TV White Space

Address Separation and Clutter Category

Digital UK Technical Note

6th December 2013

SUMMARY

The Ofcom White Space Coexistence Consultation *"TV white spaces: approach to coexistence"*, published 4th September 2013, proposes that certain reference geometry calculations should include a variable element that allows for terrain clutter types with nearest-neighbour distances of 5m, 10m and 20 m for urban, suburban and rural clutter categories respectively.

Earlier Digital UK Technical Notes (listed in Appendix 1) have assessed the typical nearest-neighbour distances for addresses in a variety of ways, but not by clutter type.

This note explores nearest-neighbour separations by clutter and concludes that the clutter type does not materially affect the typical nearest-neighbour distance. The proposed Ofcom reference geometries are therefore **not** representative of real world address separations and, if implemented in the relevant calculations, would not provide adequate protection from White Space Devices for the majority of addresses affected by these calculations, regardless of clutter type.

ADDRESS SEPARATION DISTANCES

Earlier Digital UK Technical Notes have assessed the nearest-neighbour distances for addresses both by post area and by pixel occupancy, concluding that the most frequent housing separation distance is 6m. This new analysis confirms that finding.

### DISTRIBUTION OF ADDRESSES BY CLUTTER CATEGORY

Digital UK does not have access to detailed clutter data, but we have identified that Land Cover 2007 clutter data, produced by the Centre for Ecology and Hydrology, is freely available at a 1km resolution. This data has therefore been used in this analysis. Subsequently Ofcom has proposed the use of chargeable 50m resolution Land Cover 2007 clutter data for the White Space Device pilot. While accepting that use of higher resolution clutter data will affect the allocation of addresses to clutter categories along clutter category boundaries, we believe that the 1km data is sufficient for the purposes of this report; use of the 50m data would only affect the number of households in each clutter category, rather than the conclusions themselves.

The previous Digital UK analyses have been based on post areas to facilitate reasonable calculation times. This approach has been repeated to permit comparison of the results with the previous findings, but additionally, geographic areas not related to postal addresses have also been assessed to check that the calculation methodology is not skewing the results.

Analysis 1: "HU" Post Area

Nearest-neighbour distances within the HU (Humberside) Post Area, shown shaded in Figure 1, were evaluated. This Post Area was not assessed in previous work so also provides new data.

Each address was allocated to one of three clutter data types based on the Land Cover 2007 data. The number of addresses in each category is set out in Table 1.
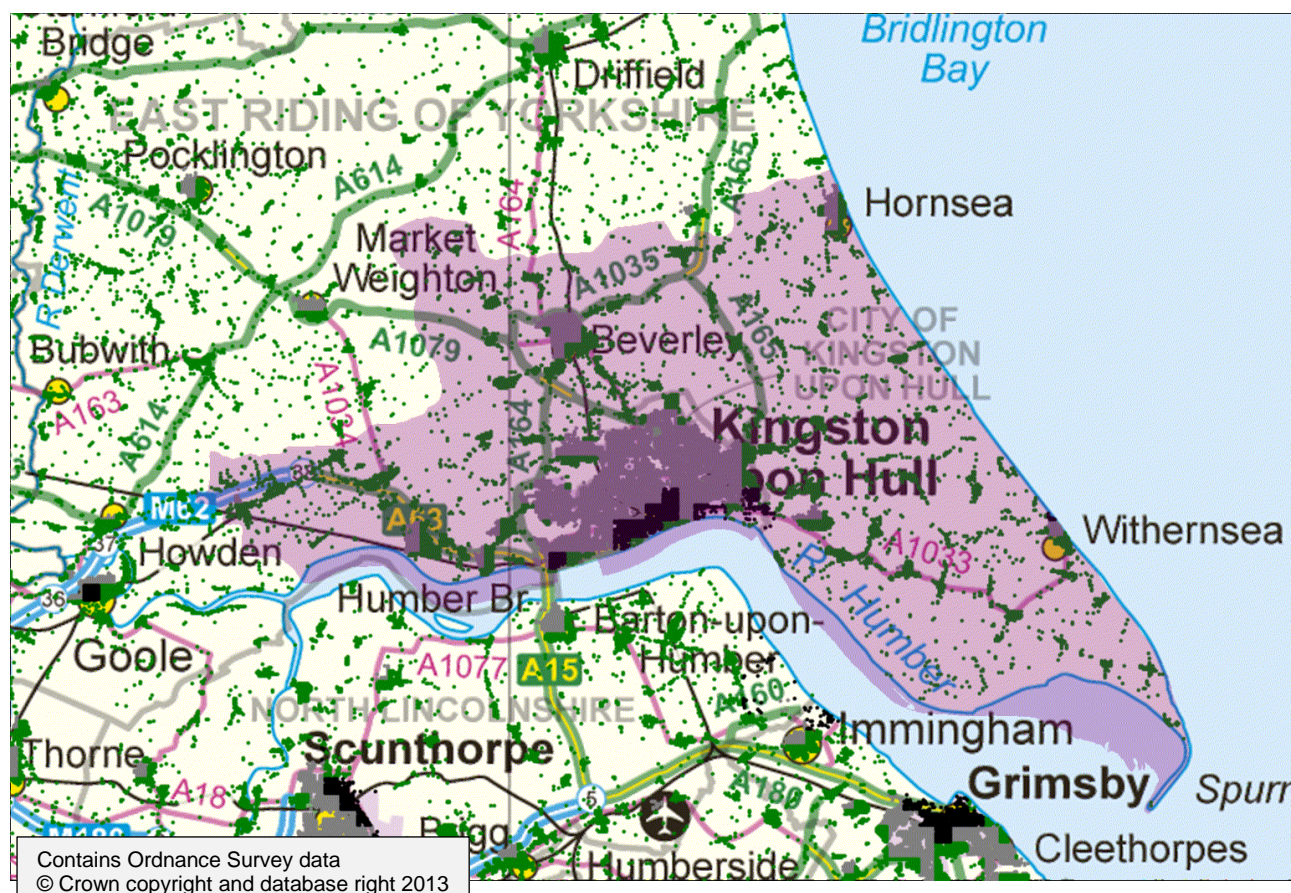

Figure 1: Pixel clutter type in HU post area

Clutter Type	Colour	Address count
Urban	Black	16,304
Suburban	Grey	137,520
Rural	Green	52,132
	Total	*205,956*

Table 1: HU post area addresses in each clutter category

Nearest neighbour distances were determined for each address in the same way as in previous reports, and the frequency and CDF determined. The results are shown in Figure 2 and Figure 3 respectively.

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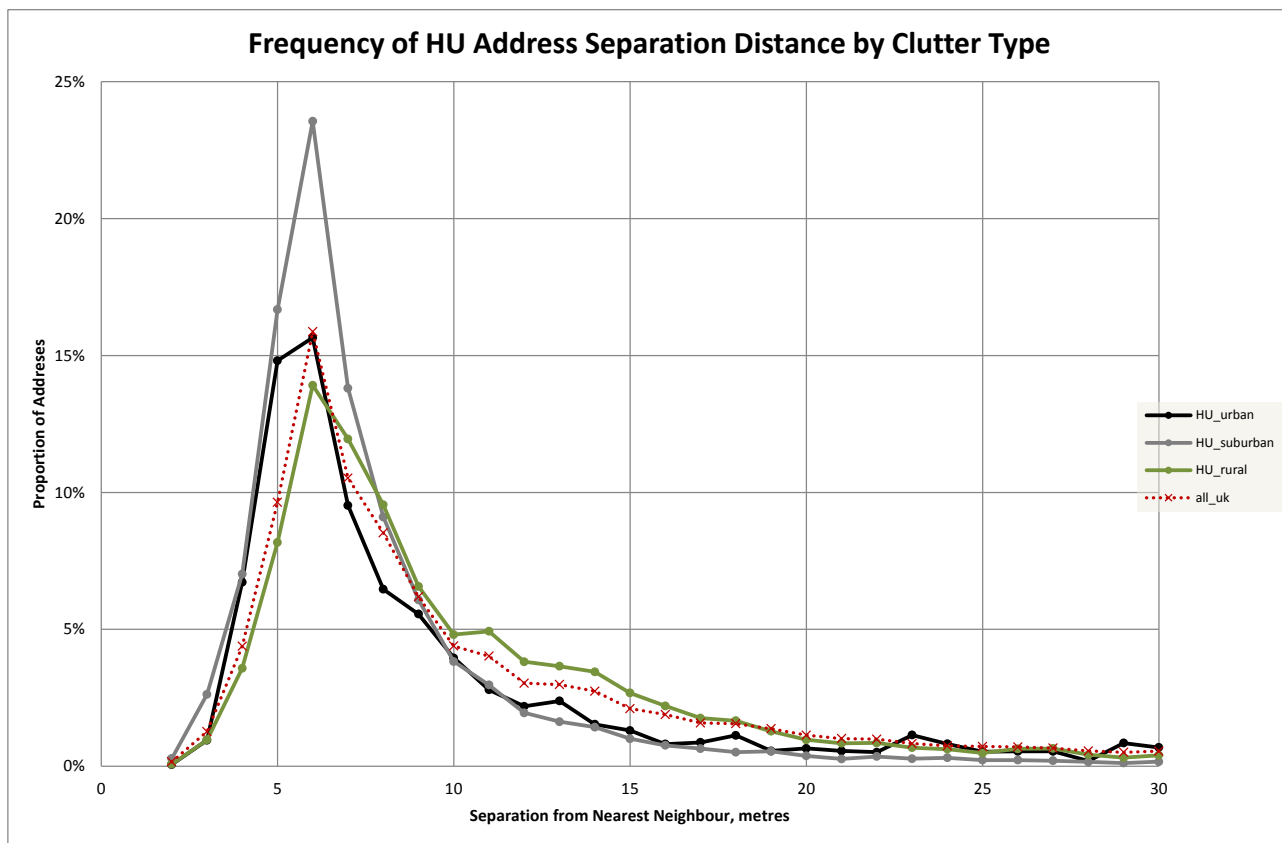
Figure 2: Frequency of address separation in HU area by clutter type
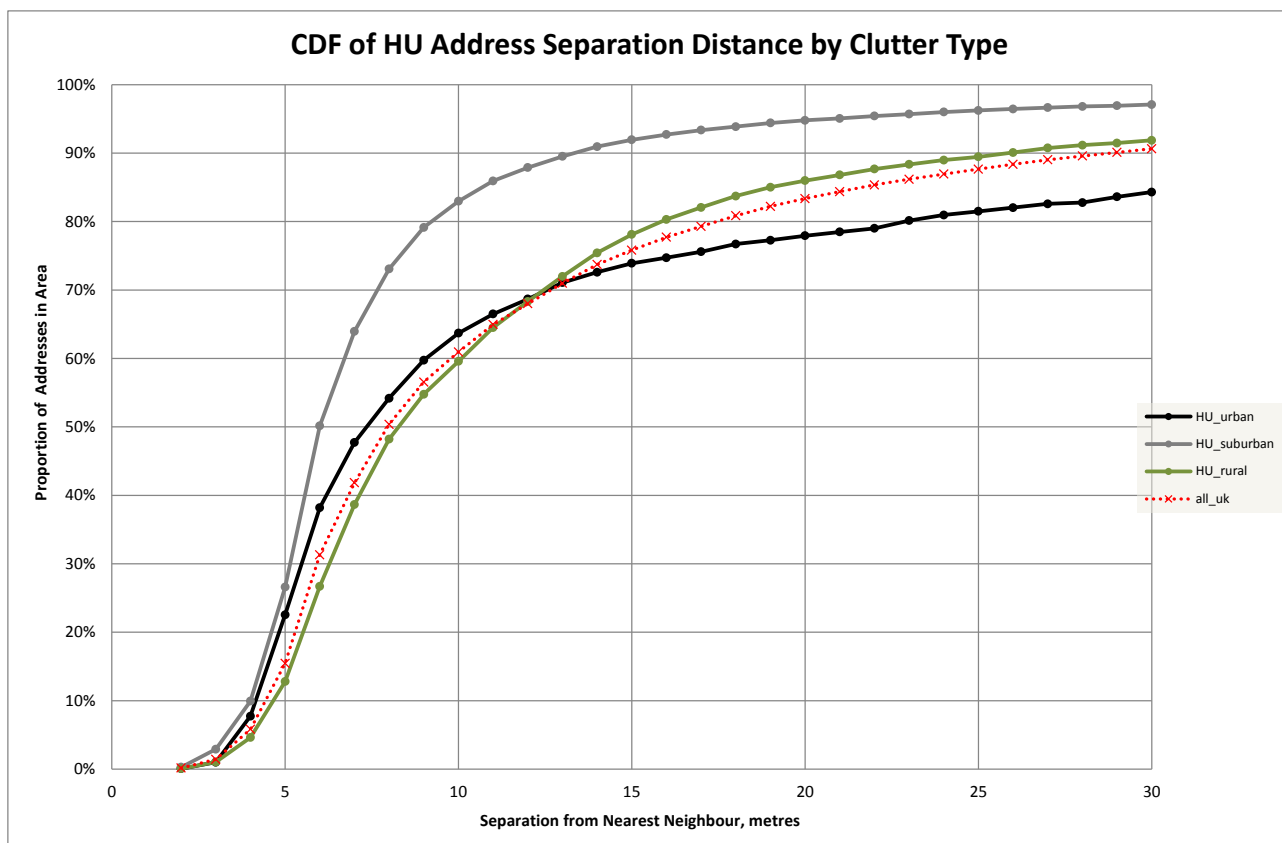
Figure 3: CDF of address separation in HU area by clutter type

The analysis shows that the address separation frequency for each clutter type has a similar distribution both to the other clutter types and to the UK average, excluding clutter. It can also be seen that, in this area, the suburban addresses are more closely packed than the urban addresses, which is contrary to initial expectations.

A comparison of the minimum separation distance CDF to the proposed Ofcom values, highlighted in orange, is shown in Table 2.

Clutter Type	Proportion of addresses with neighbours closer than		
	5m	**10m**	**20m**
Urban	23%	64%	78%
Suburban	27%	83%	95%
Rural	13%	60%	86%
All UK	16%	61%	83%

Table 2: Comparison of Ofcom proposals to HU post area data

The comparison demonstrates that the proposed WSD reference geometry separation distances proposed by Ofcom will not provide sufficient protection for the vast majority of suburban and rural addresses in the HU post area, with 23% of urban, 83% of suburban and 86% of rural addresses located at or closer than the assumed reference geometry distance from their nearest neighbour

Analysis 2: Northern half of the "SU" 100km National Grid tile

A second analysis was undertaken using the northern half of the "SU" Ordnance Survey 100km National Grid tile. This area extends across a large section of the M4 corridor as shown by the red rectangle in Figure 4 and includes parts of Salisbury Plain as well as large towns such as Reading. The number of addresses in each clutter category is shown in Table 3.


Contains Ordnance Survey data
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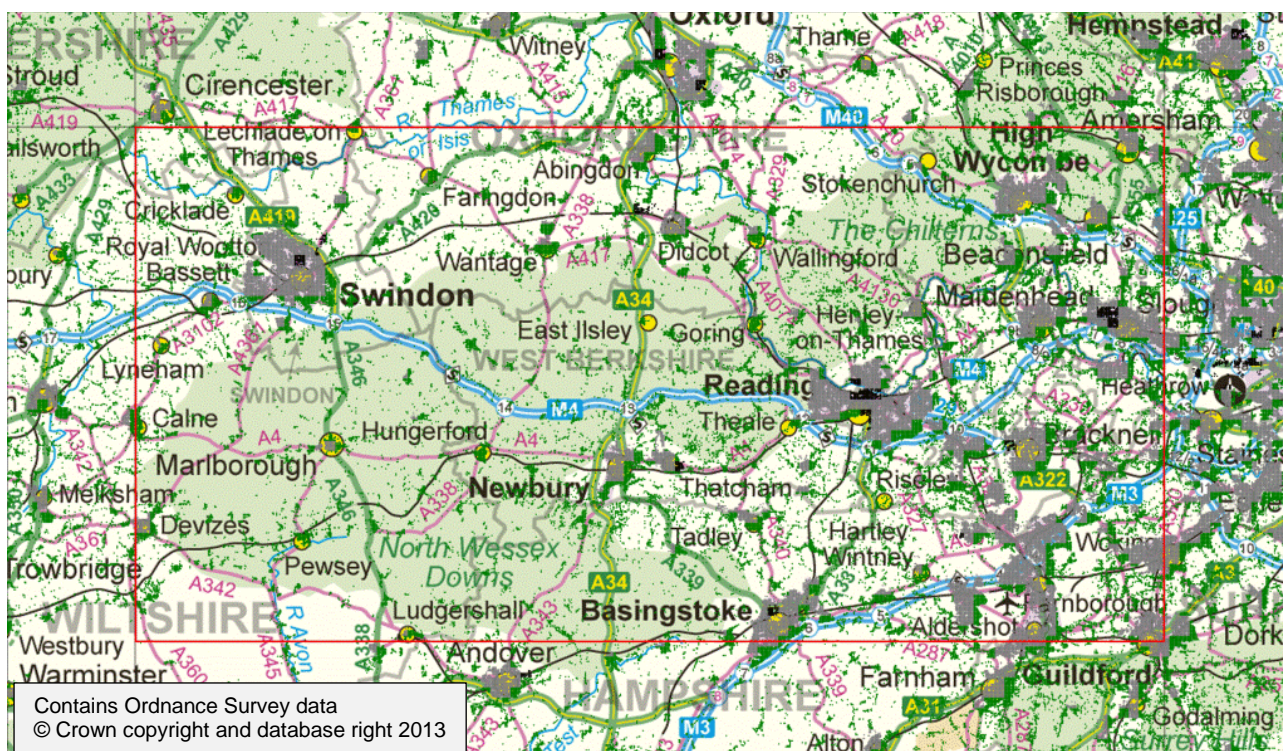
Figure 4: Pixel clutter type in northern half of "SU" 100km NGR tile

Clutter Type	Colour	Address count
Urban	Black	16,947
Suburban	Grey	587,534
Rural	Green	382,178
	Total	*986,659*

Table 3: Number of postal addresses in each clutter category for north of "SU" NGR tile

The resulting frequency and CDF distributions are shown in Figure 5 and Figure 6.
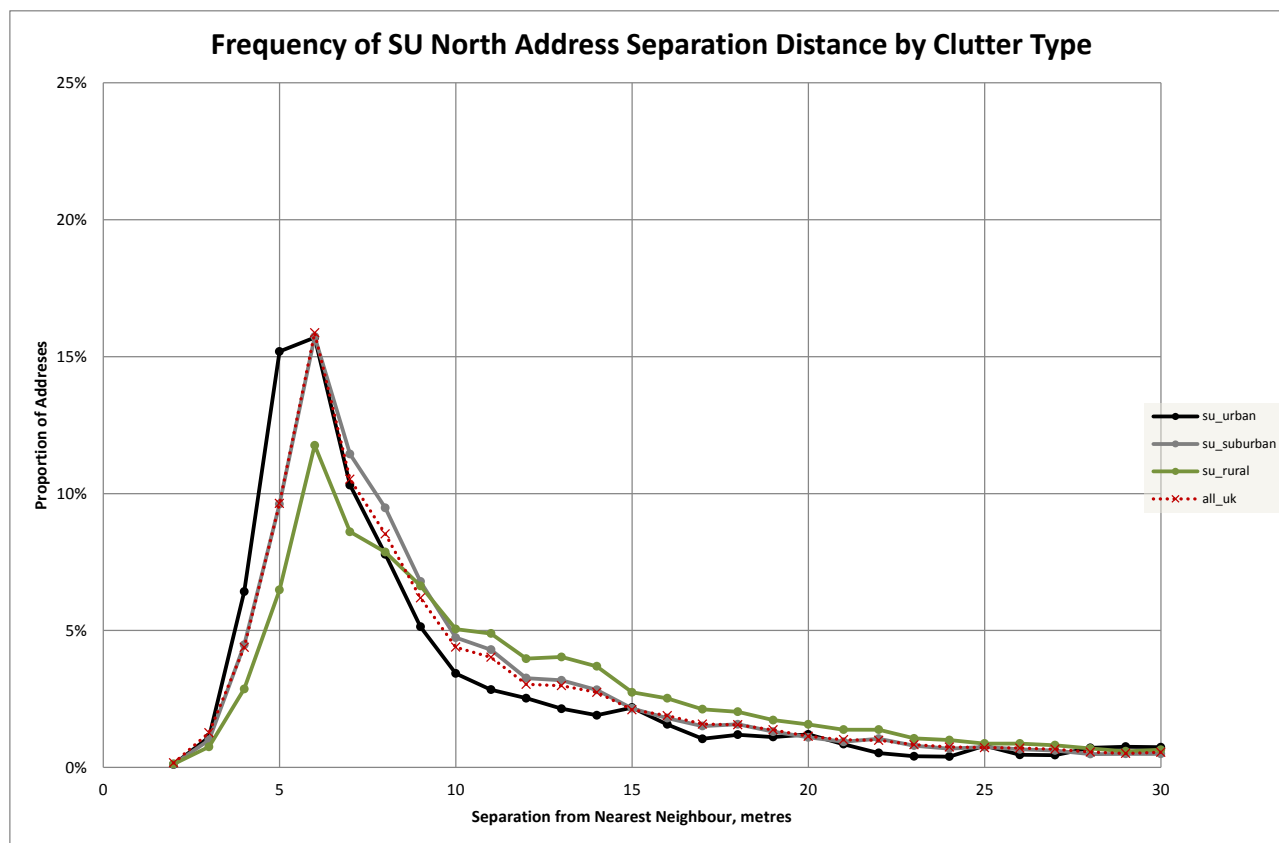
Figure 5: Frequency of address separation in north of "SU" NGR tile by clutter type
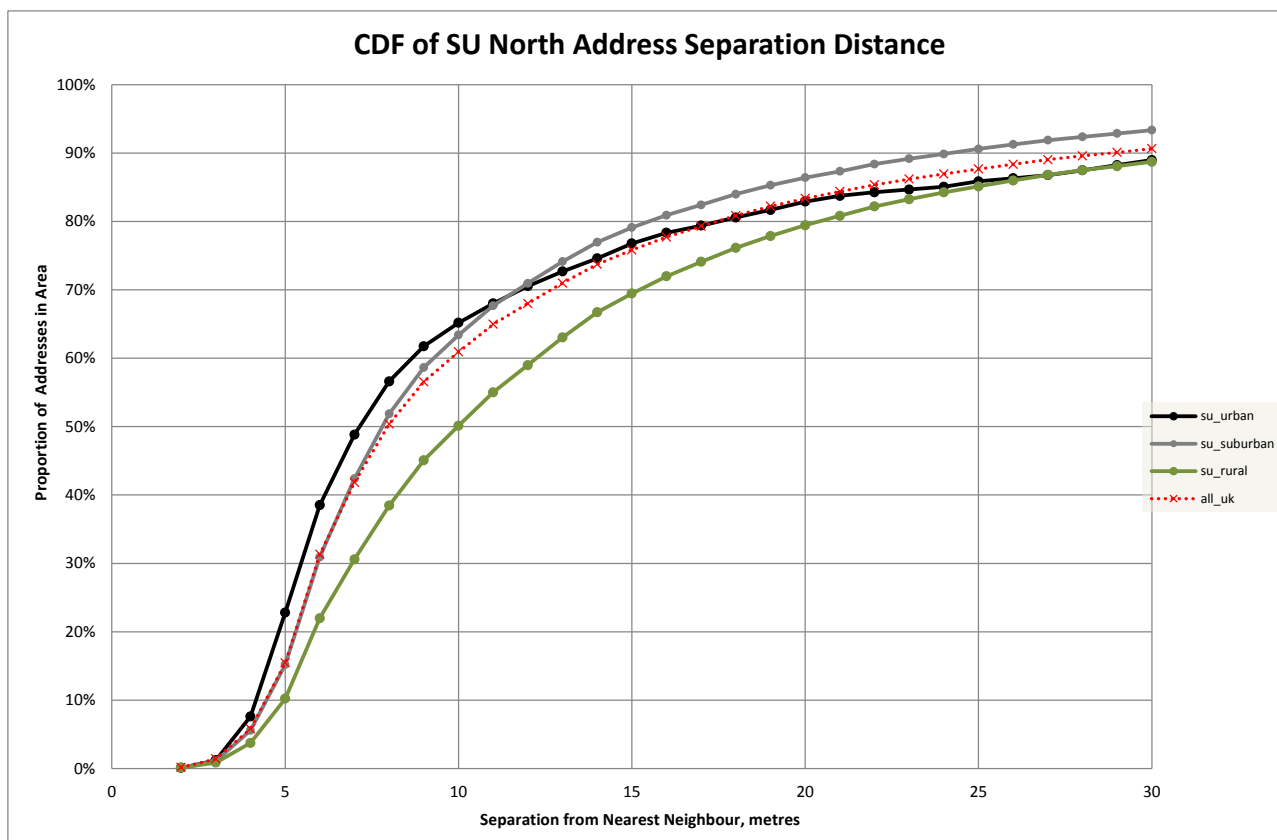
Figure 6: CDF of address separation in north of "SU" NGR tile by clutter type

A comparison of the minimum separation distance CDF to the proposed Ofcom values, highlighted in orange, is shown in Table 4.

| Clutter Type	Proportion of addresses with neighbours closer than		
	5m	**10m**	**20m**
Urban	23%	65%	83%
Suburban	15%	63%	86%
Rural	10%	50%	79%
All UK	16%	61%	83%

Table 4: Comparison of Ofcom proposals to northern half of the "SU" NGR tile

The comparison demonstrates that the proposed WSD reference geometry separation distances proposed by Ofcom will not provide sufficient protection for the vast majority of suburban and rural addresses in this area, with 23% of urban, 63% of suburban and 79% of rural addresses located at or closer than the assumed reference geometry distance from their nearest neighbour

Analysis 3: Sample rural area

A third analysis was carried out to determine whether the results would be significantly different in a largely rural area. For this, an area straddling the England/Scotland border was selected as shown by the red rectangle in Figure 7. This area only contained rural addresses as shown in Table 5.

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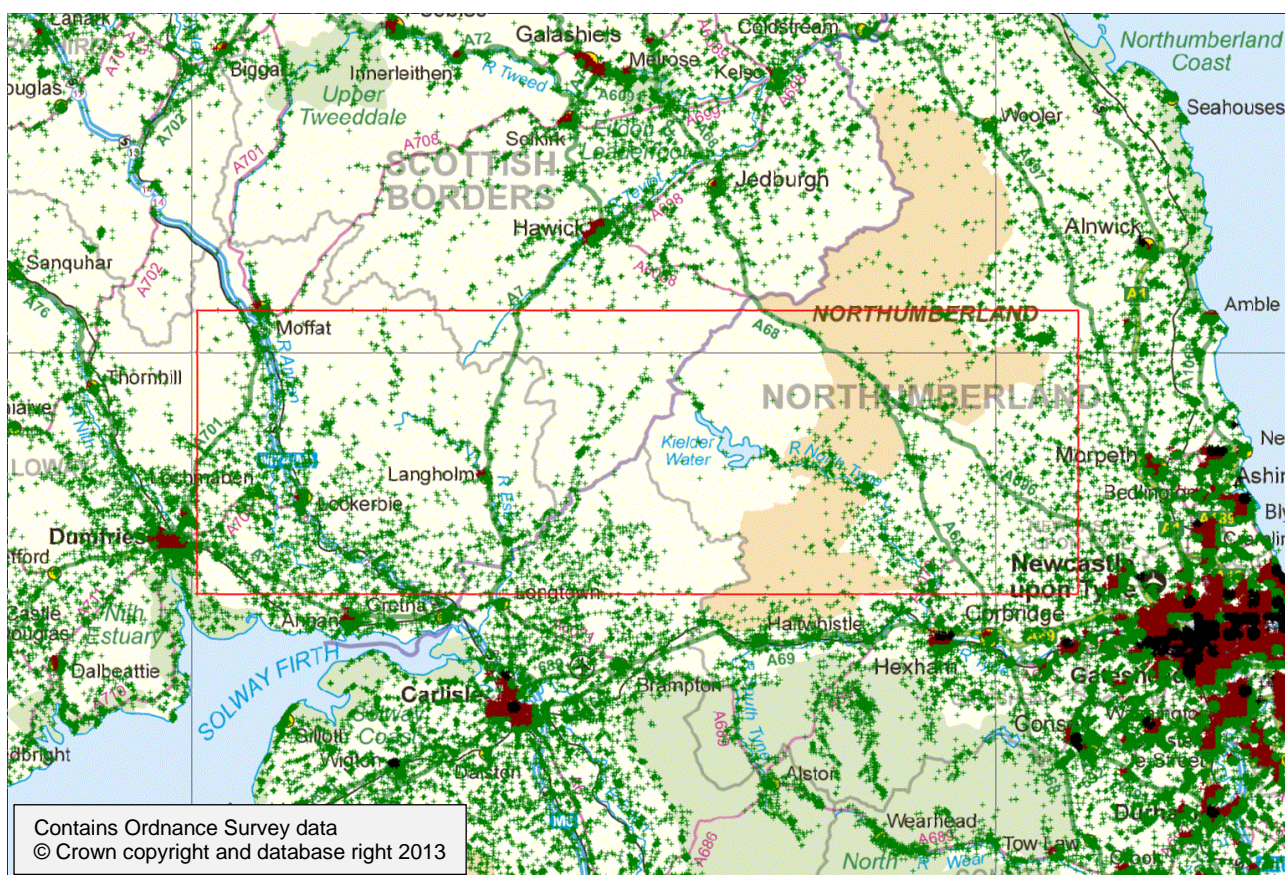
Figure 7: Area of rural pixels selected for analysis.

Clutter Type	Colour	Address count
Rural	Green	17,520
	Total	*17,520*

Table 5: Number of postal addresses in each clutter category for selected rural area

The frequency and CDF distributions are shown in Figure 8 and Figure 9 respectively.

A comparison of the minimum separation distance CDF to the proposed Ofcom value, highlighted in orange, is shown in Table 6.

	Proportion of addresses with neighbours closer than		
Clutter Type	**5m**	**10m**	**20m**
Rural	3%	36%	59%
All UK	16%	61%	83%

Table 6: Comparison of Ofcom proposals to selected rural area
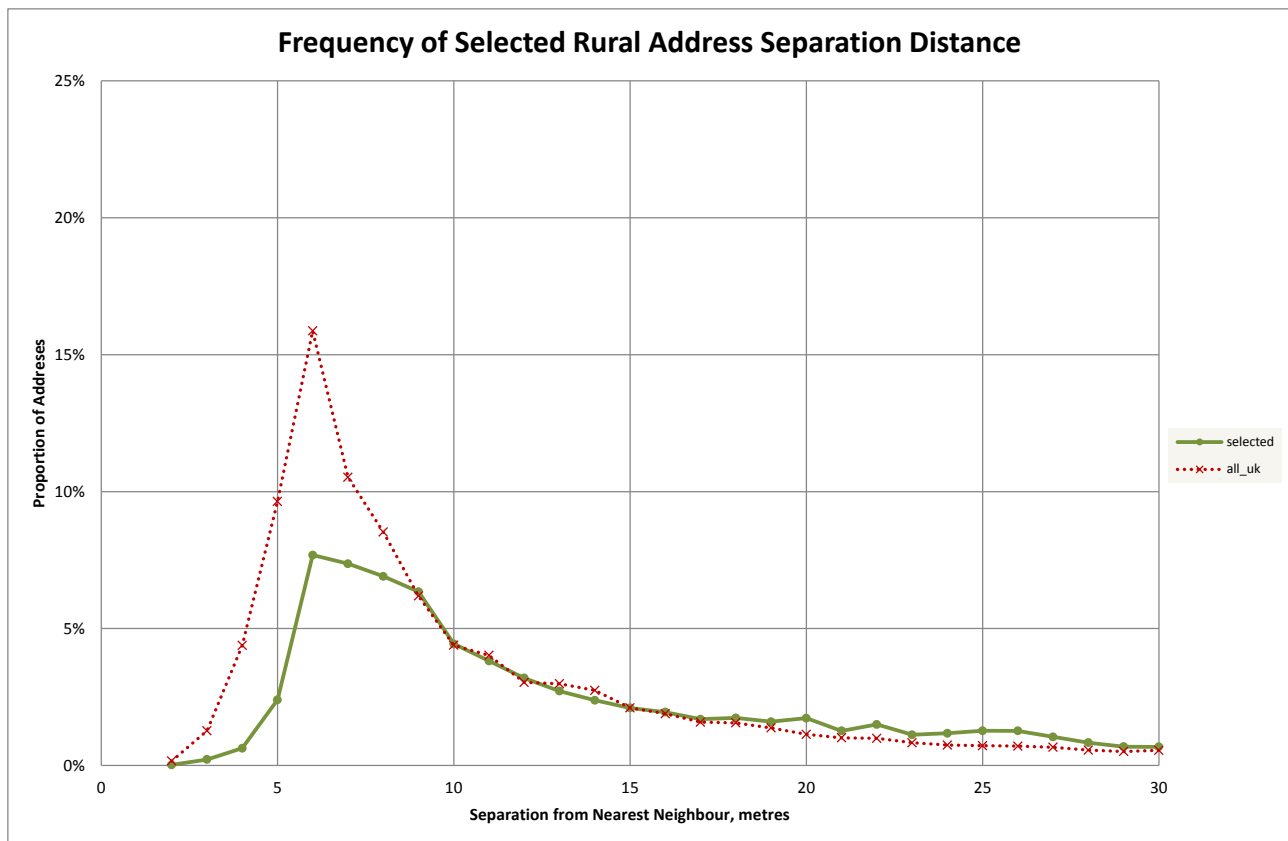
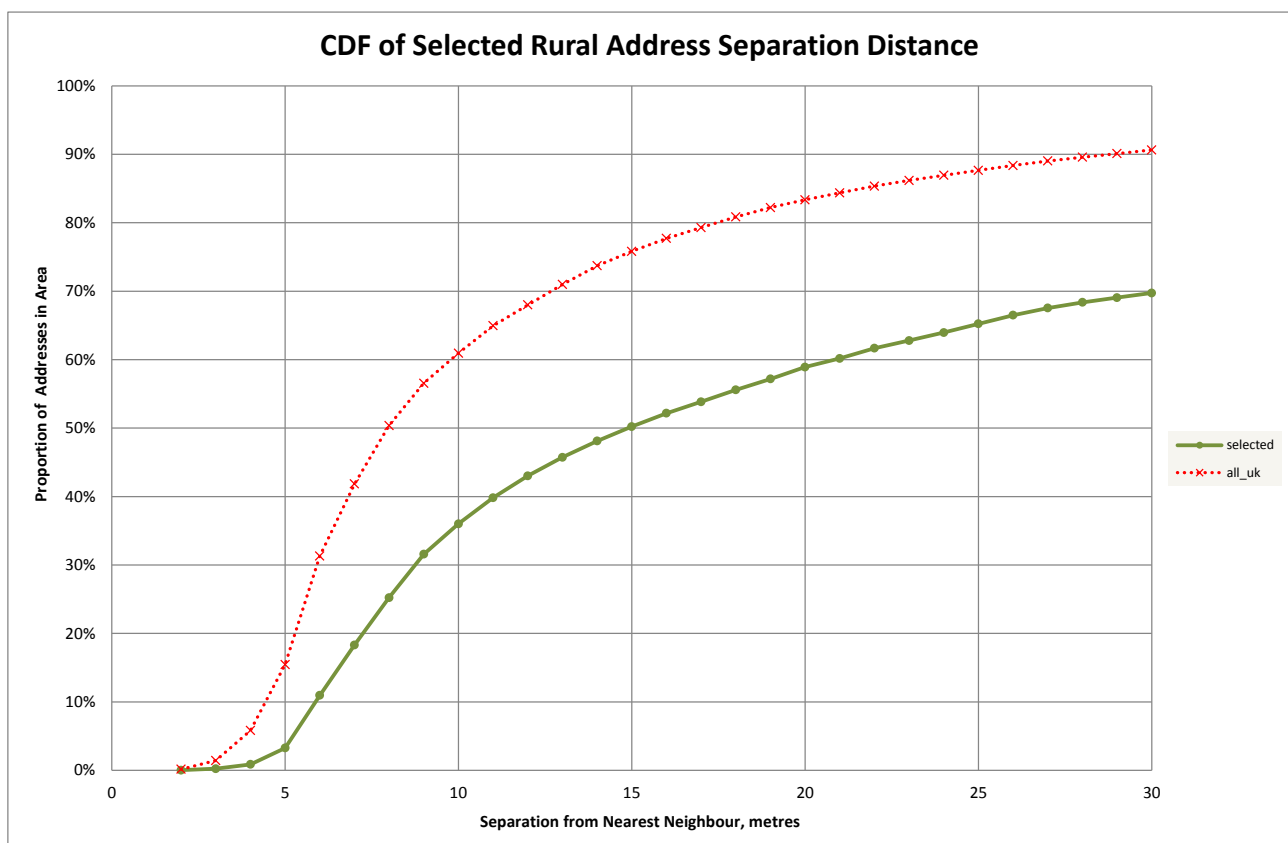**Figure 8: Frequency of address separation in sample rural area**

Figure 9: CDF of address separation in sample rural area

The results from the sample rural area show that the frequency of address separation distances peaks at the same point as the national situation, although clearly the high-separation distance tail is much longer. Similarly the CDF shows that nearly 60% of addresses have a nearest neighbour closer than the 20m proposed by Ofcom and hence again the proposed WSD reference geometry separation distances will not provide sufficient protection for the majority of addresses in this area.

CONCLUSIONS

The most frequent nearest-neighbour distance of 6m, identified in earlier reports, is reconfirmed by this analysis and appears to be unaffected by clutter type.

The CDF distributions show that the WSD reference geometry separation distances proposed by Ofcom will not provide sufficient protection for the vast majority of suburban and rural addresses where these values are used.

APPENDIX 1: RELATED TECHNICAL NOTES

This paper is one of a series prepared by Digital UK to explore the geographical distribution of addresses in the UK:

- single_occupancy_pixel_20121009.pdf
- uk_address_separation_20120323.pdf
- uk_address_distribution_20120118.pdf
- address_separation_by_housing_density_20121031.pdf

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