Operational Response Review

Risk Assessment Methodology

Planning & Intelligence Team

East Sussex Fire & Rescue Service

Risk Assessment Methodology - Contents

Executive Summary

This report describes the methodology and approach that has been employed in order to produce a comprehensive risk assessment and profile of the East Sussex Fire & Rescue Service (ESFRS) area. It illustrates:

- The approach taken in the development of an ESFRS risk-assessment methodology, taking into consideration the outcomes of a desktop-review of other FRS methodologies, IRMPs and other research documents with examples of good practice.

- The rationale for adopting the agreed risk assessment methodology and how that will be used to illustrate risks within the communities that ESFRS serve

1. Introduction

In order to develop and produce a comprehensive risk assessment and profile of the ESFRS area, a data cleansing and enrichment process was undertaken to ensure data accuracy and veracity, which is fully documented in the ORR Data Cleansing & Enrichment Process document.

This report discusses how data (both held by ESFRS and external sources) has been used analytically in order to build a comprehensive and intelligent understanding of risk across the East Sussex FRS area for use in the Operational Response Review. In particular, this document explains the process and outcomes of a desk-top review of other FRS methodologies where ESFRS undertook a feasibility study to identify if existing examples of good or notable practice could be adopted and used locally.

2. Risk Assessment Methodology

This section explains the rationale behind the approach taken in developing a risk assessment methodology.

2.1. Desktop review

A desktop research exercise was undertaken in order to construct a picture of existing notable practice within the fire sector in developing a risk assessment methodology. One of the outcomes of this exercise was establishing the fact that there is no single approach to developing a risk assessment methodology. However, it could be seen that there is a lot of similarity in the approach taken between fire and rescue services.

As part of the investigation into developing a risk-assessment methodology, there were 2 or 3 FRS methodologies that were scrutinised in more detail to see if ESFRS could adopt the methodology (lift-and-drop exercise); these are discussed in more detail below. The full documentation on each approach can be found on each respective FRS's website – below are simply highlights of what was discovered when undertaking this desktop review.

<u>Merseyside & Nottinghamshire</u>

- Merseyside's Fire Risk Assessment Methodology (FRAM) was developed in-house in order 'to support the Integrated Risk Management Plan by assessing, categorising and setting out the risk to life from

fire and other emergencies within Merseyside' and 'to illustrate our evaluation of risk which we believe the people of Merseyside are subject to'. It was developed in 2010.

- Nottinghamshire FRS have also adopted Merseyside FRS's approach, given the methodology had been previously validated by Risktec, an independent, third party organisation.

- It was appropriate that East Sussex FRS investigated the feasibility of also adopting this approach, and so analysis was undertaken.

- The risk map that Merseyside/Nottinghamshire create uses a relative ranking approach. They use the following 6 datasets in order to illustrate the significant factors affecting risk in a predetermined geographical area – the Lower Super Output Area (LSOA). Each factor has additionally been given a weighting by Merseyside, also shown in the table.

Dataset	Weighting Factor
All Dwelling Fires	1.9
All Injuries Occurring in Premises	0.46
Special Services Involving Life Risk	0.35
All Fire Deaths	0.04
All Deliberate Non-Domestic Fires	0.05
Index of Multiple Deprivation Score	1.5

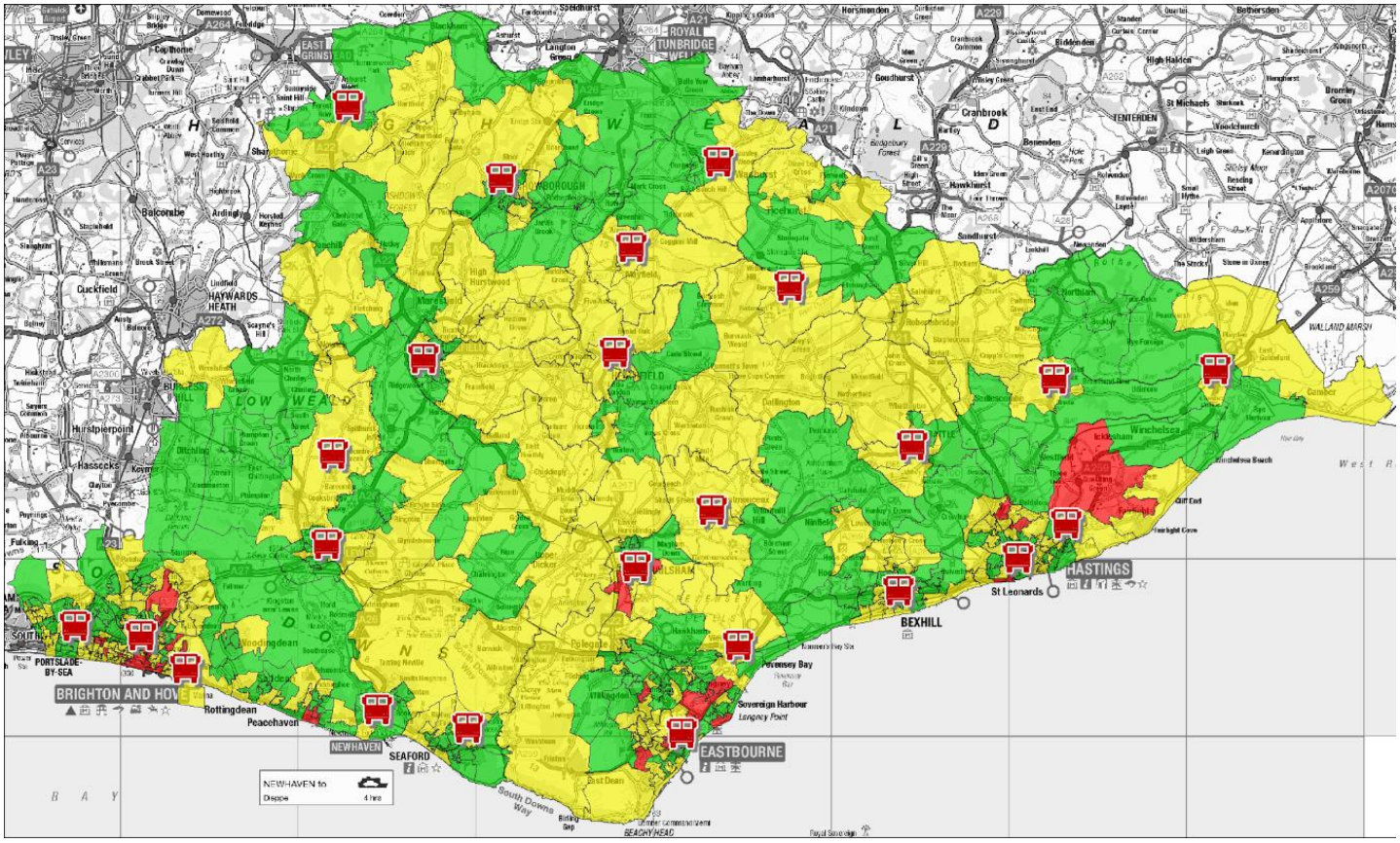
- The risk score is based on a Lower Super Output Area (LSOA). Each factor is weighted according to their importance and combined to give an overall risk score for each LSOA.

$$\sum\left(\left(\frac{dwlF}{AllDwlF}\right)\% * 1.9\right) + \left(\left(\frac{PremInj}{AllPremInj}\right)\% * 0.46\right) + \left(\left(\frac{SSInj}{AllSSInj}\right)\% * 0.35\right) + \left(\left(\frac{FireFat}{AllFireFat}\right)\% * 0.04\right) + \left(\left(\frac{DelibNonDom}{AllDelibNonDom}\right)\% * 0.05\right) + \left(\left(\frac{IMDScore}{AllIMDScore}\right)\% * 1.5\right)$$

- Risk category bands are defined on an inter-percentile range to reflect the three levels of risk defined within their response standards to fire. They are calculated to reflect their priorities and professional judgement of risk. The top 8.5% of LSOAs are assigned as 'High Risk', the bottom 42.5% are designated 'Low Risk' and those in-between become 'Medium Risk'.

- Using the same methodology, analysis was undertaken to apply this to ESFRS incidents and ESFRS areas to see if this approach could be adopted.

- Lower Super Output Areas comprise of an average of 1,500 residents (minimum 1,000). Therefore, in urban areas, LSOAs can cover a small geographical area whereas in the rural areas, the LSOAs can cover vast areas due to the sparse population. Since a significant proportion of the ESFRS area is rural in nature, many of the LSOAs were deemed to be too large to be meaningful and so Output Areas (OA) were used as the geographical area instead. Output Areas, too, are census-created boundaries and fit within Lower Super Output Areas; an LSOA typically contains 4-6 output areas. This ensures that the risk appears more granular and detailed and provides a better picture than simply using LSOAs.
- when the above methodology is applied to ESFRS, the following risk map is created showing high/medium/low risk output areas:



- The resulting 'risk map' using the Merseyside/Nottinghamshire model is quite simplistic and generally shows the majority of the geographical area is either low or medium risk. Further exploratory work was undertaken to ascertain the rationale behind adopting the specific weightings to each dataset as well as the how the LSOA risk was defined as high/medium/low.

- It was found that the weightings applied were not statistically based, but were a result of combining professional judgement and a working group reviewing the effects of various weightings.

- Furthermore, the high/medium/low banding was set in accordance with the amount of resource that Merseyside could deploy on an annual basis to manage risk within each LSOA.

- Although the approach to the Merseyside methodology has been independently validated, it would be inappropriate for ESFRS to adopt the FRAM on an 'as-is' basis, as each variable is based on professional judgement as opposed to being weighted statistically. Whilst this isn't wrong, it means that it would not be prudent to lift-and-drop the same methodology into ESFRS. Instead, a similar, thorough process would need to be undertaken in ESFRS to ensure that the resulting scoring and risk levels were intuitive and appropriate for our own FRS.

- Merseyside no longer use this risk assessment methodology.

- In light of the above discoveries, ESFRS are unable to adopt the Fire Risk Assessment methodology as developed by Merseyside FRS and used by Nottinghamshire FRS, but will take elements of good practice when developing its risk assessment methodology.

Royal Berkshire

- Royal Berkshire Fire & Rescue Service's (RBFRS) Risk Modelling Methodology was also developed in-house and has, again, been externally validated by Risktec, an independent, third party organisation. Similar to Merseyside, the model is one of relative risk, where risk is equal to the product of the likelihood and severity of that risk.

- A 'severity' for each incident type is calculated using the following formula:

$$Inc.Type\ Severity = \frac{\sum rescues + \sum(casualties * 10) + \sum(fatalities * 100)}{\sum Incidents\ of\ type}$$

- The incident type was defined by RBFRS, but was typically a concatenation of section 3.1, 3.2 or 3.3 in IRS i.e. Fire+Property Type, or Special Service+Special Service Type.

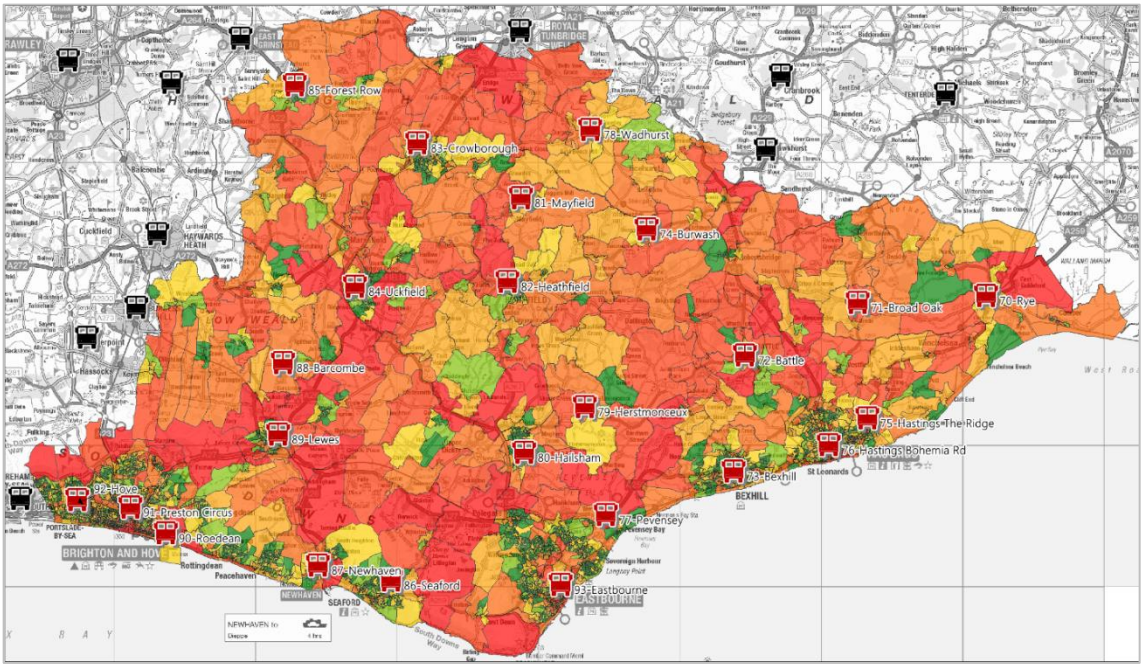
- As part of the report produced by Risktec, they advised analysis of impact of rescues due to numbers of lift and effecting entry 'rescues' that have little inherent risk. RBFRS found that there was a difference between the calculation with and without rescues but that the effect was small (due to the x10 and x100 factors for casualties and fatalities respectively) and therefore decided that 'rescues' should remain within the calculation.

- The number of incidents of each type are identified in each LSOA and multiplied by their respective severity rating to give a total absolute incident risk score. RBFRS exclude suicides and co-responding from their calculations.

- When applying the above approach to ESFRS data, it was felt that it would be inappropriate to exclude suicides from the risk assessment, particularly because within ESFRS area is a notorious area for suicides and was therefore felt that this should not be excluded from the model as this is a specific risk for ESFRS.

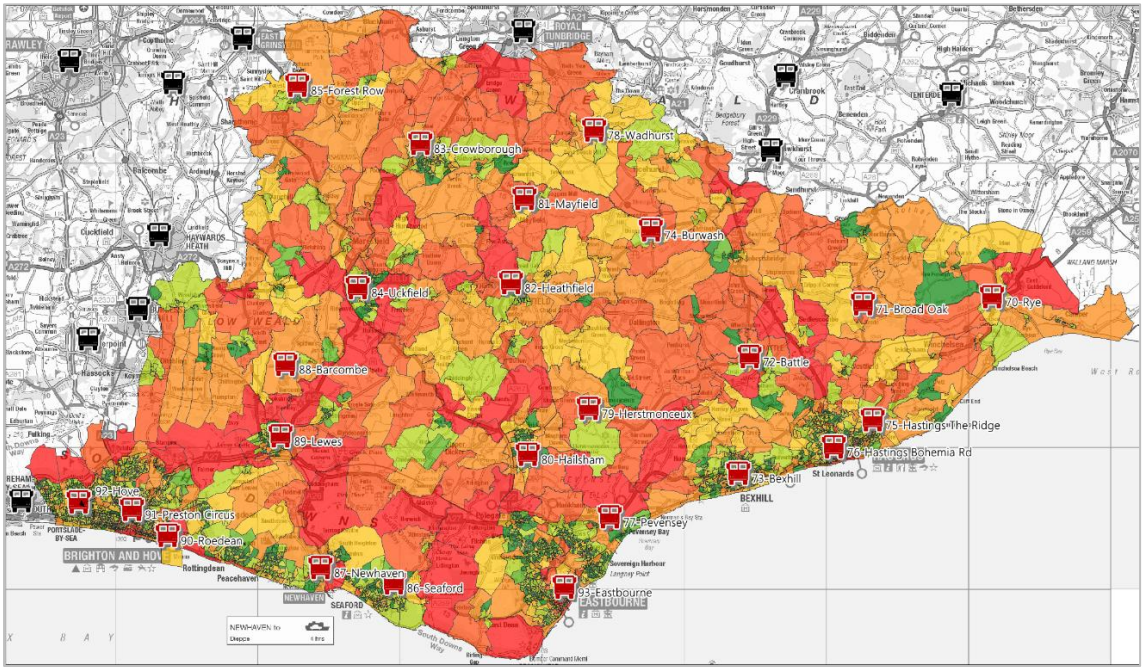
- Additionally, ESFRS produced the same analysis, but down to a more granular level (Output Area as opposed to Lower Super Output Area). This is due to the large geographical size of the LSOAs in the rural areas which would distort the view of the map, as mentioned in previous points.

- The score for each Output Area was put into seven ranges, which were statistically created using a 'natural breaks' algorithm. This is where the range breaks are determined according to an algorithm such that the difference between the data values and the average of the data values is minimised on a per range basis. This reduces error and enables one to obtain a truer representation of the data. The number of ranges was also reviewed (ranging from 3 to 9), but 7 coloured ranges produced the best result.

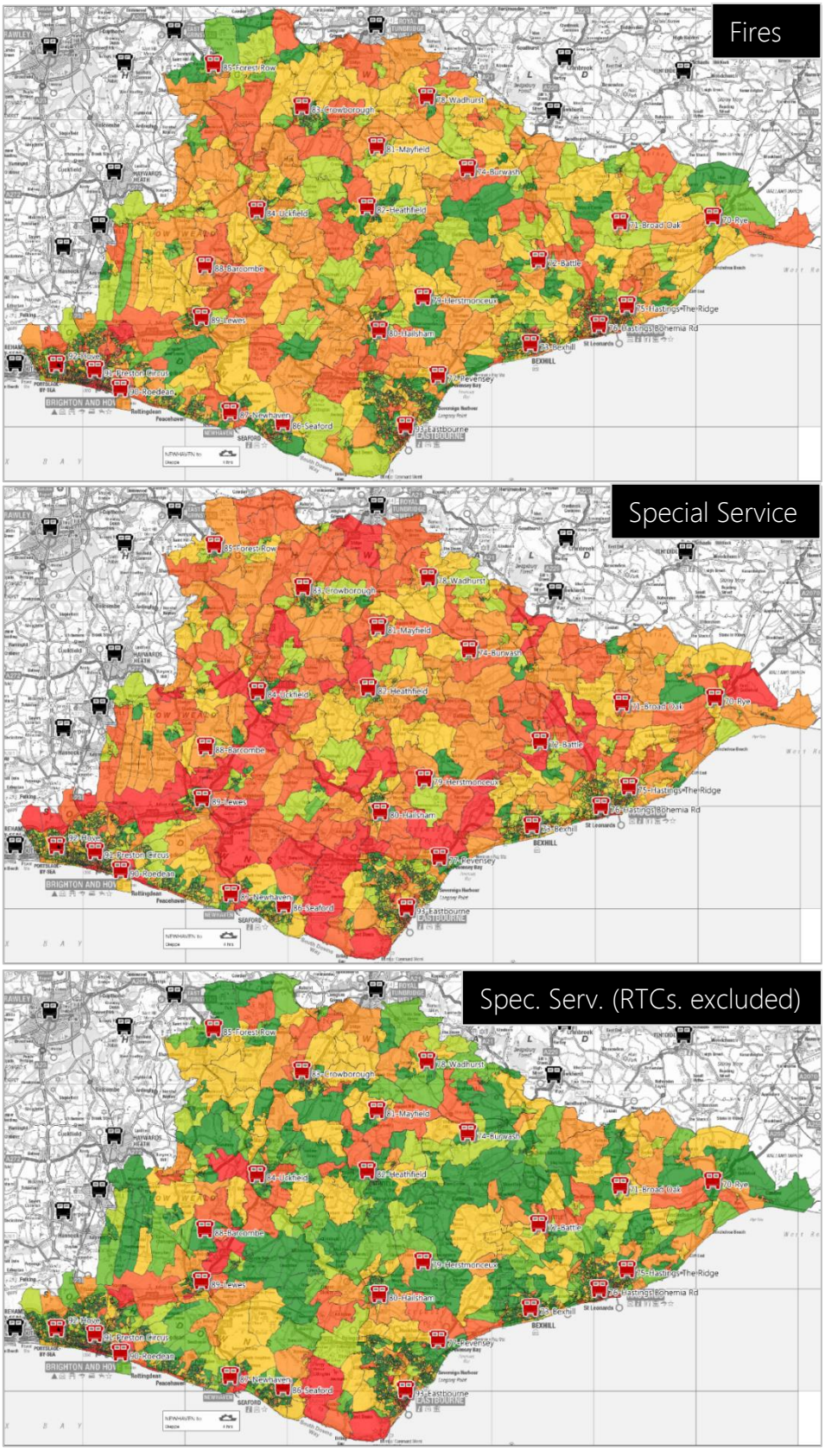


- The map above shows the overall 'absolute incident risk score' and is representative of all incidents within ESFRS over the past 9 years (Apr 2009 – Mar 2018). Since fatalities and casualties are weighted by a factor of 100 and 10 respectively, and the largest proportion of fatalities/casualties that we attend occur in Road Traffic Collisions, the above map is heavily weighted towards Special Service (especially RTC) risk.

- RBFRS used the factors 100:10:1 for fatalities, casualties and rescues. However, the report produced for Merseyside by Risktec that validated both Merseyside's and Royal Berkshire's approach, stated the 100:10:1 ratio was for fatalities, serious injuries and slight injuries. ESFRS therefore recalculated the risk scoring to remove 'rescues' from the calculation (i.e. rescues with no injury – this excluded a lot of erroneous rescues such as 'lift releases' and, since ESFRS attend more lift-releases than most Fire & Rescue Services, this has an impact). The resulting scoring and map is as follows (please note, one cannot directly compare 'colours' with the previous map, as the natural breaks ranges are different between each map:



- Whilst clearer than the previous map, the fact still remains that it is predominately a special service map due to the large number of injuries (fatal, serious or slight) within RTCs. Mapping showing Fires & Special Service risks separately was produced to see each category and its relative dispersal of risk across the ESFRS area, as shown below:



- Although the approach to the Royal Berkshire methodology has been independently validated, it is felt that it is inappropriate for ESFRS to adopt the methodology on a lift-and-drop basis for the following reasons:
    - The final outcome (a risk score for each OA) displayed on a map is not immediately intuitive and is heavily skewed to showing special service (RTC) risk.
    - Whilst RBFRS 'removed' incident types that skewed the resulting maps (e.g. suicides and co-responding), ESFRS felt that this was then not showing an accurate picture.
    - Whilst in industry it is recognised that there is a triangle in the consequences of an incident between fatalities and major and minor injuries on a typical scale of 1:0.1:0.01, this is likely to be based on analysis of workplace/industrial accidents and, as such, it is more likely that these ratios follow a normal distribution. However, for fires and other similar emergencies, these events are more random and the ratio of fatalities and casualties do not necessarily follow a normal distribution.
    - Furthermore, for operational response purposes (and prevention purposes), there is the challenge as to which is riskier (likelihood vs severity) – an area that has had 50 dwelling fires but with no injuries, or an area with 1 dwelling fire with a fatal injury – where does operational response focus? And where does prevention work focus?
    - The score for each area is arbitrary, which makes explaining what is happening in that area more difficult.
    - Since fatalities are weighted so heavily, it means that some incident types are scored very highly in terms of their severity. However, ESFRS attendance to these particular incident types does not mitigate risk in any way. For example, 'assist other agency' or 'effecting entry' scores relatively high in terms of severity, but a proportion of these will be to incidences of 'body retrieval' etc. In other words, we have attended an incident where there is a fatality, but our role is not one of life-saving at all – therefore there is a question raised around accepting all fatalities are weighted by a factor of 100.

- Therefore, ESFRS are unable to adopt the Fire Risk Assessment methodology as developed by Royal Berkshire FRS.

- ESFRS recognises that it would be useful to develop a risk assessment methodology that is based on sound, statistical evidence and weightings, derived from fire-sector specific research and good practice. ESFRS understand that the NFCC have commissioned such a piece of work and are currently engaging with FRSs to understand how risk is identified, analysed and calculated nationally, in order to develop a toolkit to enable local FRSs to adopt a similar approach that is based on the 'best bits' of all the work currently being undertaken by UK FRSs.

- The ESFRS approach to understanding risk, will be an overlay of the data as described in section 2, to understand where specific risks are – both inherent, potential and historical and to consider these against ESFRS response times. Incident density maps will show the areas that we have mobilised to the most and this can be further scrutinised by looking at where our 'critical' incidents have occurred historically.

2.2. ESFRS Approach

Having concluded the desktop research review of approaches and methodologies used by other Fire & Rescue Services, ESFRS have developed an approach to identifying and assessing risk within the community.

It was felt that it would not be appropriate to use a weighted scoring methodology, such as Merseyside, Nottinghamshire and Royal Berkshire use, without having each stage in the calculation assessed and ratified. Risktec, who independently validated the methodology of both Merseyside and Royal Berkshire, validated the approach taken to undertaking a risk assessment, which included having a robust process to challenge and agree the weightings used through working groups and professional judgement. At this time, whilst desirable, ESFRS are not in a position to commission this piece of analytical research due to non-negotiable time restraints relating to the Operational Response Review.

As stated previously, ESFRS understand that the NFCC have commissioned such a piece of analytical research and are currently engaging with FRSs to understand how risk is identified, analysed and calculated nationally, in order to develop a toolkit to enable local FRSs to adopt a similar approach that is based on the 'best bits' of all the work currently being undertaken by UK FRSs. Therefore ESFRS have sought to use a more intuitive approach that does not rely upon weightings at this time.

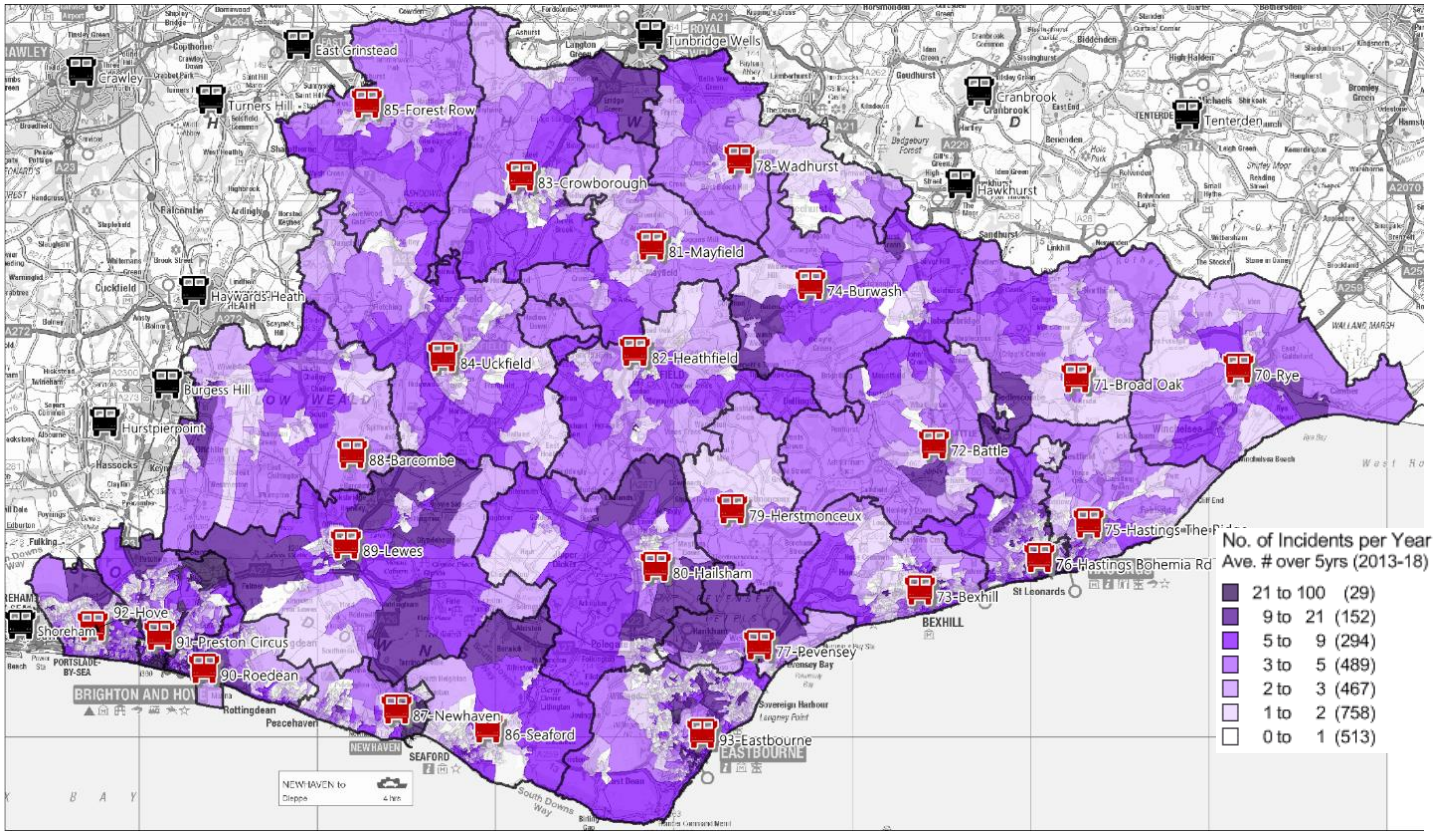
The approach taken to understanding and assessing risk needs to be a holistic approach. As highlighted above, at this time ESFRS are not in a position to be able to combine individual risks and weight them in order to create a risk score; the approach taken will be a layered approach.

2.3. Incident Density Mapping

The first step has been be to look at the numbers and types of incidents to which ESFRS have attended historically. This has been considered by the Planning & Intelligence Team, who have looked at all 9 years of incident data held within the Incident Recording System.

Using the approach of Merseyside, Nottinghamshire and Royal Berkshire, which shows risk by area (in their case, Lower Super Output Areas), ESFRS have created a series of risk maps which seek to demonstrate the dispersion of historical incidents by Output Area.

The first map shows the areas to which we have responded to on a graduated scale as shown below:



The above map shows incidents to which we have attended within ESFRS – taking the average number of incidents in each area over the last 5 years (Apr 2013 to Mar 2018). It includes all incident types – Fires, Special Service and False Alarms. The ranges are calculated using 'natural breaks'. This is where the range breaks are determined according to an algorithm such that the difference between the data values and the average of the data values is minimised on a per range basis. This reduces error and enables one to obtain a truer representation of the data. The number of ranges was also reviewed (ranging from 3 to 9), but 7 coloured ranges produced the best result.

Additionally, the colour of the map was changed from the typical Red-Amber-Green, as this naturally is associated with High-Medium-Low, and so it was felt that a neutral, single colour on a graduated scale was more helpful.

2.4. 'Critical' Incident Density Mapping

In addition to producing a map that shows the areas that represent where our historical activity has been higher or lower, it was agreed that ESFRS should also agree a methodology to determine which historical incidents could be classified as 'critical incidents' so that a similar map could be produced that shows the areas that represent where our historical life-risk incidents have been higher or lower. These would be incidents which typically had either fatalities, casualties or rescues. Historically, ESFRS had attendance standards for 'life-threatening incidents' (dwelling fires & RTCs), but it was felt that this could be widened to classify other incident types as 'critical' if they also involved some life-risk. ESFRS have determined the following criteria for classifying an incident as a 'critical incident':

Fire incidents

- Fires resulting in injury
    - Any fire (where section 3.1 Incident Type is Fire) which resulted in 1 or more injuries and/or rescues is classed as a critical fire incident.
      N.B. Injuries/rescues have been defined using IRS section 9, as follows:
        - 9.6 Extent of harm as a result of incident
            - Fatal
            - Injury (incl. rescue with injury)
                - Victim went to hospital, injuries appear to be serious
                - Victim went to hospital, injuries appear to be slight
                - First aid given at scene
                - Precautionary check recommended
            - Rescue (without injury)

Special Service incidents

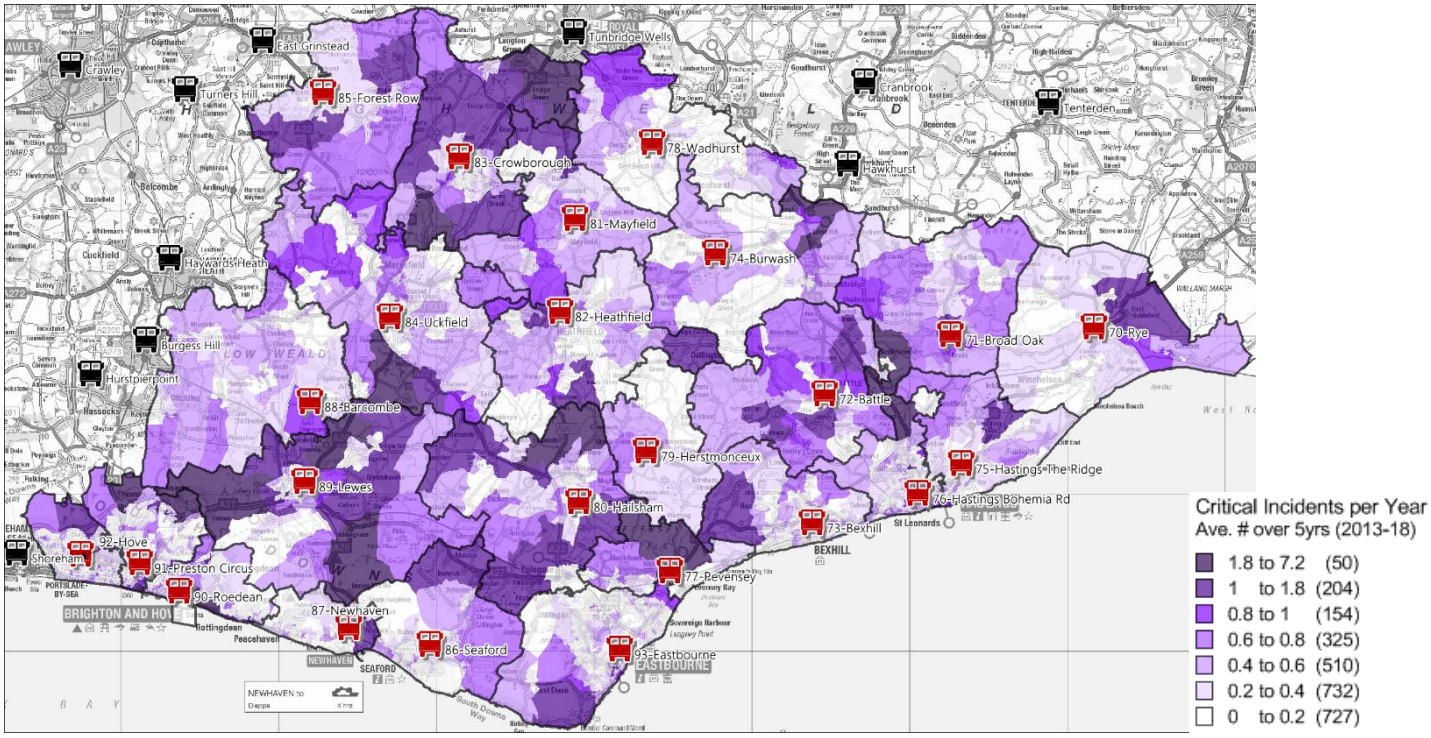
- Road Traffic Collision with life-risk –All Road Traffic Collisions (either where section 3.3 Spec. Serv. Type is RTC or where section 5.22 IsRTC is true) of any type i.e.…
    - Advice only
    - Extrication of person(s)
    - Make scene safe
    - Make vehicle safe
    - Medical assistance only
    - Other, release of person(s)
    - Stand by – no action
    - Wash down road

  …and resulting in any fatalities, casualties or rescues are classed as 'critical', as above (i.e. fatalities, serious & slight injuries, first aid at scene and precautionary check-up recommended and rescues with no injuries)

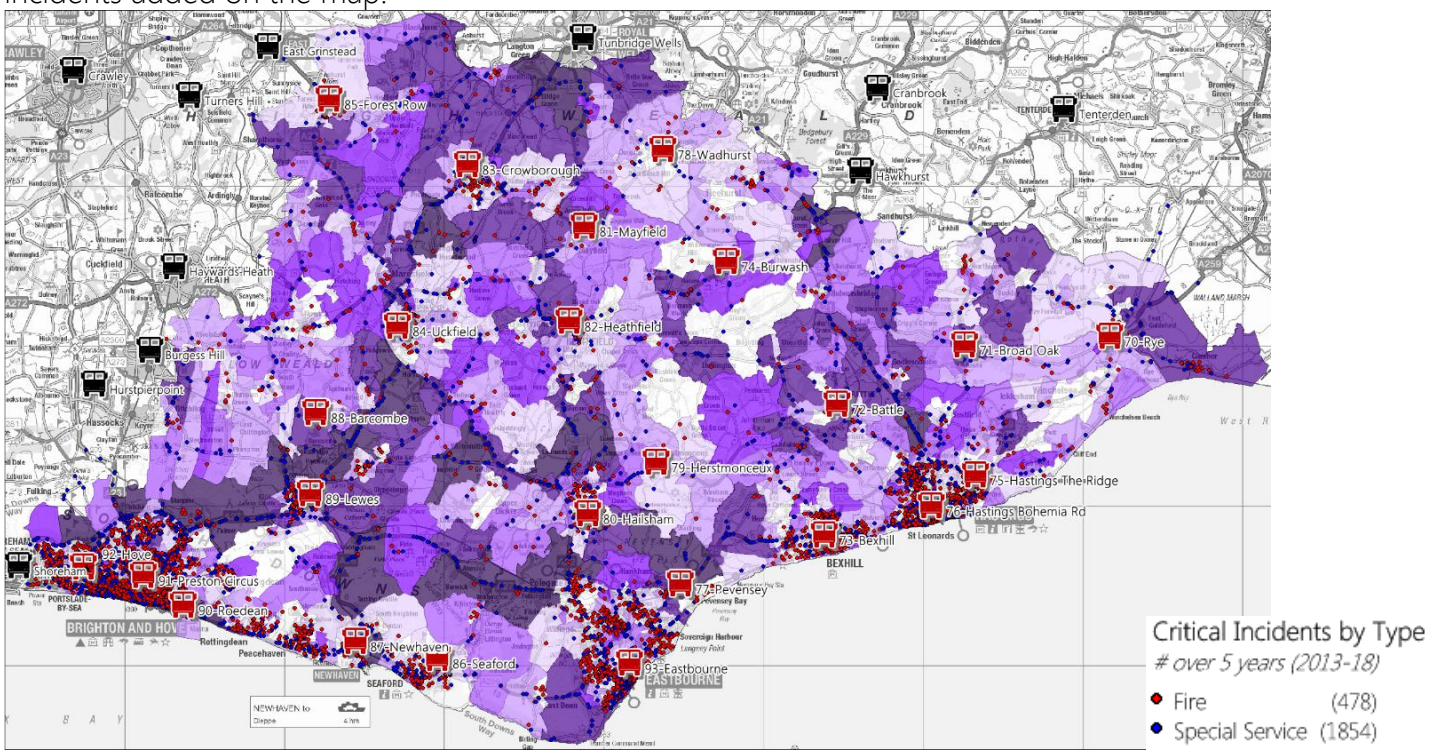
- Other Special Service with injury – All other Special Service incidents that resulted in an injury that is not already captured in the above RTC section have been classed as 'critical'. Injuries have been defined using IRS section 9 as follows:
    - 9.6 Extent of harm as a result of incident
        - Fatal
        - Injury (incl. rescue with injury)
            - Victim went to hospital, injuries appear to be serious
            - Victim went to hospital, injuries appear to be slight
            - First aid given at scene
            - Precautionary check-up recommended

  Special Service incidents (not RTCs) where there were 'Rescue(s) without injury' only are not classed as 'critical' in this context.

The following 'density' maps show the dispersal of the critical incidents to which we have responded to on a graduated scale as shown below. Please note that the ranges on these maps are different to the map showing 'All Incidents', so should not be directly colour-compared:

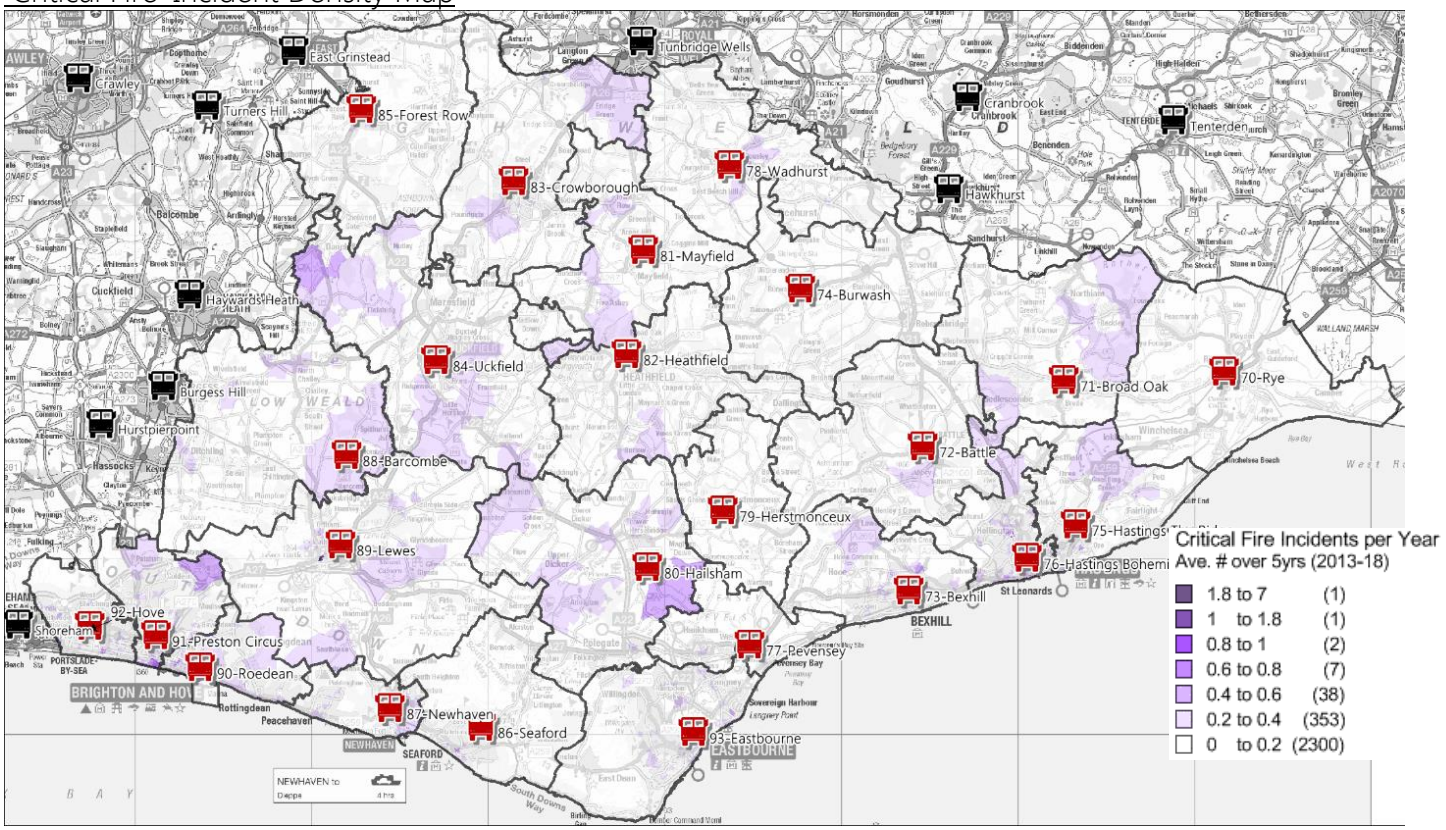


The above map shows the combination of all critical incidents across both fire and special service incident types. The darker shades outside of the urban areas of ESFRS typically represent a high number of Road Traffic Collisions. As such, the 'actual' risk is more linear as it travels through an output area, as much of the geographical area will be unpopulated. The map below demonstrates this as it overlays the actual critical incidents added on the map:

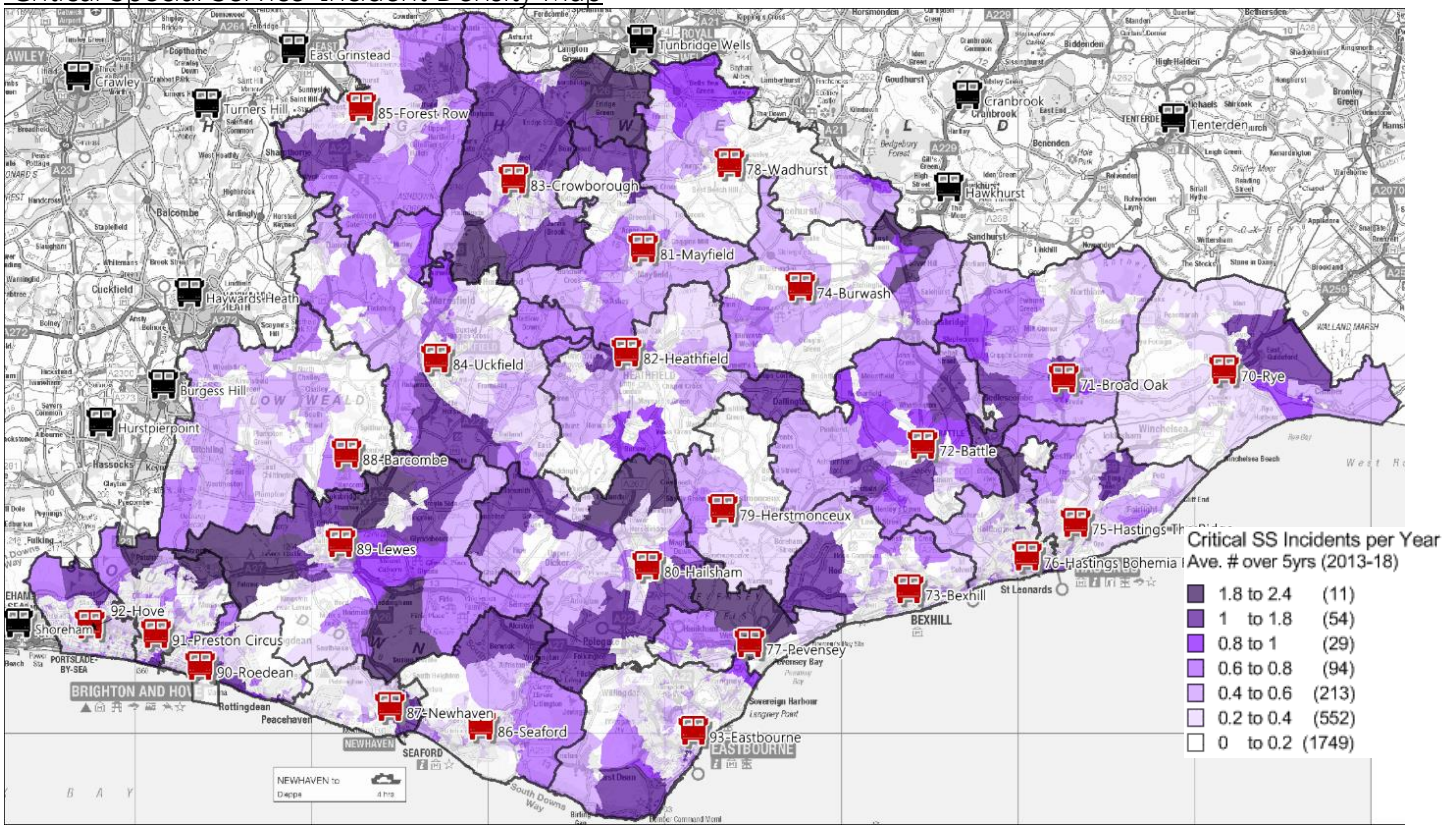


Furthermore, we can see the individual dispersion of critical incidents broken down by 'critical fires' and 'critical special service' types, as shown in the maps below. This enables comparison to be made as to the type of 'critical' risks within each area.

‘Critical Fire’ Incident Density Map



‘Critical Special Service’ Incident Density Map



3. Risk Stratification

The outcome of the processes described in the above sections has enabled ESFRS to have a spatial awareness of the areas within the Service area that represent risk, both in terms of its likelihood and severity. However, it's clear that this doesn't represent the totality of risk for each area; rather, it is a view – a snapshot, based on historical incidents to which East Sussex FRS has been involved. For, whilst it provides a rich picture of our 'realised-risk' i.e. risks that have actually happened – real historical incidents, it does not take into account inherent risk or foreseeable, future risk. ESFRS response times also need to be taken into account when understanding risk – particularly the areas that fall outside the new attendance standards.

Therefore, in order to build a more comprehensive risk profile, ESFRS will begin to overlay other risk information, from both internal and external data sources, in order to produce a series of maps, tables and aggregate views of risk, in a layered approach. This layered, stratified approach creates a rich picture of understanding risk, which will help informed professional judgements to be made.

The datasets to be considered have already been covered in the ORR Data Cleansing & Enrichment Process document, but key areas of further analytical work will be undertaken in the following areas:

3.1. The impact of proposed housing development areas

In order to be able to identify and quantify foreseeable risk, analyses will be undertaken regarding proposed developments across the East Sussex Fire & Rescue Service area. Both commercial and residential developments will be considered; however, specific predictive assessments can be undertaken for residential housing developments due to national research that has been undertaken over many years in this area, and a prediction of both dwelling fire risk and RTC risk can be made.

Dwelling Fire Risk

Proposed housing development areas, complete with numbers and types of households have been sought from Local Planning offices across the 6 Local Authority areas covering ESFRS. Analysis will be undertaken to provide an initial assessment' of the impact on community risk, based on the available information provided by Local Authorities as we as national/local research. For each development area an analysis of the following will be considered to identify dwelling fire risk:

- No. of dwellings
- A prediction of the total residents
- A prediction of the number of residents apportioned into the following property types: houses, flats, sheltered flats, caravans and bungalows.
- A prediction of the average response time for the 1st fire appliance
- A prediction of the average response time for the 2nd fire appliance
- A judgement on the assigned casualty level of the area

The above will enable ESFRS to calculate the predicted number of additional dwelling fire fatalities, serious injuries and slight injuries within each property type and give an indication of the overall risk of death per person compared to national averages.

Predicted fatalities, serious and slight injuries are calculated using algorithms defined by comprehensive national research, which also feature as the underlying risk calculations within the government's Fire Service Emergency Cover (FSEC) toolkit:

Predicted fatalities

$$x = P1 * 0.0129 * exp(0.0668 * Rt1) + 0.85 * P2 * 0.0229 * exp(0.06 * Rt1) * (Rt2/Rt1 * 0.0435 + 0.994)$$

…where

x is the predicted fatalities

P1 is the proportion of incidents needing one appliance

P2 is the proportion of incidents needing two appliances

Rt1 is the response time of the first appliance

RT2 is the response time of the second appliance

Predicted serious injuries

$$y = 0.037e0.0234x$$

…where

y is the proportion of fatality, casualty or rescues that are serious

x is the response time of the first appliance

e is the exponential function.

Predicted slight injuries

$$z = -0.007x + 0.678$$

…where

z is the proportion of fatality, casualty or rescues that are slight

x is the response time of the first appliance

Road Traffic Collision Risk

Similarly, for each development area an analysis of the following will be considered to identify RTC risk:

- A prediction of the average response time for the 1st fire appliance
- A prediction of the average response time for the 2nd fire appliance
- Total length of road (km) in the development area broken down by the following road types: motorway, A road, B road, C road, unclassified road
- A judgement on the assigned RTC group mean rate

The above will enable ESFRS to calculate the predicted number of additional RTC fatalities, serious and slight injuries and give an indication of the overall risk of death per km per year:

$$y = ((((0.0024 * RT1) + 0.0202)) * 0.93))) * (((RT2/Rt1) * 0.026)) + 0.93))))$$

…where

Rt1 is the response time of the first appliance

RT2 is the response time of the second appliance

0.93 is a correction factor

y is the rate of death per development area, expressed as a fraction

3.2. Societal Risk

There is a large amount of data on societal risk, from population estimates, growth, diversity, employment, age, economy etc. and these require consideration as part of the overall approach to understanding risk whether inherent, actual or perceived. Some can be analysed in a quantitative way, whereas others will need to be assessed in a qualitative way. Tourism, for example is a significant entity for the area of East Sussex, which drastically changes our community profile over time, whether by day of week, or month of year. Our historic incident profile includes that shifting community profile, but ascertaining and assessing the impact of tourism in a quantitative way from our historical incident data would be difficult, and so a broader, qualitative approach sometimes needs to be taken to assess each risk.

That being said, the following datasets demonstrate some of the key pieces of data where further analytical work will be undertaken:

The Index of Multiple Deprivation (IMD) is the official measure of relative deprivation for Lower Super Output Areas in England, ranking each area from 1 (the most deprived area) to 32,844 (the least deprived). There are 494 LSOAs in the ESFRS area, and these have been also ranked locally from 1-494. This enabled us to compare areas, identifying the most deprived areas and the types of deprivation within each area. However, it must be stressed that the IMD does not quantify how deprived/affluent an area is, nor does it identify deprived individuals within an area. Historical analysis has demonstrated a positive correlation between the number of incidents to which ESFRS attend and the relative deprivation of an area.

The Cube is a tool that has been developed by ESFRS to identify those most at risk from fire. The Cube uses a variety of external data sources, merged with ESFRS data in order to identify individual households as well as areas that represent a higher fire risk. The Cube contains information on the following:

Mosaic Public Sector is a dataset produced by Experian and gives detailed lifestyle, socio-demographic and behavioural information for each household within ESFRS to help better identify, understand and meet our customers' needs. Over 850 million pieces of information across 450 different data points are condensed using the latest analytical techniques to identify 15 summary groups and 66 detailed types which are then analysed against historic accidental dwelling fires to identify which types of people are having fires, as well as the types of fires they are having. This enables ESFRS to assign each household an initial fire-risk rating based on its mosaic profile before overlaying additional information ESFRS may hold on that household.

Mosaic Lifestyle Groups (15)

Group		Group Description
A	Country Living	Well-off owners in rural locations enjoying the benefits of country life
B	Prestige Positions	Established families in large detached homes living upmarket lifestyles
C	City Prosperity	High status city dwellers living in central locations and pursuing careers with high rewards
D	Domestic Success	Thriving families who are busy bringing up children and following careers
E	Suburban Stability	Mature suburban owners living settled lives in mid-range housing
F	Senior Security	Elderly people with assets who are enjoying a comfortable retirement
G	Rural Reality	Householders living in inexpensive homes in village communities
H	Aspiring Homemakers	Younger households settling down in housing priced within their means
I	Urban Cohesion	Residents of settled urban communities with a strong sense of identity
J	Rental Hubs	Educated young people privately renting in urban neighbourhoods
K	Modest Traditions	Mature homeowners of value homes enjoying stable lifestyles
L	Transient Renters	Single people privately renting low cost homes for the short term
M	Family Basics	Families with limited resources who have to budget to make ends meet
N	Vintage Value	Elderly people reliant on support to meet financial or practical needs
O	Municipal Challenge	Urban renters of social housing facing an array of challenges

Mosaic Lifestyle Types (66)

Type		Type Description
A01	Rural Vogue	Country-loving families pursuing a rural idyll in comfortable village homes while commuting some distance to work
A02	Scattered Homesteads	Older households appreciating rural calm in stand-alone houses within agricultural landscapes
A03	Wealthy Landowners	Prosperous owners of country houses including the rural upper class, successful farmers and second-home owners
A04	Village Retirement	Retirees enjoying pleasant village locations with amenities to service their social and practical needs
B05	Empty-Nest Adventure	Mature couples in comfortable detached houses who have the means to enjoy their empty-nest status
B06	Bank of Mum and Dad	Well-off families in upmarket suburban homes where grown-up children benefit from continued financial support
B07	Alpha Families	High-achieving families living fast-track lives, advancing careers, finances and their school-age children's development
B08	Premium Fortunes	Influential families with substantial income established in large, distinctive homes in wealthy enclaves
B09	Diamond Days	Retired residents in sizeable homes whose finances are secured by significant assets and generous pensions
C10	World-Class Wealth	Global high flyers and families of privilege living luxurious lifestyles in the most exclusive locations of the largest cities
C11	Penthouse Chic	City workers renting premium-priced flats in prestige central locations, living life with intensity
C12	Metro High-Flyers	Ambitious people in their 20s and 30s renting expensive apartments in highly commutable areas of major cities
C13	Uptown Elite	High status households owning elegant homes in accessible inner suburbs where they enjoy city life in comfort
D14	Cafés and Catchments	Affluent families with growing children living in upmarket housing in city environs
D15	Modern Parents	Busy couples in modern detached homes balancing the demands of school-age children and careers
D16	Mid-Career Convention	Professional families with children in traditional mid-range suburbs where neighbours are often older
D17	Thriving Independence	Well-qualified older singles with incomes from successful professional careers living in good quality housing
E18	Dependable Me	Single mature owners settled in traditional suburban semis working in intermediate occupations
E19	Fledgling Free	Pre-retirement couples with respectable incomes enjoying greater space and spare cash since children left home
E20	Boomerang Boarders	Long-term couples with mid-range incomes whose adult children have returned to the shelter of the family home
E21	Family Ties	Active families with teenage and adult children whose prolonged support is eating up household resources
F22	Legacy Elders	Elders now mostly living alone in comfortable suburban homes on final salary pensions
F23	Solo Retirees	Senior singles whose reduced incomes are satisfactory in their affordable but pleasant owned homes
F24	Bungalow Haven	Seniors appreciating the calm of bungalow estates designed for the elderly
F25	Classic Grandparents	Lifelong couples in standard suburban homes enjoying retirement through grandchildren and gardening
G26	Far-Flung Outposts	Inter-dependent households living in the most remote communities with long travel times to larger towns

G27	Outlying Seniors	Pensioners living in inexpensive housing in out of the way locations
G28	Local Focus	Rural families in affordable village homes who are reliant on the local economy for jobs
G29	Satellite Settlers	Mature households living in expanding developments around larger villages with good transport links
H30	Affordable Fringe	Settled families with children owning modest, 3-bed semis in areas of more affordable housing
H31	First-Rung Futures	Pre-family newcomers who have bought value homes with space to grow in affordable but pleasant areas
H32	Flying Solo	Young singles on starter salaries choosing to rent homes in family suburbs
H33	New Foundations	Occupants of brand new homes who are often younger singles and couples with children
H34	Contemporary Starts	Young singles and partners setting up home in developments attractive to their peers
H35	Primary Ambitions	Forward-thinking younger families who sought affordable homes in good suburbs which they may now be out-growing
I36	Cultural Comfort	Thriving families with good incomes in multi-cultural urban communities
I37	Community Elders	Established older households owning city homes in diverse neighbourhoods
I38	Asian Heritage	Large extended families in neighbourhoods with a strong South Asian tradition
I39	Ageing Access	Older residents owning small inner suburban properties with good access to amenities
J40	Career Builders	Singles and couples in their 20s and 30s progressing in their field of work from commutable properties
J41	Central Pulse	Youngsters renting city centre flats in vibrant locations close to jobs and night life
J42	Learners & Earners	Inhabitants of the university fringe where students and older residents mix in cosmopolitan locations
J43	Student Scene	Students living in high density accommodation close to universities and educational centres
J44	Flexible Workforce	Young renters ready to move to follow worthwhile incomes from service sector jobs
J45	Bus-Route Renters	Singles renting affordable private flats away from central amenities and often on main roads
K46	Self Supporters	Hard-working mature singles who own budget terraces manageable within their modest wage
K47	Offspring Overspill	Lower income owners whose adult children are still striving to gain independence meaning space is limited
K48	Down-to-Earth Owners	Ageing couples who have owned their inexpensive home for many years while working in routine jobs
L49	Disconnected Youth	Young people endeavouring to gain employment footholds while renting cheap flats and terraces
L50	Renting a Room	Transient renters of low cost accommodation often within subdivided older properties
L51	Make Do & Move On	Yet to settle younger singles and couples making interim homes in low cost properties
L52	Midlife Stopgap	Maturing singles in employment who are renting short-term affordable homes
M53	Budget Generations	Families supporting both adult and younger children where expenditure can often exceed income

M54	Childcare Squeeze	Younger families with children who own a budget home and are striving to cover all expenses
M55	Families with Needs	Families with many children living in areas of high deprivation and who need support
M56	Solid Economy	Stable families with children renting better quality homes from social landlords
N57	Seasoned Survivors	Deep-rooted single elderly owners of low value properties whose modest home equity provides some security
N58	Aided Elderly	Supported elders in specialised accommodation including retirement homes and complexes of small homes
N59	Pocket Pensions	Elderly singles of limited means renting in developments of compact social homes
N60	Dependent Greys	Ageing social renters with high levels of need in centrally located developments of small units
N61	Estate Veterans	Longstanding elderly renters of social homes who have seen neighbours change to a mix of owners and renters
O62	Low Income Workers	Older social renters settled in low value homes in communities where employment is harder to find
O63	Streetwise Singles	Hard-pressed singles in low cost social flats searching for opportunities
O64	High Rise Residents	Renters of social flats in high rise blocks where levels of need are significant
O65	Crowded Kaleidoscope	Multi-cultural households with children renting social flats in over-crowded conditions
O66	Inner City Stalwarts	Long-term renters of inner city social flats who have witnessed many changes

Exeter Data (GP-registered +65s) is an annual dataset shared by the NHS containing >170,000 records of GP-registered over 65s – the address, date of birth and sex of the individual. These have been linked within the Cube by the Unique Property Reference Number (UPRN) relating to the address of the property. The UPRN is not supplied by the NHS, so ESFRS undertakes a lengthy process to append UPRNs to the Exeter data. Once linked to the Cube, these records can be mapped.

Home Safety Visit (HSV) details are linked to The Cube, detailing when the last HSV took place, along with a number of risk flags that were highlighted at the time of the most recent HSV including:

- Alcohol misuse
- Disabled
- Hearing impaired
- History of fires
- Liquid oxygen cylinder(s) in property
- Lone pensioner
- Mental health issues
- On long-term medication
- Over 65
- Over 80
- Oxygen cylinder(s) in property
- Reduced mobility
- Rented accommodation
- Sight impaired

- Single parent family
- Smoker

Again, the UPRN is not held for each HSV, so ESFRS undertakes a lengthy process to manually identify and append the correct UPRN to each record so that it can be linked to other information easily. There are currently over 125,000 HSV records in total but since some of these HSVs represent return visits, there are currently circa 92,000 distinct HSV visits that are held within the Cube. This dataset allows us to identify which homes have/haven't had a HSV and when it took place, as well as linking back to mosaic lifestyle types and Exeter data.

iCoder variables are additional variables supplied by Experian that are supplied alongside our annual refresh of Mosaic Public Sector. The additional information against each household provides yet more detailed analysis to be undertaken and includes:

- (H) Age - estimate based on the head of the household. Where there is both a male and a female head of the household, the older of the two ages is chosen. There are 11 age bands.

- (H) Decision Maker Type – identifies the type of person or persons who are likely to make decisions for the whole household based on the combination of adults in the household and their ages. Where a couple are most likely to be making decisions jointly this is identified. Separate codes are also given to households that contain individuals sharing who are unlikely to make joint household decisions.

- (H) Directorships – identifies households where at least one company director lives. Should there be a director of a small company and a director of a large company at the same address, then the household would reflect the larger of the two.

- (H) Family Lifestage – shows the combined stage of life and family status, including children. Derived by analysing the combination of adults and children living in a household and the age of the individuals.

- (H) Household Composition – identifies the type of family living at an address, derived by analysing the combination of genders and surnames at an address. There are 11 bands.

- (H) Households with Children – identifies the presence and age of children in a household based on predictive modelling techniques.

- (H) Number of Adults in Household – indicates the number of people ages 18 or above living as a household unit

- (H) Length of Residency – identifies the length of time that the longest residing head of household has been at the same address. There are 11 bands.

- (H) Lifestage – shows the combined stage of life and family status and derived by analysing the combination of adults living at a household and the age of the individuals. There are 16 bands.

- (H) Property Type – identifies the type of building of an address – purpose-built flats, converted flats, farm, named building or other.

- (H) Residence Type – identifies whether a property is terraced, semi-detached, detached, a flat or a bungalow.

- (H) Tenure – identifies whether a property is owner-occupied, council/housing association or privately rented.

'Rurality' Risk is calculated using ESFRS attendance standards isochrones to identify households and data that falls outside of these travel-time boundaries, thus representing a 'rurality' risk. This helps to quantify and prioritise where preventative fire safety initiatives might need to be directed.

Other Risk Information is also linked to The Cube, such as the Index of Multiple Deprivation and legacy Adult Social Care records. The resulting dataset gives a rich picture of societal/household risk and allows ESFRS to target at household, street, output area, lower super output area, ward, station area or local authority level.

In summary, in order to build a more comprehensive risk profile, ESFRS will begin to illustrate and overlay risk information from multiple sources, both internal and external data sources, in order to produce a series of maps, tables and aggregate views of risk, in a layered approach. This layered, stratified approach creates a rich picture of understanding risk, which will help informed professional judgements to be made. These will form the basis of individual station profiles that will provide a holistic overview of the station area, contextualised with other station areas and/or ESFRS as a whole and will include information on:

Population and household analysis, socio-demographic comparisons, historical incidents within the station area and incidents attended by individual fire appliances, through to other inherent risks within the station area, such as road risk, water risks, environmental risks, heritage risks and other operational risks.

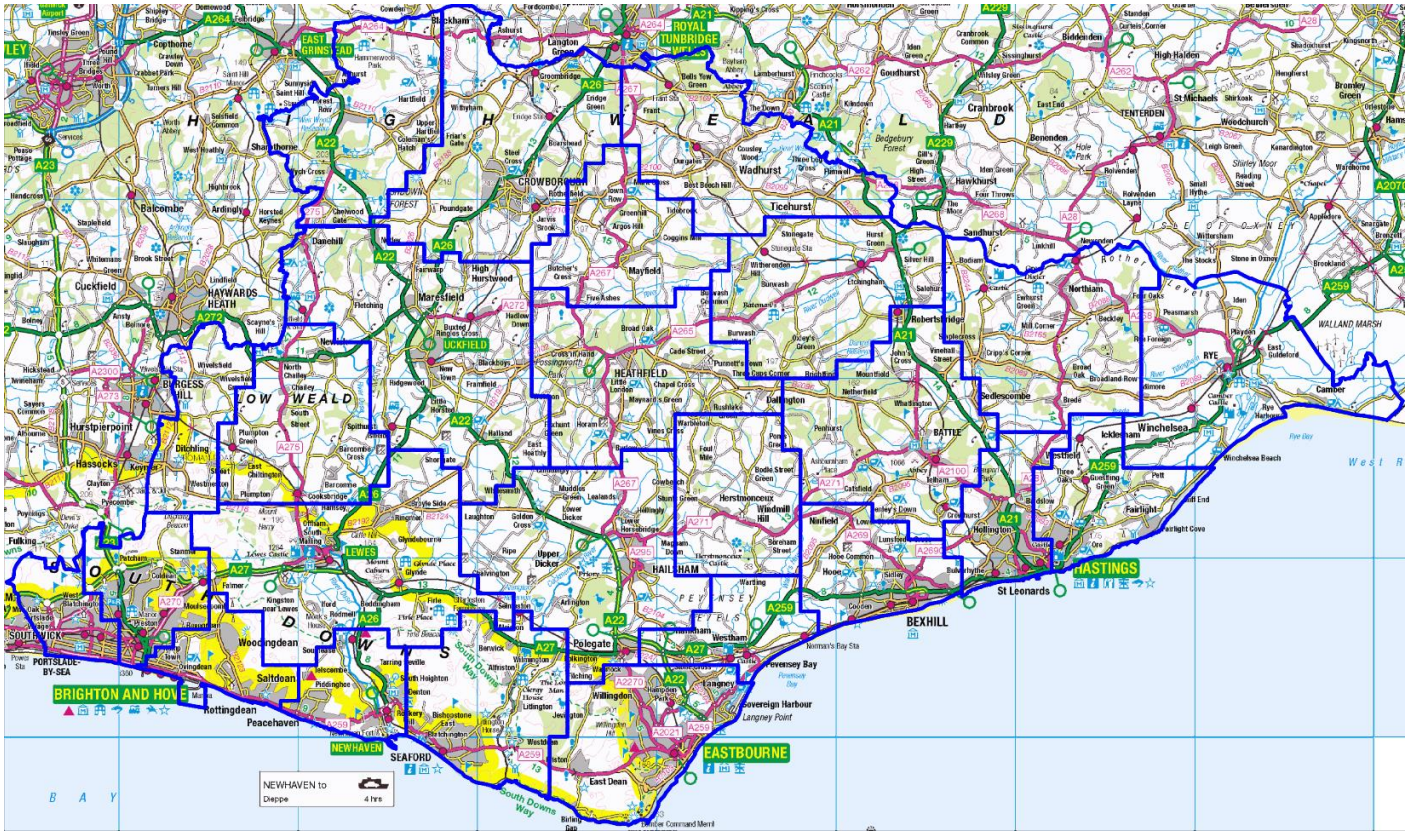
4. Station Area Boundaries

This section explains how the station area boundaries that are to be used in Stage I of the Operational Response Review are created and what the boundaries do and do not represent.

It is worth noting that this approach has been in place for over 10 years in ESFRS.

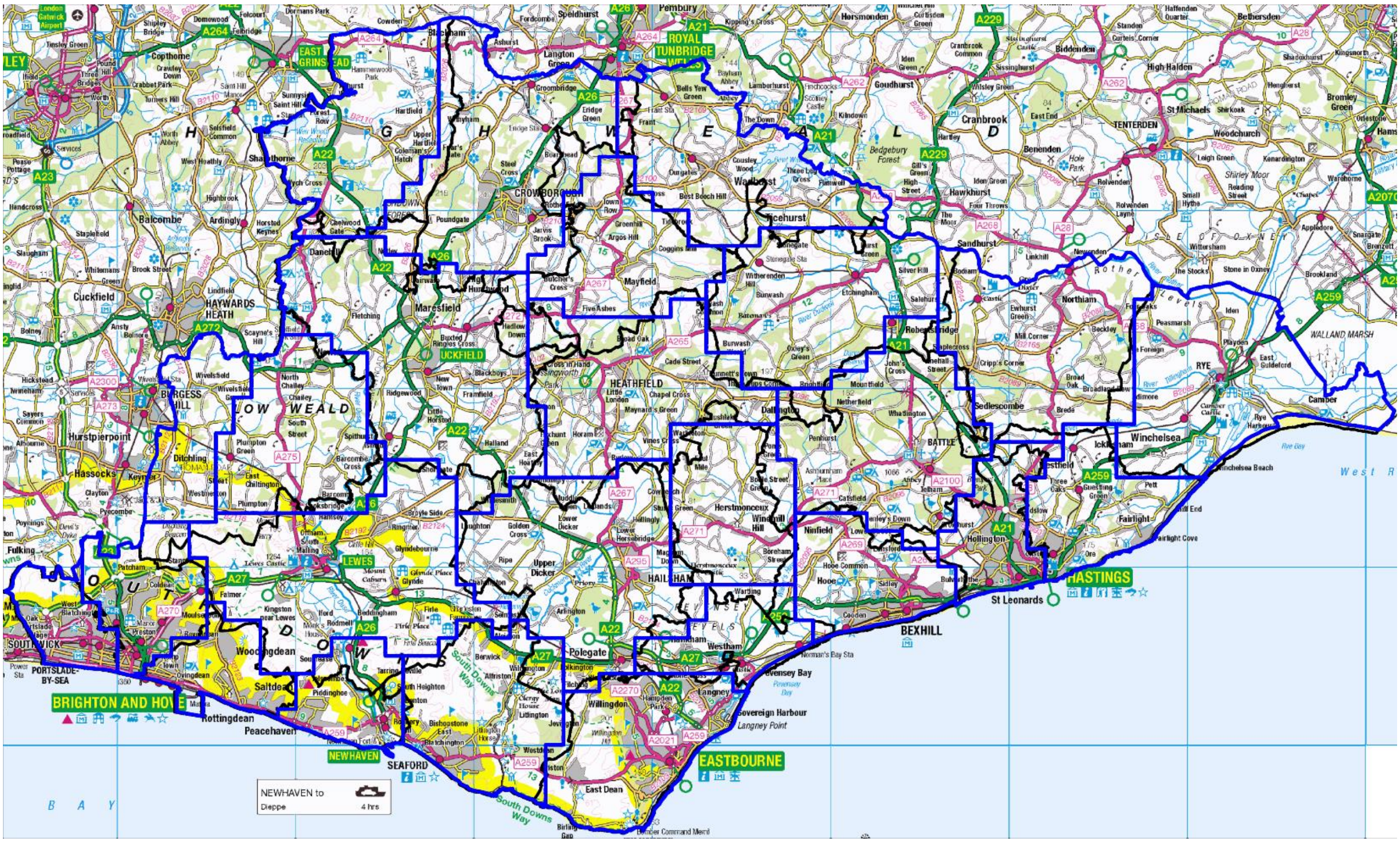
Station Grounds

For the majority of operational staff, the map below is likely to be the most familiar representation of the local station 'ground'. Based on grid squares, and used in the old (pre-4i) mobilising system, these boundaries were effectively a representation of the turn-out areas for each station. Interestingly, the actual boundaries were different within the mobs system itself, but the maps were never updated to reflect the changes made over the years. In fact, they are so old that the underlying mapping does not sit true with these boundaries due to updated GPS transformational calculations and tectonic plate movements!



Station Admin Areas

For over ten years, ESFRS have used output area (OA) boundaries to create the OA-aligned station areas. OAs are the smallest census geography (containing an average of around 130 households), and these can aggregate up into other geographies such as lower super output areas (LSOAs), wards, local authority areas etc. and are used widely across all public sector organisations and therefore our station areas are really useful to be able to be mapped in this way. This allows us to directly compare our data with a multitude of other data sources which has been really helpful – for example, census socio-demographic comparisons, household and population projections, degrees of deprivation, 3rd party data from other public sector organisations etc. because these are all based on the same geographies. It's a common approach and many FRSs base their descriptive statistics on these common geographies (output areas / super output areas).

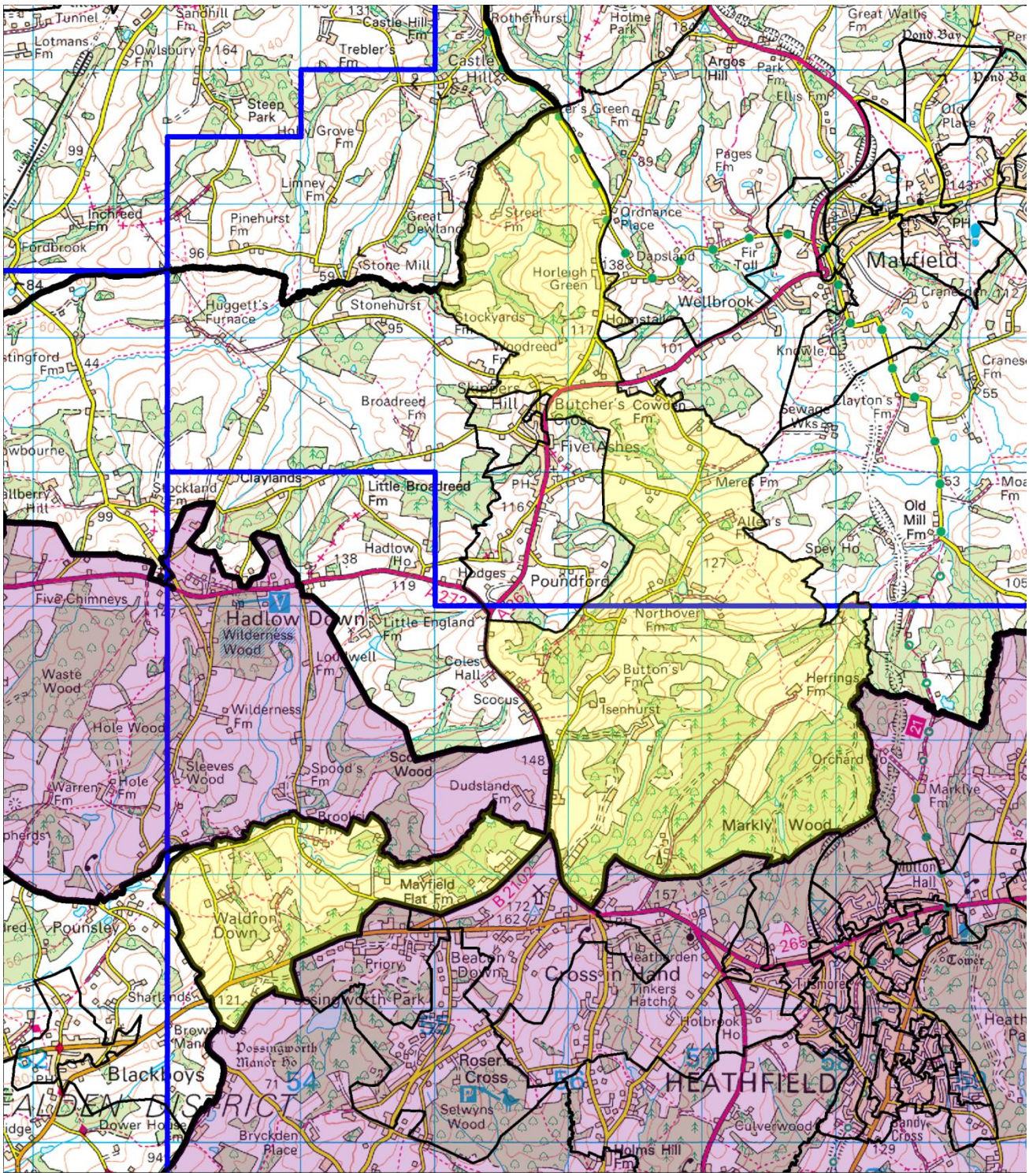


Using the census output area boundaries, work is undertaken to create station areas that align, as closely as possible, to the 'station grounds' – the map above shows the difference – the original station 'grounds' in blue with the OA-aligned station areas in black. Care is undertaken to correctly 'assign' each output area to a particularly station. Whilst the majority of areas can be assigned relatively easily, there are some (particularly in the rural areas where the geographical size of the output area is large due to low population density) which require professional judgement to be made. In these instances, judgement is made based on a balance between population weighting within the area and the geographical spread of the OA across 2 or more station areas. These boundaries are updated every 10 years or so, when newly released census data are released.

Importantly, it should be stressed that the 'new' station areas (aligned to OAs) are <u>not</u> portrayed as being exactly synonymous with station 'turn-out' areas – the station areas in the ORR are not turnout areas i.e. these are station <u>admin</u> areas as opposed to station <u>turnout</u> areas; remembering too that there are no station grounds in the 4i mobilising system.

Example – Heathfield

The following pages will go through a worked example of the process adopted, using the most challenging output area assignment by far, which is the one shown below, which lies across the Heathfield and Mayfield boundary.



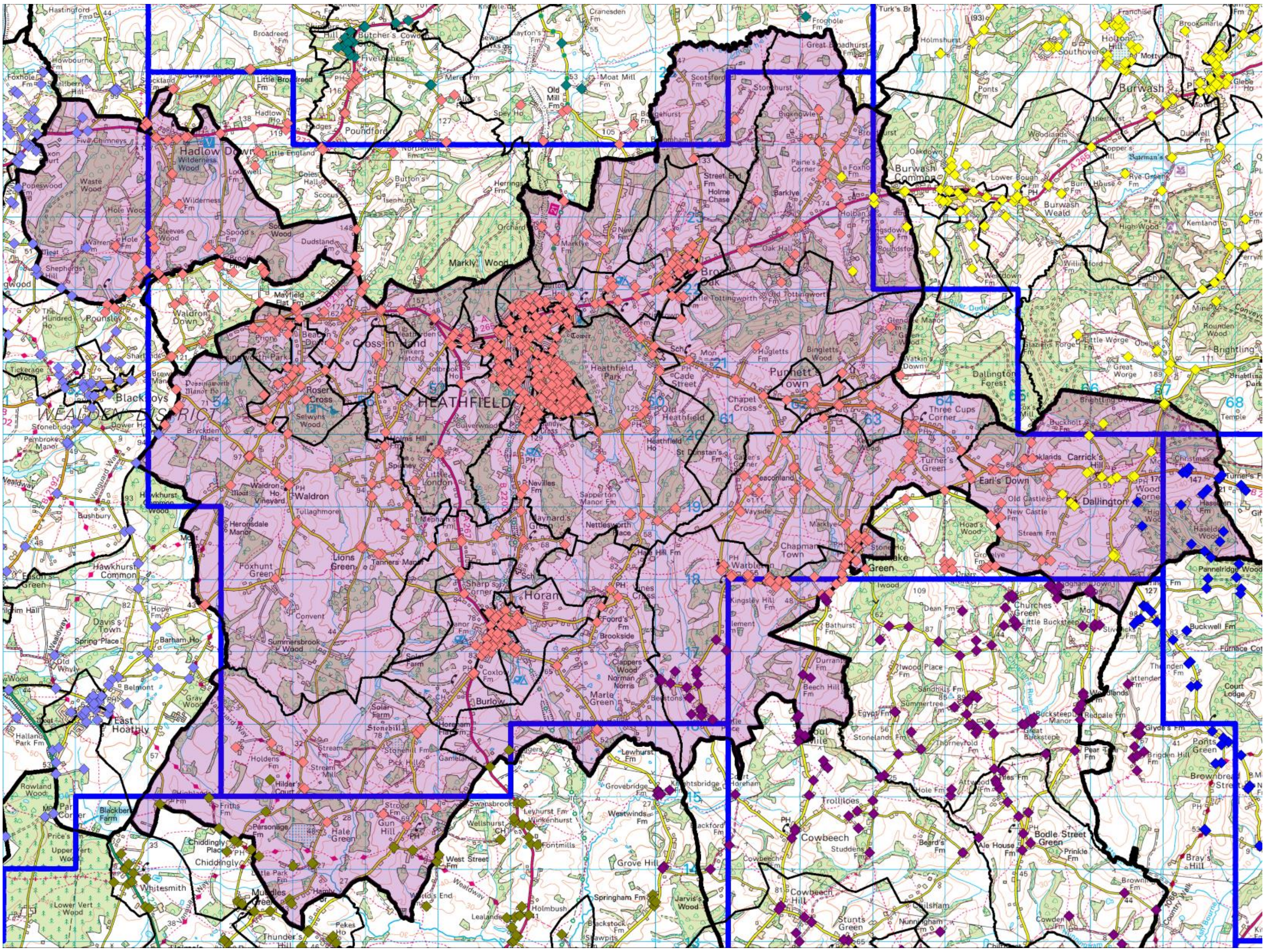
Unfortunately, the change between the 2001 and 2011 census produced this very oddly-shaped output area (coloured yellow) – which looks like 2 OAs but it is just a single OA, which needed to be assigned to either Heathfield or Mayfield station area – a decision really where nobody is a winner!

Geographically, the output area is split fairly evenly across the two station areas; population wise it is fairly evenly split; historical incidents too are split across both station areas.

This output area was ultimately assigned to Mayfield because, had it been assigned to Heathfield, this would have created 3 orphan output areas to the west of the output area, and would have meant Heathfield would have part of its boundary intersecting with Crowborough. So, for these reasons alone, this particular output area had to be assigned to Mayfield.

As mentioned previously, the OA-aligned station areas are not turn-out areas, although they try and follow the original 'station grounds' that operational staff were used to historically.

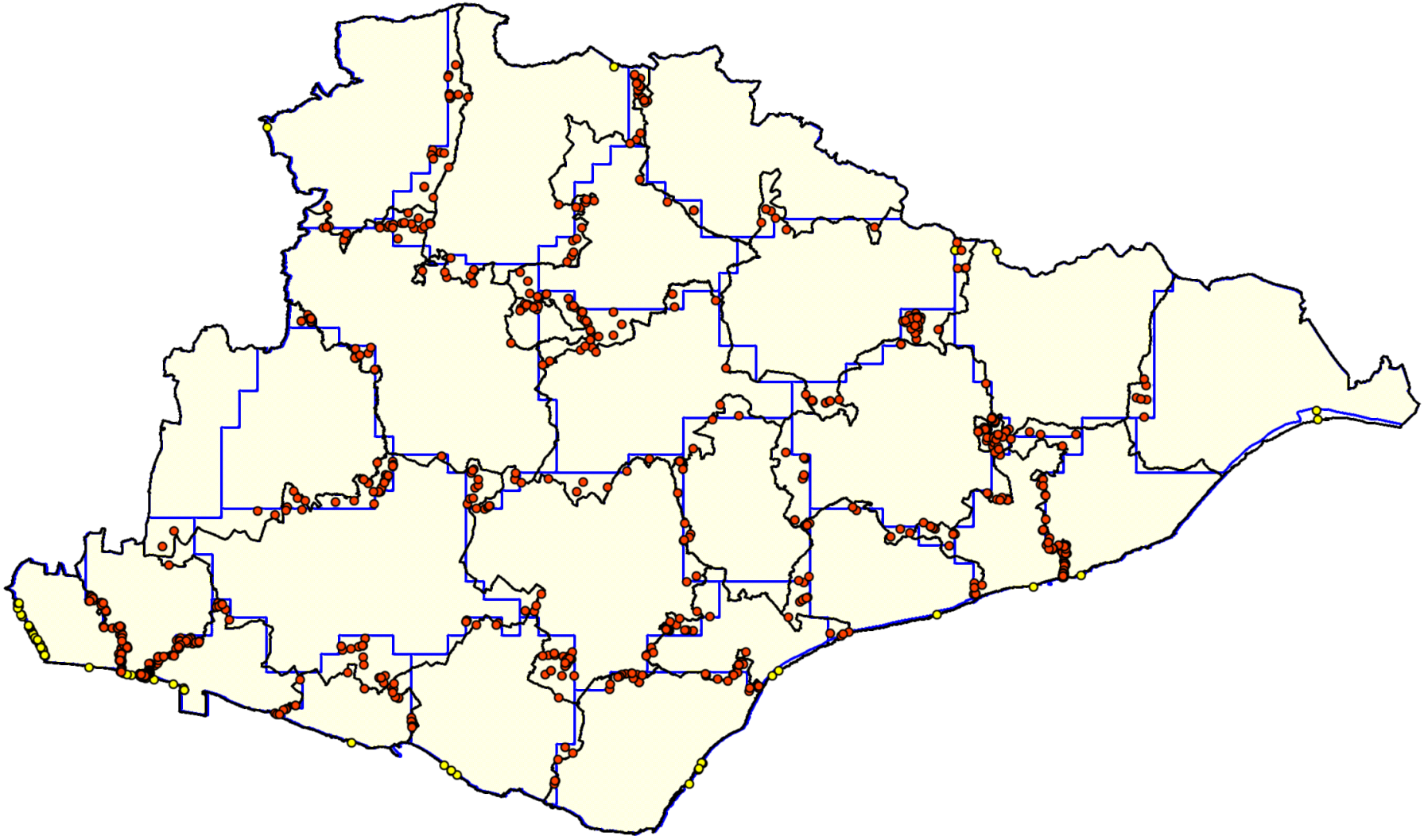
Stage II modelling will also encompass response times to each area based on the road network and average turn-out times. Therefore, the 'turn-out areas' are better denoted in the map below, where each road junction had been colour-coded to show which station is likely to reach that road junction first. This is based on a combination of the average turnout time of the fire appliance, plus the travel time to that road junction and is more likely to represent the areas to which each station can reach first (traffic congestion excepting).



(NB. this map is based on 24hr averages, therefore Crowborough's average turnout times are combination of on-station/on-call responses (Crowborough shown in lilac on left side of map))

Impact

The map below shows the total number of incidents over the last 5-year review period of the Operational Response Review (April 2013 – March 2018). 97.2% of incidents have been assigned the same 'station area' as the original 'station ground'. To quantify how many incidents are 'affected' by utilising this method, it can be seen that there are a total of 1,324 incidents out of the 47,219 incidents within the review period which are 'affected' (2.8%), although 6% of these are incidents which move from/to outside the ESFRS boundary – the majority of which are in Hove (denoted in yellow on map below).



The matrix below shows the breakdown of incidents over the 5 years and the relationship between the traditional 'station ground' and the output area aligned station area.

Output Area (OA11) aligned Station Admin Area	Traditional 'Station Ground'																											# outside stn area	% outside stn area
	Barcombe	Battle	Bexhill	Broad Oak	Burwash	Crowborough	Eastbourne	Forest Row	Hailsham	Hastings Bohemia Rd	Hastings The Ridge	Heathfield	Herstmonceux	Hove	Lewes	Mayfield	Newhaven	Pevensey	Preston Circus	Roedean	Rye	Seaford	Uckfield	Wadhurst	Outside ESFRS	Grand Total		
Barcombe	573														2				2				26			603	30	5.0
Battle		592	3	12	5					11			10													633	41	6.5
Bexhill		2	2,433							8			11					9							1	2,464	31	1.3
Broad Oak		48		263						2															1	314	51	16.2
Burwash		54		7	394							1												4	2	462	68	14.7
Crowborough						1,023										12							8	22	1	1,066	43	4.0
Eastbourne							5,680		4									22				3				5,709	29	0.5
Forest Row						20		347															2		1	370	23	6.2
Hailsham							12		1,397			1	8					2				28	8			1,456	59	4.1
Hastings Bohemia Rd		16								4,795	55														2	4,868	73	1.5
Hastings The Ridge				3						62	1,671														1	1,737	66	3.8
Heathfield		1							5			653	1			2							11			673	20	3.0
Herstmonceux									4			3	126													133	7	5.3
Hove														4,635					52						44	4,731	96	2.0
Lewes	37								3						1,535		22		1	4		9	10			1,621	86	5.3
Mayfield						1						38				210							6	1		256	46	18.0
Newhaven																	1,651			9		4			1	1,665	14	0.8
Pevensey			4				9		15									335							2	365	30	8.2
Preston Circus														57					8,646	342					3	9,048	402	4.4
Roedean																			24	4,210					9	4,243	33	0.8
Rye				6																	651				2	659	8	1.2
Seaford							3		2								9					998			4	1,016	18	1.8
Uckfield	9					19		4	1			1			2								1,094			1,130	36	3.2
Wadhurst					2											4								388		394	6	1.5
Outside ESFRS							6			1	1														1,595	1,603	8	0.5
Grand Total	619	713	2,440	291	401	1,063	5,710	351	1,431	4,879	1,727	697	156	4,692	1,539	228	1,682	368	8,725	4,565	651	1,042	1,165	415	1,669	47,219		
# outside stn gnd	46	121	7	28	7	40	30	4	34	84	56	44	30	57	4	18	31	33	79	355	0	44	71	27	74			
% outside stn gnd	7.4	17.0	0.3	9.6	1.7	3.8	0.5	1.1	2.4	1.7	3.2	6.3	19.2	1.2	0.3	7.9	1.8	9.0	0.9	7.8	0.0	4.2	6.1	6.5	4.4			

It's also worth pointing out that the ORR data-cleansing process demonstrated that there were significant improvements made to the locational accuracy of the incident data before being used in Stage I and II of the ORR (details of which are available on the intranet as Appendix A of the Operational Response Review Main Report).

Over the 5 year review period between April 2013 and March 2018, there were 1,282 incidents which were relocated to a different (correct) station ground (i.e. before even beginning to assign them to an OA-aligned station area). This was due to the comprehensive location-checking of incidents prior to embarking on the Operational Response Review, which equates to 2.7% of incidents over the 5 years being placed in the wrong station ground. The report also highlighted that there were around 10k incidents over the 9 years that were not checked for locational accuracy, so it is likely that this percentage is higher.

This highlights again, the importance of ensuring that incidents are correctly geo-located and recorded within the Incident Reporting System (IRS) in the first place.

Conclusion

Hopefully this explanation has helped to detail the process that was undertaken in order to create OA-aligned station areas, why it was done, what they represent and, importantly, what they don't represent. Finally, in order to allay any concerns over the impact of using these station areas on ORR Stage II modelling, please be assured that:

- No station activity will be 'lost' in the data analysis/station profiling in Stage I. Each fire appliance's mobilisations to incidents will be captured over the 9 year period and will be detailed in the latter half of the 'Incident' section of the station profiles (the first half providing details of the incidents occurring within the geographical areas)
- As the ORR Project moves from Stage I into Stage II (modelling options), the toolkits which are used to model the impact on performance and workload of appliances are not dependent on station areas i.e. they work on a 'next-nearest-available pump' logic, not dissimilar to the mobilising system in that station 'grounds' don't 'exist'. Additionally, the toolkit for modelling the impact on community risk is based on output areas across the ESFRS area, and does not attempt to identify station areas. The bottom line is that, the boundaries of the station areas will not be materially affecting stage II modelling outcomes.
- However, by adopting the station area boundaries that were used in stage I has enabled ESFRS to better understand and link/aggregate risk which would have otherwise been impossible, as explained in the above sections.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