

# Risk Modelling for Rural Communities

## Fire Services Emergency Cover Model (FSEC)



Highland and Islands Fire Brigade

Divisional Officer Trevor Johnson

# F.S.E.C. Modelling

**Response**

**Fire Safety  
Activity**

**Impacts on**

- Predicted Fatalities**
- Predicted Property Loss**

# F.S.E.C. inputs & outputs

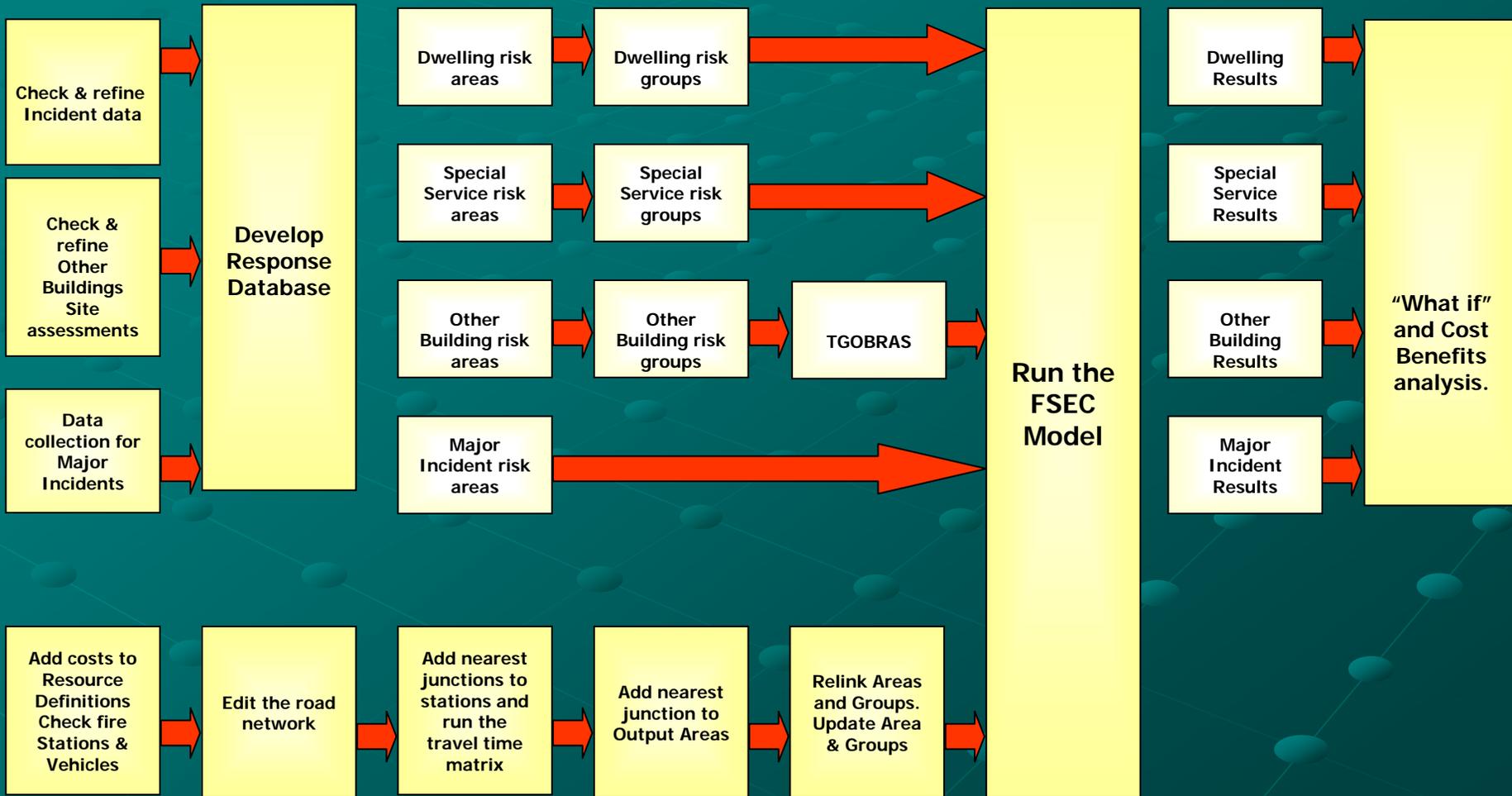
## Inputs

- Incident data
- Fire stations & vehicles
- Road network
- Other building site assessments
- Planning scenarios

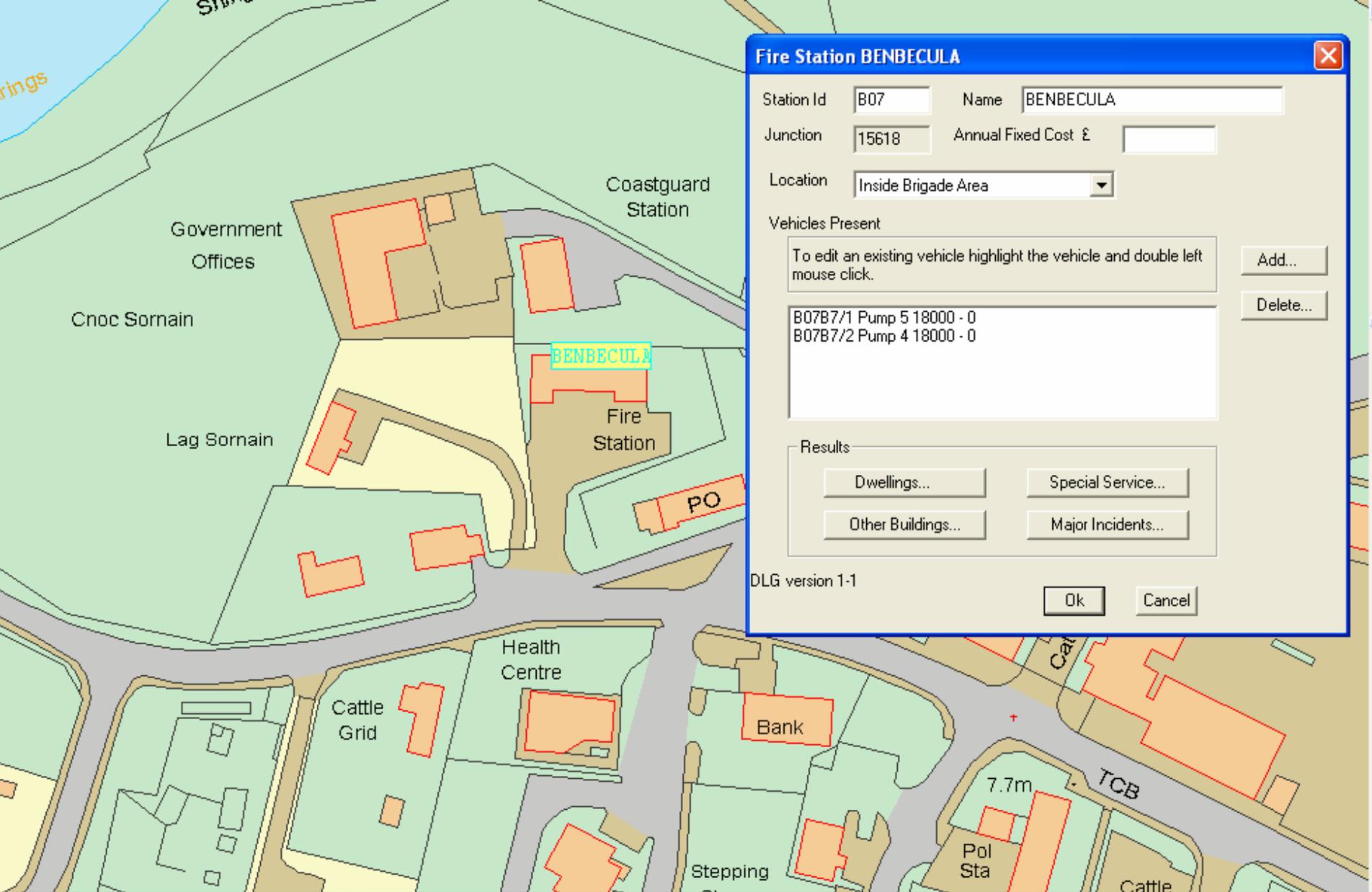
## Outputs

- Predicted fatalities
- Predicted property loss
- Fire cover cost comparison

# Overview of the FSEC Process

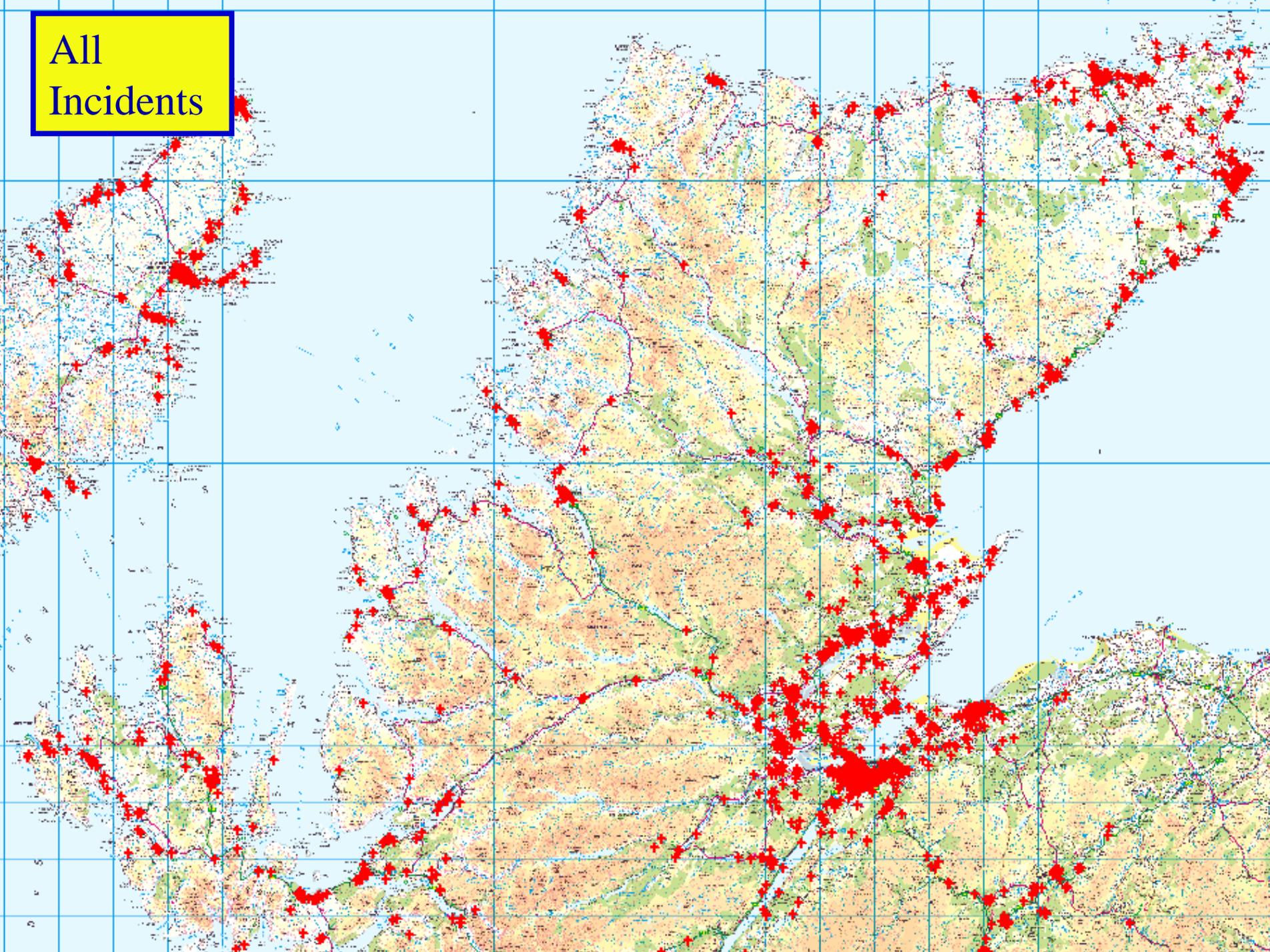




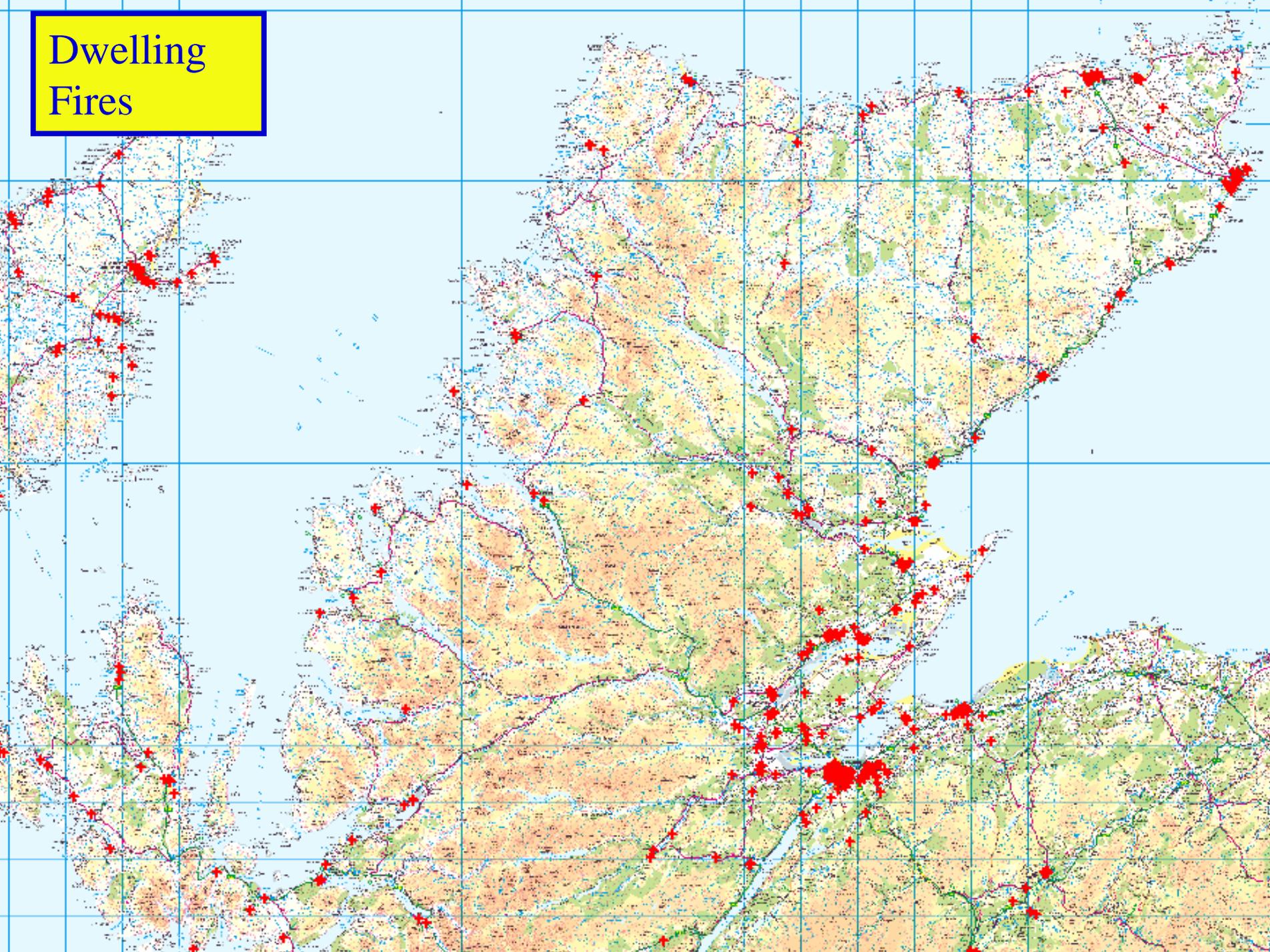


Station Locations - Benbecula corrected + details

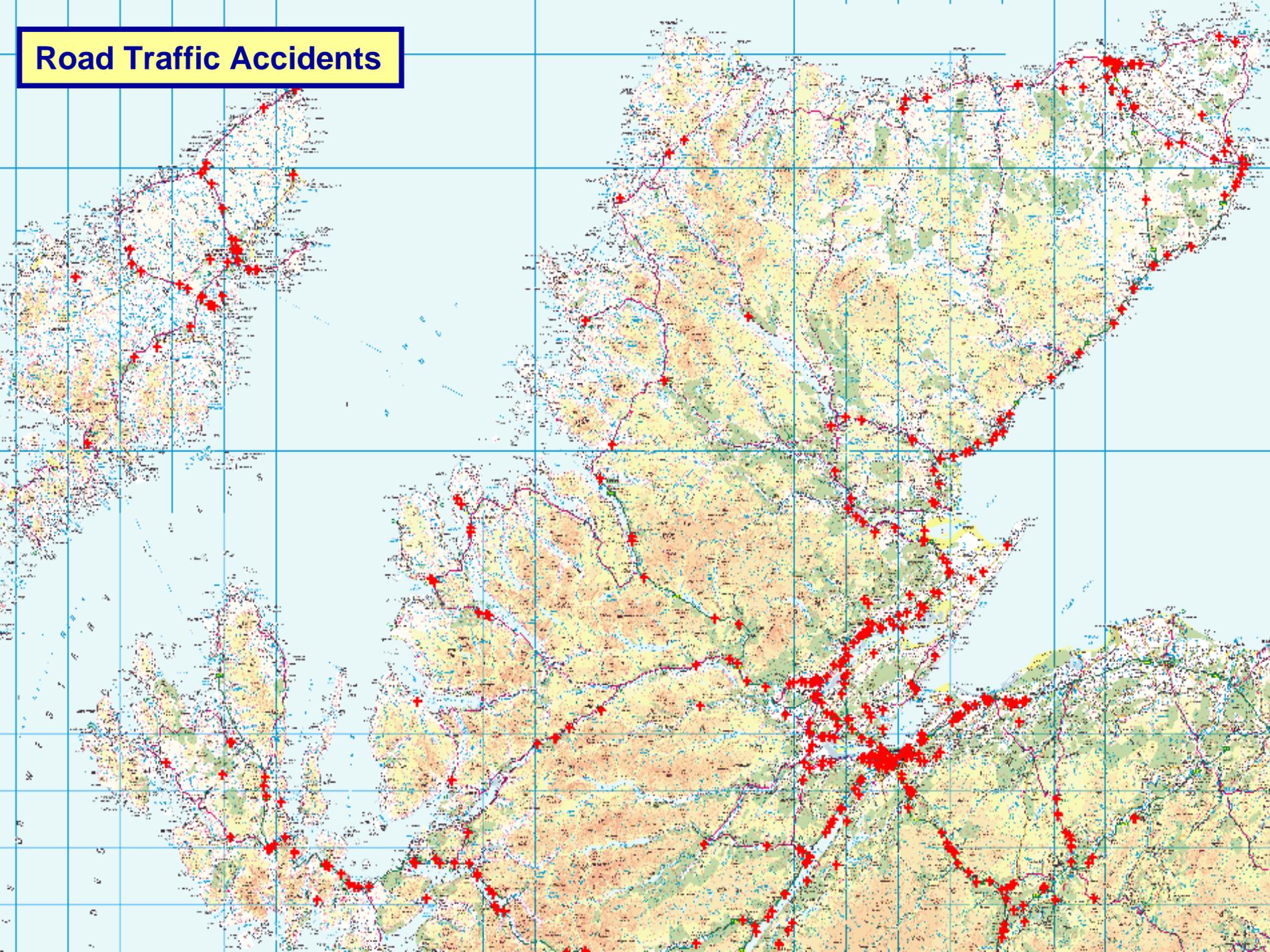
All Incidents



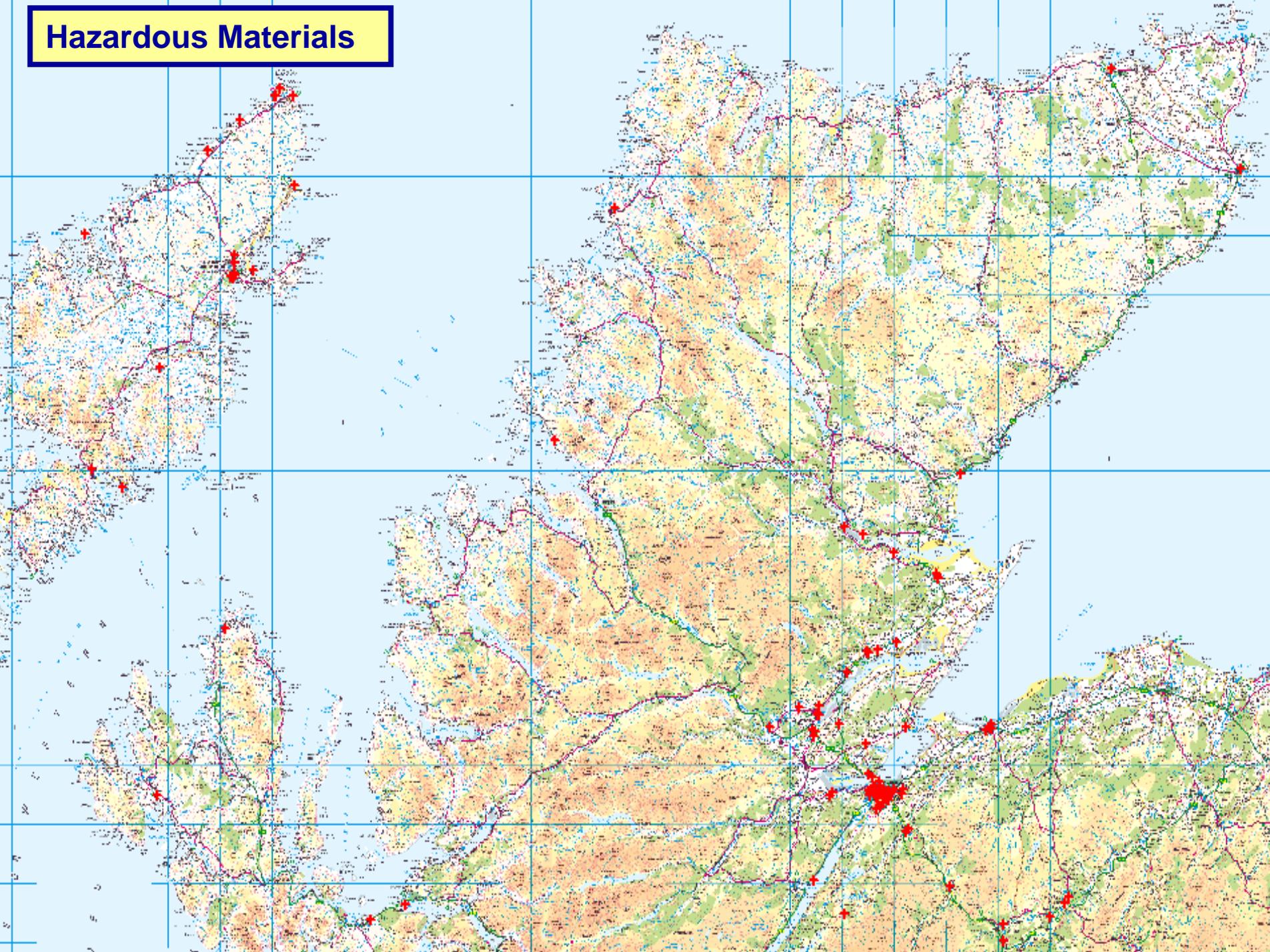
# Dwelling Fires



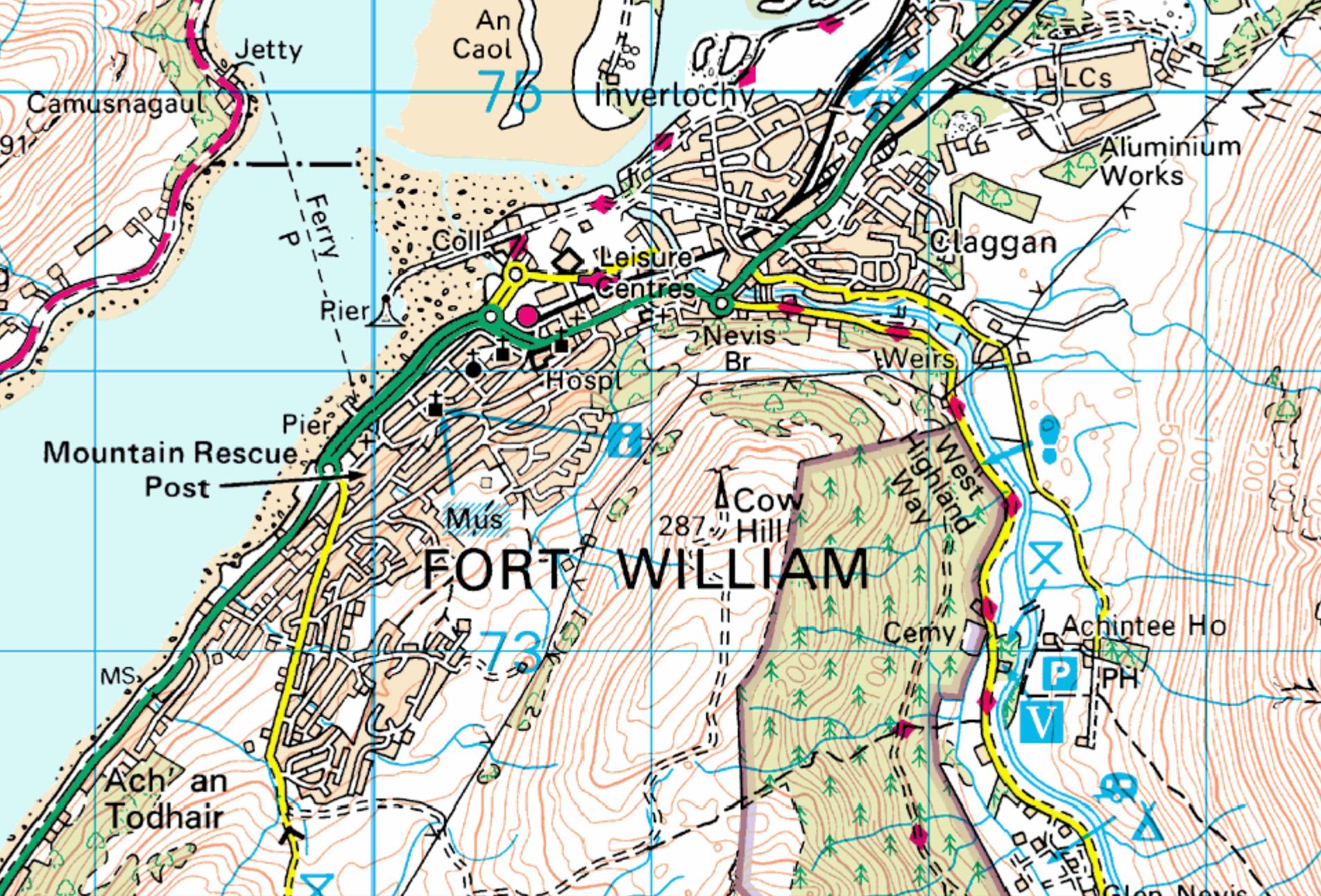
# Road Traffic Accidents



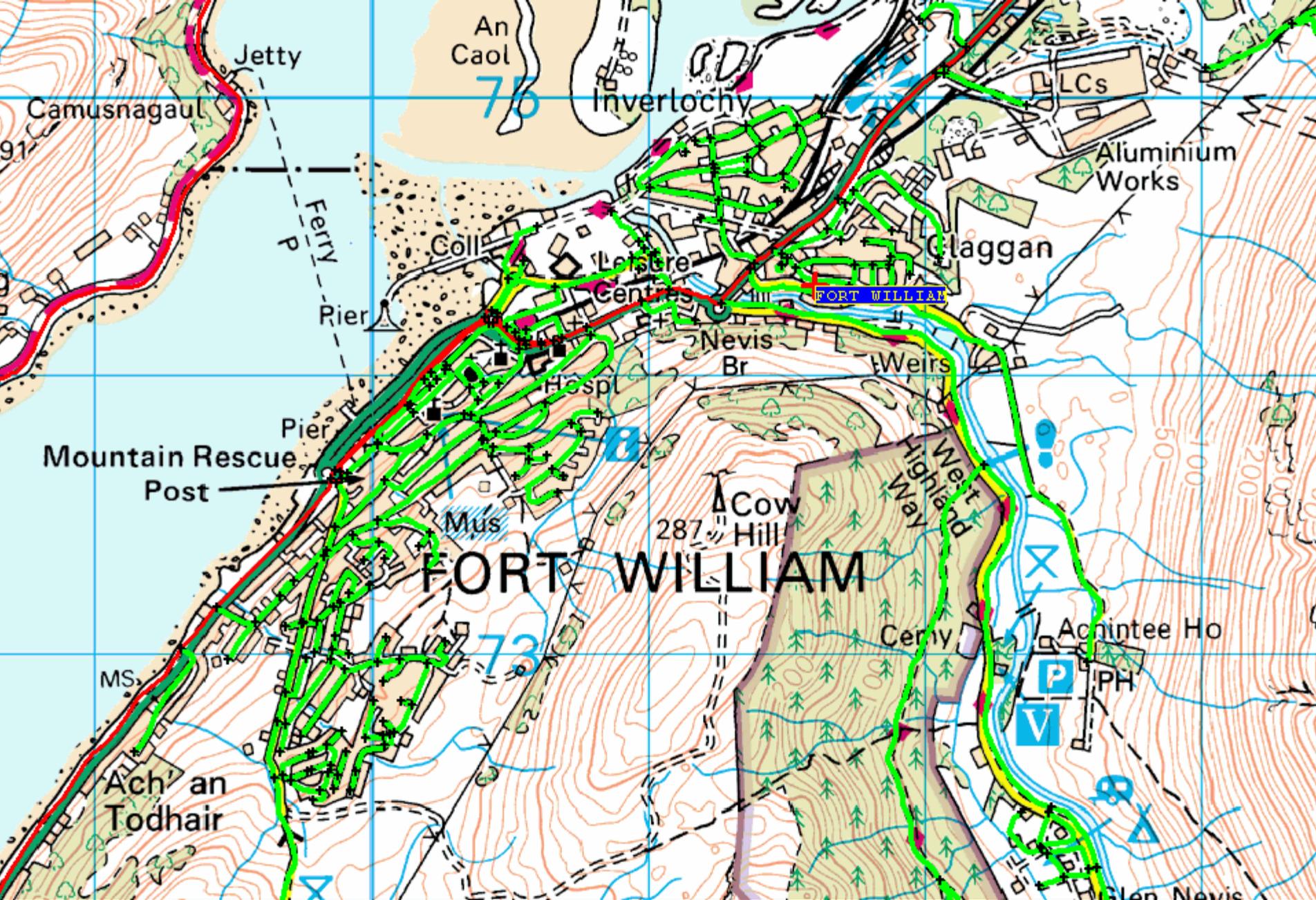
# Hazardous Materials



# Road Network



Road Network



Road Network – Fort William

## Road Junction

Road Junction Grid Ref 210238 773985

Junction Number

Junction Name

Nearest Stations (Travel Time in mins)

Genuine Dead End

Station Key

Station	<input type="text" value="A06"/>	<input type="text" value="A29"/>	<input type="text" value="A10"/>	<input type="text" value="A24"/>	<input type="text" value="A26"/>	<input type="text" value="F74"/>
---------	----------------------------------	----------------------------------	----------------------------------	----------------------------------	----------------------------------	----------------------------------

Travel Time	<input type="text" value="1.99"/>	<input type="text" value="14.12"/>	<input type="text" value="47.03"/>	<input type="text" value="50.32"/>	<input type="text" value="52.58"/>	<input type="text" value="59.6"/>
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Station	<input type="text" value="77-134"/>	<input type="text" value="A50"/>	<input type="text" value="A21"/>	<input type="text" value="A08"/>	<input type="text" value="A09"/>	<input type="text" value="A05"/>
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Travel Time	<input type="text" value="66.84"/>	<input type="text" value="69.52"/>	<input type="text" value="69.53"/>	<input type="text" value="69.82"/>	<input type="text" value="72.64"/>	<input type="text" value="73.47"/>
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Station	<input type="text" value="A31"/>	<input type="text" value="A27"/>	<input type="text" value="77-132"/>	<input type="text" value="A22"/>	<input type="text" value="B49"/>	<input type="text" value="A04"/>
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Travel Time	<input type="text" value="76.3"/>	<input type="text" value="76.69"/>	<input type="text" value="83.94"/>	<input type="text" value="85.25"/>	<input type="text" value="91.9"/>	<input type="text" value="93.62"/>
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Station	<input type="text" value="A39"/>	<input type="text" value="A25"/>	<input type="text" value="A01"/>	<input type="text" value="A49"/>	<input type="text" value="A47"/>	<input type="text" value="B47"/>
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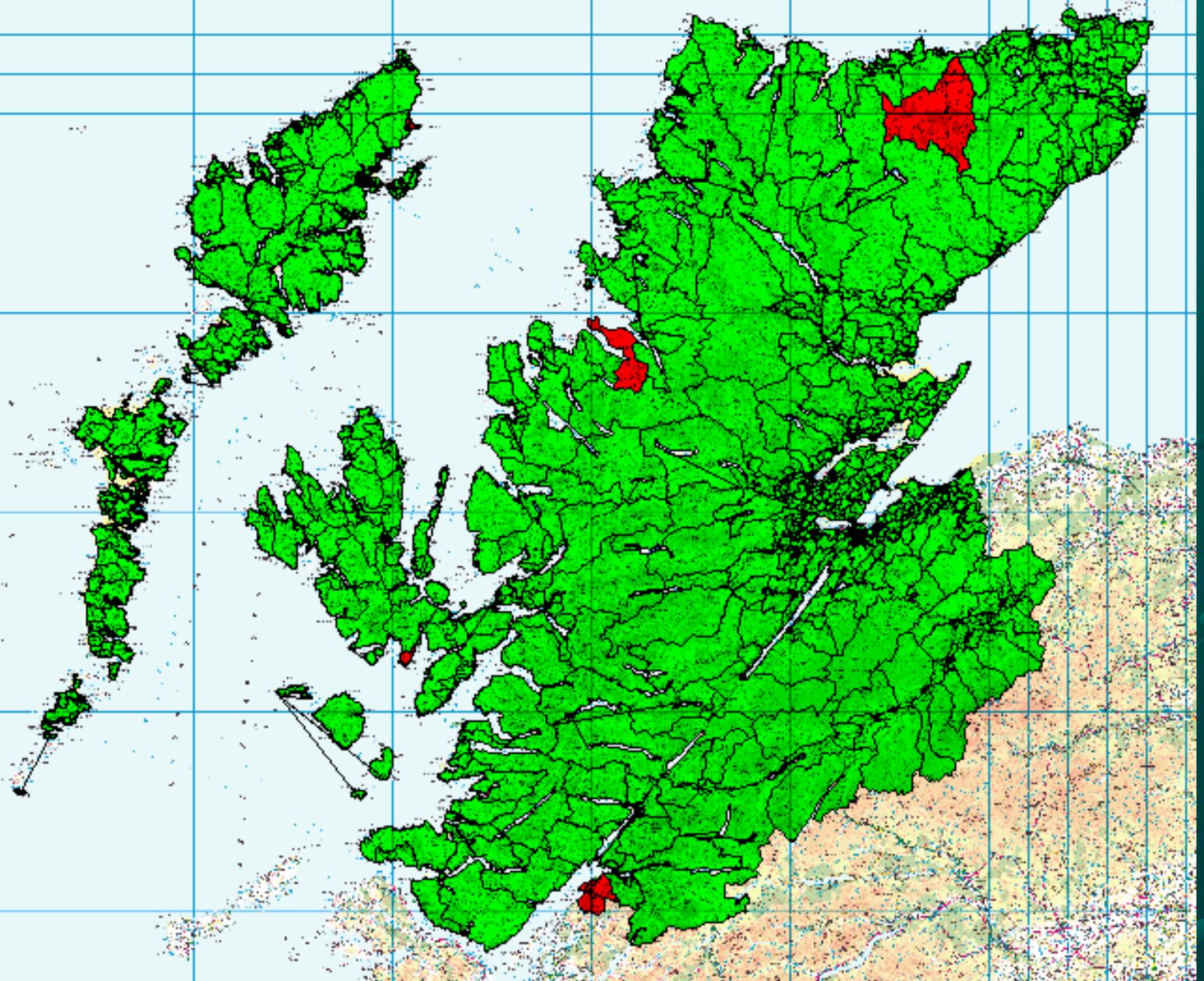
Travel Time	<input type="text" value="94.4"/>	<input type="text" value="96.45"/>	<input type="text" value="100.39"/>	<input type="text" value="101.22"/>	<input type="text" value="102.48"/>	<input type="text" value="110.1"/>
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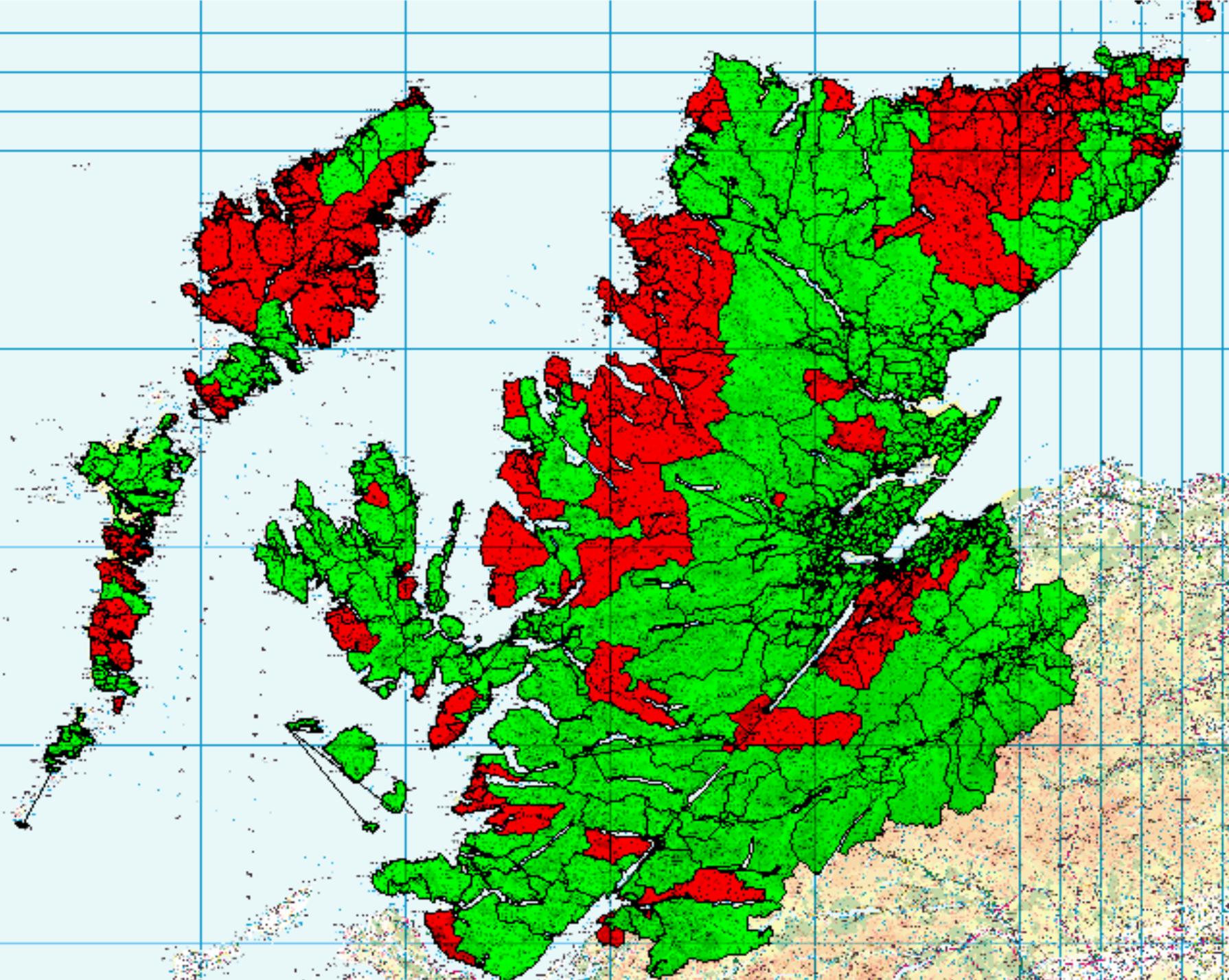
Station	<input type="text" value="B01"/>	<input type="text" value="A48"/>	<input type="text" value="B09"/>	<input type="text" value="B39"/>	<input type="text" value="A23"/>	<input type="text" value="A03"/>
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Travel Time	<input type="text" value="110.17"/>	<input type="text" value="110.31"/>	<input type="text" value="111.56"/>	<input type="text" value="112.77"/>	<input type="text" value="113.07"/>	<input type="text" value="113.53"/>
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- C06 KIRKWALL
- C07 STROMNESS
- C09 BRAE
- C08 LERWICK
- B11 BROADFORD
- A08 MALLAIG
- B10 PORTREE
- B06 STORNOWAY
- 77-1357 TOBERMORY FIRE
- B05 ULLAPOOL
- C10 KINLOCHBERVIE
- C05 LAIRG
- C04 GOLSPIE
- C01 THURSO
- C02 WICK
- B08 GAIRLOCH
- B09 KYLE OF LOCHALSH
- B01 DINGWALL
- 82-426 FORRES
- A04 AVIEMORE
- C03 DORNOCH
- B02 FORTROSE
- A03 GRANTOWN
- B03 INVERGORDON

DLG version 1-1

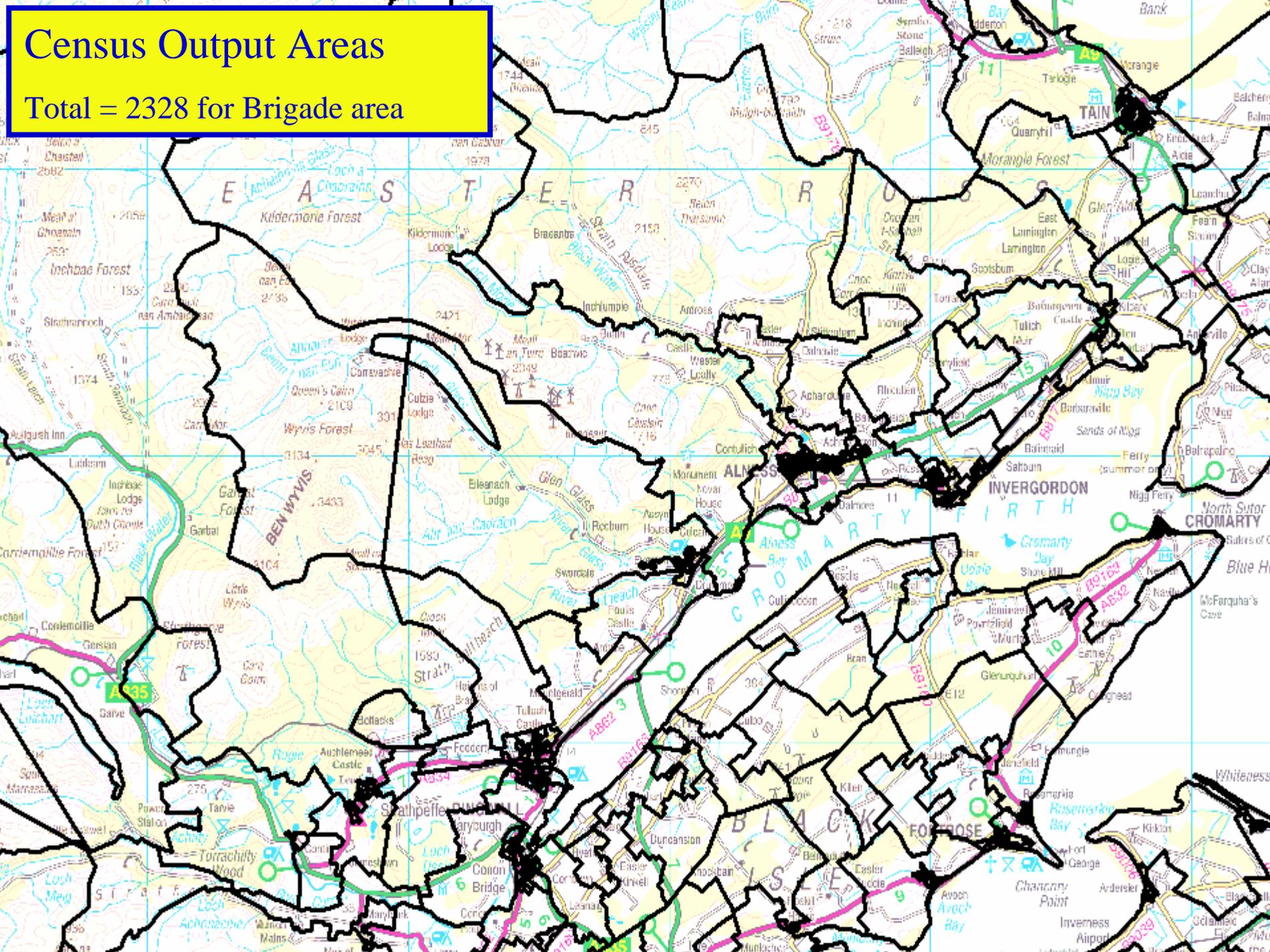


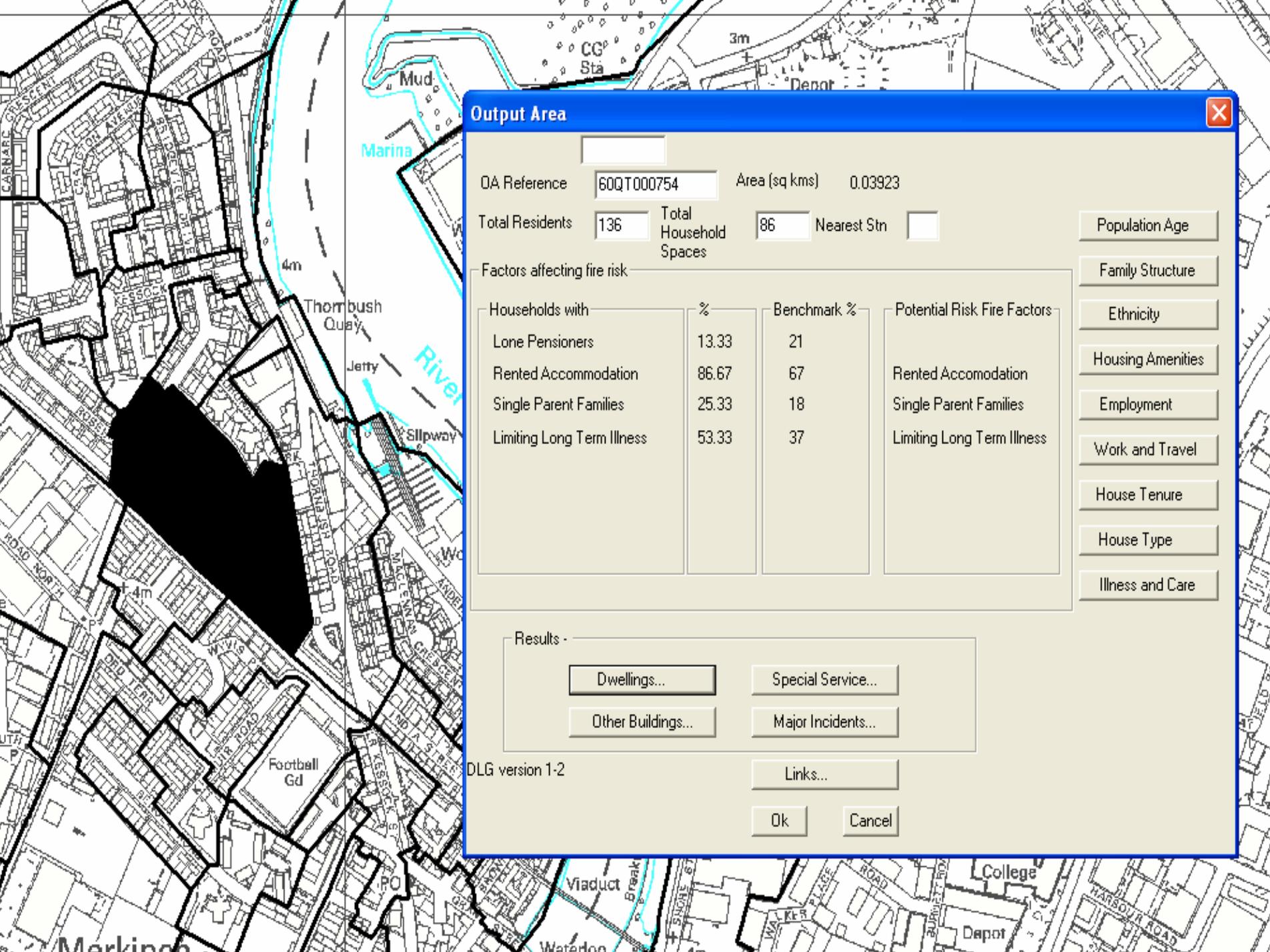


# Dwelling Risk

# Census Output Areas

Total = 2328 for Brigade area





### Output Area



OA Reference  Area (sq kms) 0.03923

Total Residents  Total Household Spaces  Nearest Stn

#### Factors affecting fire risk

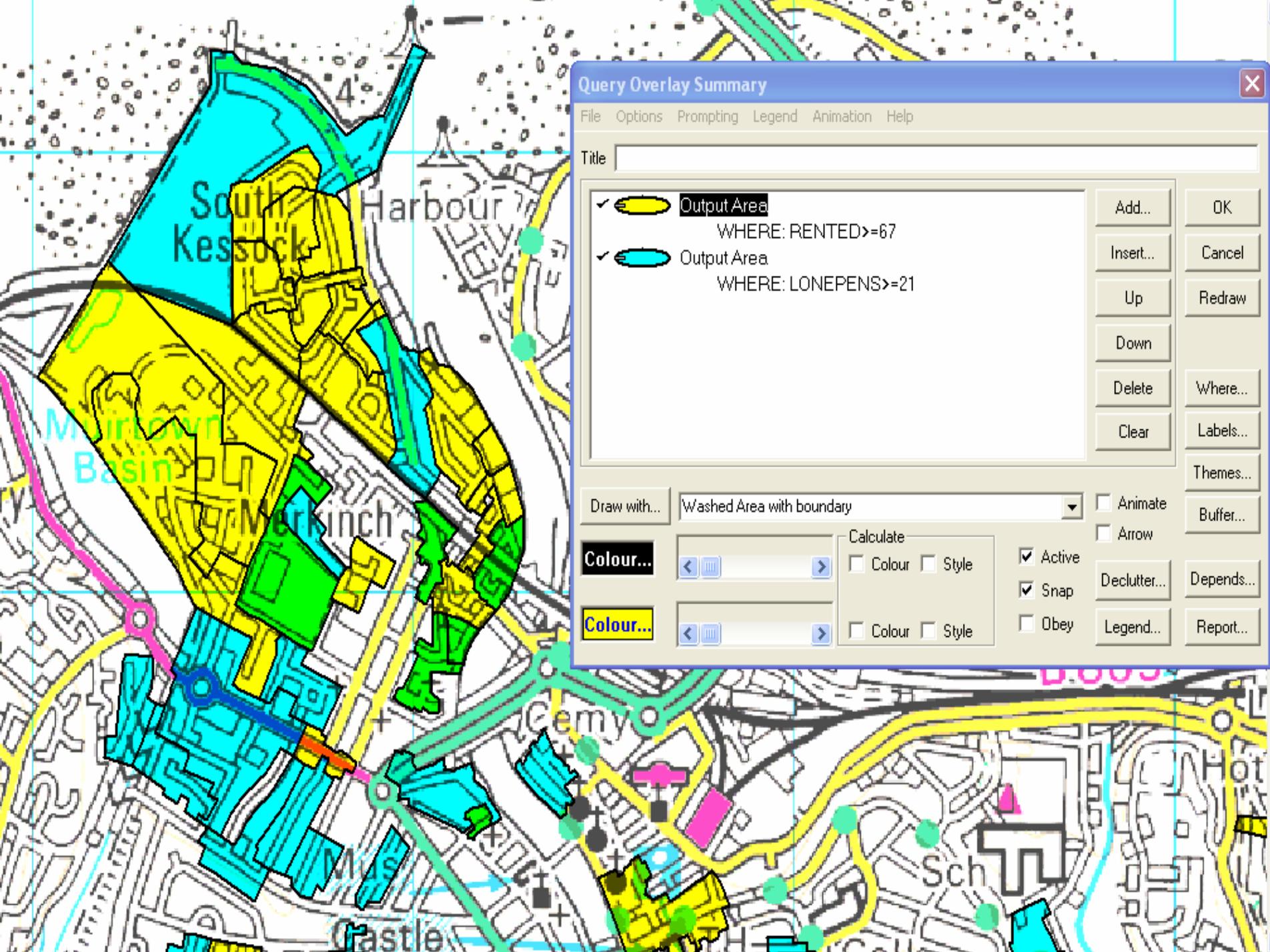
Households with	%	Benchmark %	Potential Risk Fire Factors
Lone Pensioners	13.33	21	
Rented Accommodation	86.67	67	Rented Accomodation
Single Parent Families	25.33	18	Single Parent Families
Limiting Long Term Illness	53.33	37	Limiting Long Term Illness

- Population Age
- Family Structure
- Ethnicity
- Housing Amenities
- Employment
- Work and Travel
- House Tenure
- House Type
- Illness and Care

#### Results -

- Dwellings...
- Special Service...
- Other Buildings...
- Major Incidents...
- Links...
- Ok
- Cancel

DLG version 1-2



### Query Overlay Summary

File Options Prompting Legend Animation Help

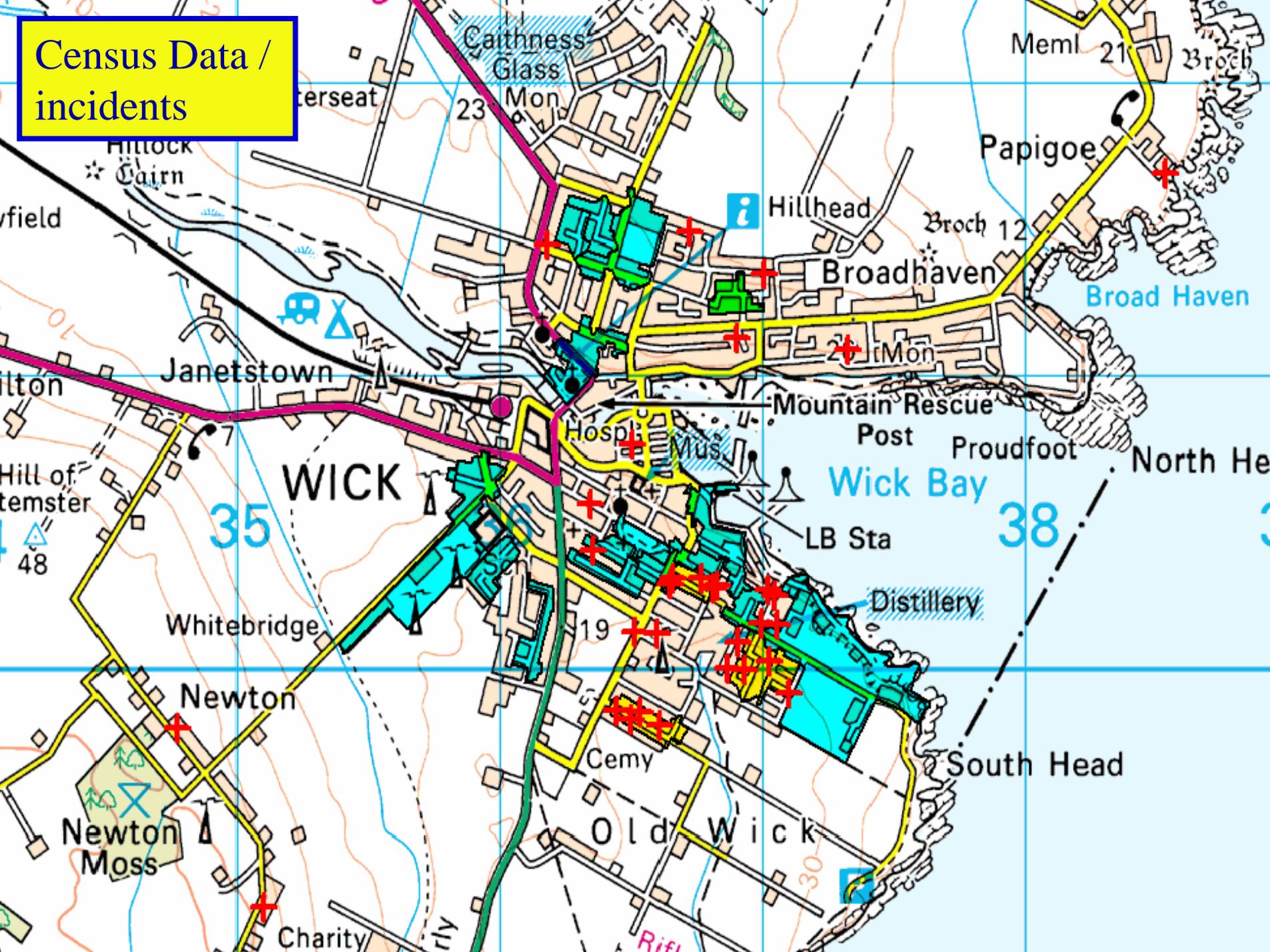
Title

<input checked="" type="checkbox"/>  <b>Output Area</b> WHERE: RENTED>=67	Add...	OK
<input checked="" type="checkbox"/>  <b>Output Area</b> WHERE: LONEPENS>=21	Insert...	Cancel
	Up	Redraw
	Down	
	Delete	Where...
	Clear	Labels...
		Themes...
		Buffer...

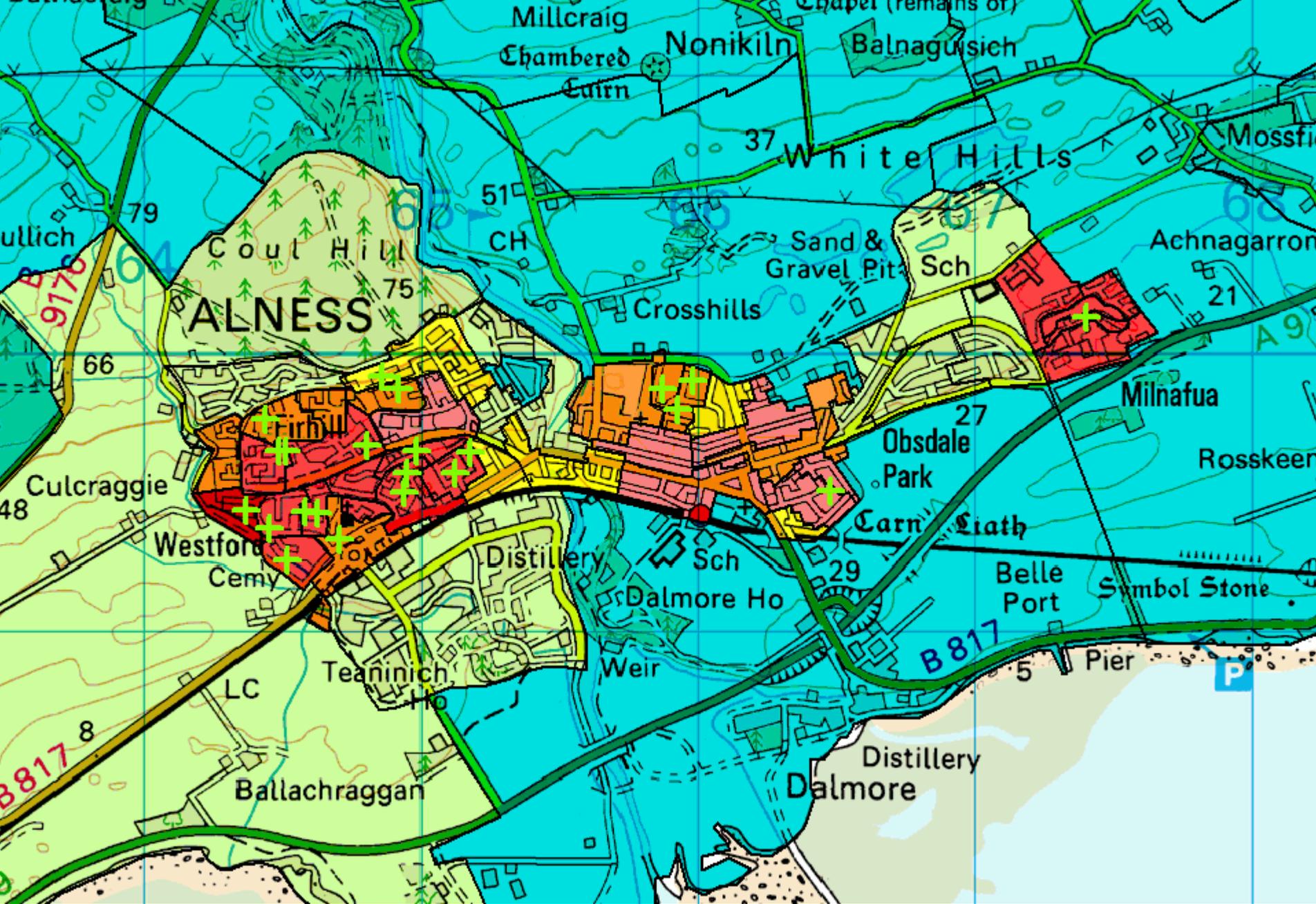
Draw with... Washed Area with boundary  Animate  Arrow

<b>Colour...</b> 	Calculate <input type="checkbox"/> Colour <input type="checkbox"/> Style	<input checked="" type="checkbox"/> Active	Declutter...	Depends...
<b>Colour...</b> 	<input type="checkbox"/> Colour <input type="checkbox"/> Style	<input checked="" type="checkbox"/> Snap	Legend...	Report...
		<input type="checkbox"/> Obey		

Census Data / incidents







Dwelling Risk Areas + Dwelling Fires - Alness

# Risks

## ● Risk to Property

- Basic costs
- Heritage Risk
- Commercial Risk
- Environmental Risk

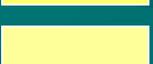
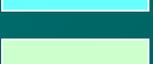
## ● Risk to Life

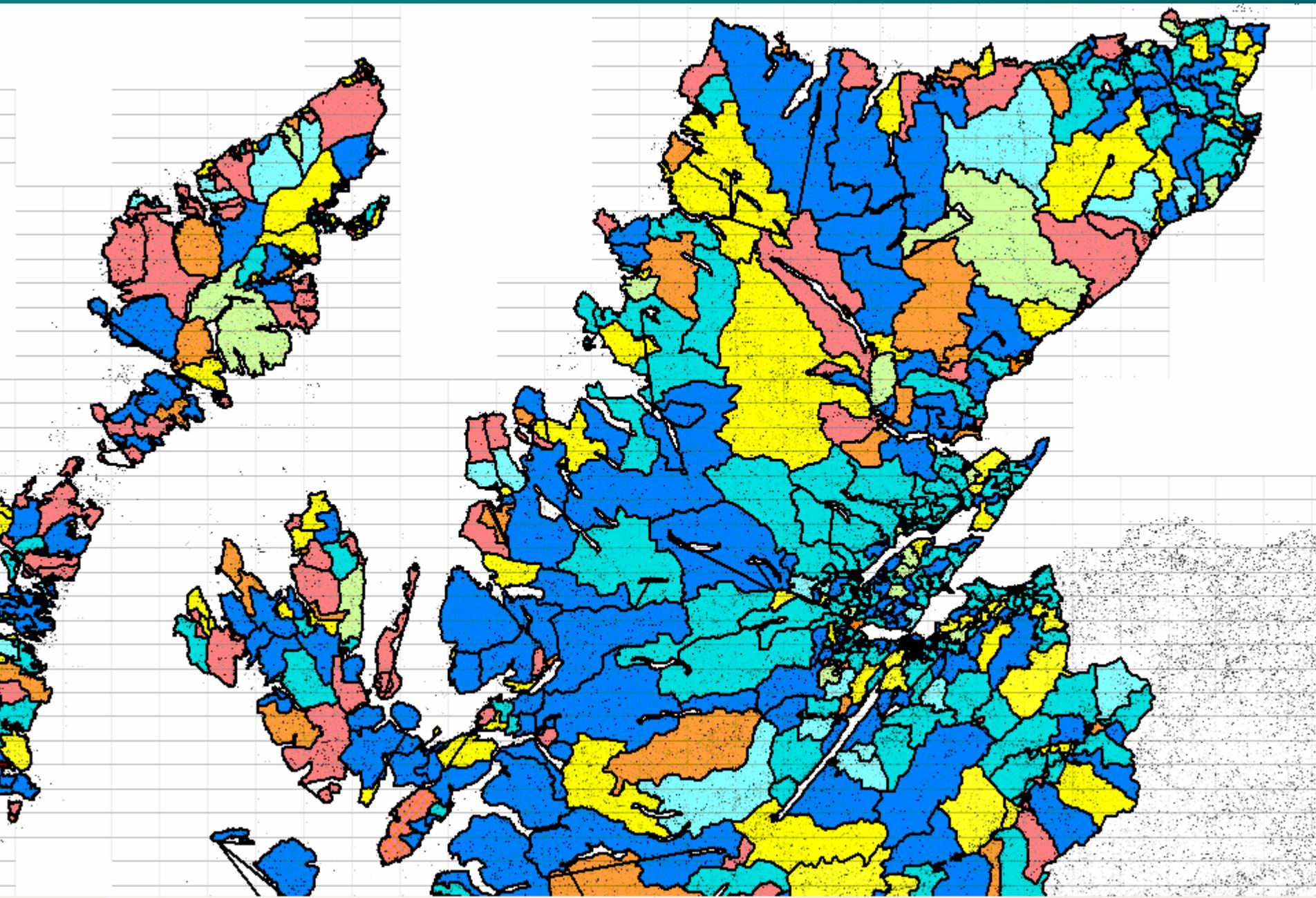
- Individual Life Risk
- Societal Life Risk
- Firefighter Life Risk

# Methodology

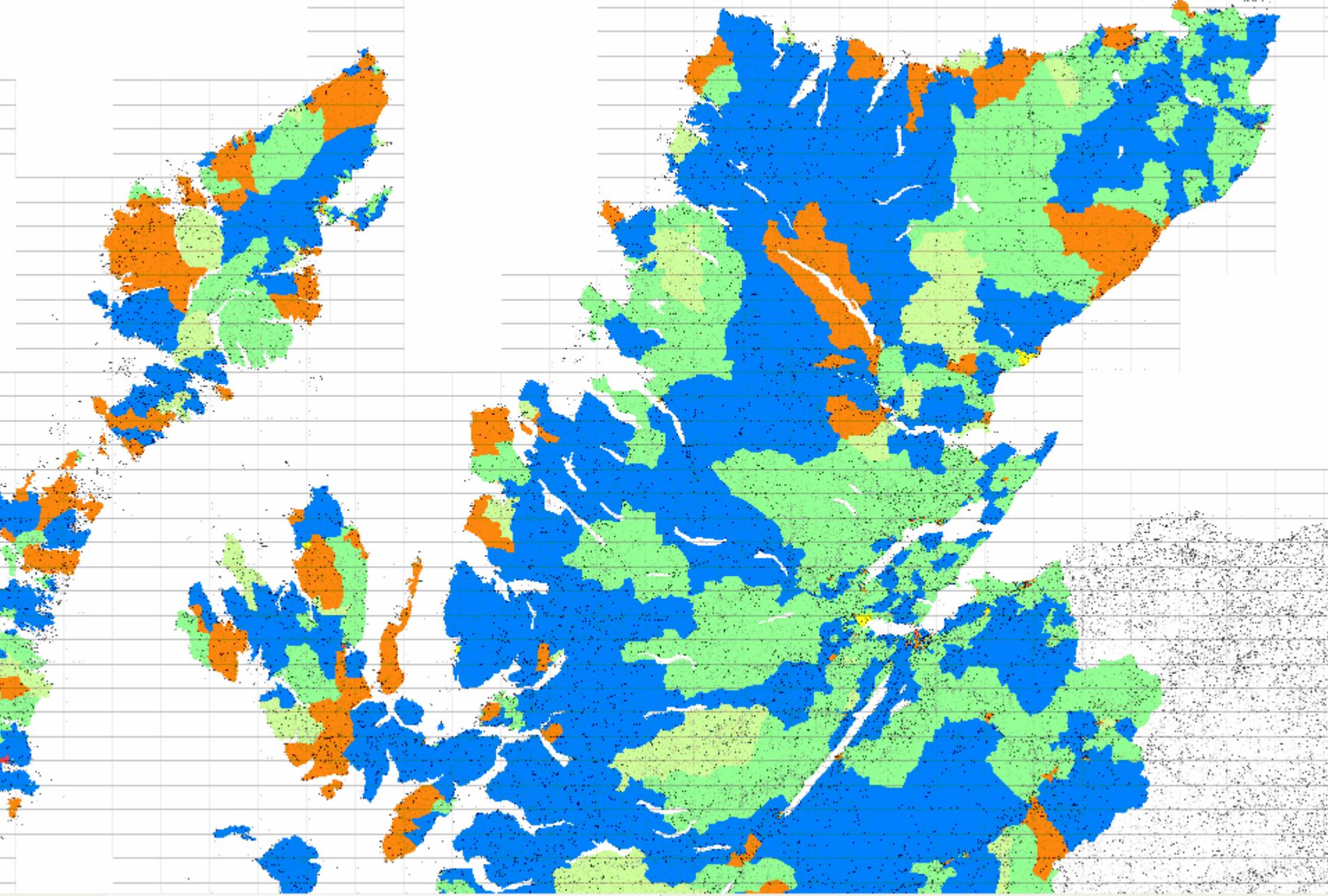


# FSEC Risk Colour Coding

	<b>Very High percentage of Rented accommodation and Lone Pensioners</b>
	<b>Very High percentage of Rented accommodation</b>
	<b>Very High percentage of Lone Pensioners</b>
	<b>High percentage of Rented accommodation and Lone Pensioners</b>
	<b>High percentage of Rented accommodation</b>
	<b>High percentage of Lone Pensioners</b>
	<b>Medium percentage of Rented accommodation and Lone Pensioners</b>
	<b>Medium percentage of Rented accommodation</b>
	<b>Medium percentage of Lone Pensioners</b>
	<b>Low percentage of Rented accommodation and Lone Pensioners</b>
	<b>Low percentage of Rented accommodation</b>
	<b>Low percentage of Lone Pensioners</b>
	<b>Very Low percentage of Rented accommodation and Lone Pensioners</b>



Dwelling Risk Areas

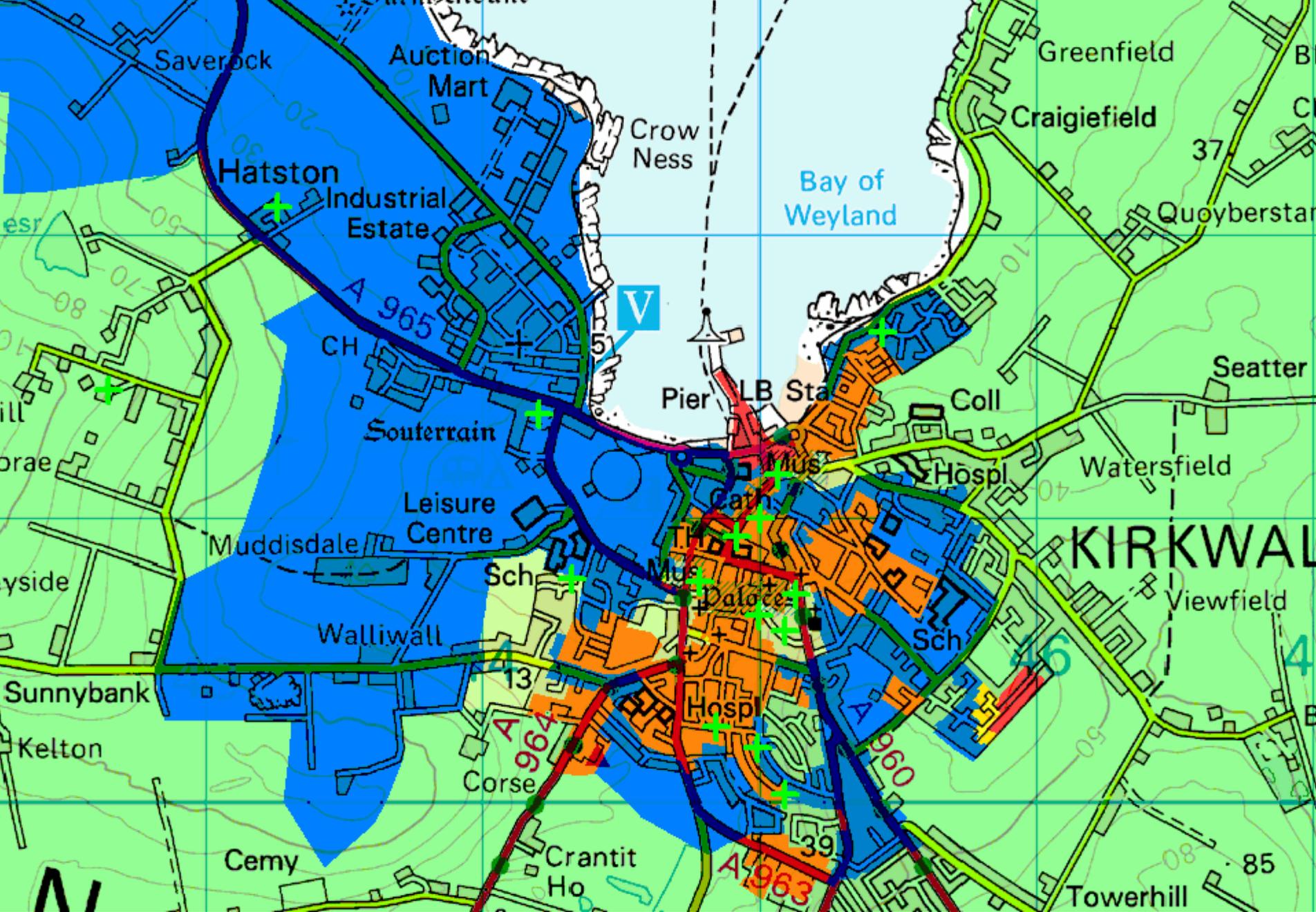


Dwelling Risk Groups - Merged



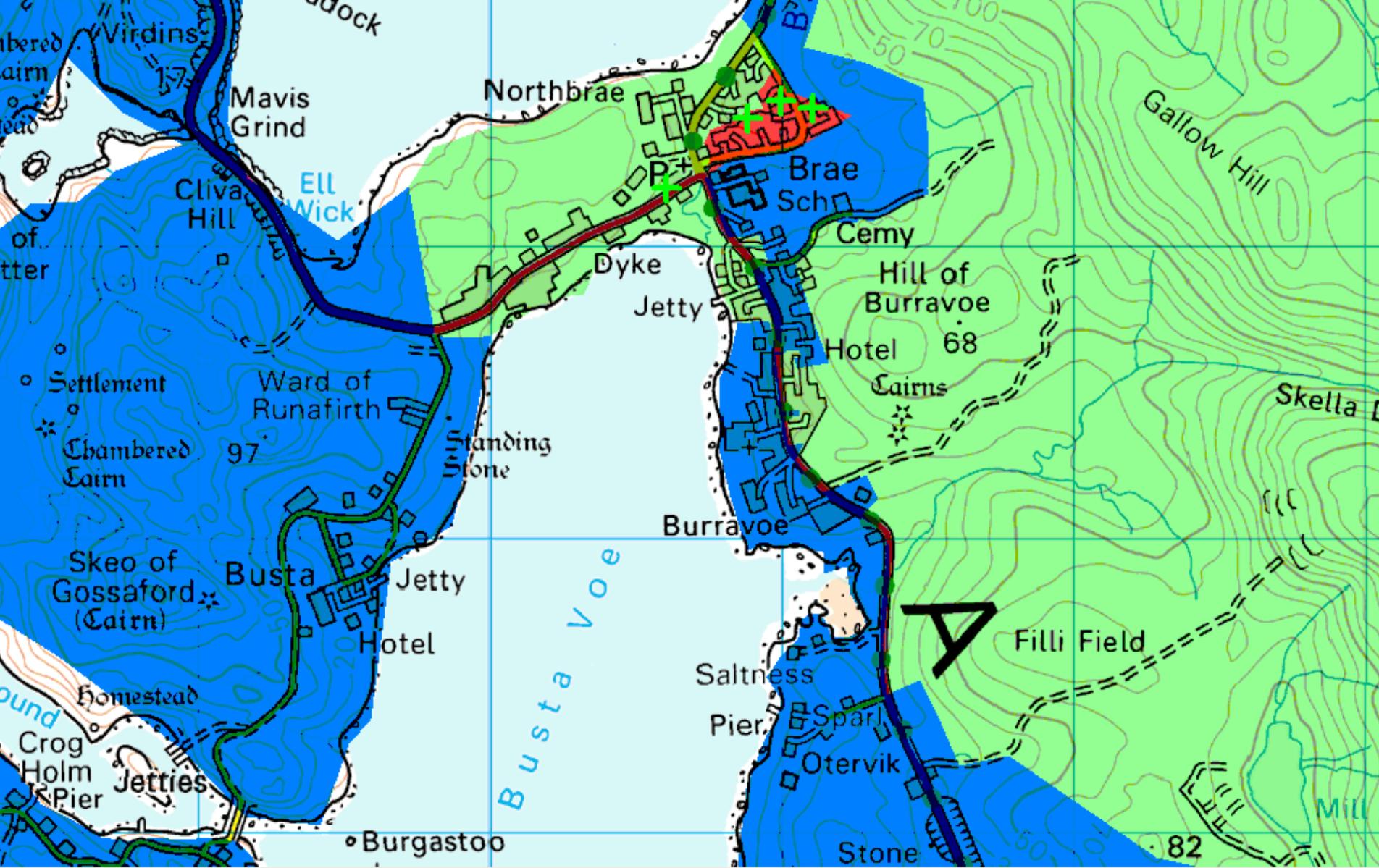






Dwelling Risk Groups - Kirkwall





Dwelling Risk Groups - Shetland - Brae

# Other Buildings Module

Occupancy Type
Hospital
HMO, Tenement
Care Home
Purpose Built Flats $\geq$ 4 storeys
Hostel
Hotel
House converted to Flat
Other Sleeping Accommodation
Licensed Premise
Shop
Further Education
Public Building
School
Other Premises Open to the Public
Factory or Warehouse
Office
Other Workplace

Fire Frequencies  
have been  
calculated for  
17 Occupancy Types



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# LERWICK

Shetland Sound  
Lerwick Harbour

Garthspool

Freefield

Pavilion  
Gilbertson  
Park

Hayfield  
House

Sch  
22m

Coun Offs

The  
Sletts

Langstane

Bus  
Station

Pol  
Sta

Car Park

Alexandra  
Wharf

Beacon  
North Jetty

Ferry (Vehicular) Terminal

Charlotte (1665)

Albert  
Wharf

Albert  
Dock

Victoria Pier

Beacons

Breakwater

Bressay  
Slip

Stn

Bains Beach

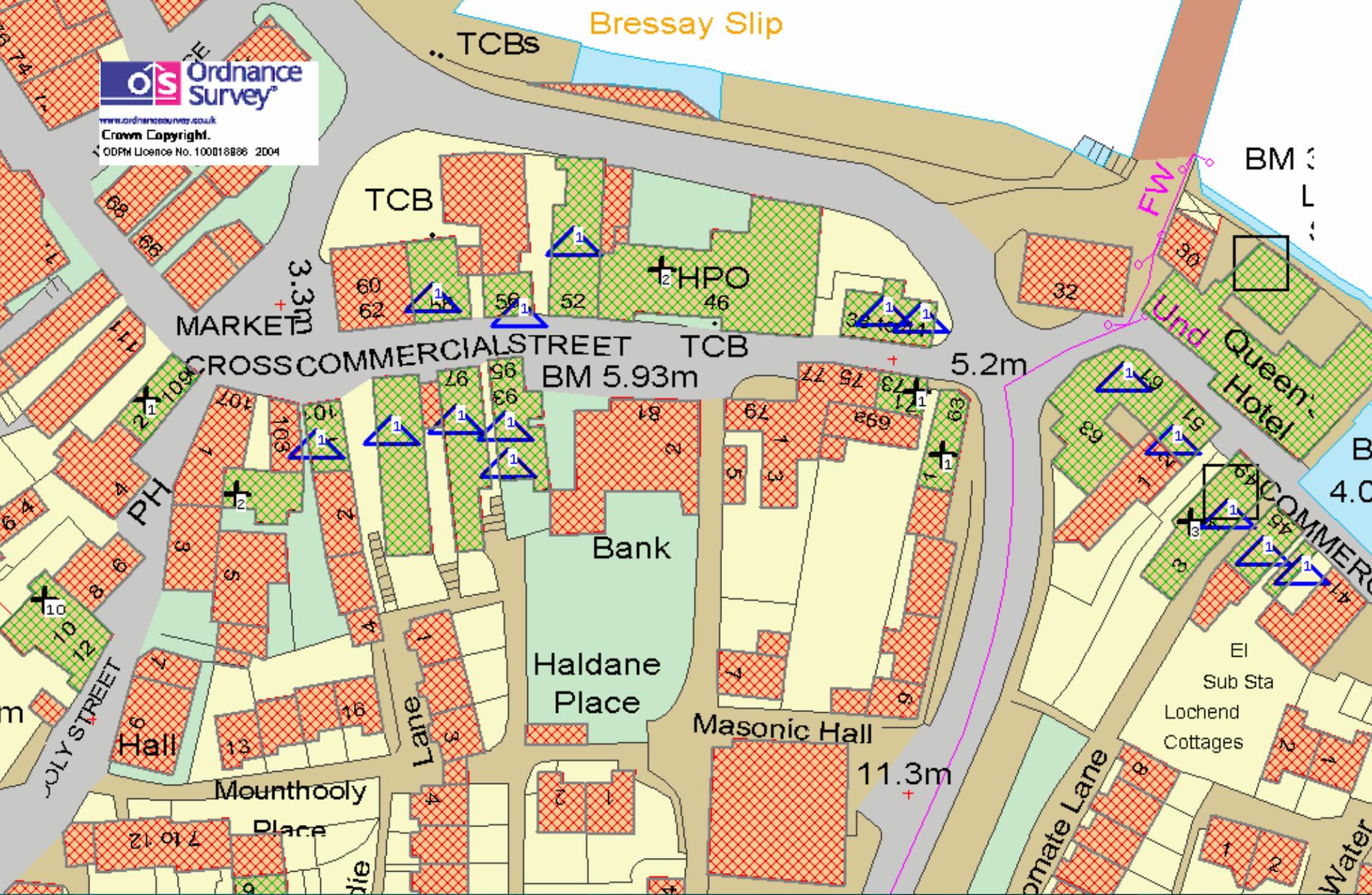
Craigie Stn

Copland's Pier

Greenfield Place

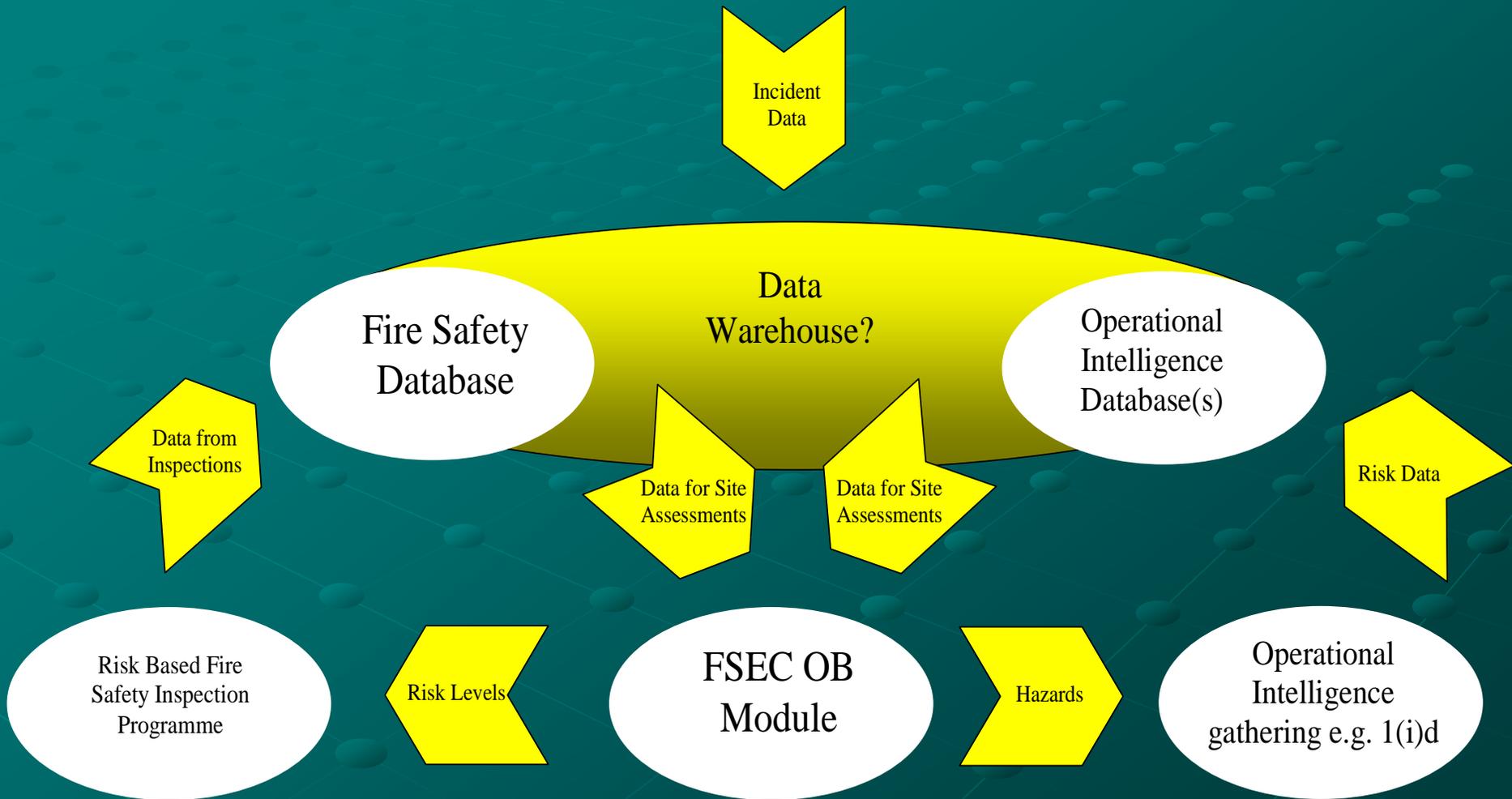
Carmy

Sch



Other Buildings – Lerwick, Shetland

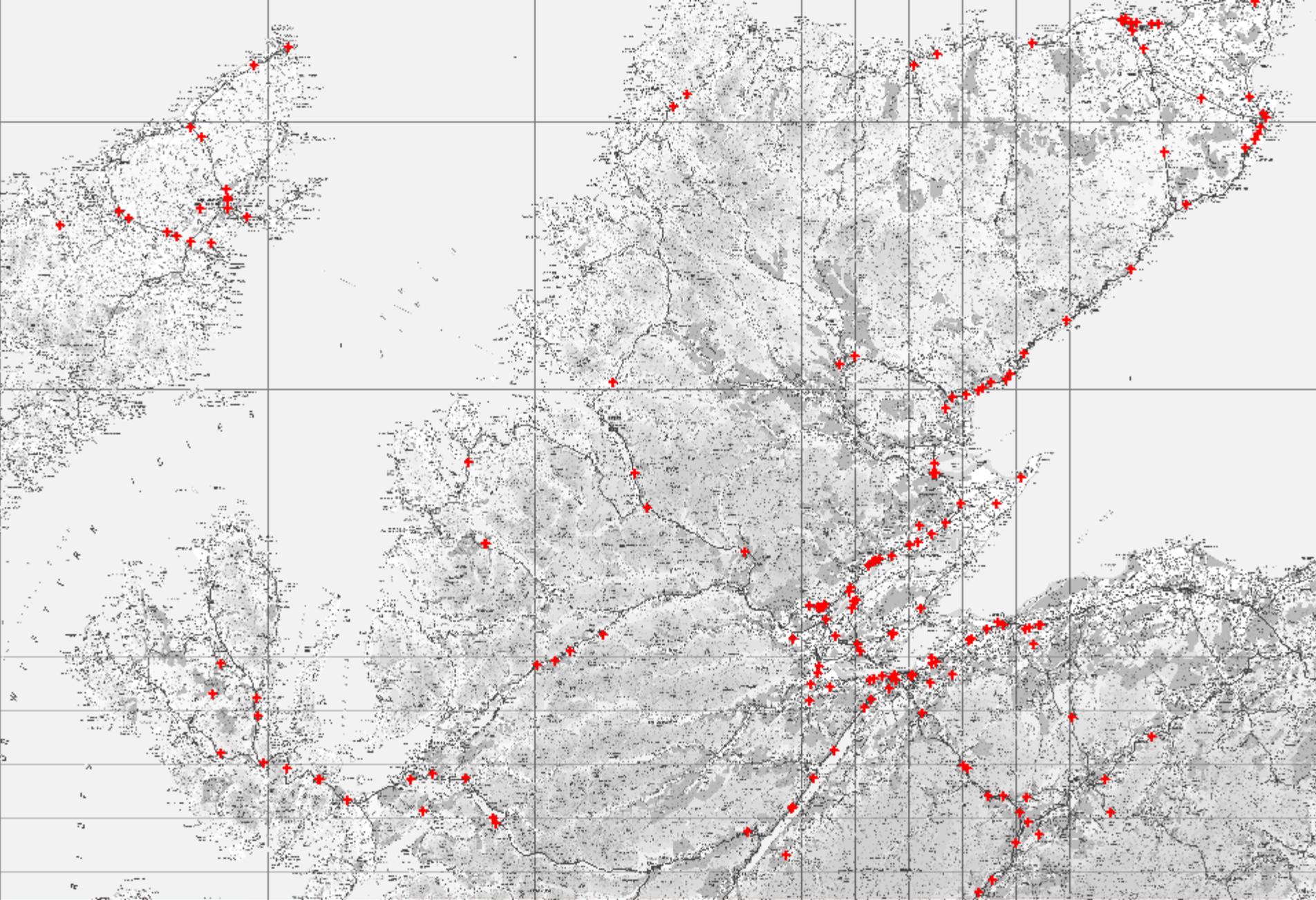
# Long Term F.S.E.C. - O.B. Links



# Special Services Module

# Special Services Types

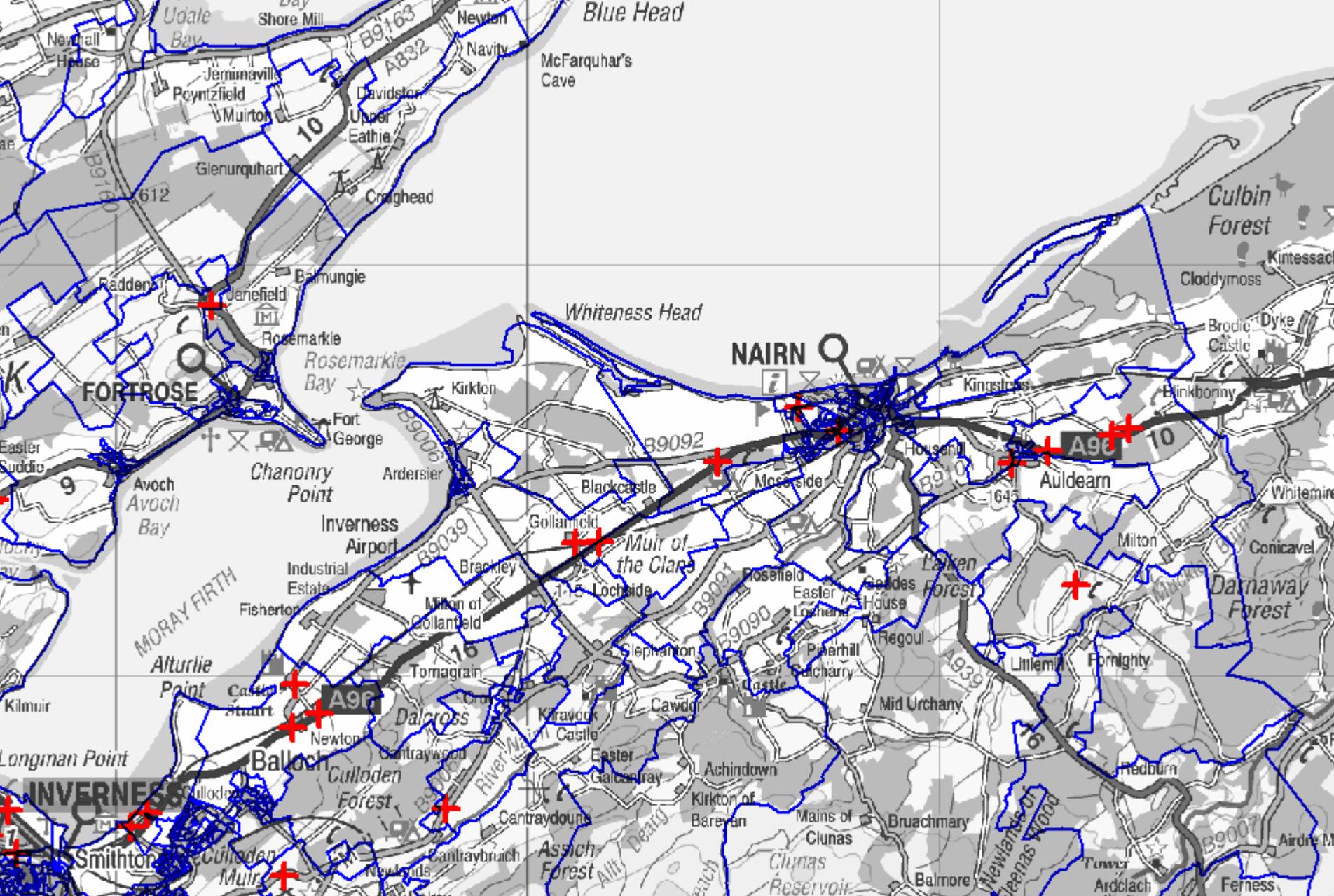
- Road Traffic Accidents
- Extrications
- Lift Rescues
- Lock in/Lock out
- Hazardous Materials
- Line Rescues
- Ladder Rescues
- Water Rescues
- Other Special Services



Road Traffic Accidents - Life Critical

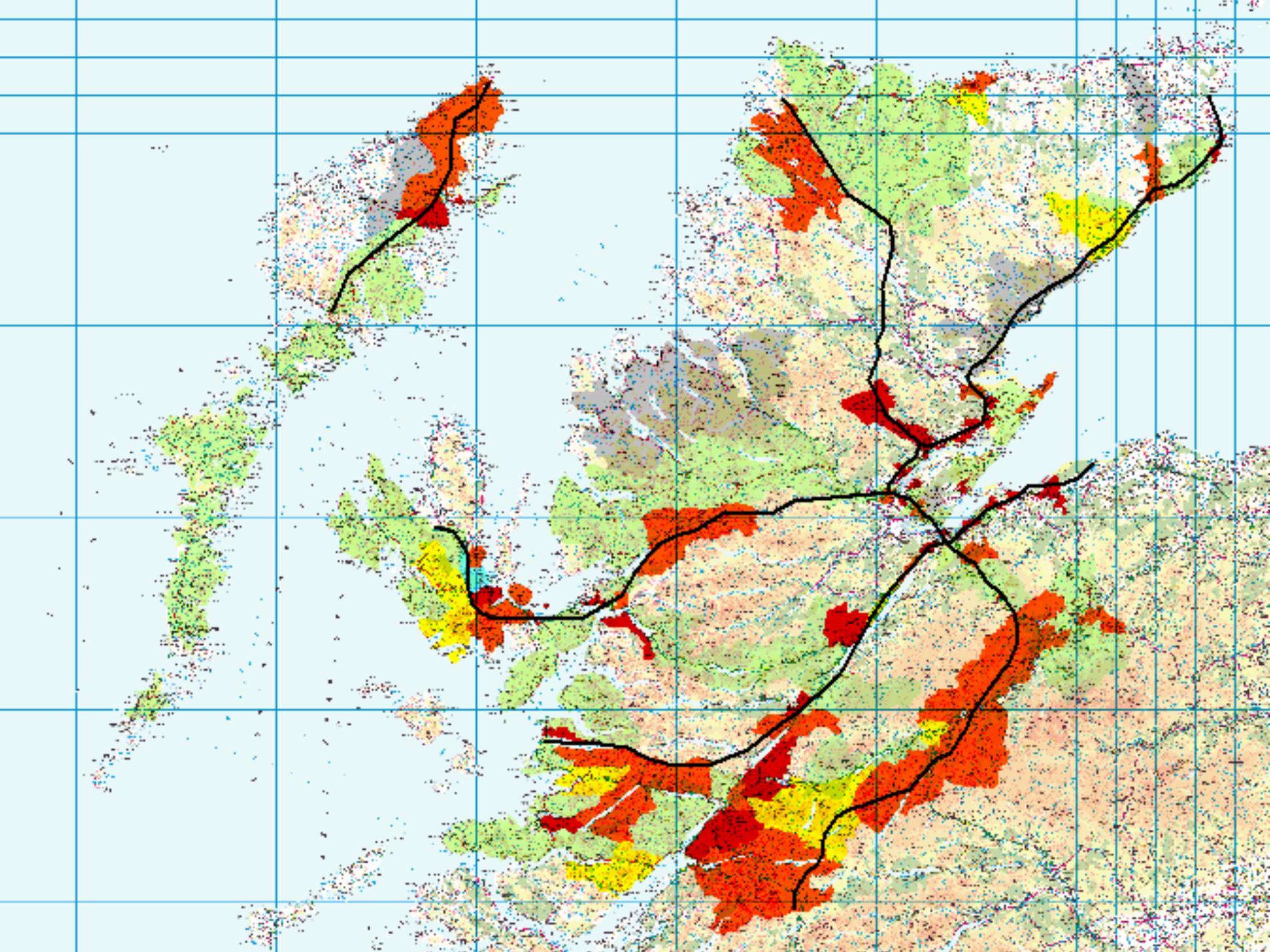


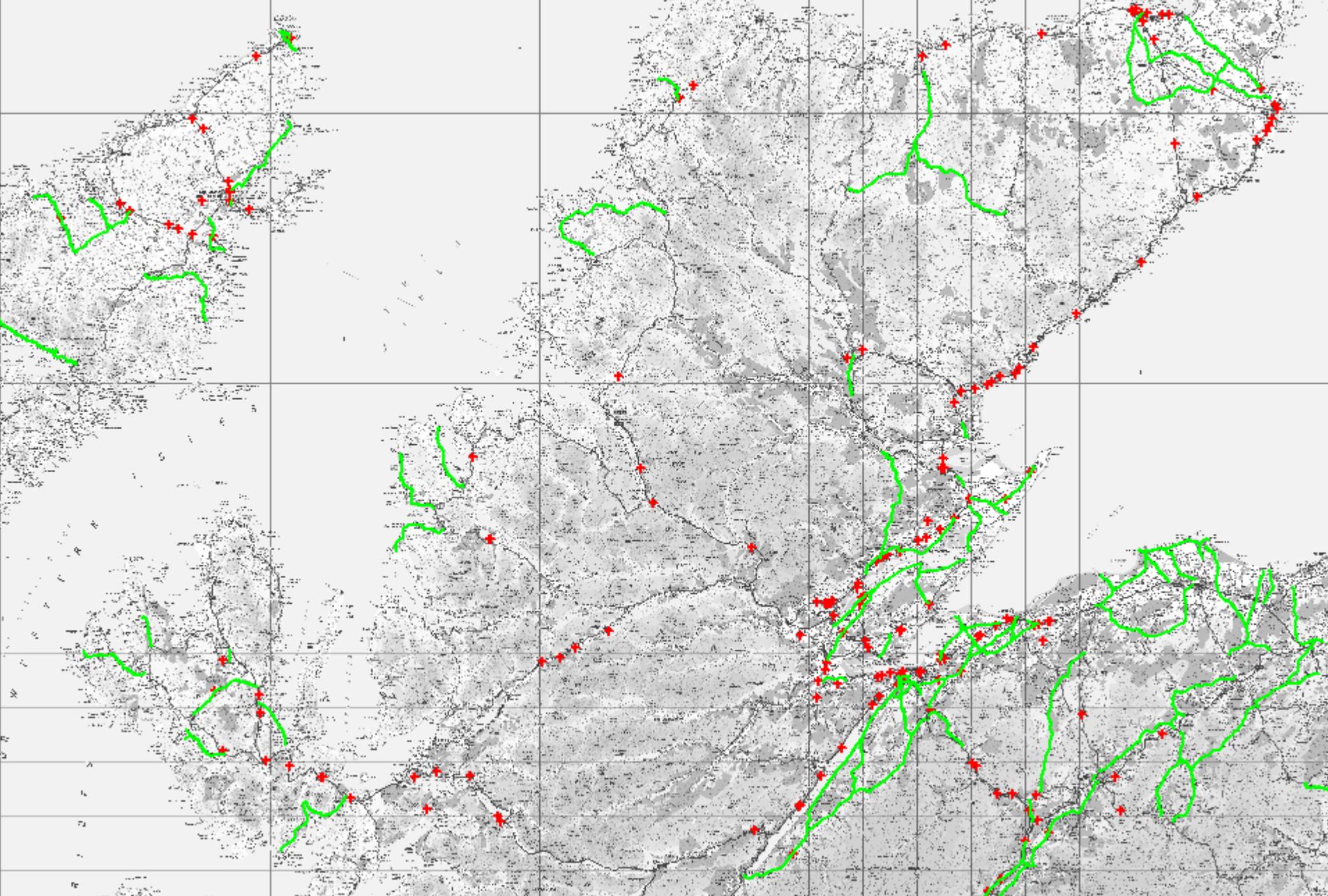
A96 Inverness to Nairn



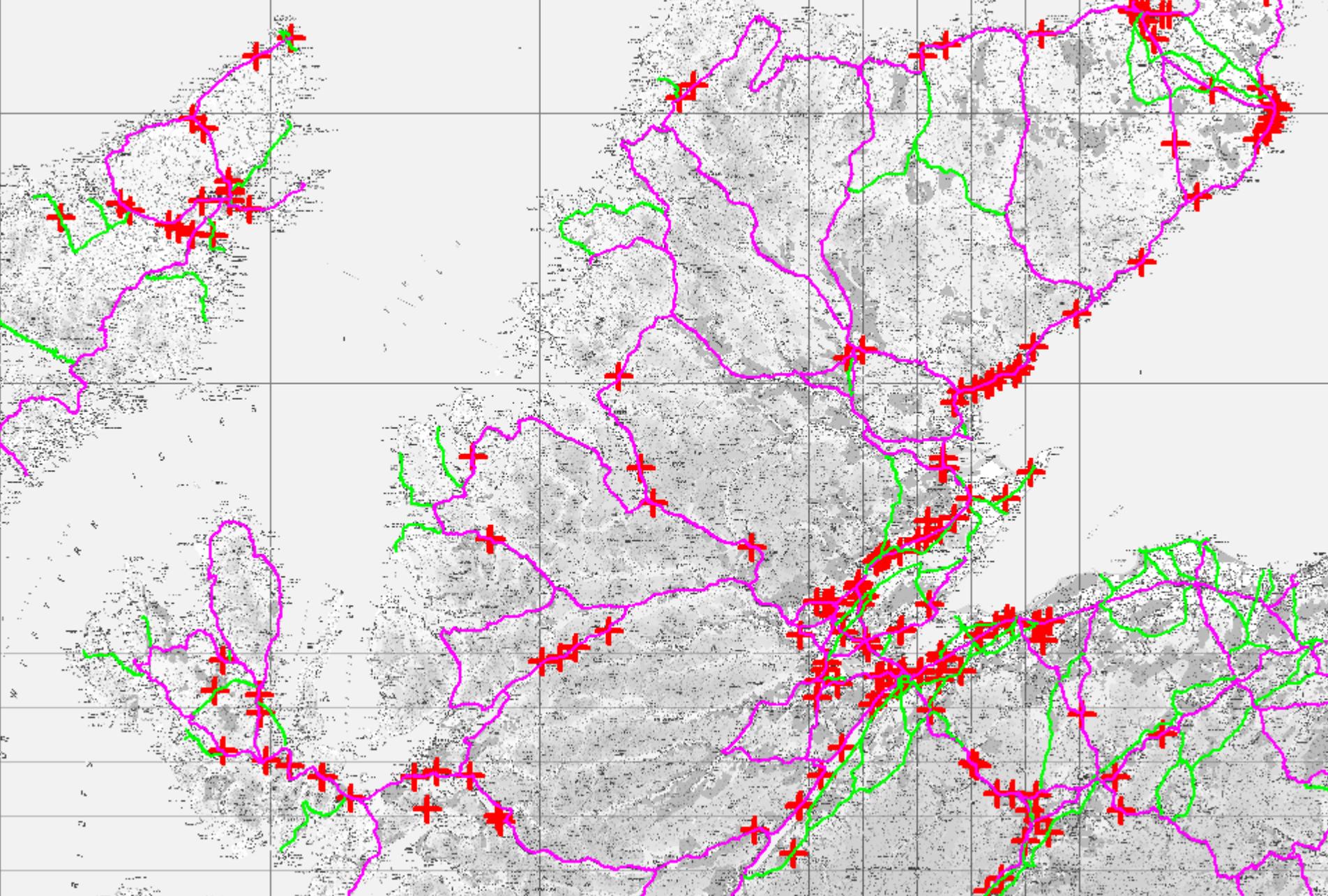
A96 - RTA Data







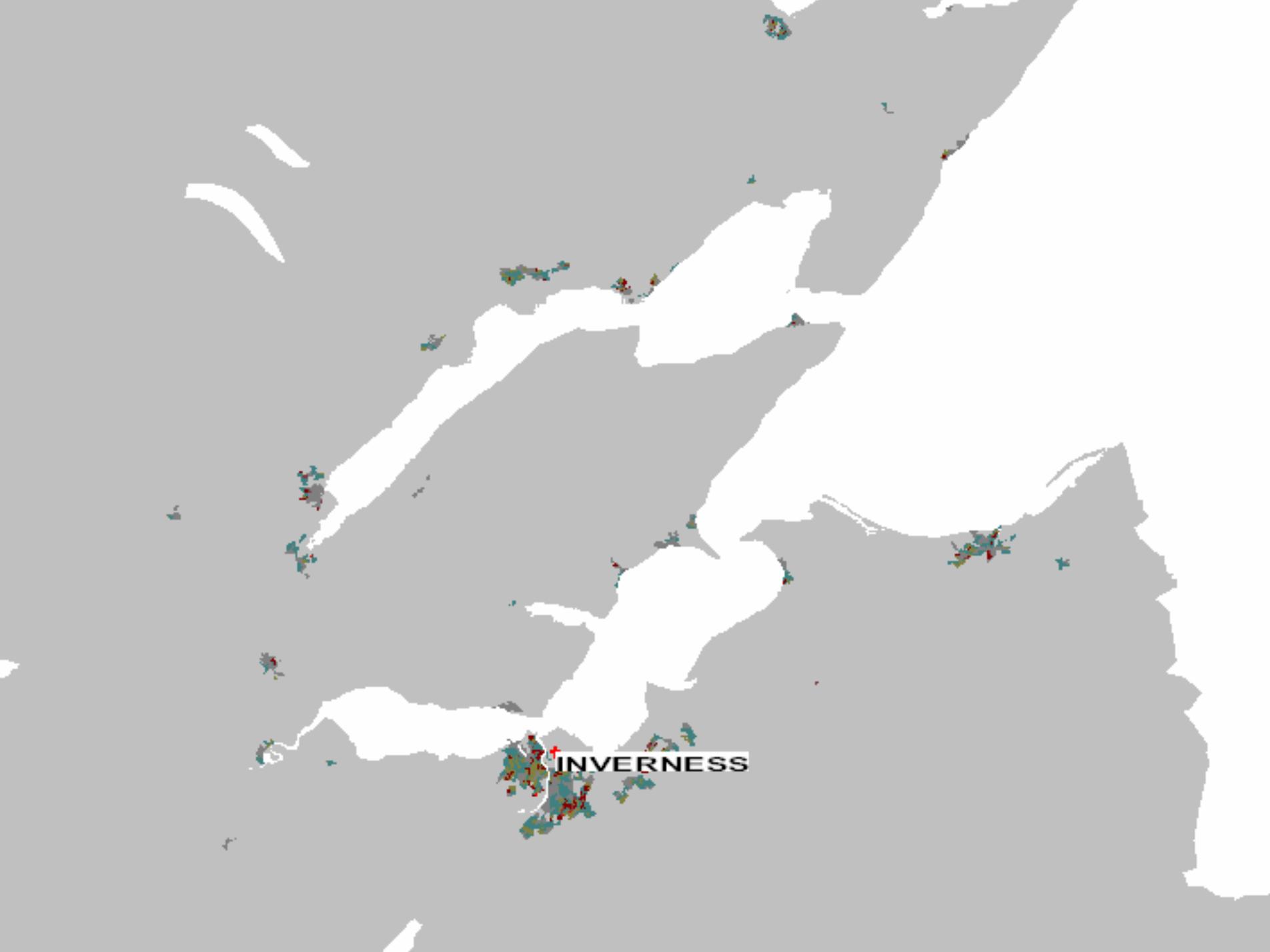
Road Traffic Accidents - Life Critical + 'B' Class Roads



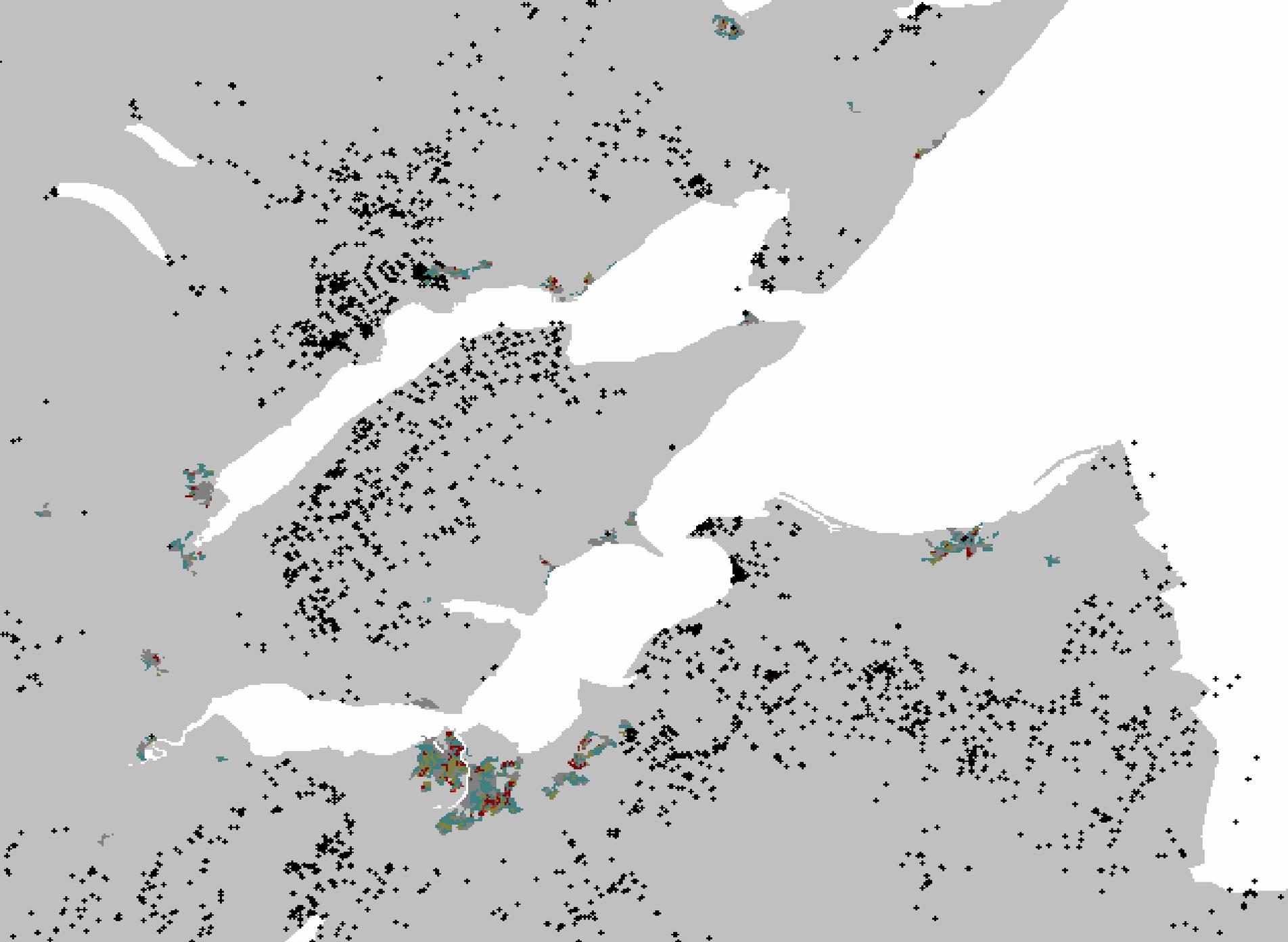
Road Traffic Accidents - Life Critical + 'A' and 'B' Class Roads

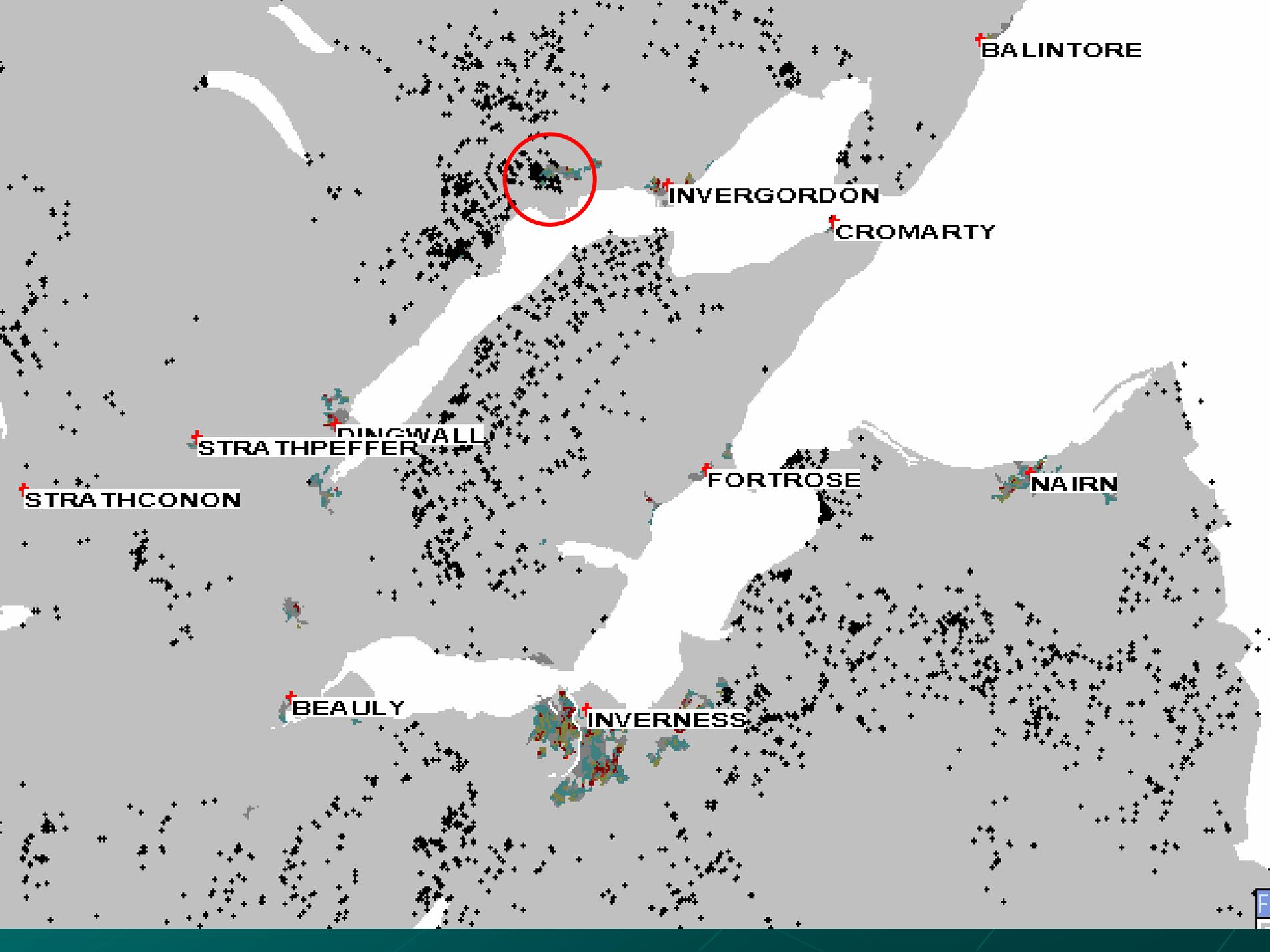
# Theoretical Risk Modelling

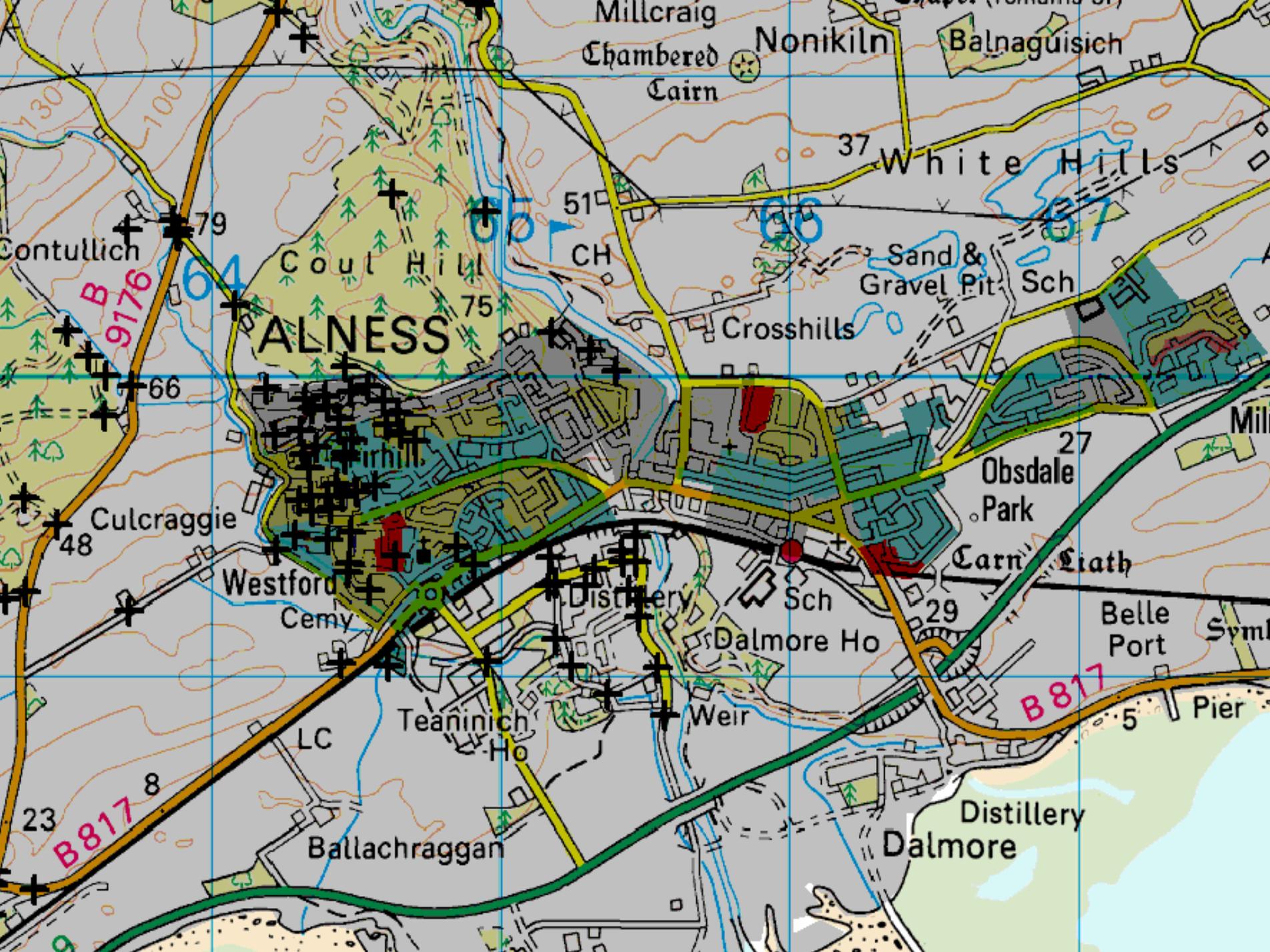




INVERNESS







Millraig Chambered Cairn Nonikiln Balnaguisich

37 White Hills

Contullich

Coul Hill 75

51 CH

Sand & Gravel Pit Sch

ALNESS

Crosshills

Culcraggie 48

27 Obsdale Park

Westford Cemy

Distillery

Dalmore Ho

Carn Siath

Belle Port

Teaninich Ho

Weir

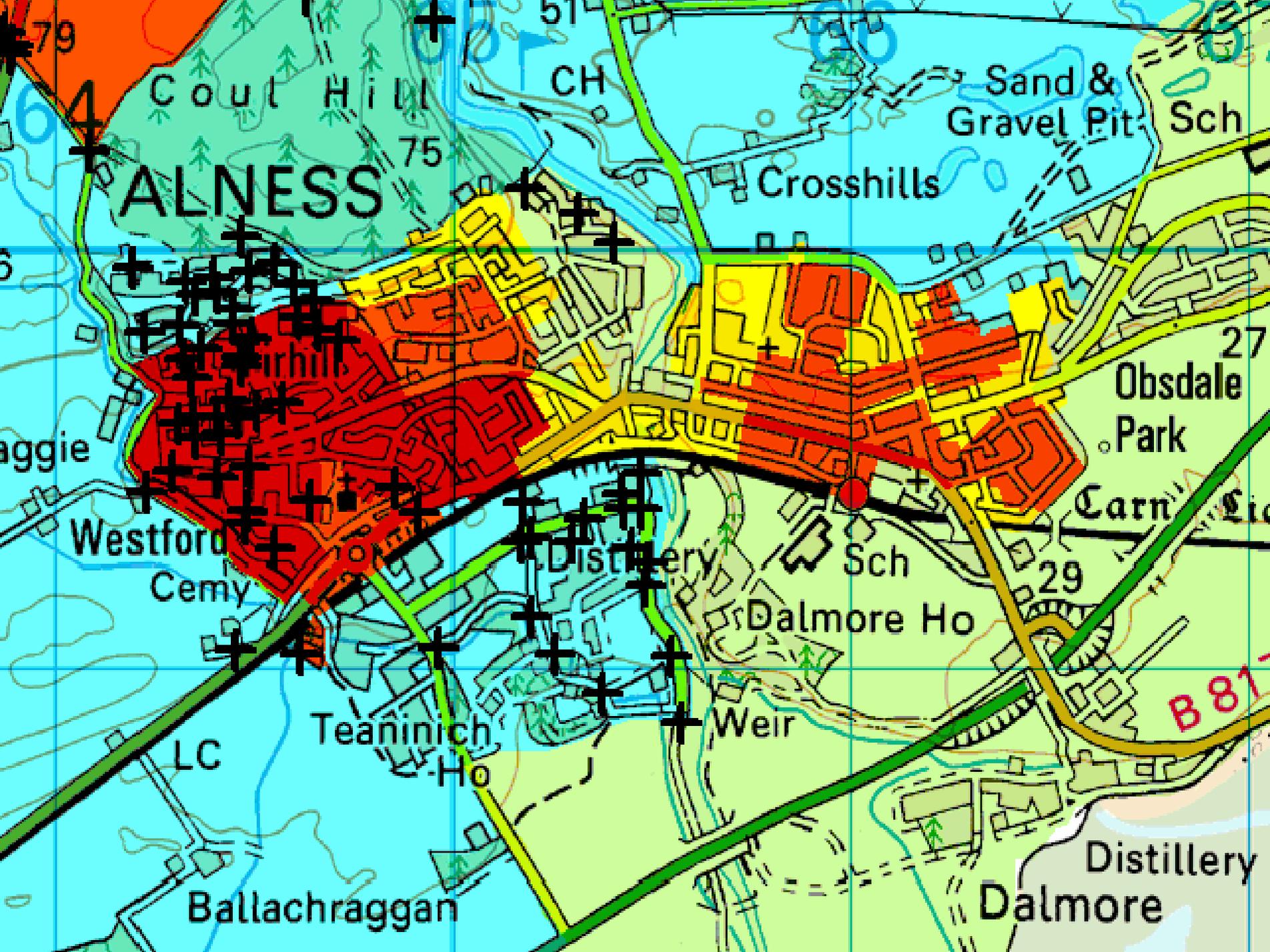
Pier

Ballachraggan

Distillery Dalmore

B817 8

B817 5



# ALNESS

Cout Hill

CH

Sand & Gravel Pit Sch

Crosshills

Obsdale Park

Carn Sch

Westford Cemy

Distillery

Sch

Dalmore Ho

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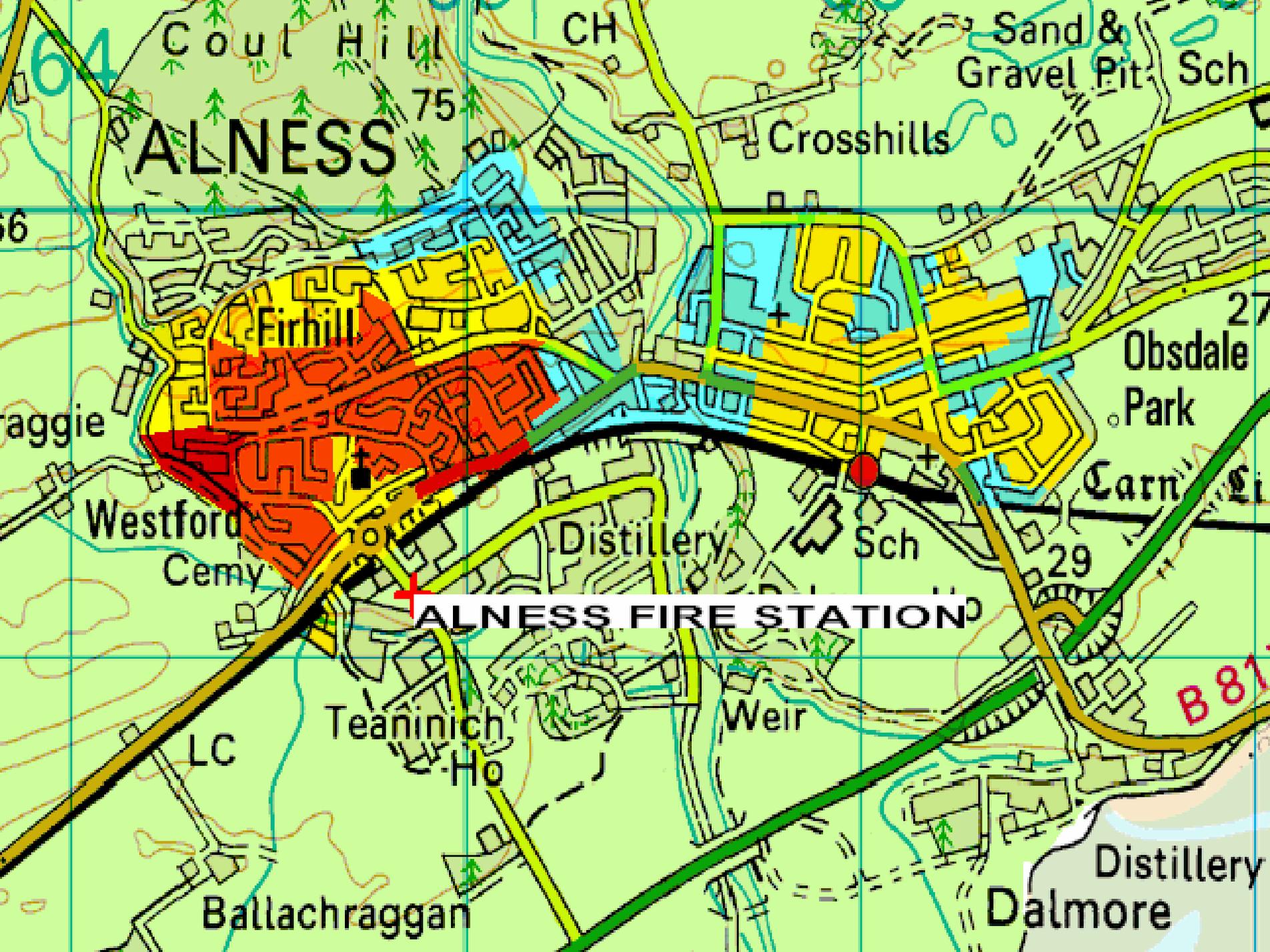
Weir

Ballachraggan

Distillery Dalmore

B81





# ALNESS

ALNESS FIRE STATION

Firhill

Crosshills

Sand & Gravel Pit Sch

Obsdale Park

Westford Cemy

Distillery

Sch

Carn Sch

Teaninich Ho

Weir

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Ballachraggan

Distillery Dalmore

Coul Hill

CH

75

27

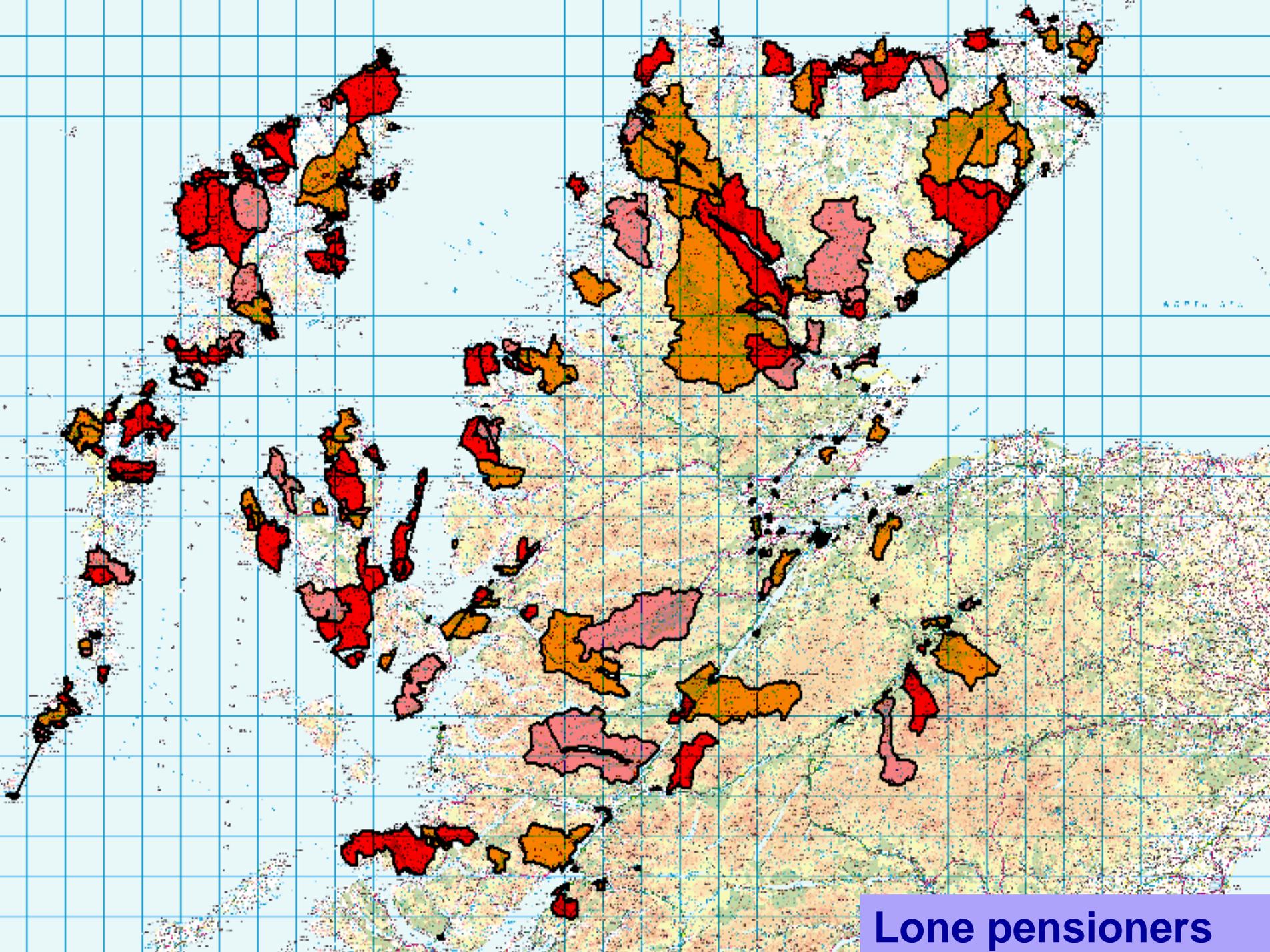
29

64

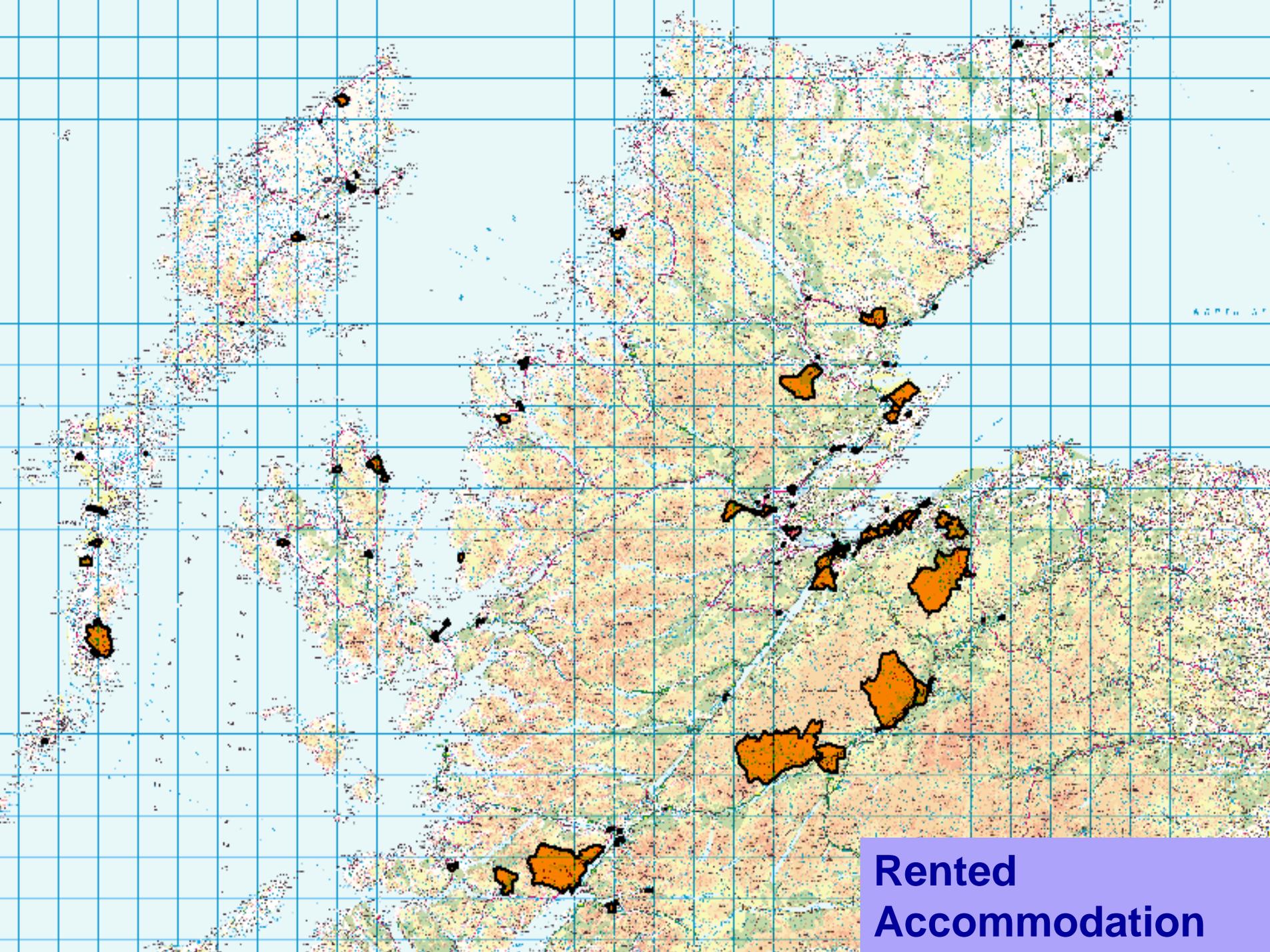
66

raggie

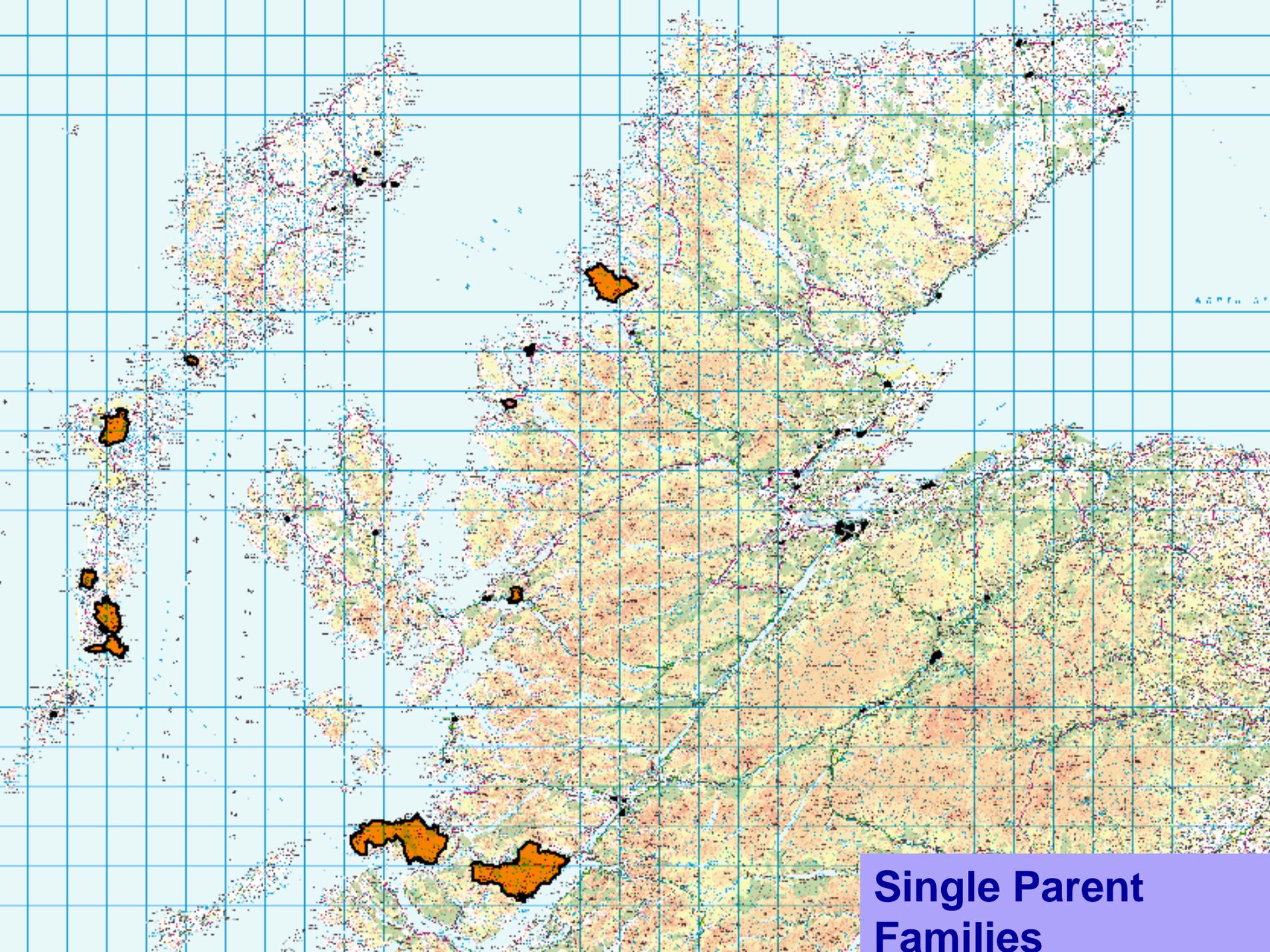
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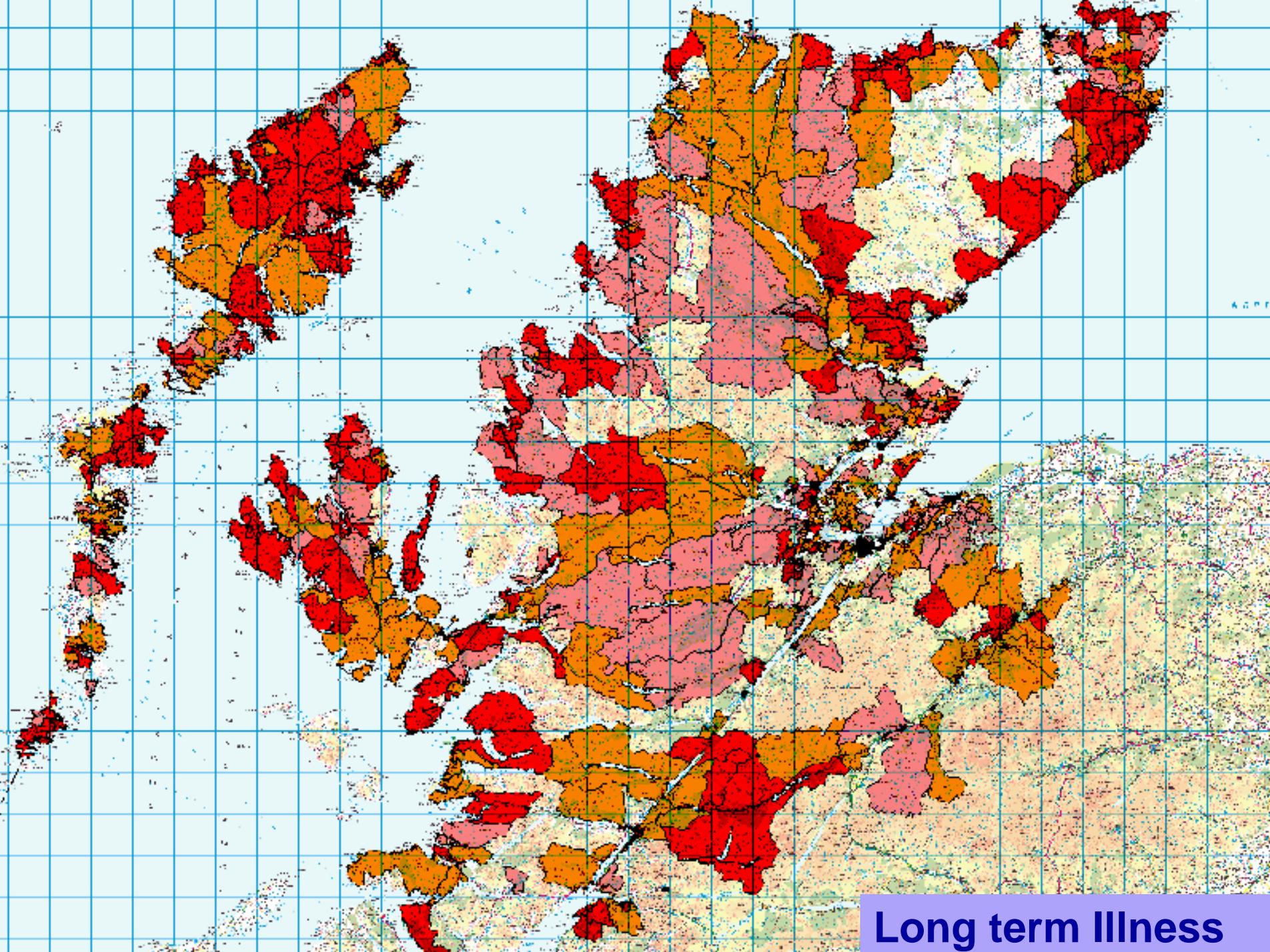
Lone pensioners



**Rented  
Accommodation**



**Single Parent  
Families**



**Long term illness**

# FSEC Outputs

- **Predicted Fatalities**
- **Predicted Casualties**
- **Estimated property loss**
- **Areas to focus risk reduction initiatives**
- **Areas to develop partnership initiatives**
- **Ability to ask 'what if'**

# Using the FSEC toolkit results

Vehicle Deployment Strategy	Dwelling Fatalities	OB Fatalities	SS Fatalities	Property damage	Total Cost	Total Lives Saved	Net Additional Cost	Cost per additional life saved	Benefit-Cost Ratio
	1.499247	0.002234	3.79	£87,003	£25,462,413				
Pump at 49	1.41812	0.002069	3.72	86293.7577	£26,142,789	0.151292	£679,667	£4,492,419	0.22
Pump at 51	1.434526	0.001	3.78	£77,154	£26,142,789	0.075955	£670,528	£8,827,959	0.13

- Cost effective location for pump is station 49

# Using the FSEC toolkit results

Predicted Fatalities	
The total number of predicted fatalities in other buildings c	0.23
Cost	
The total cost of the fire cover provision per year /£	27,735,961
Property	
Estimated property loss per year with no intervention /£	234,128,711
The total estimated property loss per year /£	8,357,975
PS	
No of OAs - Time has been met	0
No PSs Used	5

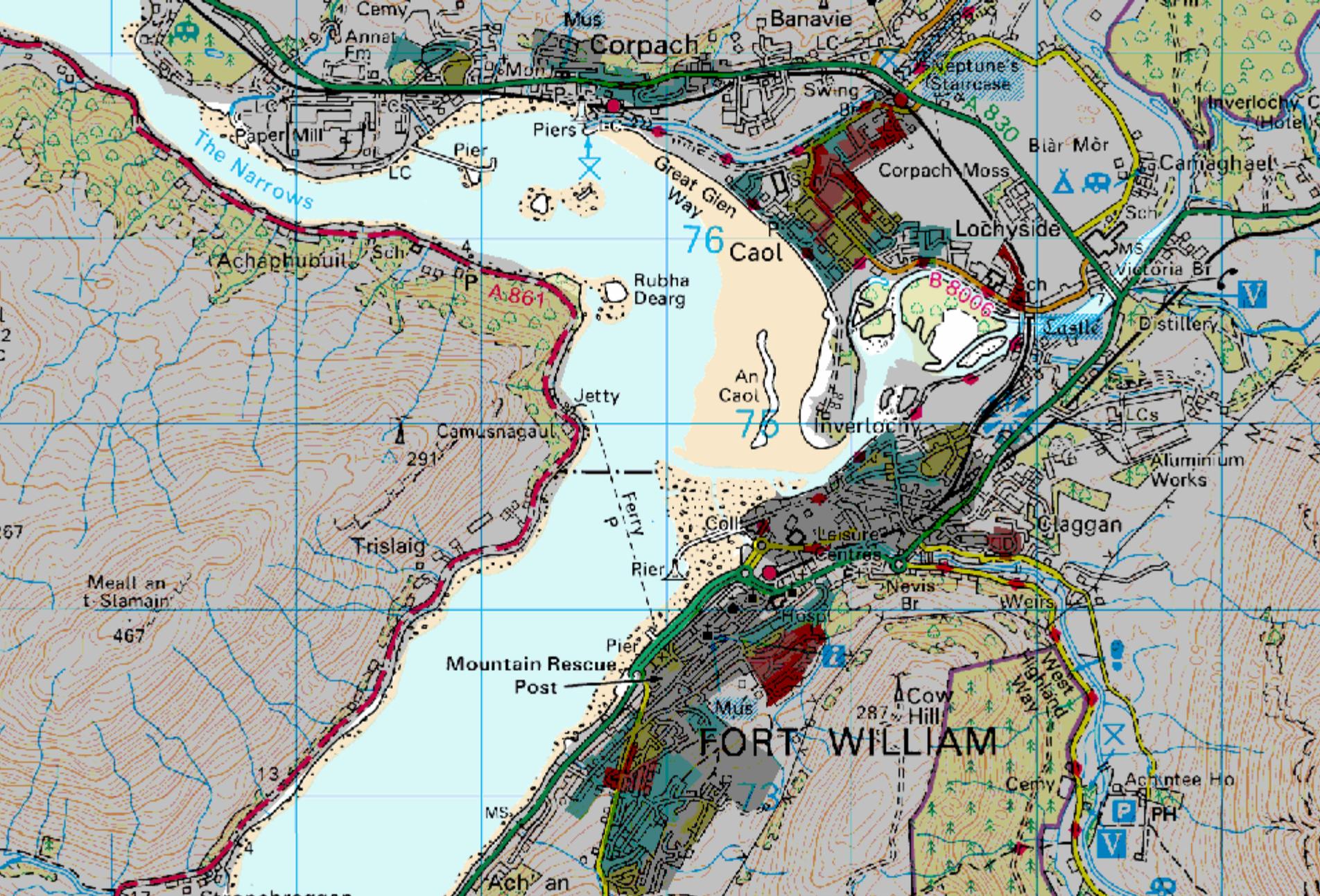
Predicted Fatalities	
The total number of predicted fatalities in other buildings c	0.23
Cost	
The total cost of the fire cover provision per year /£	27,735,961
Property	
Estimated property loss per year with no intervention /£	224,214,343
The total estimated property loss per year /£	8,142,098
PS	
No of OAs - Time has been met	0
No PSs Used	5

- Other Buildings Performance Predictor
- No change in predicted fatalities
- > £200,000 of property saved per year

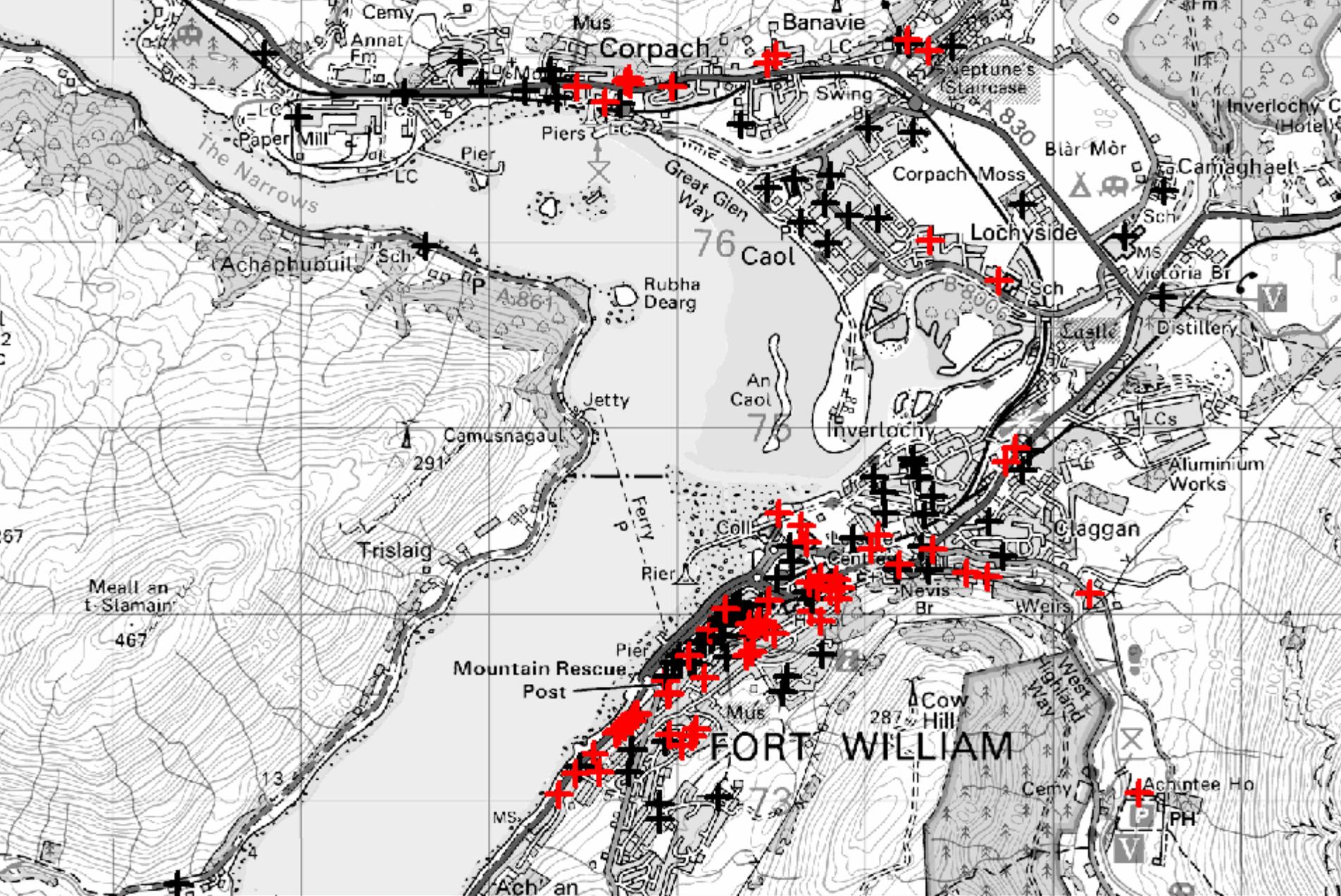
# Summary



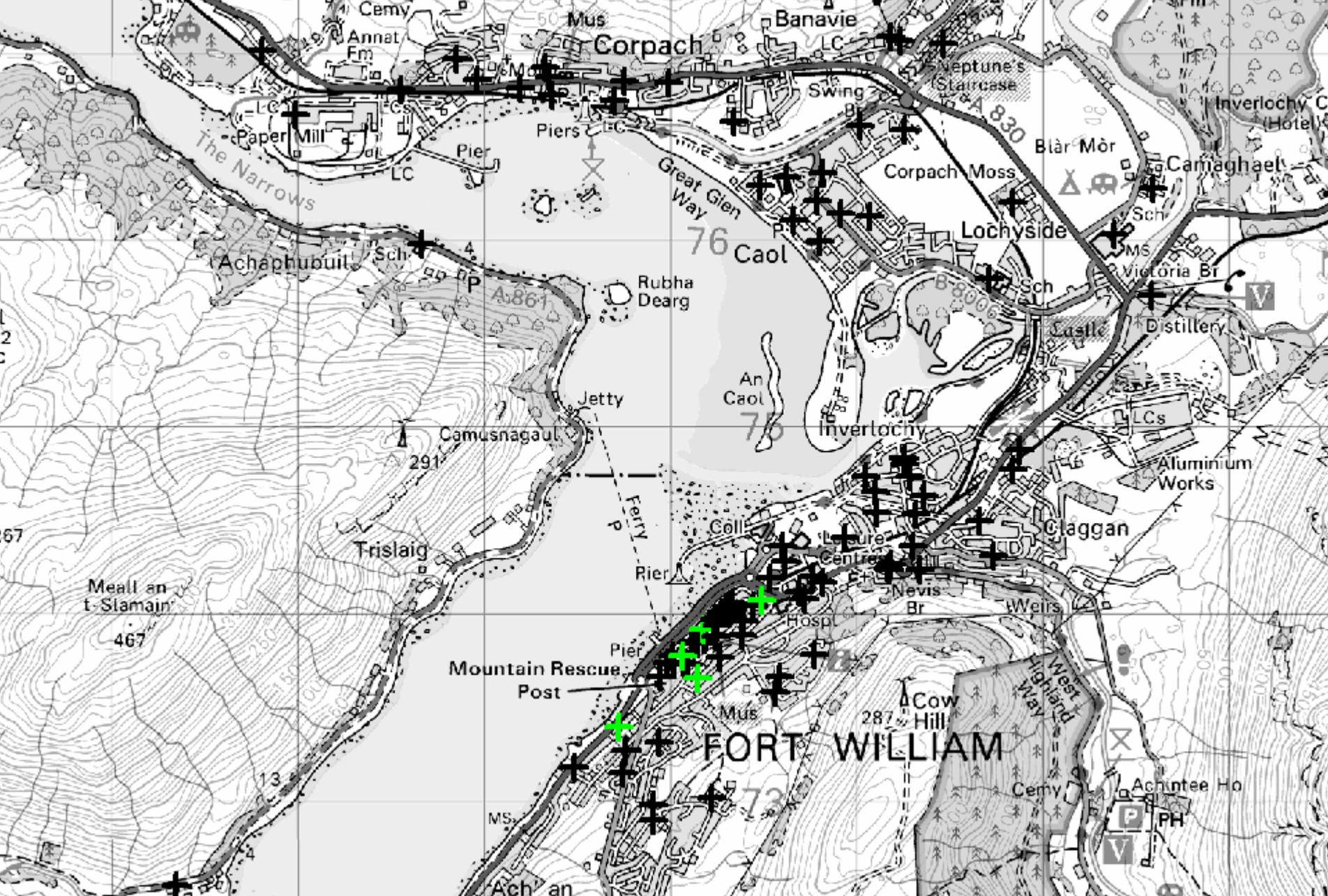
**Fort William – Census Output Areas**



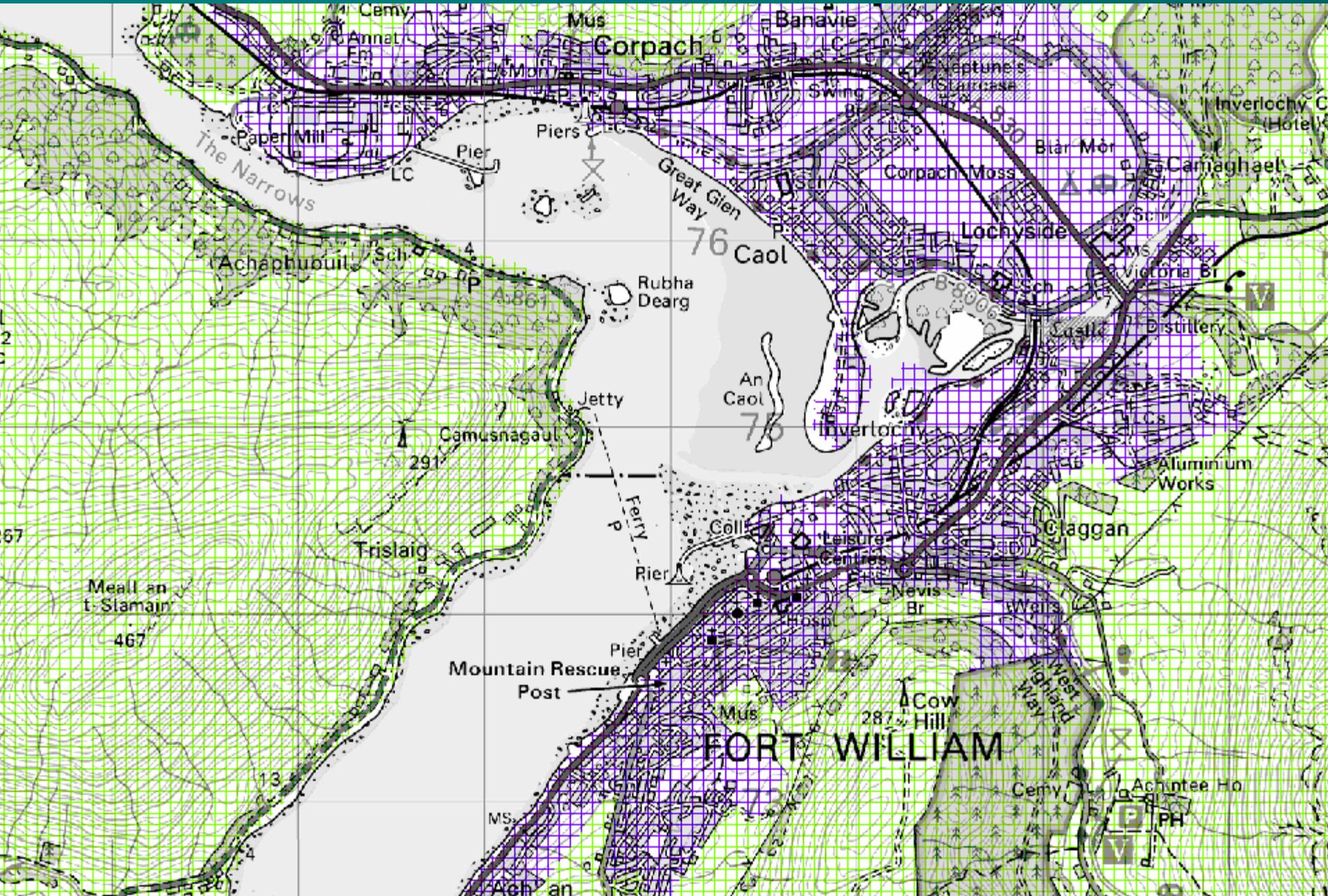
**Fort William – Population Density**



## Fort William - Other Buildings + Risk Assessments



**Fort William – Site Assessments – Storeys  $\geq 4$**



**Fort William – Other Buildings – Risk Area 8**

## Other Buildings Risk Area

Area number  Description

Background area ?

All Occupancies

Descriptions

Ass. Summary

	Number		Number		Number
Hospitals (A)	<input type="text" value="0"/>	Houses converted to flats (G)	<input type="text" value="0"/>	Shops (N)	<input type="text" value="117"/>
Care Homes (B)	<input type="text" value="3"/>	Other Sleeping Accomodation (H)	<input type="text" value="0"/>	Other Premises Open to the Public (P)	<input type="text" value="44"/>
HMOs (C)	<input type="text" value="2"/>	Further education (J)	<input type="text" value="1"/>	Factories and Warehouses (R)	<input type="text" value="34"/>
Flats (D)	<input type="text" value="0"/>	Public Buildings (K)	<input type="text" value="3"/>	Offices (S)	<input type="text" value="65"/>
Hostels (E)	<input type="text" value="2"/>	Licensed Premises (L)	<input type="text" value="24"/>	Other Workplaces (T)	<input type="text" value="79"/>
Hotels (F)	<input type="text" value="70"/>	Schools (M)	<input type="text" value="10"/>		

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Update Numbers

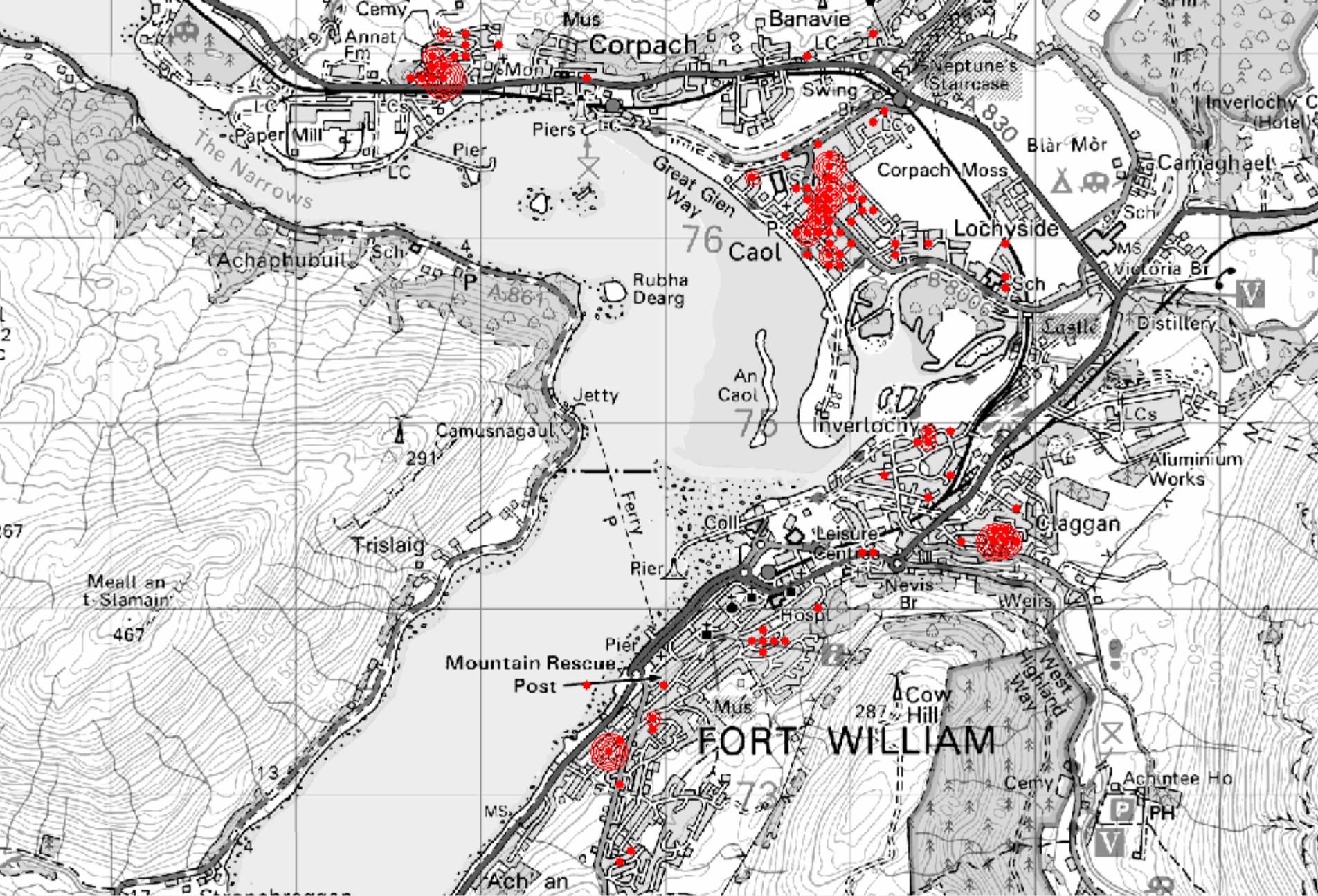
Ok

Cancel

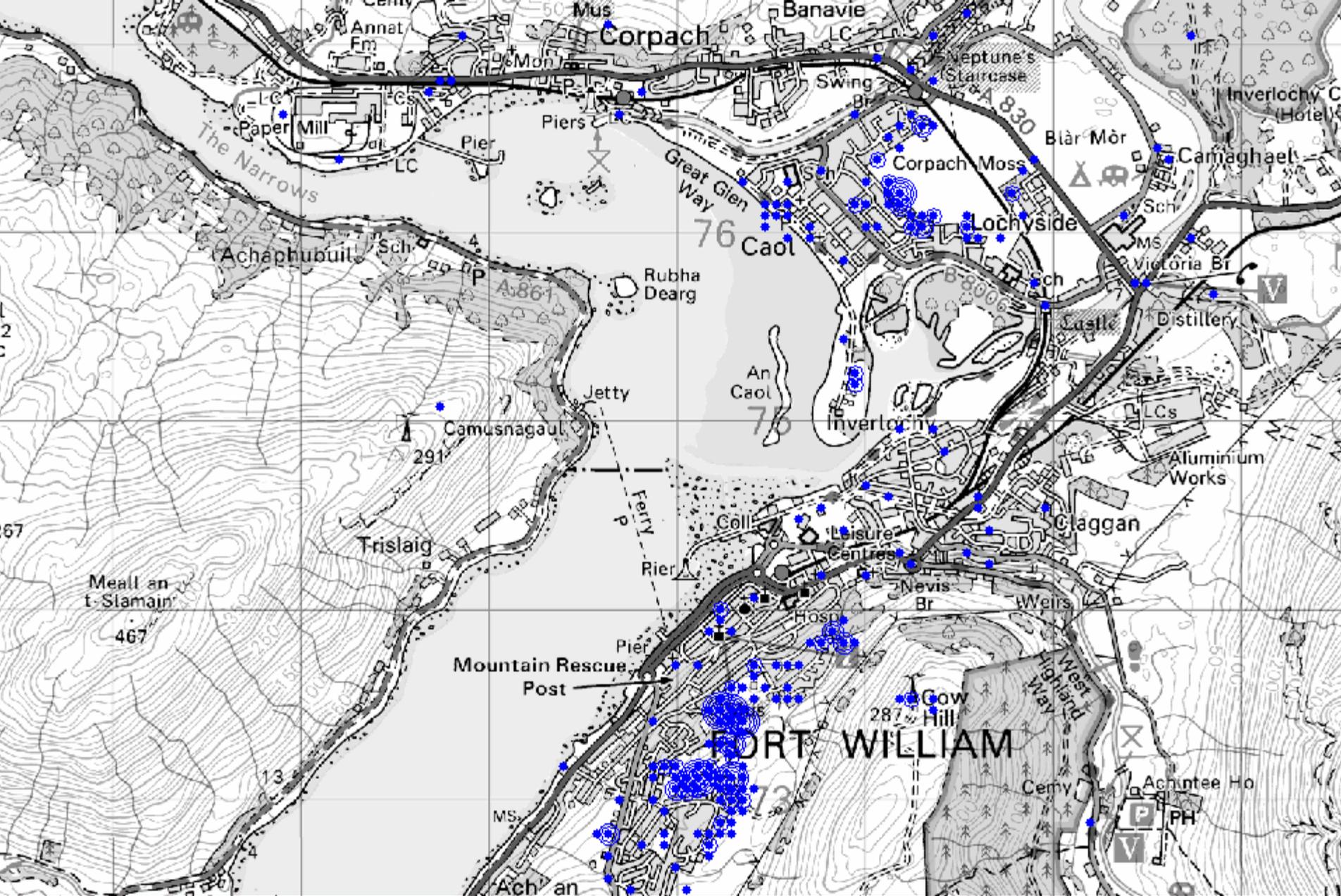
Mountain Rescue  
Post

Mus  
287  
Cow Hill  
FORT WILLIAM

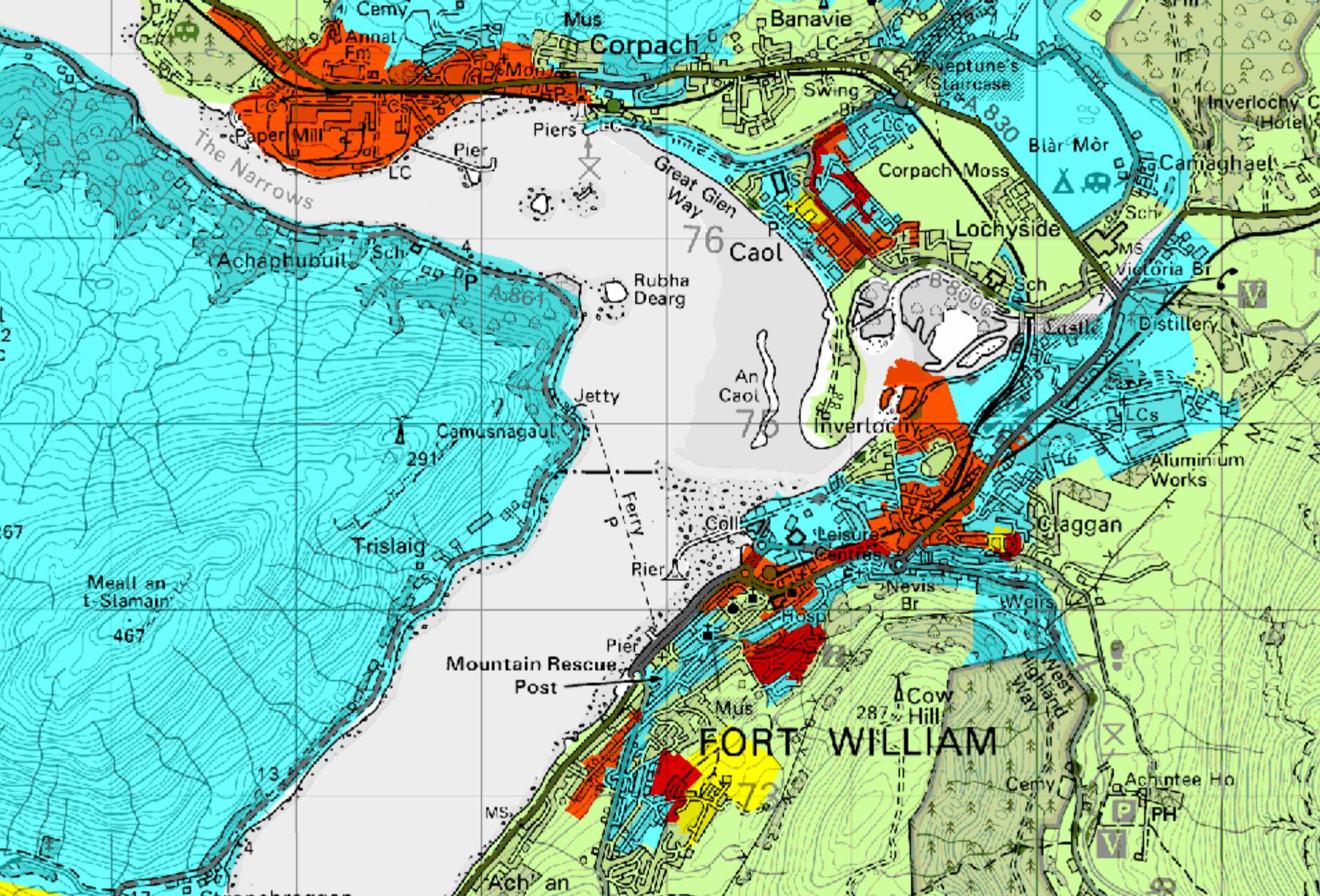
Fort William – Other Buildings Risk Area 8 – Building Numbers



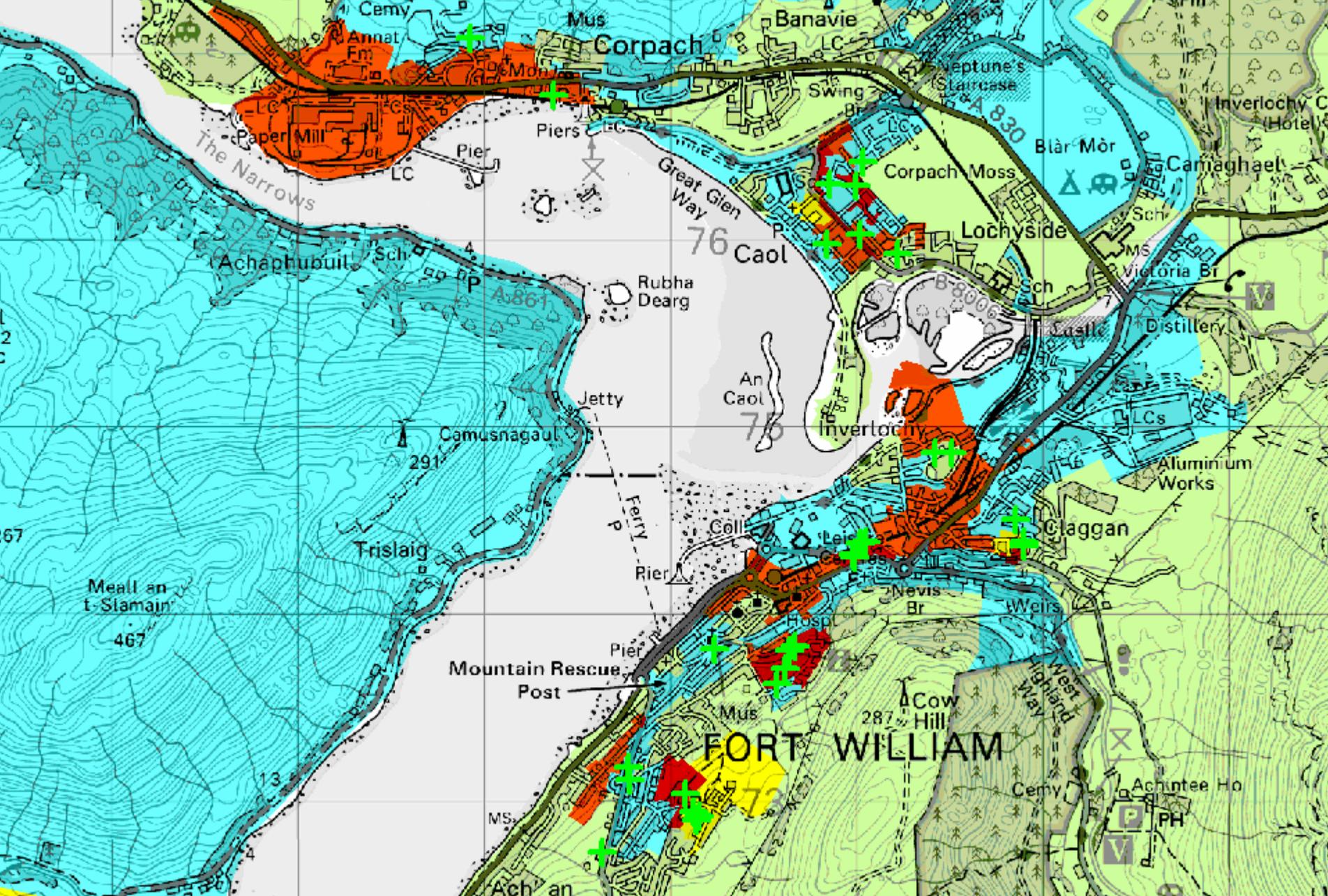
**Fort William – Chimney Fires**



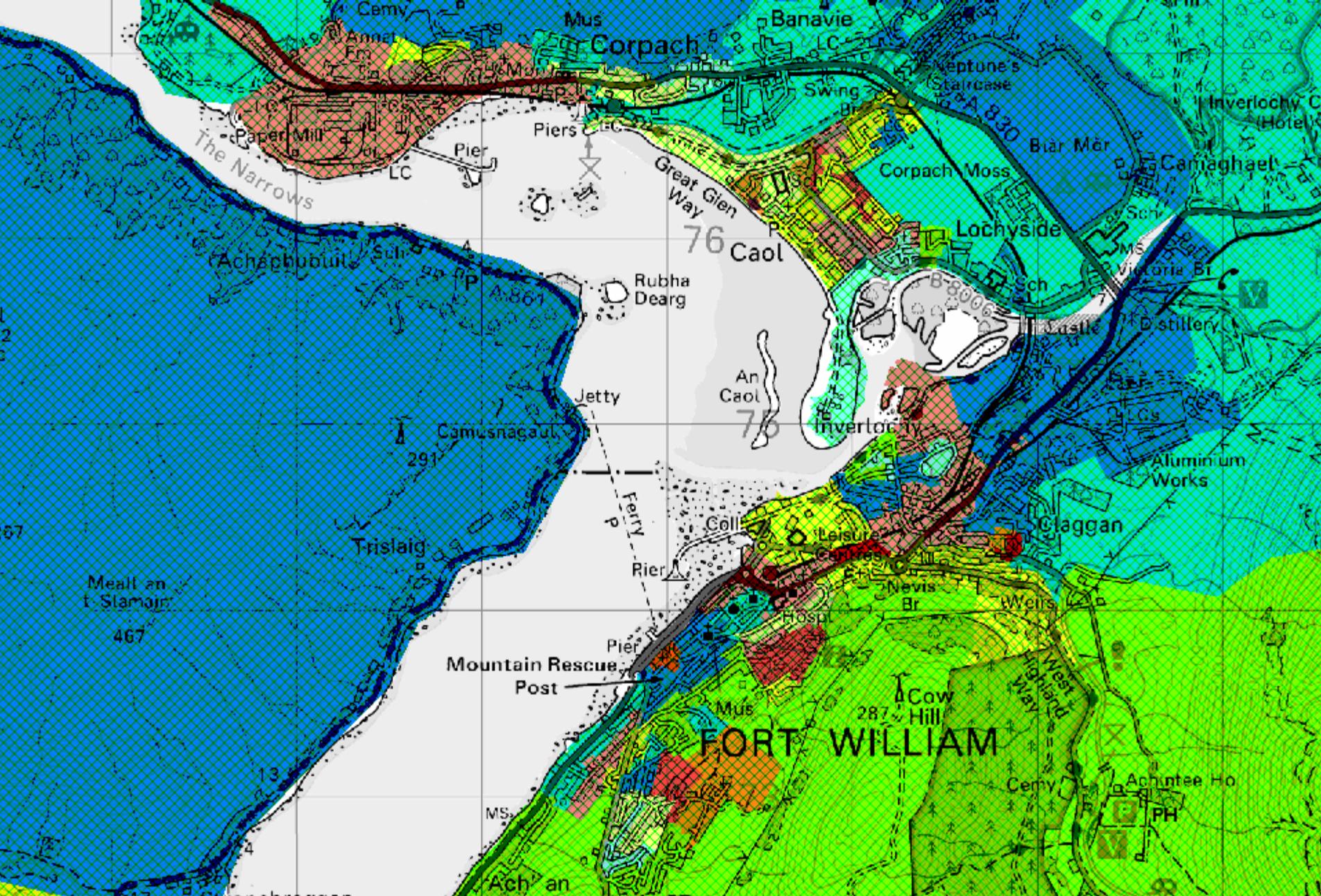
**Fort William – Small vegetation fires**



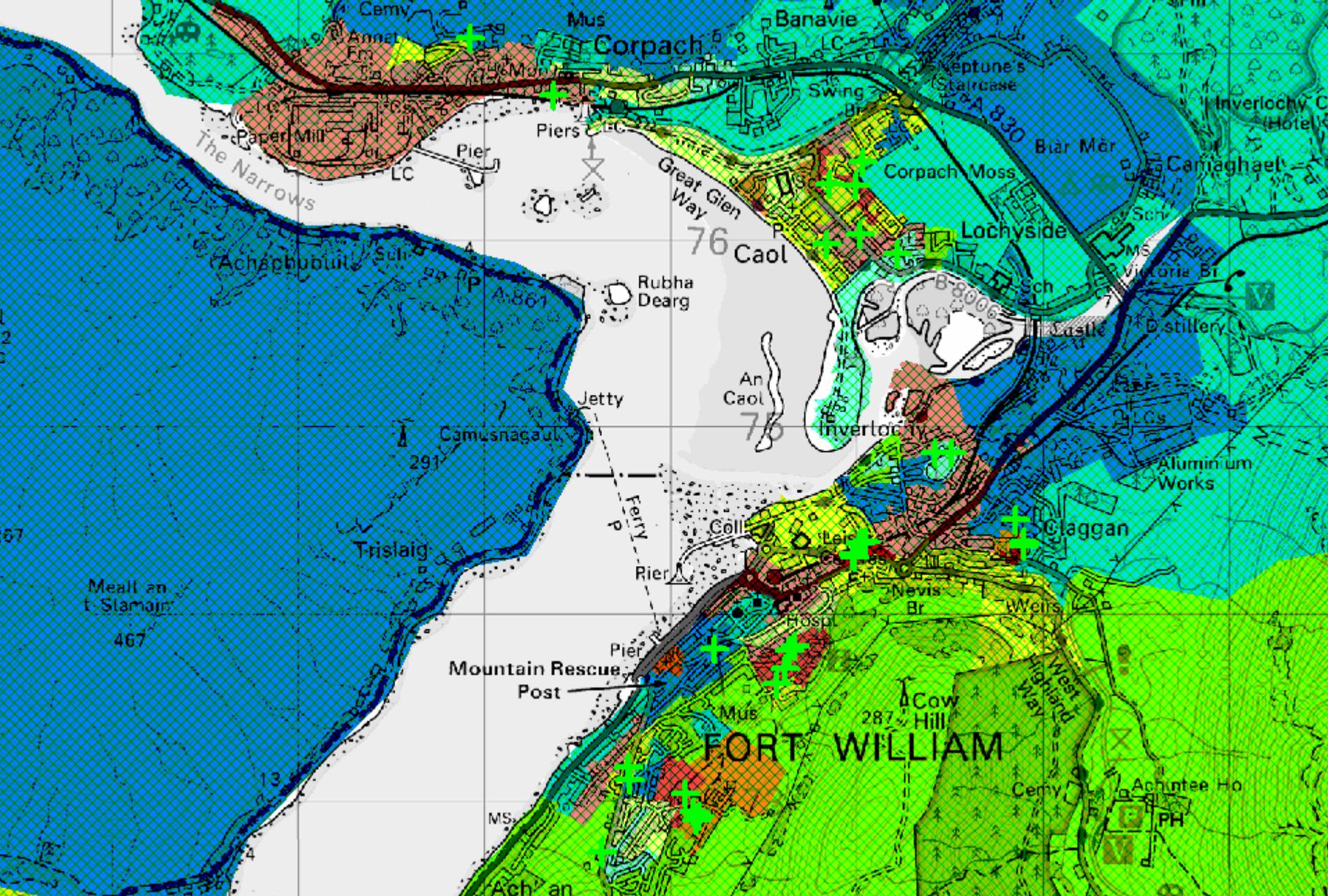
**Fort William – Predicted Casualty Rates**



**Fort William – Predicted Casualty Rates / Property Fires**

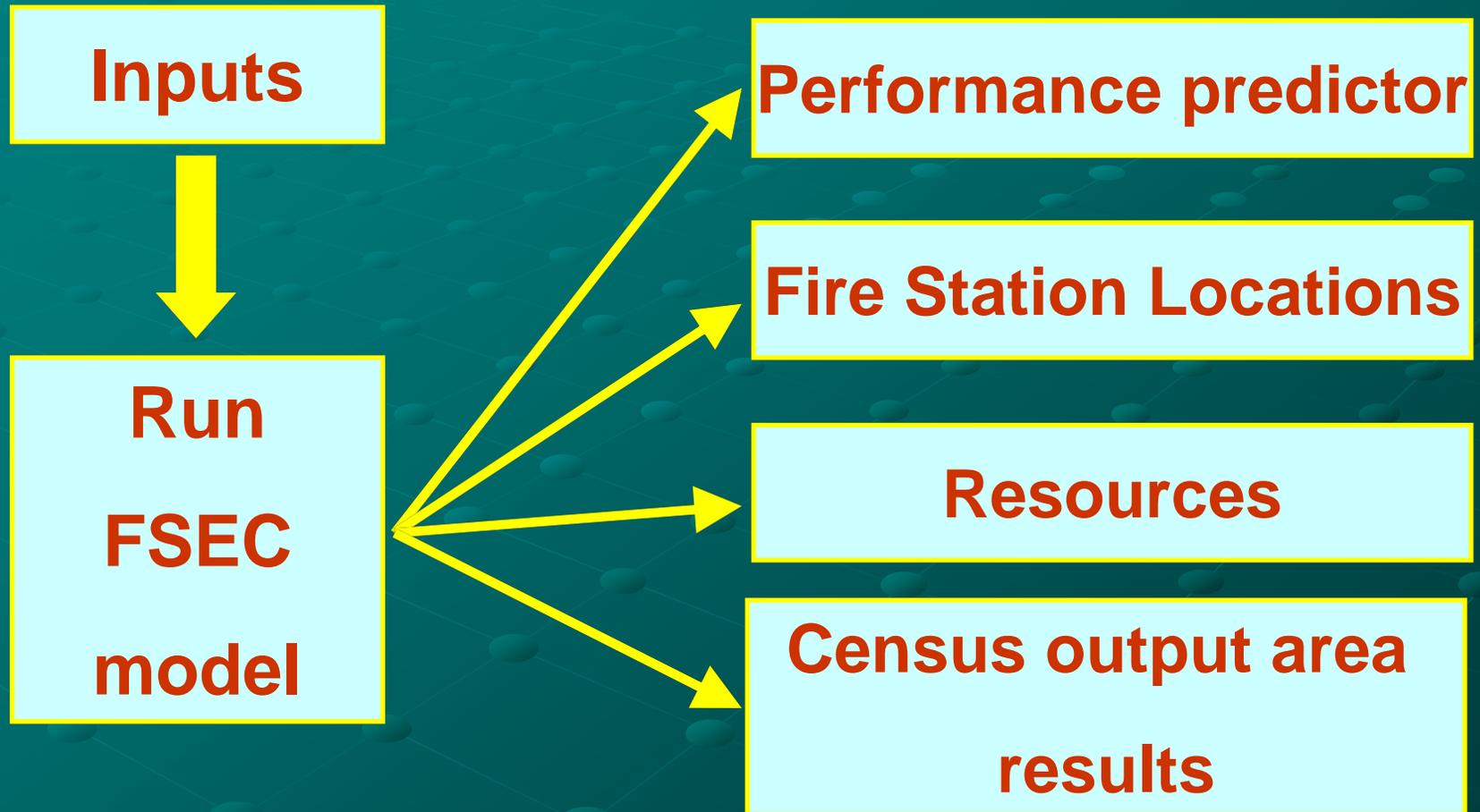


## Fort William – Risk Factors



**Fort William – Risk Factors / FDR1 Fires**

# F.S.E.C. common theme



# What can FSEC do for Fire & Rescue Services

- **Identify risk areas well above average**
  - **Target area for risk reduction strategies**
  - **Identify premises with poor fire precautions**
- **Plan optimum location for fire stations and vehicles**
  - **Experiment with resource allocation**
  - **Explore fire cover by time of day / night**

# F.S.E.C. summary

- **Measures risk in a robust and consistent manner**
- **Predicts the impact of fire service response**
- **Predicts the impact of fire safety measures**
- **Allows managers analyse “What if.....” scenarios**

# Risk Modelling for Rural Communities

## Fire Services Emergency Cover Model (FSEC)



Highland and Islands Fire Brigade

Divisional Officer Trevor Johnson

The background is a solid teal color with a subtle, repeating pattern of small, light-colored circles connected by thin lines, creating a grid-like effect that recedes into the distance.

Questions?



