 per cent by 2008; and increase year-on-year the proportion of users successfully sustaining or completing treatment programmes. Secure sustained annual national improvements in NHS patient experience by 2008, as measured by independently validated surveys, ensuring that individuals are fully involved in decisions about their healthcare, including choice of provider. Improve the quality of life and independence of vulnerable older people by supporting them to live in their own homes where possible by: increasing the proportion of older people being supported to live in their own home by one per cent annually in 2007 and 2008; and, Increasing by 2008 the proportion of those supported intensively to live at home to 34 per cent of the total of those being supported at home or in residential care. Reduce to four hours the maximum wait in A&amp;E from arrival to admission, transfer or discharge; and reduce the proportion waiting over one hour. Guaranteed access to a primary care professional within 24 hours and to a primary care doctor within 48 hours. Improve life outcomes of adults and children with mental health problems through year-on-year improvements in access to crisis and CAMHS (child and adolescent mental health services).</td>
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| Department of Education| Improve children’s communication; social and emotional development so that by 2008 50% of children reach a good level of development at the end of the Foundation Stage and reduce inequalities between the levels of development achieved by children in the 20% most disadvantaged areas and the rest of England.  
  • Incident rate of fatal and major injuries to fall by 3%  
  • Incident rate of work related ill-health by 6%  
  • Number of working days lost per 100,000 workers from injury and ill-health by 9%  
  • The number of events reported by licence holders, which HSE’s Nuclear Installations Inspectorate judges as having the potential to challenge a nuclear safety system, by 7.5%  
  • Number of major and significant hydrocarbon releases in the offshore oil and gas sector by 45%  
  • The number of relevant RIDDOR in the onshore sector by 15% | Improve children’s communication, social and emotional development | Through running local schools based fire safety educational activities the FRS can help educate and alert both children and adults to the main causes of fires, fire prevention, fire extermination and other pertinent issues.  
  The young fire setters activities can help reduce youth involvement in arson. |
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| **Health and Safety Executive** | **By 2010:**  
  • Reduce incidence rates of fatalities and major injuries by 10%  
  • Reduce incidence rates of work related ill-health by 20%  
  • Reduce the number of working days lost per worker from work-related injury and ill-health by 30%                                                                 |                        |                           |
| **Construction Industry**    | • Reduce incidence rates of fatal and major injuries by 40% (2004/05)  
  • Reduce incidence rates of fatal and major injuries by 66% (2009/10)                                                                                                                                             |                        |                           |