Note for Applicants on Coverage of Local Television

Minimum coverage requirements and transmission arrangements

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Section 1

Transmitter locations

1.1 This *Coverage Note* provides indicative details of the coverage that might be achieved by local TV transmitters in each of the locations being considered for local TV services. The Note is being published because Ofcom considers that potential applicants for the local TV multiplex licence may find this information useful when commencing their own technical analysis. The Note reflects Ofcom's estimate about coverage but applicants will need to inform themselves in order to develop their own view of the coverage which is possible in each of the locations. Applicants will need to form a view on this for the commercial decisions which they need to make when considering whether to apply for the multiplex licence, and the Technical Plan build out which they are willing to commit to as part of that application. It is hoped that this Note will provide some initial assistance in order to help applicants arrive at their own view.

1.2 Terrestrial television services are broadcast by a network of approximately 50 main transmitters and over 1,000 smaller relay transmitters. The list of local TV locations in this *Coverage Note* considers 58 of those transmitters serving 49 locations (comprising the minimum roll-out of 21 'Phase 1' locations, and 28 further possible 'Phase 2' locations[1] where technical coverage plans have been developed) that generally serve the largest number of households with a good spread across the UK. Figure 1 shows the 49 locations. Phase 2 also contains a further 16 locations where no expressions of interest have been received to date, and these 16 locations are not considered in this document.

1.3 We begin with defining local areas by transmitter location because, unlike for radio, most TV reception is through fixed rooftop aerials that only work well when receiving signals from the direction in which they are pointing. As these aerials will be pointing towards the established transmitter sites, these provide a sensible basis for identifying where it may be possible to provide services targeting local communities.

1.4 We commissioned an assessment of the available spectrum at each of the larger of the UK's broadcast transmitters. Most of these will broadcast six UK-wide multiplexes (each carrying a number of television services) at the completion of digital switchover. The six multiplexes require six transmission channels at each transmitter site from the 31 channels available to TV broadcasting. Although this leaves 25 channels unused at each transmitter station, many are in use at adjacent stations and cannot therefore be used for broadcasting at sufficiently high powers to achieve useful coverage without unacceptable interference occurring.

1.5 The assessment therefore attempted to identify the best unused frequency that could be sufficiently clear to permit the broadcasting of an additional local multiplex. Notional antenna patterns were then developed that took into account the requirement not to cause undue interference to the other digital television multiplexes.

[1] See Section 3 of the *Licensing Local TV* statement for details of multiplex roll-out requirements.

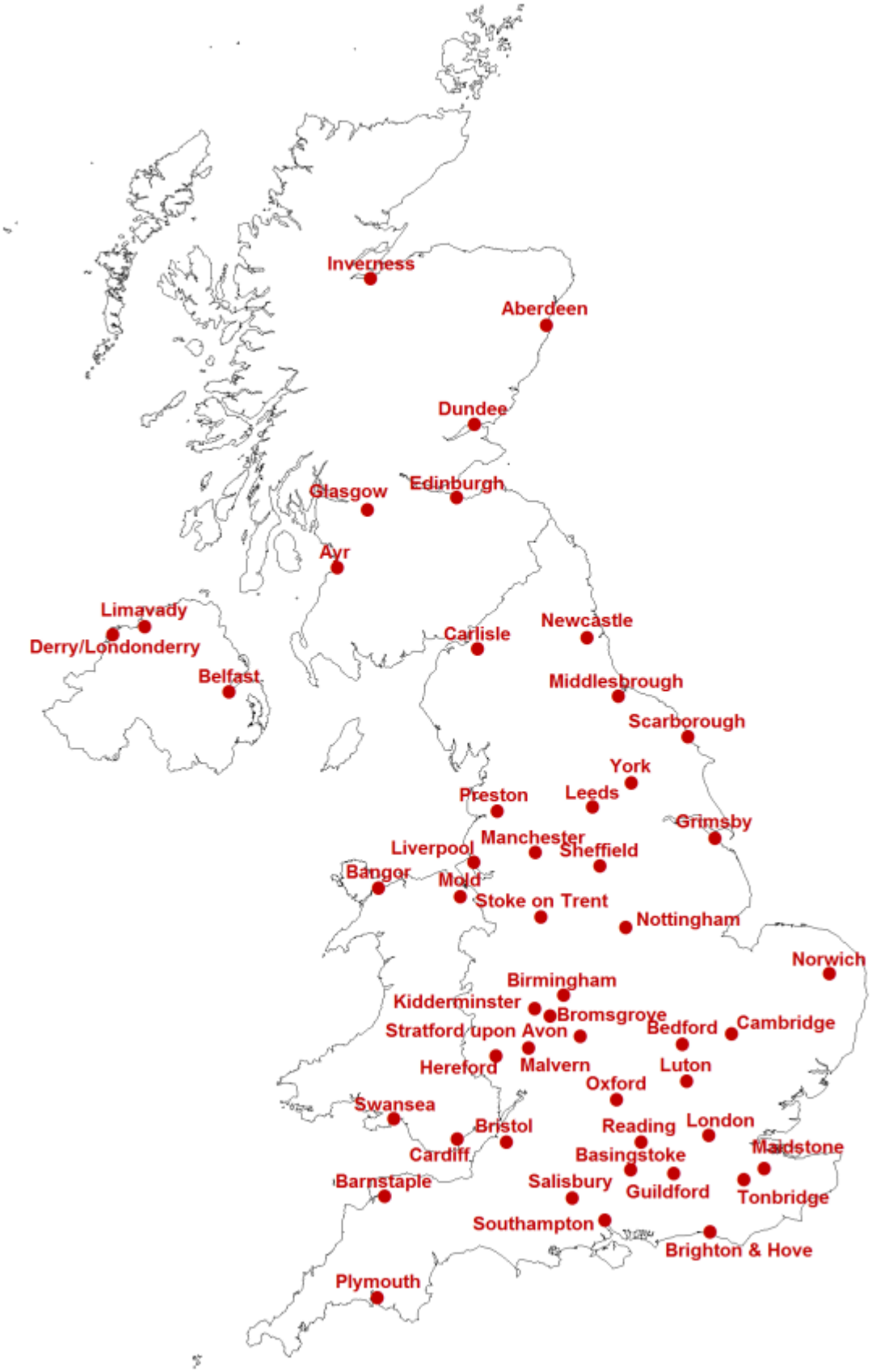

Figure 1: 49 local TV locations that are considered in this document

Section 2

Assumptions and Caveats

2.1 In carrying out the assessment of the feasibility of GI spectrum to accommodate local multiplexes, we have had to make a number of assumptions. The most significant are set out in this section.

Antennas

2.2 We have assumed that separate local multiplex broadcasting antennas would be installed at each transmitter. We have further assumed that these antennas would be mounted at around half the height of the transmitter mast in the case of main transmitter masts, and slightly below the antennas used by the six UK-wide multiplexes in the case of relay transmitter masts.

2.3 We do not at this stage have detailed information about whether the main transmitting antennas used by the six UK-wide multiplexes (and generally situated at the top of masts) could be shared by the local multiplexes. We have therefore adopted a cautious approach to modelling the antenna so as not to overstate the possible coverage that could be achieved.

2.4 The actual coverage achieved in each location will depend on how closely the final technical arrangement matches our assumptions.

2.5 Physical space for the new local multiplex antenna will need to be found on the transmitter mast. Should this antenna be higher or lower in practice than the height we have assumed, there may be an increase or decrease in the coverage that could be achieved.

2.6 If the local multiplex can share the main antenna, it would probably achieve more extensive coverage than that shown in the maps in Annex 1. A detailed site-by-site assessment and commercial negotiation would be required to determine the feasibility of the local multiplexes sharing antennas with the UK-wide multiplexes. Sharing the main antenna will definitely not be possible in some cases as they will not meet the necessary antenna pattern restrictions.

Modulation

2.7 In our initial coverage analysis we assumed that a robust signal mode, QPSK rate 2/3, would be used by the local multiplex. This mode offers capacity of 8 Mbit/s. However, following subsequent technical research,[2] we now propose that the QPSK rate 3/4 signal mode, which offers a slightly higher capacity of 9 Mbit/s, should be adopted: QPSK rate 3/4 is likely to be able to provide sufficient capacity to carry three video services with less technical complexity and can potentially provide better picture quality than QPSK rate 2/3. QPSK rate 3/4 does however have slightly reduced coverage for a given transmitter power than QPSK rate 2/3.

2.8 In response to our consultation, some stakeholders suggested that it could be desirable under certain circumstances for the multiplex to operate using a more

[2] Zetacast: Local Television Multiplex Capacity Assessment: http://stakeholders.ofcom.org.uk/consultations/local-tv/zetacast/

robust mode, possibly QPSK rate 1/2. As we have set out in our statement, Ofcom would be prepared consider requests for the multiplex to operate with alternative signal modes subject to there not being a detrimental impact upon the local TV service providers. Should QPSK rate 1/2 be adopted, then coverage would be slightly more extensive than for rate 3/4.

2.9 Indicative population coverage figures based on QPSK rate 3/4 are provided in Table 1 and in Annex 1 of this document to reflect the currently assumed transmission mode. We have also provided coverage figures for QPSK rate 2/3 and rate 1/2 for comparison purposes in Annex 2. The indicative coverage maps provided in Annex 1 are based on QPSK rate 2/3. If QPSK rate 3/4 is adopted by the local multiplex, the coverage areas achieved in practice will be slightly reduced compared to those shown in these maps, whereas for QPSK rate 1/2, coverage will be slightly more extensive than is shown.

2.10 If a different signal mode is ultimately adopted, further variations to the indicative coverage of the local multiplexes are likely to occur. Further information on the applicable transmission standards is provided in the *Invitation to Apply for the Local Multiplex Licence*.[3]

Impact on other DTT multiplexes in the UK

2.11 The planning methodology adopted during the assessment and design of notional transmission arrangements for the local multiplexes has been developed to result in minimal impact on the coverage of the UK-wide multiplexes. For example, the power of the local TV transmitters has been kept to modest levels to minimise interference caused to the UK-wide multiplexes. Also, a notional local antenna arrangement has been developed for each site to ensure that the local multiplexes do not cause unacceptable interference to other DTT services.

2.12 Coverage predictions are carried out using a sophisticated computer modelling system that breaks the UK into 100m x 100m 'pixels' and calculates the likelihood of reception in each pixel. The model does not have detailed information on the reception conditions in each square and has to make generalised allowances for things like the presence of buildings and trees. We also have to rely upon estimations of the viewing patterns of households in some areas where the coverage of adjacent transmitters overlaps and there is a choice of transmitter from which they can receive their programmes.

2.13 While the planning for the introduction of local television services is based on a principle of minimising the impact upon reception of the UK-wide multiplexes, there is a degree of uncertainty inherent in the coverage and impact predictions. It is therefore possible that the number of households that can receive local television services in some locations may be under or overestimated, as might the number of households whose reception might be affected by the introduction of the local television multiplexes. The method and principles we have adopted are very similar to those used to plan coverage for digital switchover (including the impact of interference from one transmitter to another) which means that we can have confidence that the predictions are correct in the majority of situations.

2.14 In addition, the planning method does not take account of the protection of Re-Broadcast Links (RBLs). RBLs are used by the PSB multiplexes to provide a signal

[3] http://licensing.ofcom.org.uk/tv-broadcast-licences/local/

feed from a main station to its relay stations, or from relay station to relay station in a relay chain. Protection could be offered by restricting the local TV station's signals in the direction of the RBL; by improving the RBL (for example, through upgrading the aerials); or a combination of both.

2.15 Further consideration of the obligations to be placed upon the local TV multiplex operator in relation to the impact upon RBLs and upon reception of the UK-wide multiplexes is provided in the *Invitation to Apply for the Local Multiplex Licence*.

International considerations

2.16 The UK is obliged through international treaty to limit below a defined level the signals that broadcast services in the UK put into neighbouring countries in Europe. This level is called the coordination trigger threshold[4] and our neighbouring countries are under reciprocal agreements to limit the levels of signals they put into the UK.

2.17 As it is often necessary to exceed the trigger thresholds for transmitters near national boundaries, a process exists to coordinate and agree the use of the frequencies used by the transmitters in each country to manage and minimise the impact of interference from one country into another. For the UK, the transmitters in the south and east of England and in Northern Ireland are most likely to need coordination.

2.18 The indicative plans for local services presented in this document envisage limiting interference towards the Continent and Ireland to 29dBuV/m. Whilst this level has been used as the basis of coordination of the UK-wide multiplexes, it exceeds the coordination trigger threshold (nominally about 23 dBuV/m). Some local TV multiplexes may therefore be subject to the coordination process and will need to be agreed with the affected administrations. International co-ordination of a high level of exported field strength can take some time (months or even years in exceptional cases). The field strength level we are proposing only exceeds the trigger threshold by a modest margin and it is expected that a coordination agreement could be reached in a reasonable time frame.

Influence of domestic aerial direction

2.19 The coverage predictions contained in Annex 1 have been derived using the same coverage criteria as are used for planning digital switchover. The maps indicate in purple the maximum coverage (assuming QPSK rate 2/3 modulation) from each transmitter where households are predicted to be able to receive the local multiplex. This is called 'gross' coverage.

2.20 It is very unlikely that all households in the gross coverage area have aerials pointing towards the transmitter. Consequently the number of households that could actually receive the local multiplexes and the area actually covered in practice would be somewhat smaller. No comprehensive database exists of where aerials are pointing in any particular area and the only way to obtain reliable information is to carry out a rooftop survey. Further information on population coverage is provided in Section 3.

Influence of domestic aerial group

2.21 Traditionally domestic aerials have been designed to work over only a part of the total range of UHF channels; these are called 'grouped aerials'. The grouped aerial

[4] The coordination trigger threshold is nominally 23dBuV/m.

approach was sensible as the frequencies used by the historic four analogue television services were usually close together, and the task of designing aerials was made easier by tailoring their response to these relatively narrow channel groups.

2.22 At digital switchover, some of the digital programme services from some transmitters will make use of transmission channels that lie outside the existing analogue aerial group for a particular area. Households in those areas may need to replace their aerials with a wideband design to be able to receive all of the digital programme services reliably. Wideband aerials can receive services on any of the UHF channels and many aerials that have been installed in the last 10 to 15 years are of this type. A considerable number of grouped aerials do however remain in use.

2.23 To maximise the likelihood that households will be able to receive the local multiplexes, we have attempted to find transmission channels that are within, or close to, the existing aerial group. This has not been possible in all cases and the Aerial Compatibility column of Table 1 provides guidance on the areas where at least some households may have aerials that are not best suited to receiving the local multiplexes. We adopted the following categories:

2.23.1 *In group:* The local multiplex channel falls within the analogue aerial group. Households that are predicted to lie within coverage and have an aerial meeting the standard assumptions that points towards the appropriate transmitter should be able to receive the local multiplex.

2.23.2 *Just outside*: The local multiplex channel is within a few channels of the analogue aerial group. Although not designed to work on these channels, a grouped aerial can still be expected to perform reasonably well, although some households that are predicted to be in coverage may not be able to receive the local multiplex as a result of their aerial's performance tailing off.

2.23.3 *Outside with others*: The local multiplex is outside the aerial group, but so are some of the other digital programme services. Households therefore have a strong motivation to replace their aerials with a wideband type if they would like to receive all of the programme services. It is unrealistic to expect that all have done so though and some households that are predicted to be in coverage may therefore not be able to receive the local multiplex.

2.23.4 *Out of group*: The local multiplex is out of analogue aerial group and some, perhaps many, households may have difficulty receiving the local multiplex unless they have replaced their aerials with a wideband design. In most of these areas, DTT services did operate out of group for many years prior to digital switchover although they have moved back into group at switchover. This would have provided an incentive to households to install wideband aerials, but not all would have done so.

Adjacent channel interference

2.24 Local TV multiplexes could be susceptible to adjacent channel interference from the UK-wide multiplexes and hence the coverage they achieve in practice could be less extensive than predicted. Four mechanisms will contribute to the susceptibility of local TV multiplexes:

2.24.1 Operating at a lower power level relative to the UK-wide multiplexes;

2.24.2 Restricted antenna pattern relative to other multiplexes;

2.24.3 A significant difference in the height of the local multiplex transmitting antennas in relation to other multiplexes at the same transmitting site; and

2.24.4 Another multiplex offset towards the local multiplex in particular a UK-wide multiplex using extended carrier DVB-T2.

2.25 To some extent, each of these can be managed. The main mitigation method is the choice of modulation scheme; the more robust the modulation scheme, the more resilient the service albeit at the cost of data capacity, i.e. fewer services can be accommodated within the multiplex. We are proposing that the local multiplexes make use of a robust QPSK modulation scheme.

2.26 Other than modulation scheme, careful choice of antenna pattern and the position of the antenna can help mitigate interference. Where possible, the antenna pattern should match that of the UK-wide multiplex, at least over the primary service area of the local service. Also, the antenna height should be as close as possible to that used by the UK-wide multiplex, though this may be restricted by lack of space on the structure. In such a case, these two criteria could be met by sharing the same antenna as the UK-wide multiplex. However, the cost of doing so, or the restrictions required, may preclude this.

Offsets

2.27 On occasion the UK-wide multiplexes use offsets, that is, the centre frequency of the multiplex is moved up or down by 167 kHz. This has been done primarily to avoid the need to employ transmitter filtering that with a very steep roll-off, particularly at band edges,[5] but also to help with the design of the chain of relay transmitters used by the public service broadcaster multiplexes. Multiplexes whose frequencies are offset towards each other are subject to an increased level of mutual interference.[6]

2.28 To mitigate the impact of operating in a channel adjacent to a multiplex incorporating an offset, it has been assumed that the local TV channel will need to employ a similar offset.

2.29 It should be noted that the coverage calculations in this note have not considered offsets. Local TV stations with adjacent channel relationships with the UK-wide multiplexes are noted in Table 1.

[5] The lower edge of channels 21 and 39 and the upper edge of channels 30 and 60.

[6] The standard planning criteria, used by Ofcom and the UK-wide TV broadcasters, suggest that offsetting a DVB-T multiplex down can reduce the adjacent channel protection ratio by 11 dB. Information on the impact of offsetting DVB-T2 is presently not available. However, even though it occupies more bandwidth within the channel, because of the reduced emissions outside of the channel, it is thought that DVB-T2 will cause no more interference than DVB-T. However, DVB-T2 does have an extended carrier mode and an offset DVB-T2 extended carrier system will infringe on the adjacent channel. This may result in an increase in interference beyond that quoted for an offset DVB-T channel.

Section 3

Indicative Household Coverage

3.1 Coverage maps have been produced based on the type of transmitter arrangement that might be used by local television multiplexes. From these maps, we have picked the largest settlement in each location that is served by the transmitter and taken its name as the principal settlement for that area. These are indicated as the primary location in Table 1. Where a transmitter serves several towns or cities, we have also listed the next largest settlements served in each location and these are detailed as secondary locations.

3.2 At sixteen of the possible Phase 2 locations[7] no expressions of interest have been received by Ofcom or the DCMS. Therefore no technical plans for these sites have been been included in this *Coverage Note*. However applicants are free to propose building out to any of these locations if they can demonstrate that there are likely L-DTPS applicants at these locations. Provisional technical plans for these locations, including indicative coverage, are available in Arqiva's 2011 Local TV Frequency Planning Study.[8]

'Petalling'

3.3 In a few cases, the coverage that could be achieved by a transmitter is very extensive and serves several cities. An example is the Winter Hill transmitter that serves most of the Granada ITV region in the north-west of England. In these cases, we have modelled the potential targeting of coverage using a technique we have named 'petalling'. This enables specific targeting of distinct locations within the transmitter coverage area. The advantage of using petalling is that separate local services can be carried in each petal. In the case of Winter Hill, separate petals could provide different local TV services for Manchester, Liverpool and Preston.

Indicative coverage

3.4 The coverage figures and maps we have produced provide an indication of the kind of coverage that might be achieved by local multiplexes. The assessment we have made of possible locations is, however, based on a purely theoretical analysis of transmitter sites and the available spectrum.

3.5 Population coverage assessments are based on a predicted TV signal strength level in each 100m x 100m area of the UK (known as a 'pixel'). All households in pixels within which at least 70% of the locations are predicted to be served are counted. No adjustment has been made for the number of households that may be receiving their TV services from other platforms such as satellite or cable. The latest figures published by Ofcom[9] for the first quarter of 2011 show that approximately 44% of primary TV sets are used to receive terrestrial television, 42% from satellite and 11% connected to cable, the remaining 3% are used for broadband TV and video on

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[7] Burnley, Carmarthen, Dover, Elgin, Falkirk, Gloucester, Greenock, Haverfordwest, Haywards Heath, Hemel Hempstead, Keighley, Lancaster, Poole, Reigate, Shrewsbury and Telford.
[8] Geographically Interleaved Broadcast Channels for 74 UK TV Stations: http://stakeholders.ofcom.org.uk/broadcasting/tv/local-tv-services/arqiva/
[9] Ofcom Communications Market Report 2011: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr11/UK_CMR_2011_FINAL.pdf

demand services. For secondary sets, the proportion making use of satellite and cable is much lower and around 75% of all homes make some use of terrestrial television on at least one set.

3.6 The total number of households in the UK is assumed to be 28.3 million: this figure is derived from the Royal Mail Postcode Address File (PAF), which includes business as well as residential addresses. All coverage figures assume that households have good quality aerials that are correctly aligned and of the appropriate group or are wideband.

3.7 Table 1 includes estimates for each location of the number of households that might be able to receive the local multiplexes, if they were broadcast using the assumed characteristics. It is not possible to provide an exact figure for the number of households that receive their television services from any particular transmitter and it is therefore difficult to be precise about how many households could receive the local multiplexes. As guidance, we have provided two measures:

3.7.1 **Gross population** represents the total number of households that could receive the local multiplex if their aerials are pointing towards the appropriate transmitter. In practice, the gross coverage of adjacent transmitters overlaps to some extent which means that households have a choice of which direction to point their aerials. Gross coverage is therefore almost always an overestimate of the number of households using a particular transmitter as some households within the gross coverage area can be expected to be watching a different transmitter. Gross coverage is nevertheless useful as it provides an upper limit for the maximum possible number of households served. Because the gross coverage of adjacent transmitters overlaps, for areas where two transmitters are proposed the gross population figure represents the gross coverage of the larger transmitter only.

3.7.2 **DPSA (Digital Preferred Service Area)** is an attempt to provide a more realistic estimate of the number of households that might be able to receive the local multiplex than gross population. The DPSA is a prediction of the areas where a particular transmitter is likely to provide better signals than other transmitters. In those areas, it is reasonable to expect that households have aerials pointing at the transmitter in question and could therefore receive the local multiplex broadcast from that transmitter. The DPSA method is a numerical prediction and cannot, however, take account of viewer preferences where households sometimes choose to receive services from a different transmitter. No allowance has been made in the figures for the proportion of households that make use of alternative platforms such as cable or satellite. In locations where two transmitters are proposed, the DPSA coverage figure is the sum of the contribution of both transmitters.

3.8 The status of the technical plan for each site is indicated in the 'Planning Status' column of Table 1:

Provisional	The technical characteristics for the proposed site are provisional, and have not yet gained formal technical approval within the UK. However, significant changes to the planned characteristics are not anticipated as a result of the approval process.
Baseline	The technical characteristics for the transmitter have been, or are expected to be technically approved within the UK. International frequency coordination (where required) has not been carried out.
Enhanced	In the light of comments from potential licence applicants, a revised technical plan has been prepared in order to provide improved coverage compared to the baseline coverage technical plan for this site.

The Planning Status of each transmitter is also shown alongside the individual site coverage maps in Annex 1.

3.9 Our initial assessment shows that the network of transmitters in Table 1 could achieve total coverage (within DPSA) of approximately 13.9 million homes.

3.10 The predicted coverage is inevitably a theoretical calculation and the actual coverage that could be achieved in practice might vary from the predicted figures. For example, the use of a transmit antenna at a different height to that assumed will change the coverage. There is also a limit to the accuracy of the computer prediction of the TV signal strength. For example, the method uses statistical clutter models rather than data on the actual buildings, trees or other potential obstacles in a particular area. The method and assumptions are however consistent with those used for digital switchover.

3.11 In the case of a new TV service being introduced into an existing broadcast environment, this method of estimating the predicted coverage for each transmitter does carry with it an implicit assumption that households will be willing to install a new receiving aerial for the new service, if their existing aerial arrangement is not adequate.

3.12 Annex 1 to this Note provides a summary of the planning assignments for each local TV station including an indicative coverage map. Note that while the household coverage figures in Annex 2 (and in Table 1) assume that QPSK rate 3/4 modulation is used, the indicative coverage maps in Annex 1 are modelled using QPSK rate 2/3 and will therefore tend to slightly overestimate the achievable geographic coverage area of QPSK rate 3/4 signals.

Table 1. List of Proposed Local TV Stations & Indicative Coverage (assuming QPSK 3/4 modulation except where noted)

Primary Location	Gross Households	DPSA Households	Transmitter Station	Channel	Planning Status	Aerial Compatibility	Adjacent Channel
Phase 1							
Belfast (inc. Lisburn)	190,000	190,000	Divis	30	Baseline	In group	Yes
Birmingham (inc. Greater Birmingham, part of Wolverhampton, Walsall, Dudley)	1,000,000	1,000,000	Sutton Coldfield Brierley Hill	51 29	Baseline Baseline	In group Out of group	
Brighton & Hove	140,000	97,000	Whitehawk Hill	54	Baseline	In group	Yes
Bristol	370,000	320,000	Mendip Bristol Kings Weston Bristol Ilchester Crescent	51 30 30	Baseline Baseline Baseline	In group Just outside Just outside	Yes
Cardiff (inc. Newport, Bridgend)	480,000	340,000	Wenvoe	51	Baseline	In group	
Edinburgh (inc. Edinburgh)	590,000	420,000	Craigkelly	52	Baseline	In group	
Glasgow (inc. East Kilbride, Motherwell, Paisley)	800,000	720,000	Black Hill	51	Baseline	In group	
Grimsby (inc. parts of Kingston upon Hull)	250,000	250,000	Belmont	27	Baseline	In group	Yes

Primary Location	Gross Households	DPSA Households	Transmitter Station	Channel	Planning Status	Aerial Compatibility	Adjacent Channel
Leeds (inc. Dewsbury, Halifax, Huddersfield, Wakefield)	980,000	840,000	Emley Moor Beecroft Hill	56 56	Baseline Baseline	Just outside In group	 Yes
Liverpool (inc. St Helens, Widnes, Wigan, Wirral)	900,000	890,000	Winter Hill petal 2 Storeton	56 30	Baseline Baseline	In group In group	Yes Yes
London - Baseline (inc. Greater London area)	3,000,000	3,000,000	Crystal Palace	29	Baseline	In group	Yes
London - Enhanced (inc. Greater London area)	4,500,000	4,100,000	Crystal Palace	29	Enhanced	In group	Yes
Manchester (inc. Bolton, Bury, Oldham, Rochdale, Salford, Stockport)	1,100,000	1,000,000	Winter Hill petal 1	56	Baseline	In group	Yes
Newcastle (inc. Gateshead, South Shields, Sunderland)	980,000	570,000	Pontop Pike	56	Baseline	In group	Yes
Norwich	150,000	140,000	Tacolneston	57	Baseline	In group	
Nottingham	270,000	270,000	Waltham Nottingham	26 50	Baseline Baseline	Outside with others Outside with others	Yes
Oxford (inc. Abingdon, Didcot)	100,000	100,000	Oxford	51	Baseline	In group	Yes
Plymouth	100,000	100,000	Caradon Hill Plympton	30 39	Baseline Baseline	In group Outside with others	
Preston (inc. Blackpool)	370,000	370,000	Winter Hill petal 3	56	Baseline	In group	Yes
Sheffield	180,000	110,000	Sheffield	55	Baseline	Outside with others	

Primary Location	Gross Households	DPSA Households	Transmitter Station	Channel	Planning Status	Aerial Compatibility	Adjacent Channel
Southampton (inc. Eastleigh, Fareham, parts of Isle of Wight, parts of Portsmouth, Winchester)	440,000	230,000	Rowridge VP	29	Baseline	In group, but different polarisation to analogue	Yes
Swansea (inc. Llanelli)	110,000	72,000	Kilvey Hill	30	Baseline	In group	Yes
Total Phase 1[10]		**12,100,000**					
Phase 2							
Aberdeen	120,000	120,000	Durris	30	Baseline	In group	Yes
Ayr (inc. Kilmarnock)	120,000	110,000	Darvel	30	Baseline	In group	Yes
Bangor*	21,000	16,000	Llanddona	51	Provisional	In group	
Barnstaple*	34,000	32,000	Huntshaw Cross Barnstaple	51 49	Provisional	In group In group	Yes
Basingstoke*	88,000	63,000	Hannington	29	Provisional	In group	
Bedford (inc. Sandy)	62,000	62,000	Sandy Heath	42	Baseline	Outside with others	
Bromsgrove	67,000	27,000	Bromsgrove	29	Baseline	In group	Yes
Cambridge*	83,000	83,000	Madingley	40	Provisional	Outside with others	
Carlisle*	110,000	90,000	Caldbeck	56	Provisional	Out of group	
Derry/Londonderry*	40,000	36,000	Londonderry	51	Provisional	In group	
Dundee (inc. Arbroath, Perth)	370,000	140,000	Angus Tay Bridge	48 51	Baseline Baseline	In group In group	Yes
Guildford (inc. parts of Woking)	150,000	54,000	Guildford	51	Baseline	In group	Yes
Hereford*	40,000	40,000	Ridge Hill petal 1	51	Provisional	Out of group	

[10] Including *London – Enhanced* coverage.

Primary Location	Gross Households	DPSA Households	Transmitter Station	Channel	Planning Status	Aerial Compatibility	Adjacent Channel
Inverness	69,000	49,000	Rosemarkie	52	Baseline	In group	
Kidderminster	34,000	21,000	Kidderminster	56	Baseline	In group	
Limavady* (inc. parts of Ballymoney&Coleraine)	54,000	35,000	Limavady	48	Provisional	In group	Yes
Luton	78,000	22,000	Luton	45	Baseline	Just outside	
Maidstone	190,000	130,000	Bluebell Hill	27	Baseline	Just outside	
Malvern	120,000	53,000	Malvern	51	Baseline	In group	Yes
Middlesbrough	280,000	210,000	Bilsdale petal 1	24	Baseline	In group	Yes
Mold* (inc. Denbigh, Ruthin)	88,000	25,000	Moel y Parc	56	Provisional	Just outside	
Reading	370,000	170,000	Hannington	29	Baseline	Out of Group	
Salisbury*	41,000	30,000	Salisbury	51	Provisional	Yes	
Scarborough	43,000	31,000	Olivers Mount	56	Baseline	In group	Yes
Stoke on Trent (inc. Newcastle under Lyme)	140,000	120,000	Fenton	29	Baseline	In group	Yes
Stratford upon Avon	62,000	28,000	Lark Stoke	48	Baseline	Outside with others	
Tonbridge	62,000	45,000	Tunbridge Wells	51	Baseline	In group	Yes
York	240,000	100,000	Bilsdale petal 2	24	Baseline	In group	Yes
Total Phases 1 and 2		**14,000,000**					

*For provisional (asterisked) sites, QPSK rate 2/3 modulation has been assumed for population coverage figures. Population coverage at QPSK rate 3/4 population will be slightly lower.

Section 4

The DTT Platform

Description of the DTT platform

4.1 The existing UK-wide DTT services will broadcast from a network of 1,156 transmitter sites when the process of digital switchover completes in October 2012. Each transmitter site will broadcast either three or six UK-wide multiplexes: all sites will carry the three Public Service Broadcaster (PSB) multiplexes (provided by the BBC and Digital 3&4 Ltd), and the UK's 80 primary transmitters will carry a further three 'commercial' multiplexes (provided by Arqiva Ltd and SDN Ltd).

Multiplex	Operator	Notes
PSB1 – BBC A	BBC	
PSB2 - D3&4	Digital 3 & 4	Consortium of Channel 3 licensees and Channel 4
PSB3 - BBC B	BBC Free To View Ltd	DVB-T2 multiplex carrying High Definition channels
COM4 - SDN	SDN	Subsidiary of ITV plc
COM5 - Arqiva A	Arqiva	
COM6 - Arqiva B	Arqiva	

4.2 An estimated 98.5% of the UK population will be served by at least three UK-wide multiplexes by the completion of switchover. Approximately 90% of the population will be served by the network of 80 principal transmitters carrying six UK-wide multiplexes. In areas outside the coverage of the 80 principal sites, a much larger number of 3-multiplex sites will provide the three 'public service' UK-wide multiplexes in areas where signals from principal transmitters are poor or unavailable.

Licensing of existing multiplex operators

4.3 All UK-wide multiplex operators hold Wireless Telegraphy Act licences from Ofcom which authorise their use of the spectrum. All multiplexes (except BBC A) also hold multiplex service licences awarded under the Broadcasting Act 1996. The BBC A multiplex is 'gifted' directly to the BBC under its Charter and associated Framework Agreement, and therefore does not require a Broadcasting Act licence.

4.4 The multiplex licences place a number of conditions upon the licensees relating to digital switchover, cooperation and interoperability. For the latter category, licensees are required to comply with the *Television Technical Performance Code*[11] and the

[11] Television Technical Performance Code: http://stakeholders.ofcom.org.uk/binaries/broadcast/guidance/tech-guidance/tv_tech_platform_code.pdf

Reference Parameters[12] which describe some minimum conditions which seek to ensure interoperability between the licensee's broadcasts and domestic receivers.

Digital Television Group (DTG) and the D-Book

4.5 Although UK DTT services use the internationally standardised DVB-T and DVB-T2 systems, in several areas these standards deliberately include significant scope for flexibility in detailed implementation options. However, the DTT platform in the UK operates on a horizontal model, with several independent multiplex operators (rather than a single platform operator), and with many manufacturers supplying a diverse range of domestic receiver equipment. It is therefore necessary to achieve effective interoperability between both the multiplexes as broadcast, as well as between the signals and receivers, in order to ensure platform stability and to facilitate the technical evolution of the platform.

4.6 Requirements in the licences of the multiplex operators (which the BBC also adheres to in the case of the BBC A multiplex) do reduce the number of options, for example in permissible basic transmission modes. These restrictions were introduced with a view to improving prospects for platform interoperability, and are contained in Ofcom's *Reference Parameters*. Nevertheless many detailed aspects of implementation lie outside the scope of the broadcasters' licences, leaving numerous choices to be made by broadcasters, multiplex operators and receiver manufacturers.

4.7 Since the launch of DTT services, the Digital Television Group[13] (a body whose membership includes both broadcasters and receiver manufacturers) has developed and maintained detailed implementation standards for DTT transmission and reception in the UK, and these are contained in its *UK Digital Terrestrial Television: Requirements for Interoperability* (known as the 'D-Book'). Manufacturers wishing to use the Freeview or Digital tick logos must ensure their receivers comply with relevant parts of the D-Book.

4.8 Detailed specifications for technical developments on the DTT platform, including Freeview+, Freeview HD, and the forthcoming Connected TV services, are agreed within the DTG and subsequently incorporated into the D-Book.

4.9 Membership of the DTG allows direct participation in the development of technical specifications, for example via the DTG's various working groups specialising in specific aspects of the DTT platform, as well as access to the D-Book.

4.10 DTG Testing is a subsidiary company whose services include providing conformance testing for DTT receiver equipment. DTG testing also manages the 'Engineering Channel', a service which provides a means for manufacturers to deploy over-air receiver software updates.

4.11 The introduction of any new DTT multiplexes, including those carrying local TV services, could raise technical coexistence issues relating to the level of interoperability with existing services. It is therefore important that the local TV

[12] Reference Parameters for Digital Terrestrial Television Transmissions in the UK: http://stakeholders.ofcom.org.uk/binaries/broadcast/guidance/tech-guidance/dttt_uk.pdf
[13] DTG website: www.dtg.org

multiplex operator and L-DTPS licensees ensure that their technical arrangements are compatible with those described within the D-Book.

4.12 The DTG has produced a paper, *UK DTT features for support of Local TV services* that describes some of the features offered by the UK DTT platform that may be of use for local TV multiplex operators and L-DTPS licensees. The paper is available for download from the DTG's website.[14]

DMOL – DTT Multiplex Operators Limited

4.13 To a large extent the existing DTT multiplexes operate as independent entities (each carries unique video, audio and associated data, for example). However, a certain amount of ongoing technical coordination takes place between the multiplexes in order to provide some platform-wide services to viewers, and to ensure full interoperability. Two significant areas where ongoing cooperation between multiplexes takes place are in providing programme schedule information (EPG data), and in the assignment of logical channel numbers (LCNs).

4.14 Each multiplex contains programme schedule data which is used by receivers to form and display an EPG, as well as carrying the data that helps home recording devices to function. In order to display an EPG containing schedules for all DTT services (and not just on the multiplex currently tuned to), schedule information is 'cross carried' by all multiplexes: i.e., each multiplex contains information on the programme services and schedules of services carried on all other multiplexes. Ofcom's *Reference Parameters* requires a core amount of schedule data ('now & next') to be cross-carried between multiplexes. In practice the multiplex operators voluntarily cross-carry much more extensive schedule data, which allows receivers to provide a full 7-day EPG.

4.15 To implement cross-carriage, and to incorporate the numerous regional variations carried by the DTT network across the UK, technical infrastructure is in place which provides a central point for the collation and subsequent distribution of 'Central Service Information' (CSI, carrying schedule information amongst other data) to individual groups of transmitter sites. Data is contributed by each multiplex operator to this central point, and it is then collated and made available for distribution to the transmitters.

4.16 The cross-carriage of Service Information data between multiplexes does impose a data capacity overhead on each multiplex, the size of which is largely dependent on the number of services or multiplexes in the cross-carriage 'pool'.

4.17 Existing DTT programme services are also assigned unique Logical Channel Numbers (LCNs). LCNs allow viewers to select their desired programme services at a consistent location in their EPGs or via their remote control (e.g., ITV2 is allocated LCN 6, or button '6' on the remote control). Centralised allocation of LCNs is required in order to prevent LCN conflicts and possible subsequent errors in receiver behaviour.

4.18 LCN allocation, as well as overall management and ownership of the CSI infrastructure, is carried out by DMOL[15] (DTT Multiplex Operators Ltd). DMOL is a

[14] DTG documents downloads: http://www.dtg.org.uk/publications/books.html
[15] DMOL website: www.dmol.co.uk

company owned by the operators of the six UK-wide DTT multiplexes (BBC, Digital 3&4, SDN & Arqiva), and DMOL membership is open to operators of local multiplexes.

4.19 As noted above, the introduction of any new DTT multiplexes, including those carrying local TV services, could raise technical coexistence issues relating to the level of interoperability with existing services: for example, the use and labelling of transport stream components including LCNs and network descriptors, as well as arrangements for the provision and distribution of schedule data to facilitate the integration of new services into the Freeview EPG system. Section 2 in the *Invitation to Apply for the Local Multiplex Licence* contains details of our proposals for technical standards and interoperability for local TV multiplexes.

Section 5

Transmission sites and Reference Offers

Background

5.1 Television broadcasting is largely based upon reception by fixed receivers, the majority of which are connected to rooftop or loft aerials that point at one specific transmitter. The existing DTT multiplexes share transmission sites: the three PSB multiplexes (BBC A, BBC B and D3&4) are broadcast from an extensive network of main and smaller relay transmitters. The three commercial multiplexes (SDN, Arqiva A and Arqiva B) are transmitted from only the larger 80 of these sites, yet will still achieve coverage of around 90% of UK households at the completion of switchover.

5.2 Although local multiplex operators could in principle build their transmitters at alternative locations, if these sites are not in the line of sight of existing aerials, their chance of achieving reliable reception are greatly reduced. A further constraint on using alternative sites is that of 'hole punching' where any households near a transmitter broadcasting only a local service might lose reception of the other six multiplexes. This might occur because in that area, the local multiplex signal would be very much stronger than that of the other multiplexes that are broadcast from a more distant transmitter. The houses near the local transmitter might be prevented from receiving signals from the more distant multiplexes in a similar manner to someone trying to listen to a quiet radio programme when someone seated nearby is talking loudly.

5.3 If all multiplexes share transmitter sites, the problem of hole punching does not usually occur as all the multiplexes maintain the same strength in relation to each other: close to the transmitter, they are all strong, while further away they all become weaker together. An added advantage is that households only need an aerial pointing at one transmitter.

Site access and price regulation

5.4 As explained above, the existing DTT multiplexes all share common transmitter sites which provides a consistent experience for viewers. In the past, two transmission companies, Crown Castle and ntl:broadcast (ntl) owned approximately half of the sites each.

5.5 Following the coming into force of new EU communications directives in 2003, Ofcom carried out a market review of broadcast transmission services.[16] Ofcom found the two transmission companies did have Significant Market Power in Network Access.[17] In practice, this meant that it would be difficult for alternative suppliers to bid to provide transmission services to customers as they would not have access to cost information for a large portion of the transmission chain. Ofcom therefore imposed several obligations on Crown Castle and ntl:

[16] Broadcast transmission services market review: http://stakeholders.ofcom.org.uk/consultations/bcast_trans_serv/?a=0

[17] Network Access covers part of the transmission chain including broadcast masts, antenna systems, power and buildings.

5.5.1 requirement to provide network access to their respective masts and sites on reasonable request;

5.5.2 requirement not to unduly discriminate in that provision of network access;

5.5.3 requirement to provide network access to their respective masts and sites on cost-orientated terms; and

5.5.4 requirement to publish a Reference Offer for that provision of network access.

5.6 In 2008, a round of ownership changes and consolidation occurred that resulted in both transmission companies coming under the ownership of a single company, Macquarie Broadcast Holdings Ltd. The Competition Commission found that this consolidation would lead to a substantial lessening in competition for both Network Access and also for Managed Transmission Services[18] in the broadcast television market. In order to obtain clearance for the acquisition to take place, Macquarie gave certain Undertakings[19] to the Competition Commission, including producing Reference Offers for Transmission Services as well as for Network Access. Both companies have now been merged into the single transmission company Arqiva which either owns or leases all of the transmission sites used to broadcast television services in the UK.

5.7 On 9 March 2012, Arqiva published Reference Offers[20] for both Network Access and Transmission Services for local television multiplexes for the 44 locations which were initially under consideration for local TV. The Reference Offers provide an indication of the likely costs of providing transmission facilities for local multiplexes in those locations. Five additional locations (Bromsgrove, Middlesbrough, Reading, Scarborough and Tonbridge) have subsequently been incorporated in to the possible Phase 2 locations set out in Section 3, but these five locations were not considered as part of the initial Reference Offers.

5.8 We expect Arqiva to publish revised Reference Offers in early May 2012 to include the five remaining sites. We also expect the revised Reference Offers to contain simplified specifications and adjusted prices for the existing 44 sites.

5.9 Local multiplex operators will be able to procure transmission services from alternative transmission companies. Use of alternative sites may be permissible, if the local multiplex operator can demonstrate that:

5.9.1 there will not be a detrimental impact upon reception of other DTT multiplexes through coverage hole punching;

5.9.2 the alternative site is in a position where it is in line with the majority of viewers TV aerials in the target area; and

5.9.3 coverage achieved from the alternative transmitter site is at least as good as that set out in Annex 1.

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[18] Managed Transmission Services includes the transmitters and monitoring equipment that together with the Network Access elements form the broadcast transmission chain.
[19] Macquarie Undertakings: http://www.adjudicator-bts.org.uk/documents/Undertakings%20-%20Non-confidential%20version.pdf
[20] http://www.arqiva.com/corporate/documentation/referenceoffers/

5.10 It is likely that the Arqiva sites will need to be used in a large number of cases due to their position and the need to use a sizeable structure to reach the target population. As noted above, alternative transmission companies will be able to provide transmission services for the multiplex licensee and Arqiva's Network Access Reference Offer will provide a cost basis for access to those sites that other transmission companies can use as the basis of developing proposals for applicants. Arqiva's Transmission Service Reference Offer provide an indication of cost should the licensee wish to use Arqiva to provide transmission services.

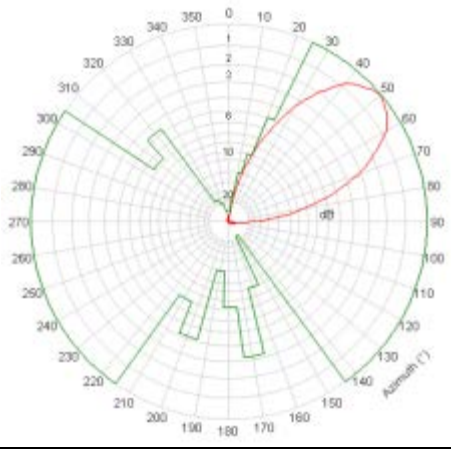
5.11 Further information on the scope and interpretation of Arqiva's Reference Offers for Local Television Services is available in Annex 2 of Ofcom's *Licensing Local Television* Statement.[21]

[21] http://stakeholders.ofcom.org.uk/consultations/local-tv/

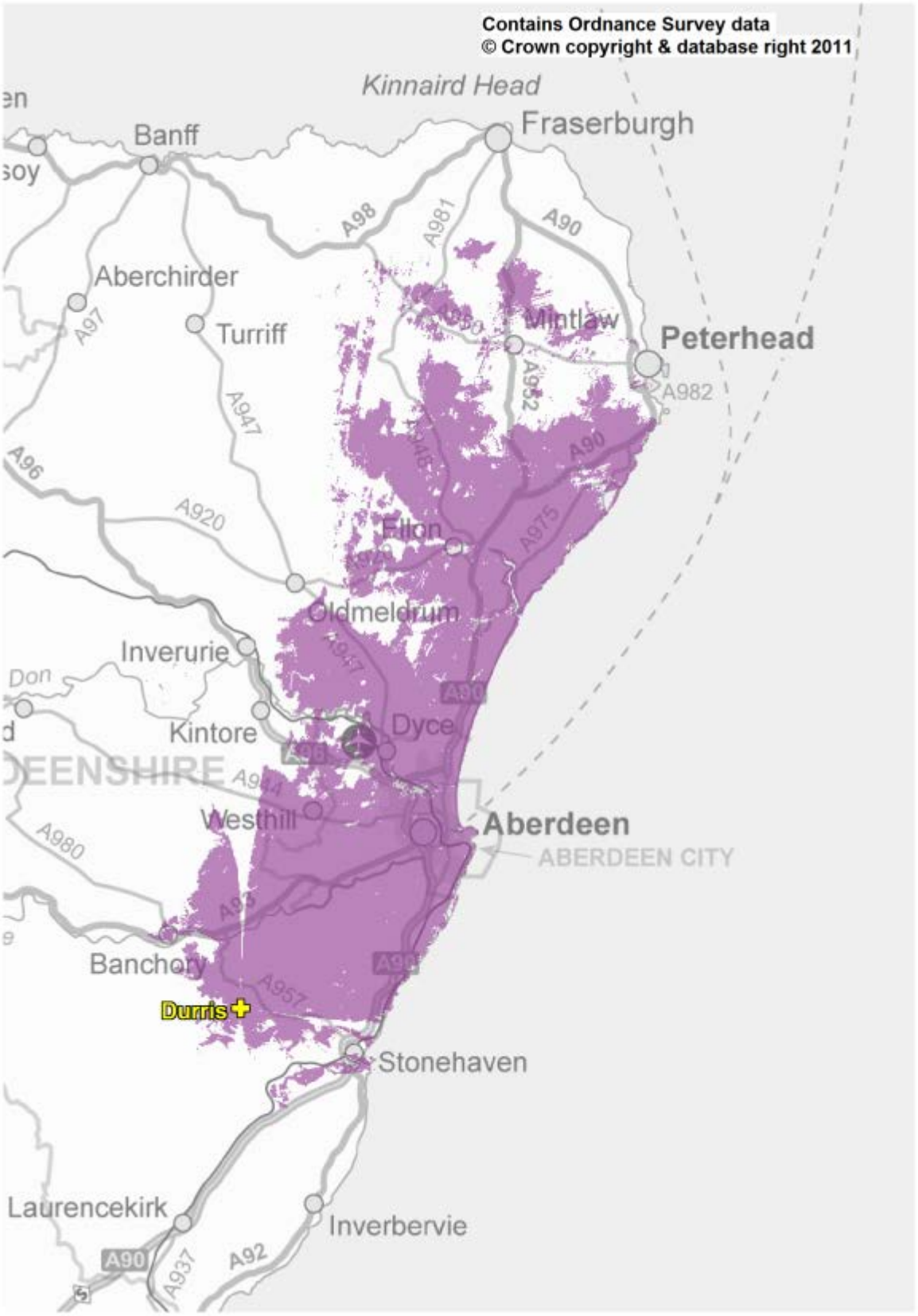
Annex 1

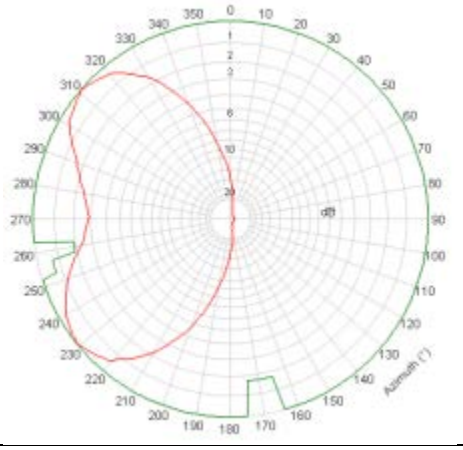
Indicative Coverage Maps

Indicative coverage maps are provided in this Annex, in alphabetical order by location.

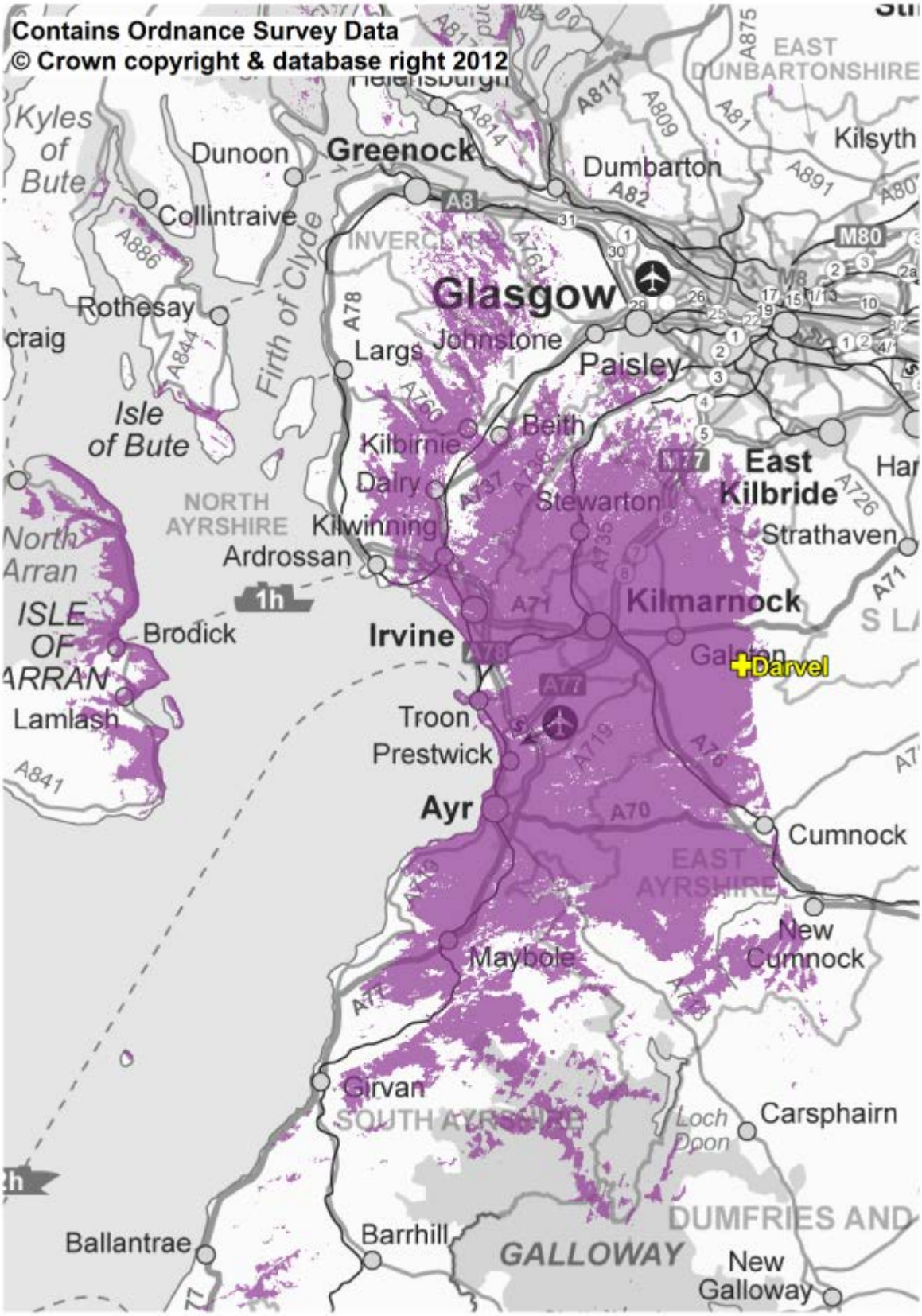
Location	Aberdeen
Station	Durris
Channel	30
Effective Radiated Power	10 kW
Assumed Antenna Height	157m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

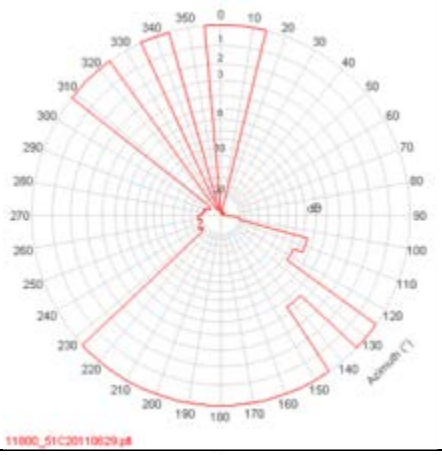
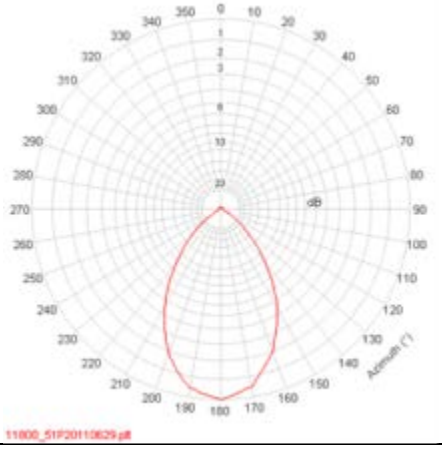
Aberdeen Indicative Coverage Map (assuming QPSK 2/3)



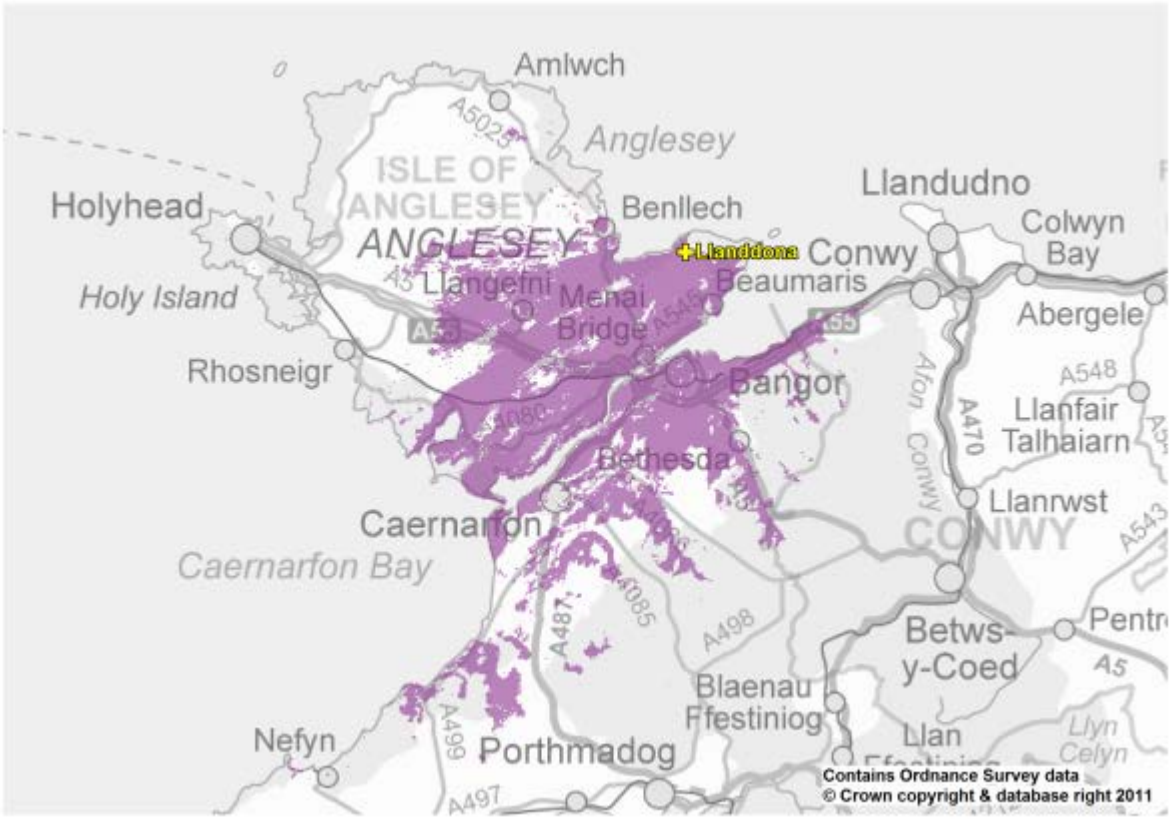
Location	Ayr
Station	Darvel
Channel	30
Effective Radiated Power	1 kW
Assumed Antenna Height	80m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

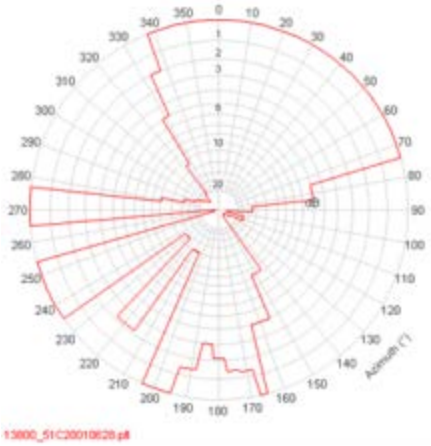
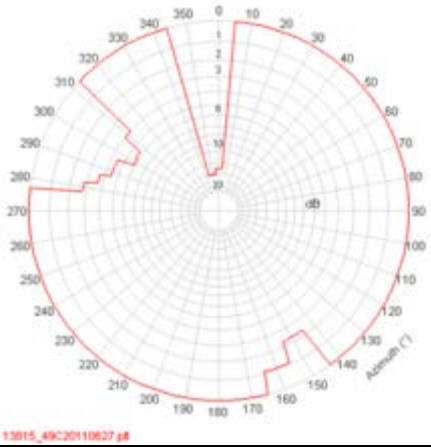
Ayr Indicative Coverage Map (assuming QPSK 2/3)

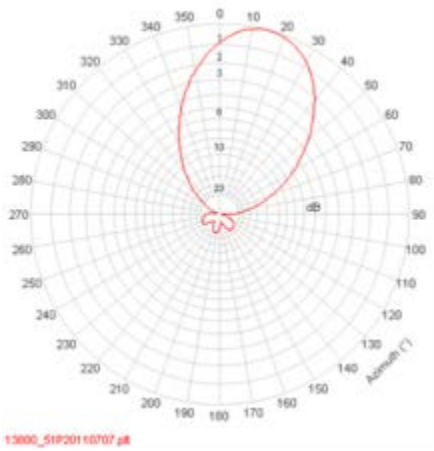


Location	Bangor
Station	Llanddona
Channel	51
Effective Radiated Power	1 kW
Assumed Antenna Height	56m
Planning Status	Provisional
Indicative Antenna Template	(with respect to 10kW) 
Assumed Practical Antenna Pattern	

Bangor Indicative Coverage Map (assuming QPSK 2/3)



Location	Barnstaple	
Station	Huntshaw Cross	Barnstaple
Channel	51	49
Effective Radiated Power	2 kW	0.001 kW
Assumed Antenna Height	79m	25m
Planning Status	Provisional	
Indicative Antenna Template	Huntshaw Cross (with respect to 10kW)  Barnstaple (with respect to 1kW) 	
Assumed Practical Antenna Pattern	Huntshaw Cross	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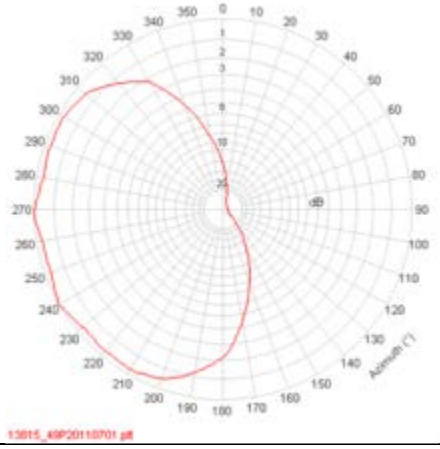
Azimuth (°)

Barnstaple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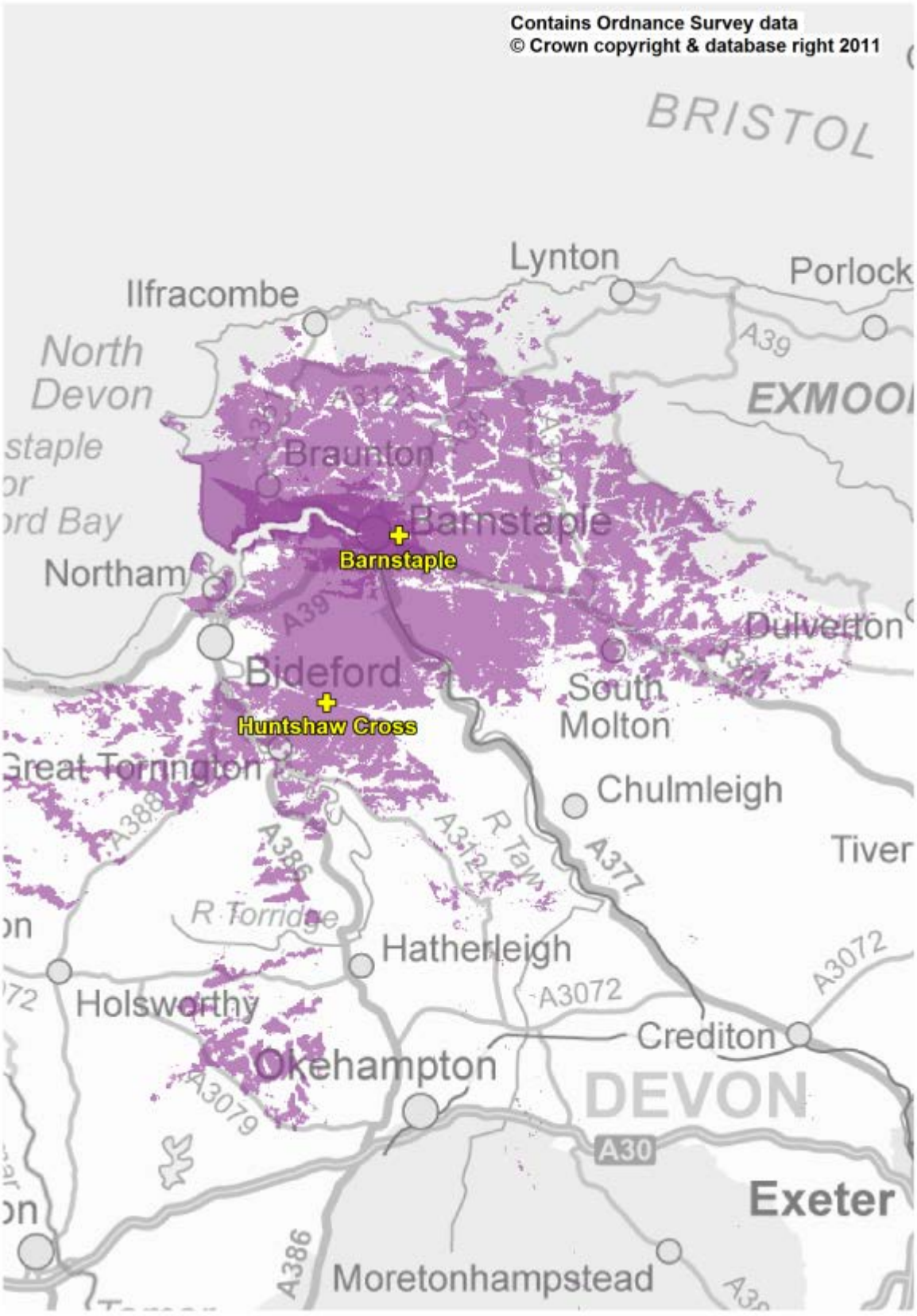
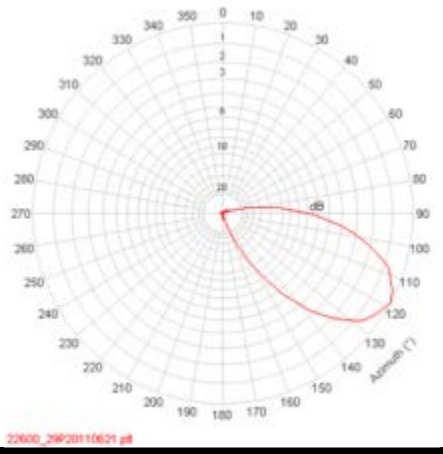
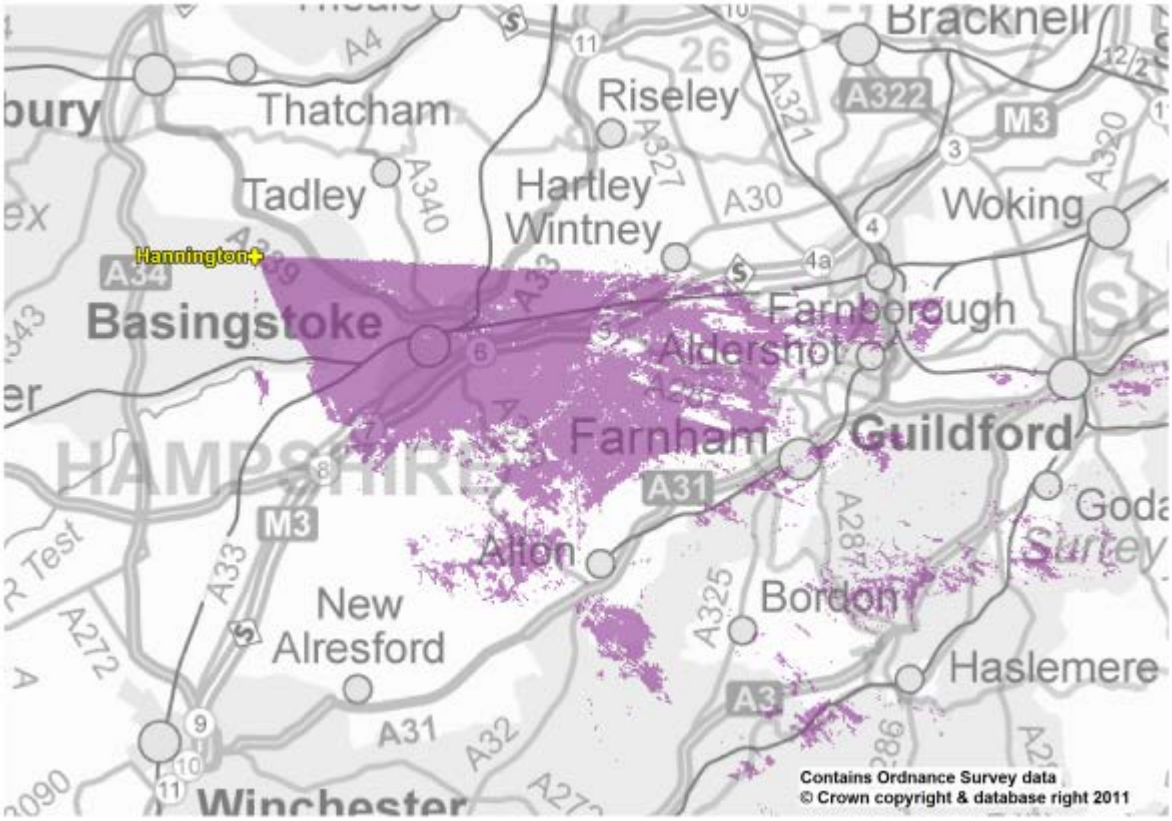
dB
Azimuth (°)

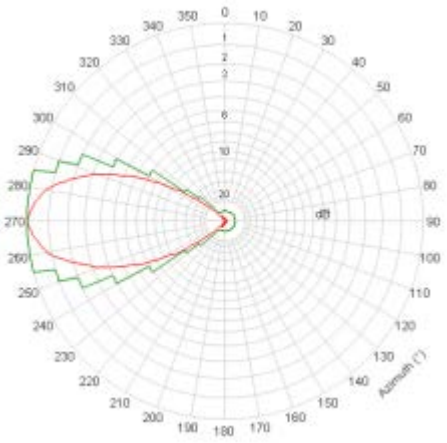
Barnstaple Indicative Coverage Map (assuming QPSK 2/3)



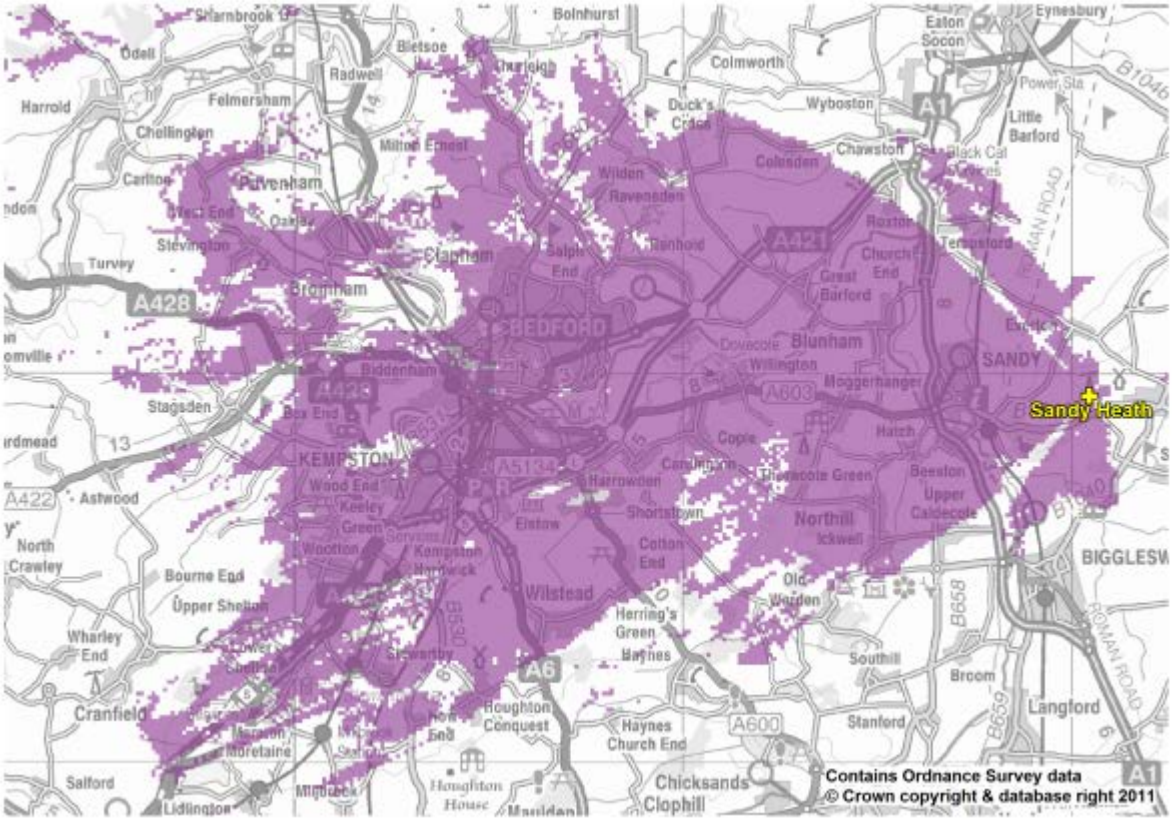
Location	Basingstoke
Station	Hannington
Channel	29
Effective Radiated Power	2 kW
Assumed Antenna Height	71m
Planning Status	Provisional
Assumed Practical Antenna Pattern	

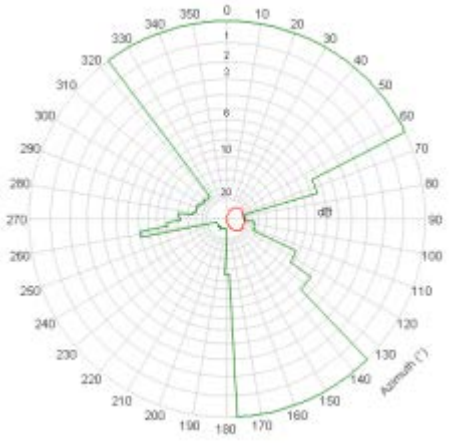
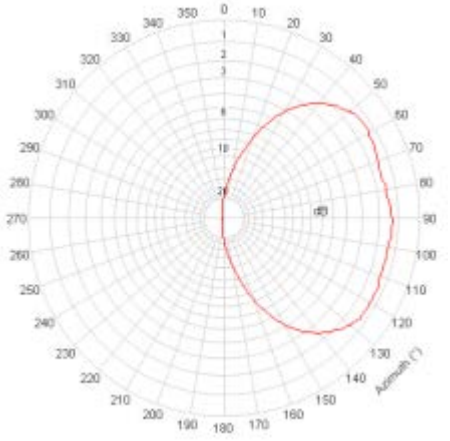
Basingstoke Indicative Coverage Map (assuming QPSK 2/3)



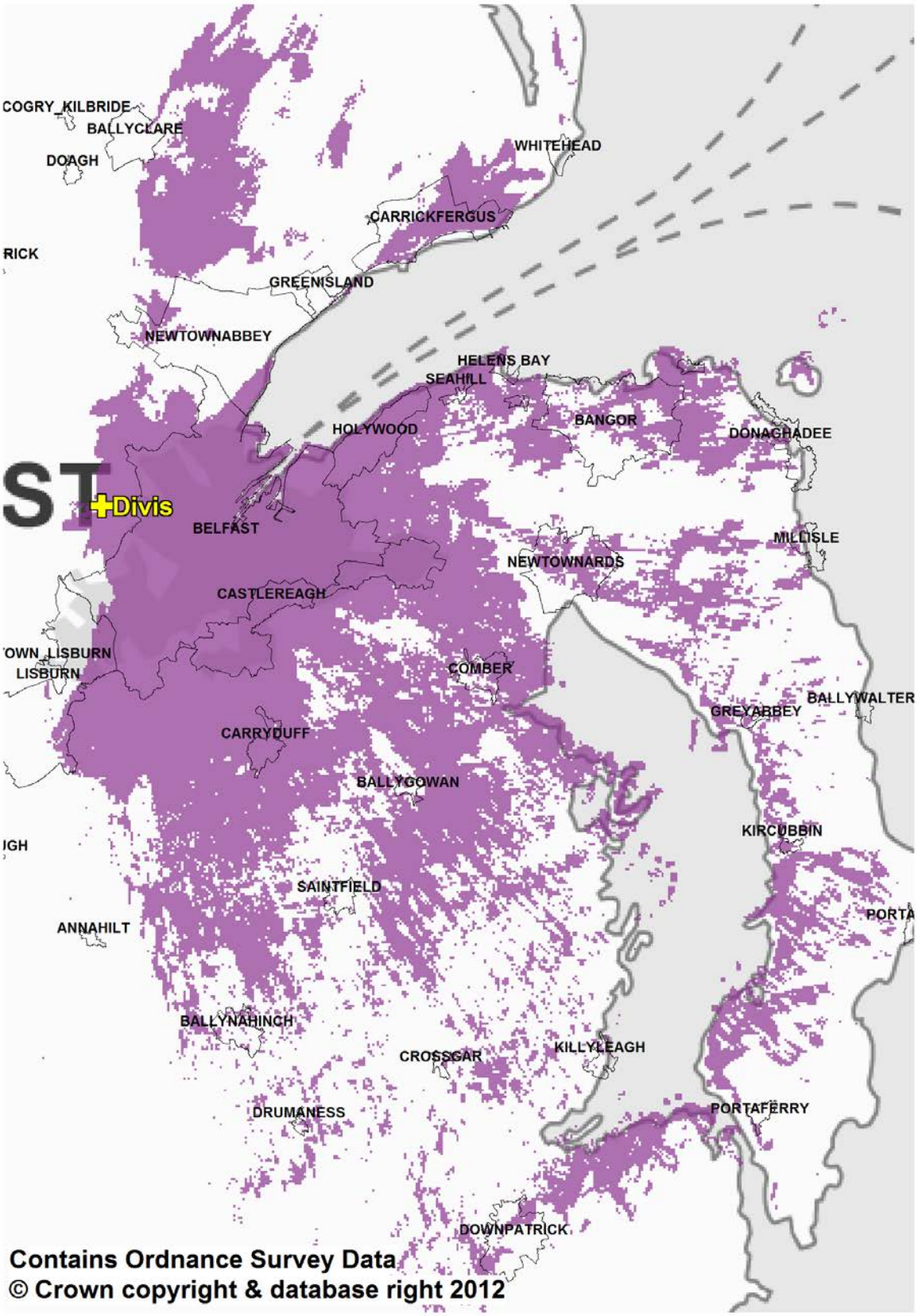
Location	Bedford
Station	Sandy Heath
Channel	42
Effective Radiated Power	2 kW
Assumed Antenna Height	119m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

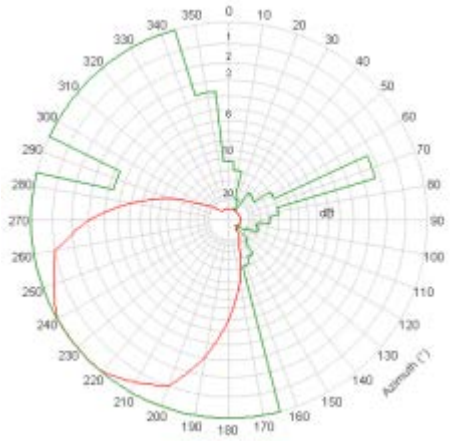
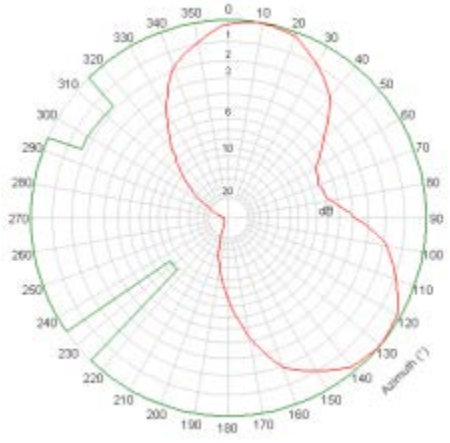
Bedford Indicative Coverage Map (assuming QPSK 2/3)



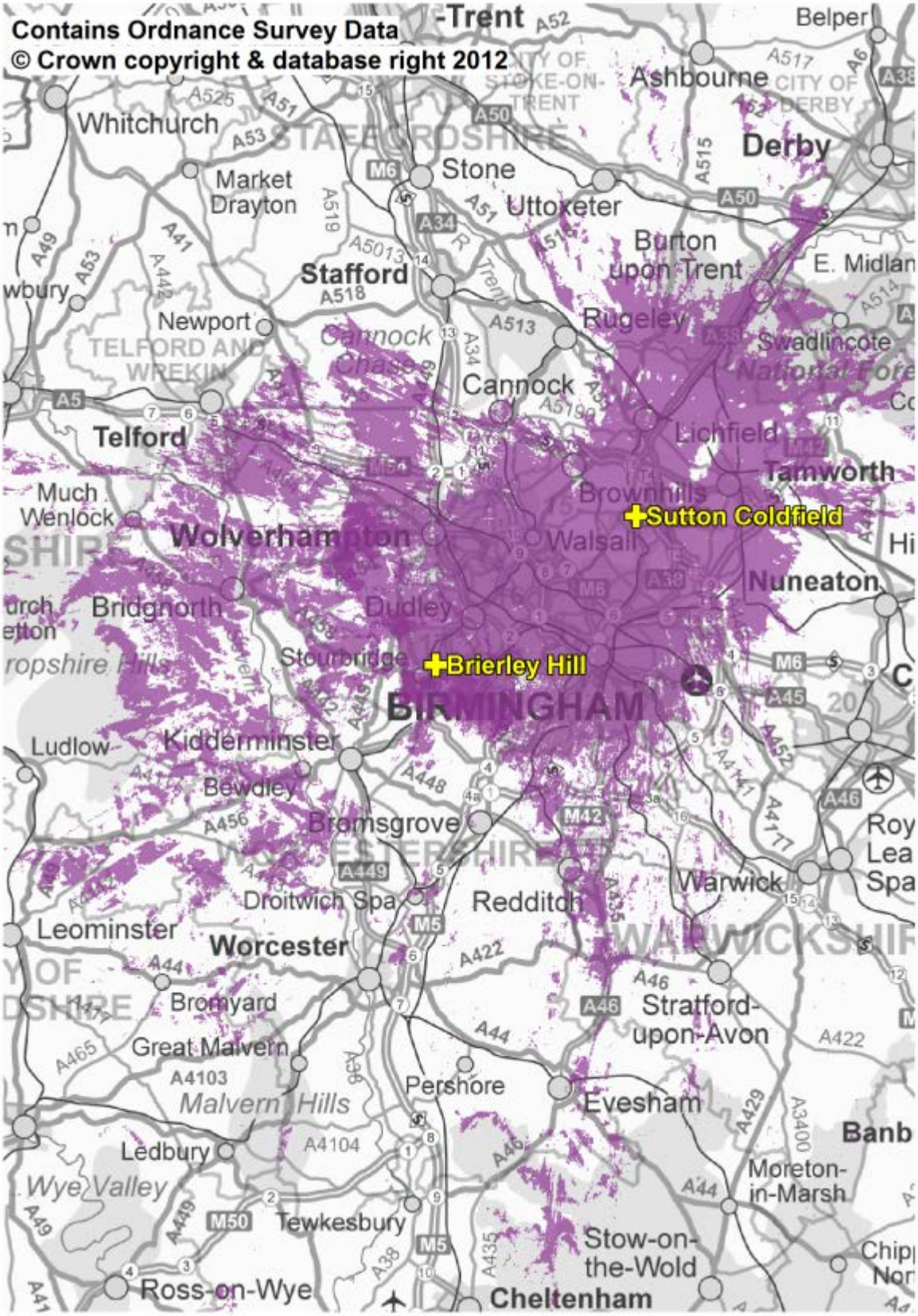
Location	Belfast
Station	Divis
Channel	30
Effective Radiated Power	5 kW
Assumed Antenna Height	93m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	
Suggest Antenna Pattern Towards Target Coverage Area (4.8° Declination)	
Suggested Vertical Radiation Pattern	

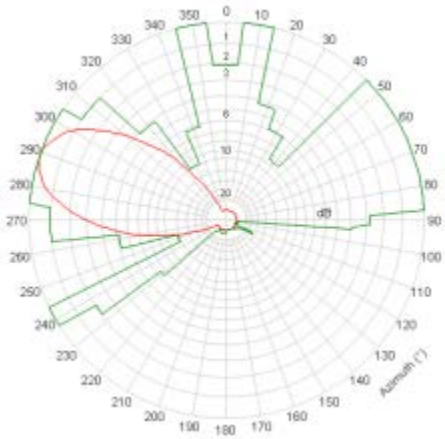
Belfast Indicative Coverage Map (assuming QPSK 2/3)



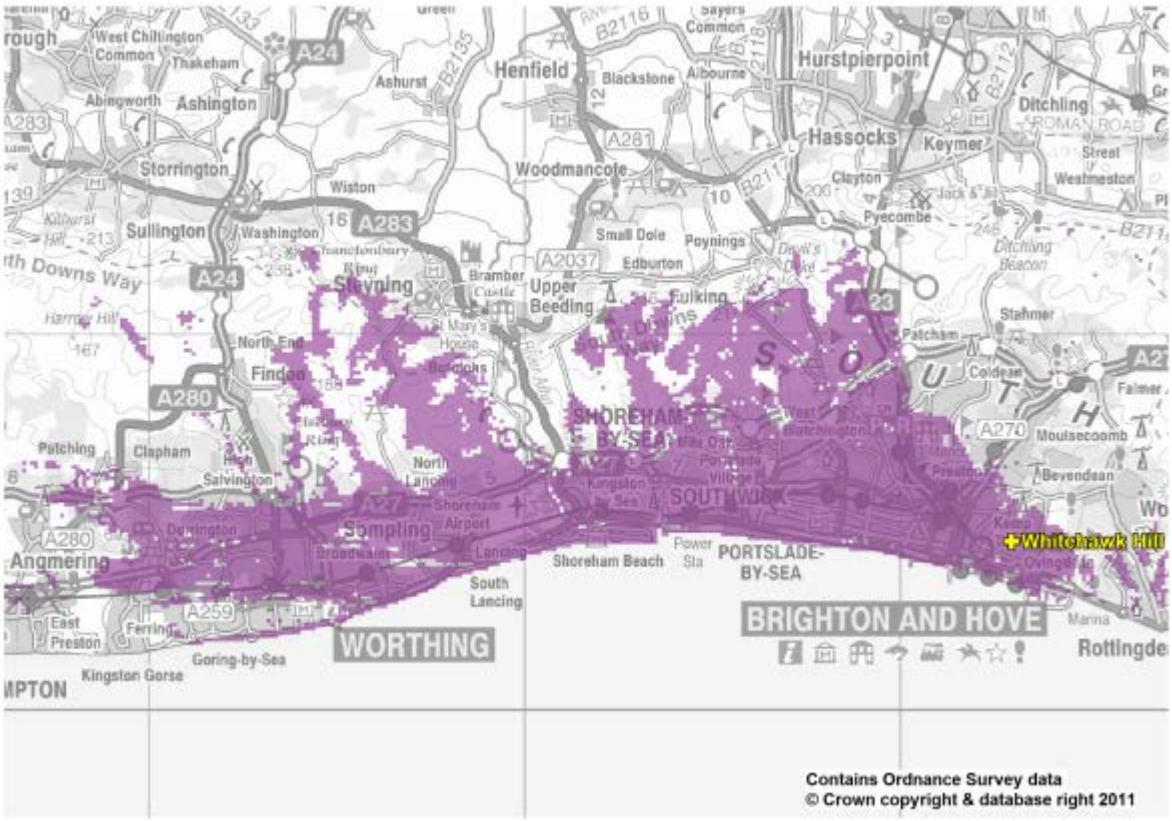
Location	Birmingham	
Station	Sutton Coldfield	Brierley Hill
Channel	51	29
Effective Radiated Power	10 kW	0.2 kW
Assumed Antenna Height	132m	44m
Planning Status	Baseline	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Sutton Coldfield  Brierley Hill (with respect to 1kW) 	

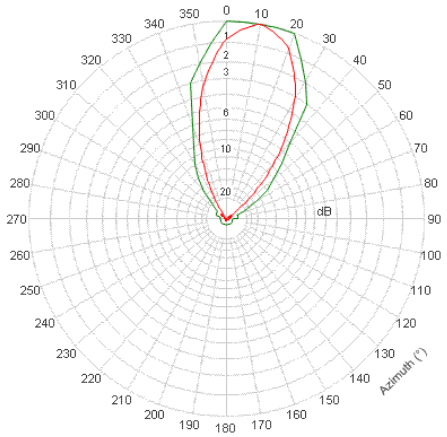
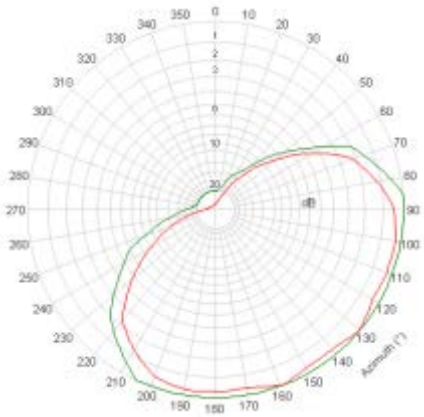
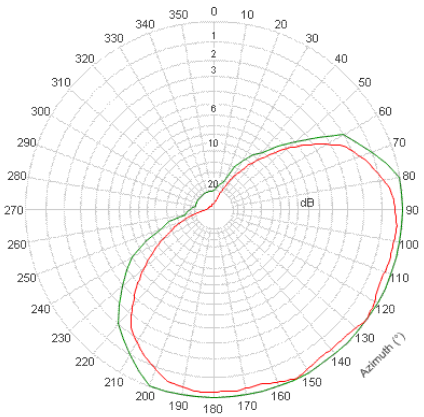
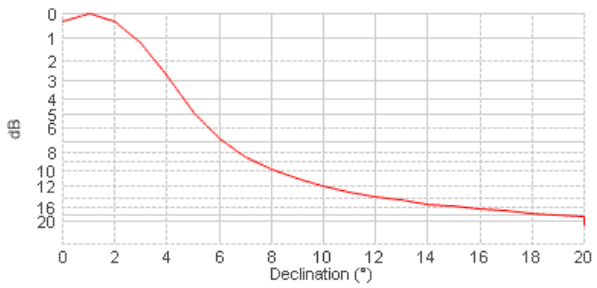
Birmingham Indicative Coverage Map (assuming QPSK 2/3)



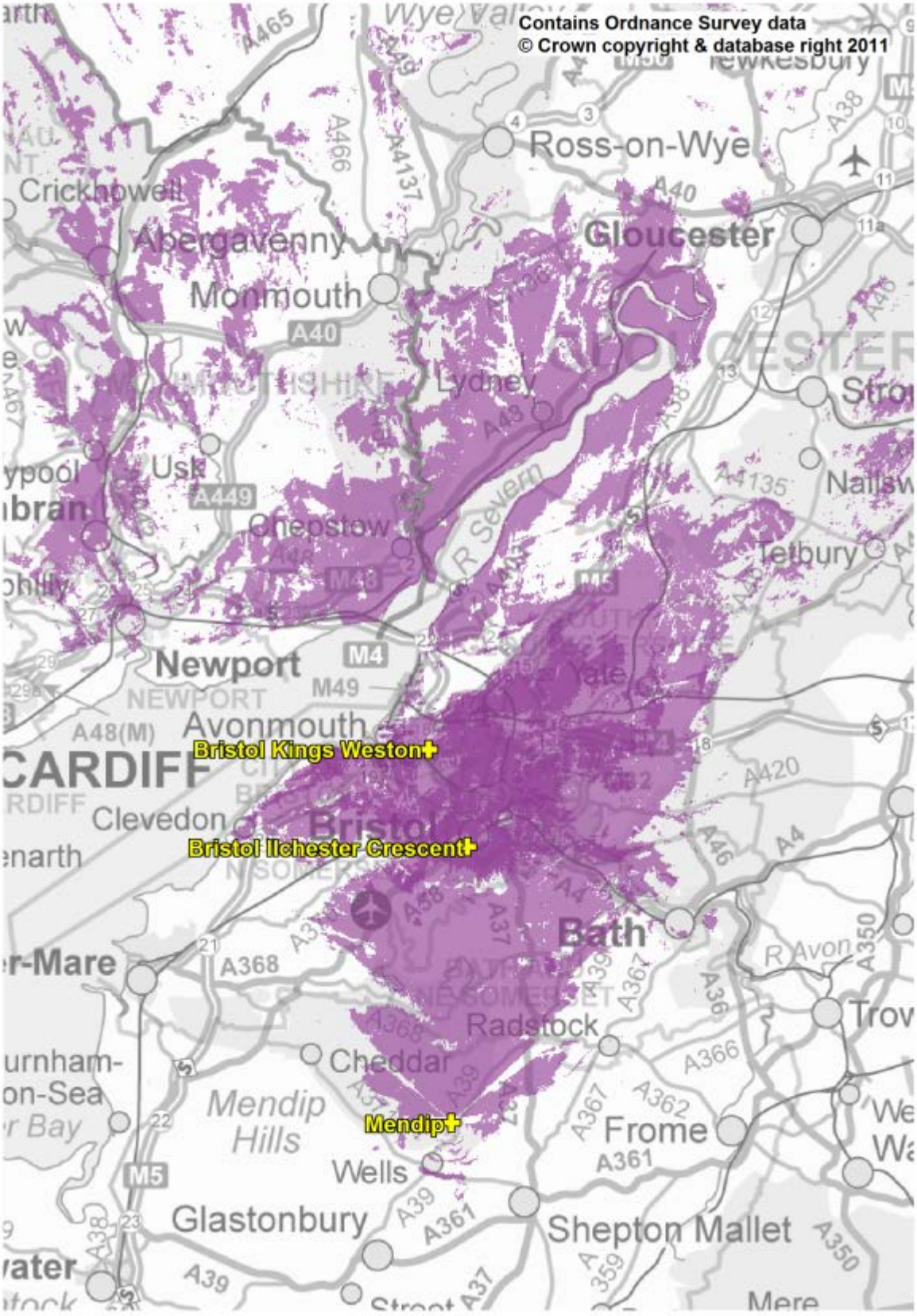
Location	Brighton & Hove
Station	Whitehawk Hill
Channel	54
Effective Radiated Power	0.4 kW
Assumed Antenna Height	39m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

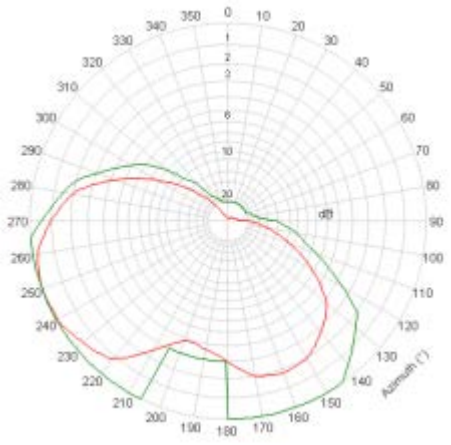
Brighton & Hove Indicative Coverage Map (assuming QPSK 2/3)



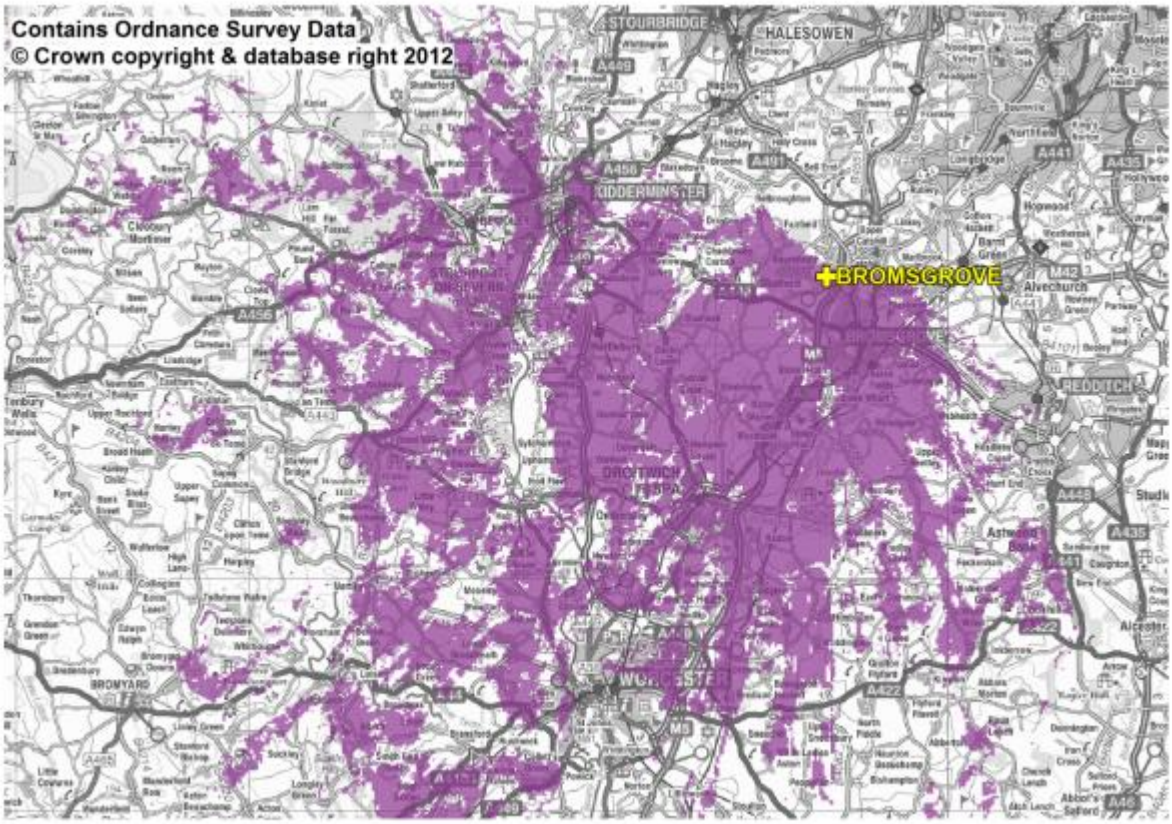
Location	Bristol		
Station	Mendip	Bristol Kings Weston	Bristol Ilchester Crescent
Channel	51	30	30
Effective Radiated Power	10 kW	0.02 kW	0.02 kW
Assumed Antenna Height	144m	42m	42m
Planning Status	Baseline		
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Mendip  Bristol Kings Weston  Bristol Ilchester Crescent 		
Suggested Vertical Radiation Pattern	Mendip 		

Bristol Indicative Coverage Map (assuming QPSK 2/3)

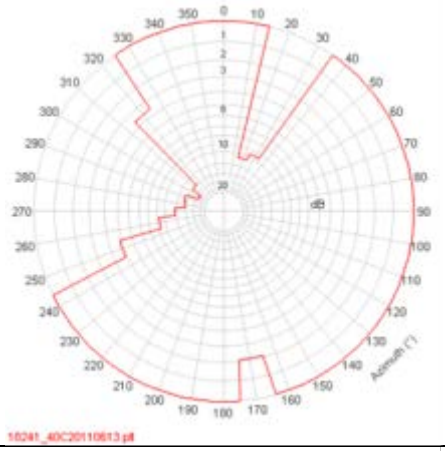
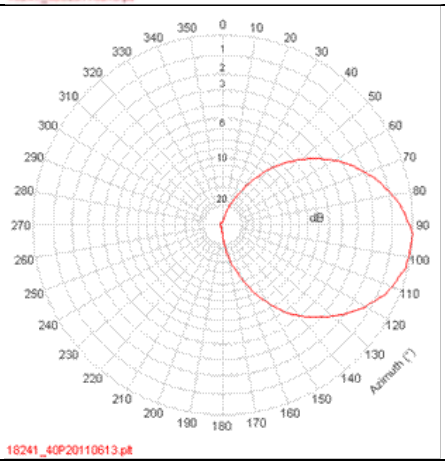


Location	Bromsgrove
Station	Bromsgrove
Channel	29
Effective Radiated Power	0.04 kW
Assumed Antenna Height	43 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

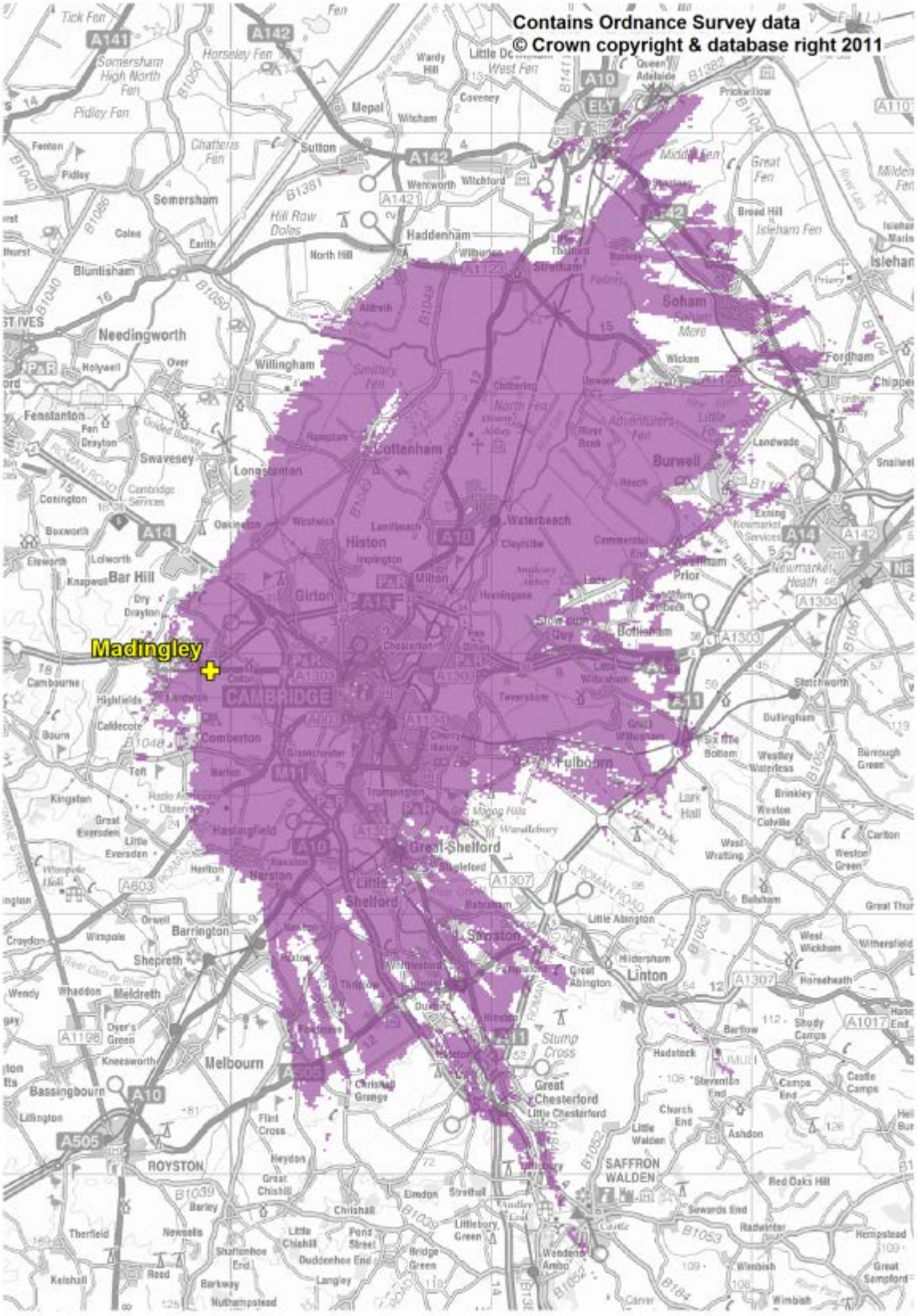
Bromsgrove Indicative Coverage Map (assuming QPSK 2/3)

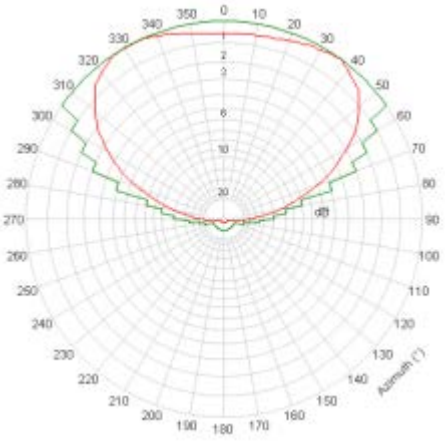


Location	Cambridge
Station	Madingley

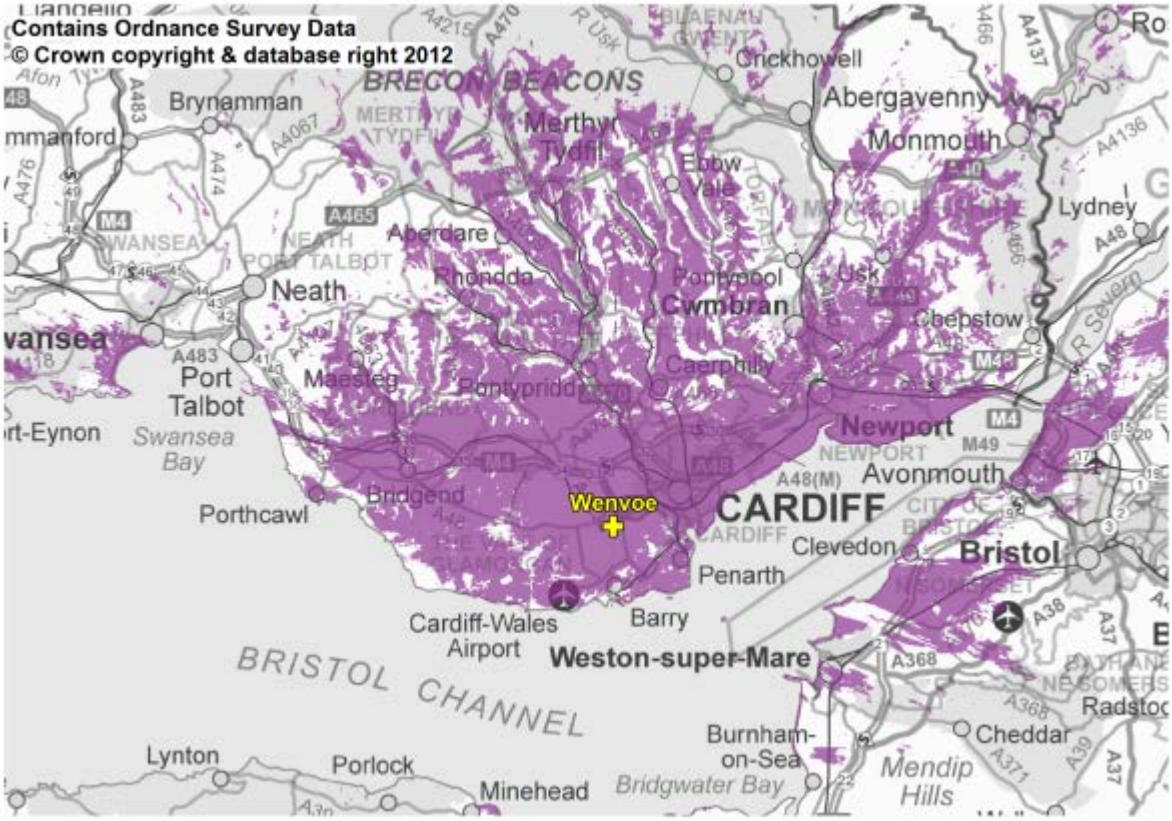
Channel	40
Effective Radiated Power	1 kW
Assumed Antenna Height	45m
Planning Status	Provisional
Indicative Antenna Template	
Assumed Practical Antenna Pattern	

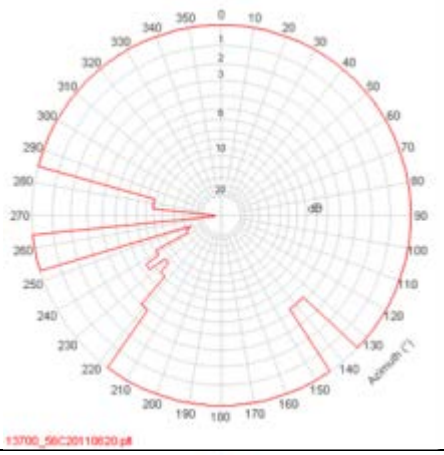
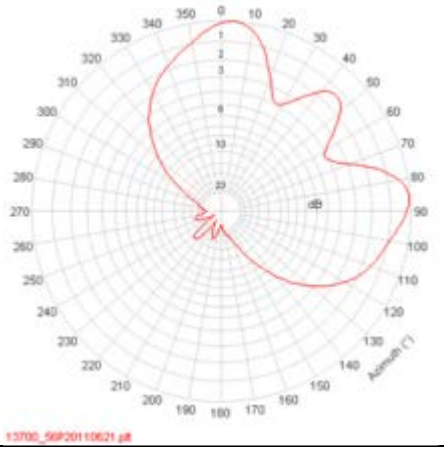
Cambridge Indicative Coverage Map (assuming QPSK 2/3)



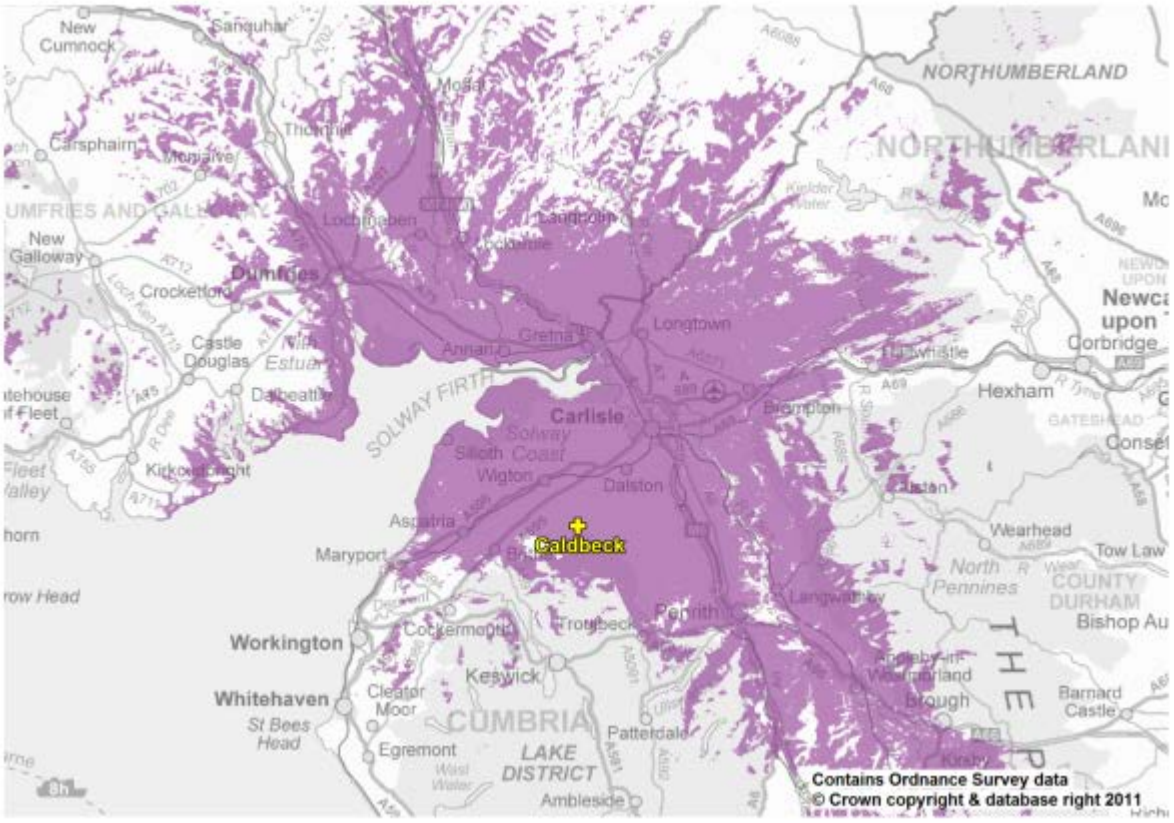
Location	Cardiff
Station	Wenvoe
Channel	51
Effective Radiated Power	10 kW
Assumed Antenna Height	129 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

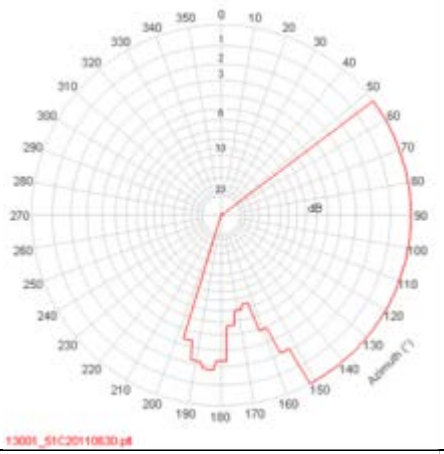
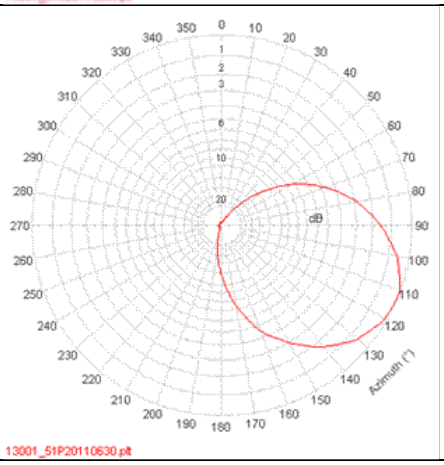
Cardiff Indicative Coverage Map (assuming QPSK 2/3)



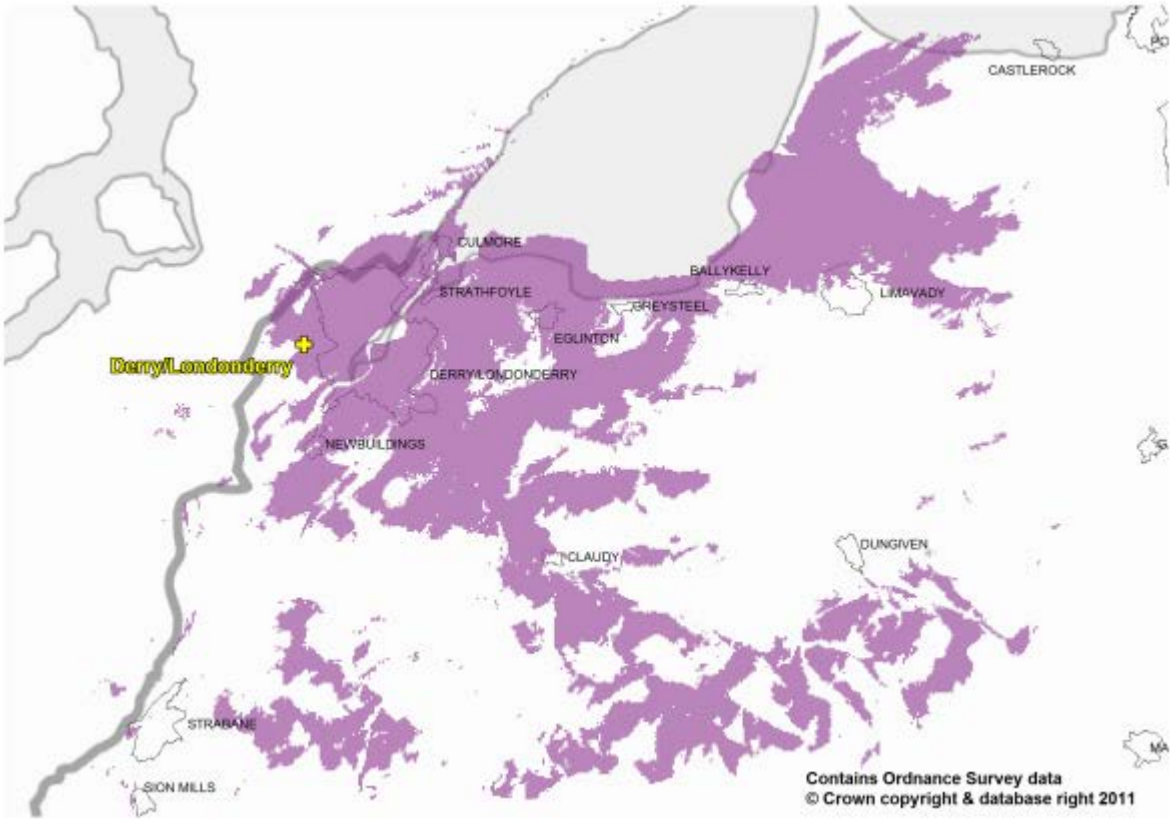
Location	Carlisle
Station	Caldbeck
Channel	56
Effective Radiated Power	5 kW
Assumed Antenna Height	165m
Planning Status	Provisional
Indicative Antenna Template	
Assumed Practical Antenna Pattern	

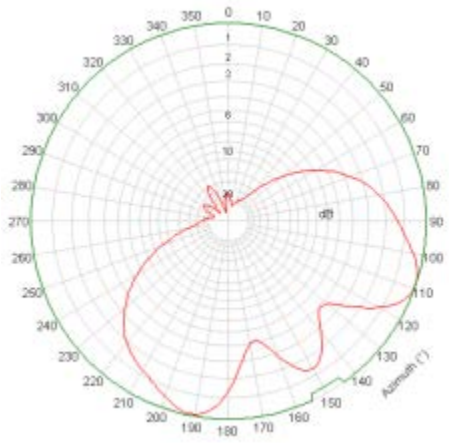
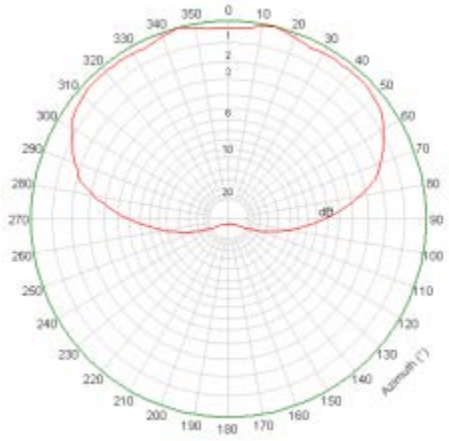
Carlisle Indicative Coverage Map (assuming QPSK 2/3)



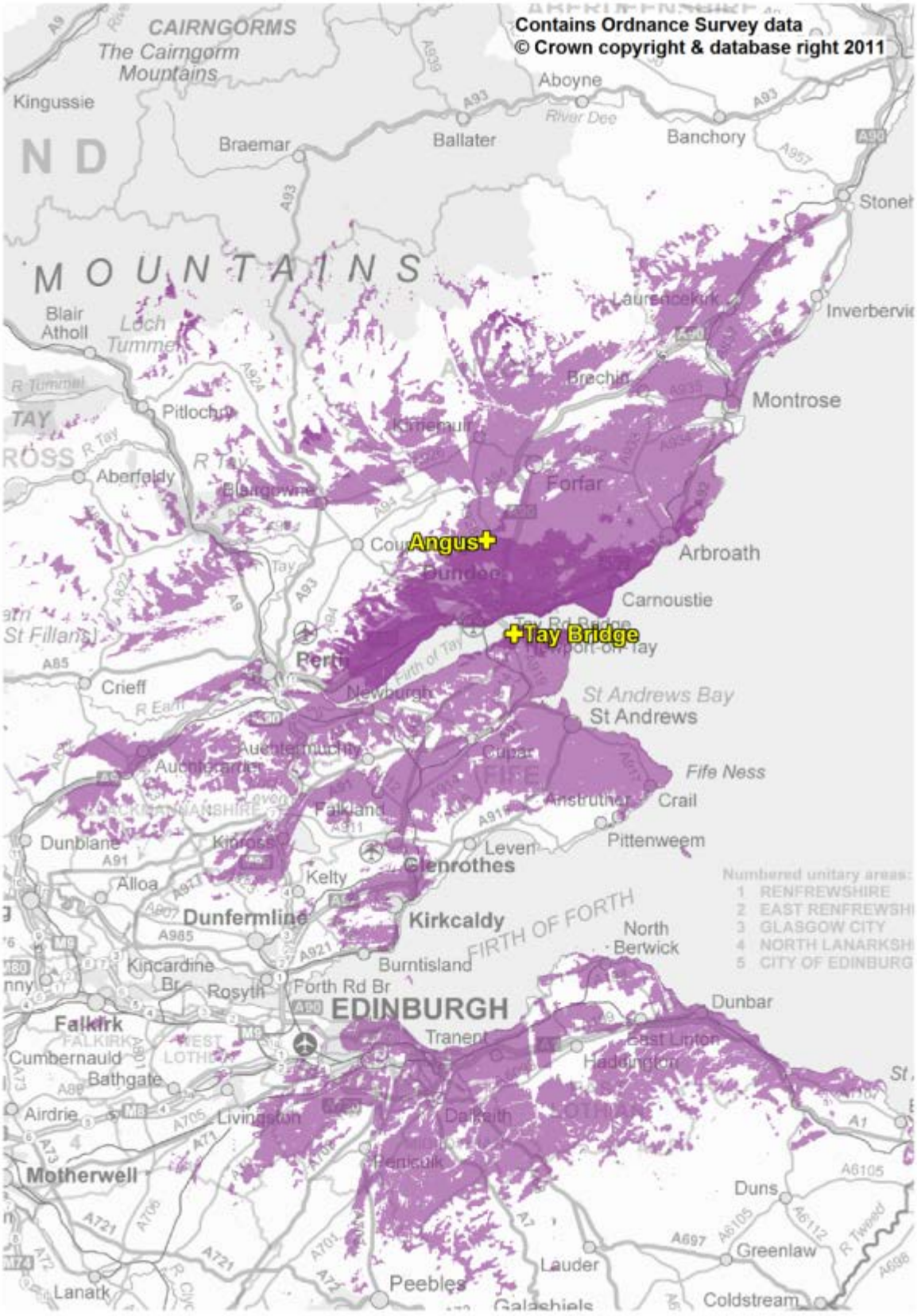
Location	Derry/Londonderry
Station	Londonderry
Channel	51
Effective Radiated Power	1 kW
Assumed Antenna Height	59m
Planning Status	Provisional
Indicative Antenna Template	
Assumed Practical Antenna Pattern	

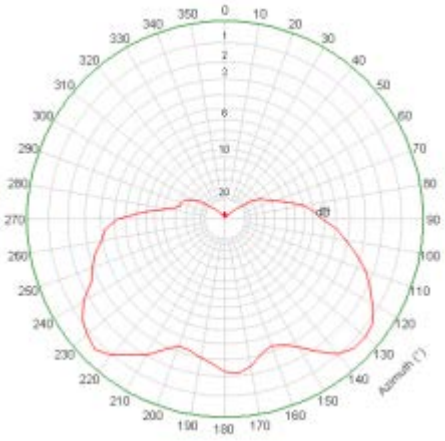
Derry/Londonderry Indicative Coverage Map (assuming QPSK 2/3)



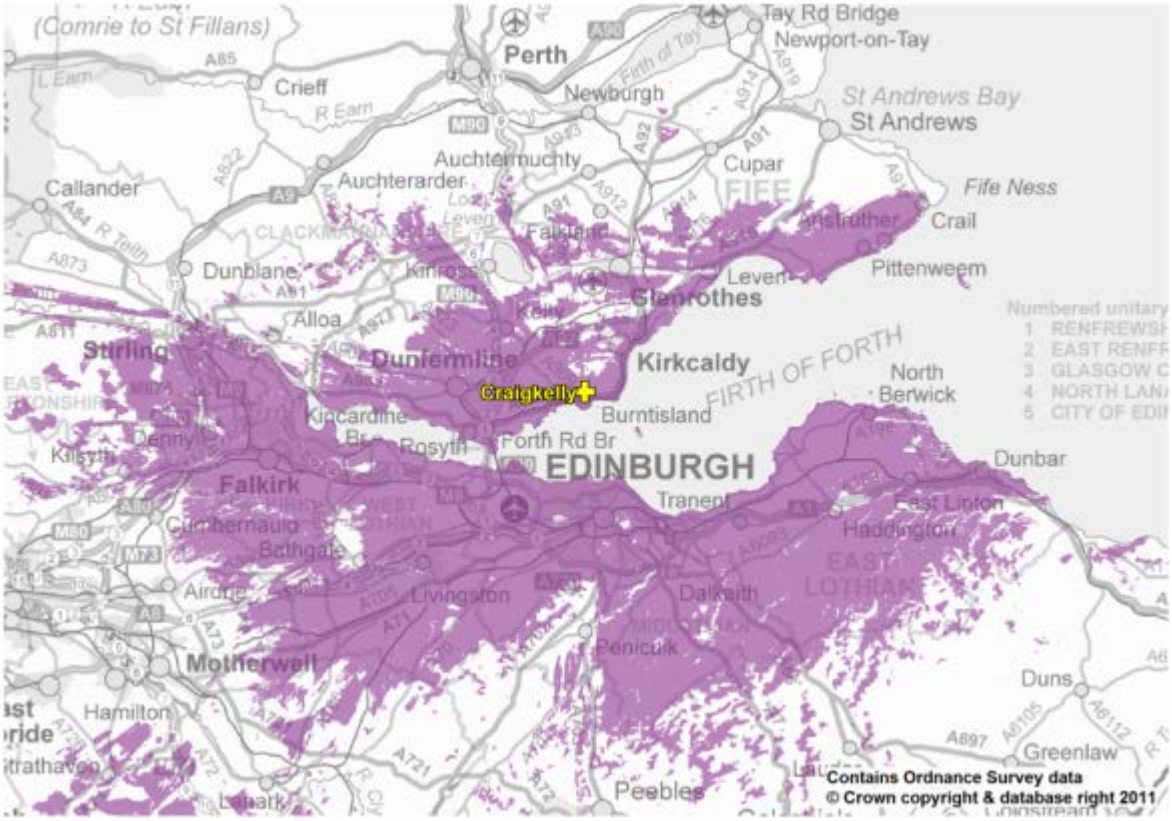
Location	Dundee	
Station	Angus	Tay Bridge
Channel	48	51
Effective Radiated Power	1 kW	0.01 kW
Assumed Antenna Height	117m	43m
Planning Status		
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Angus  Tay Bridge 	

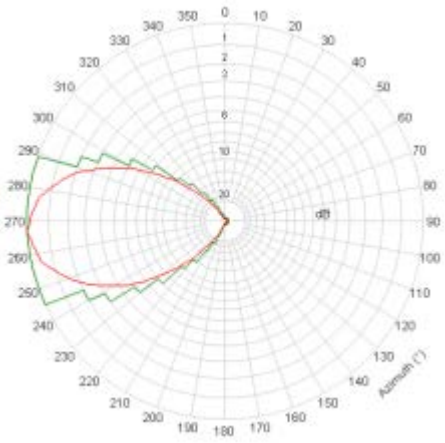
Dundee Indicative Coverage Map (assuming QPSK 2/3)



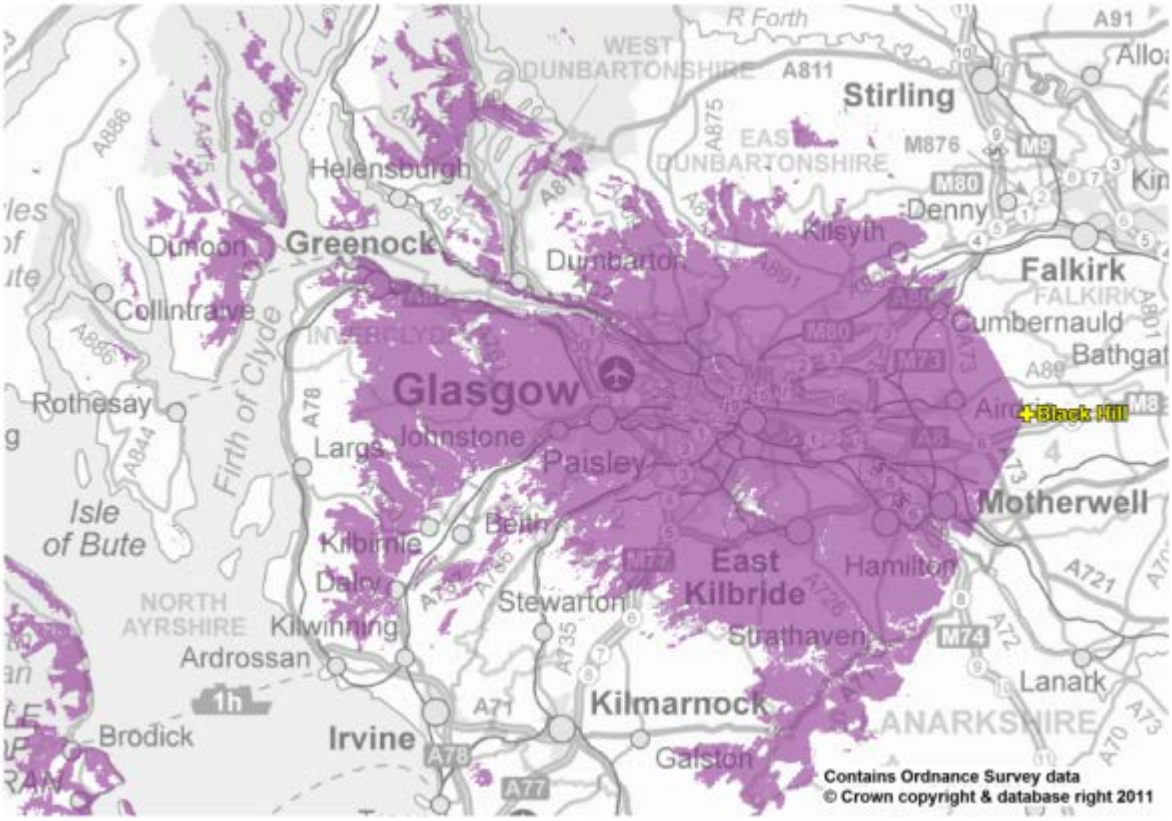
Location	Edinburgh
Station	Craigkelly
Channel	52
Effective Radiated Power	5 kW
Assumed Antenna Height	65m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

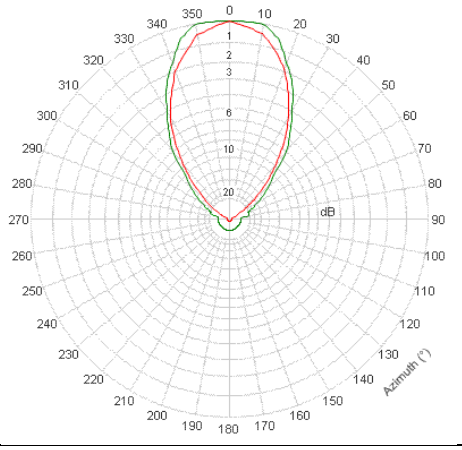
Edinburgh Indicative Coverage Map (assuming QPSK 2/3)



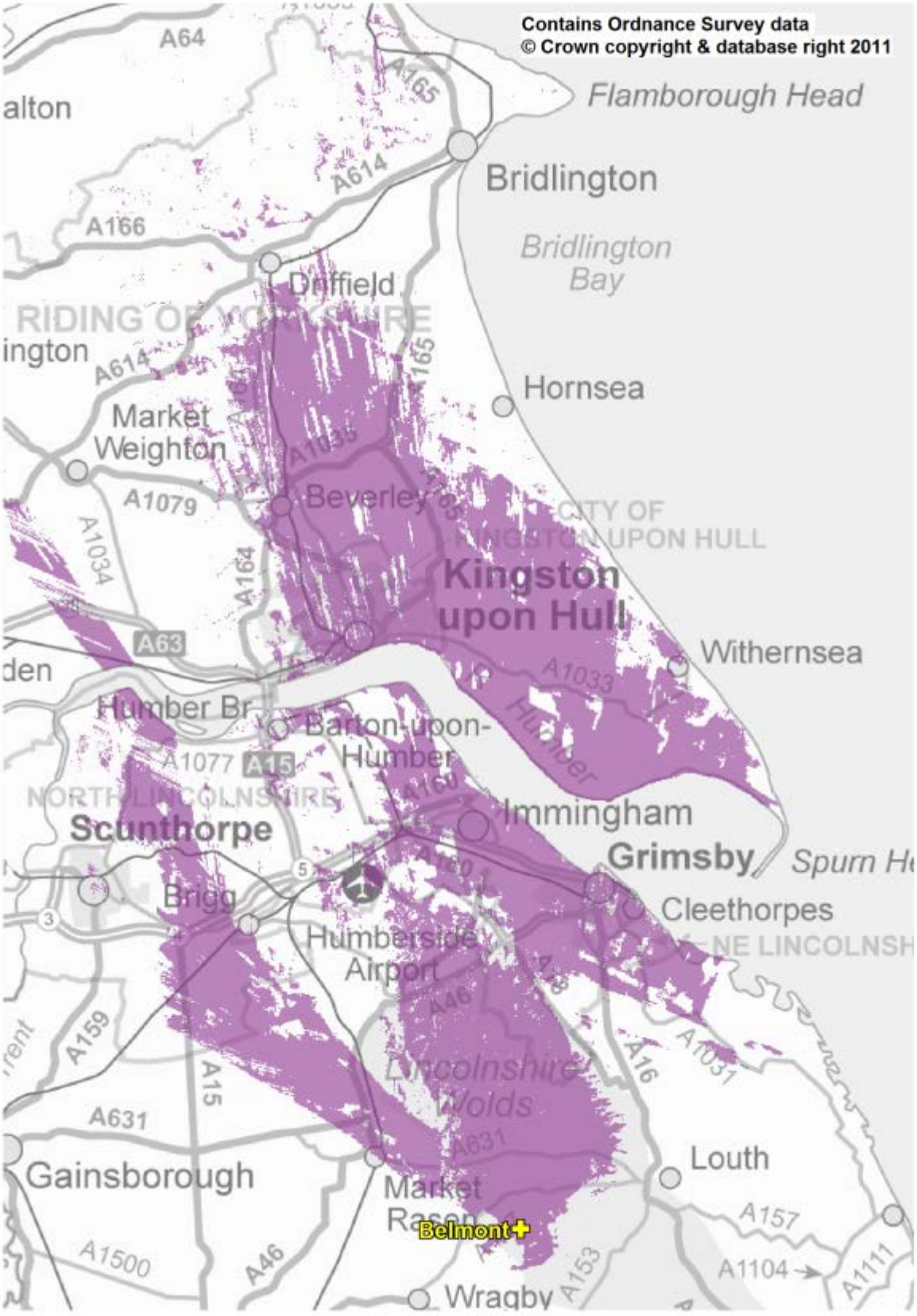
Location	Glasgow
Station	Black Hill
Channel	51
Effective Radiated Power	5 kW
Assumed Antenna Height	154m
Planning Status	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

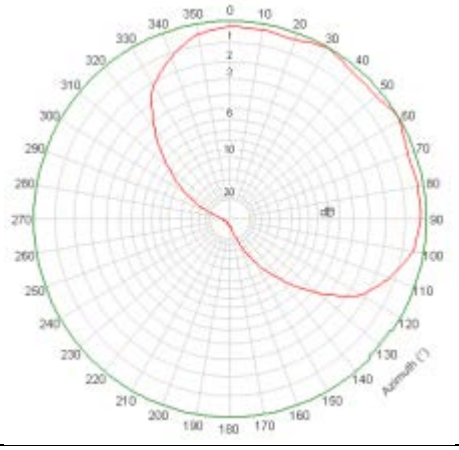
Glasgow Indicative Coverage Map (assuming QPSK 2/3)



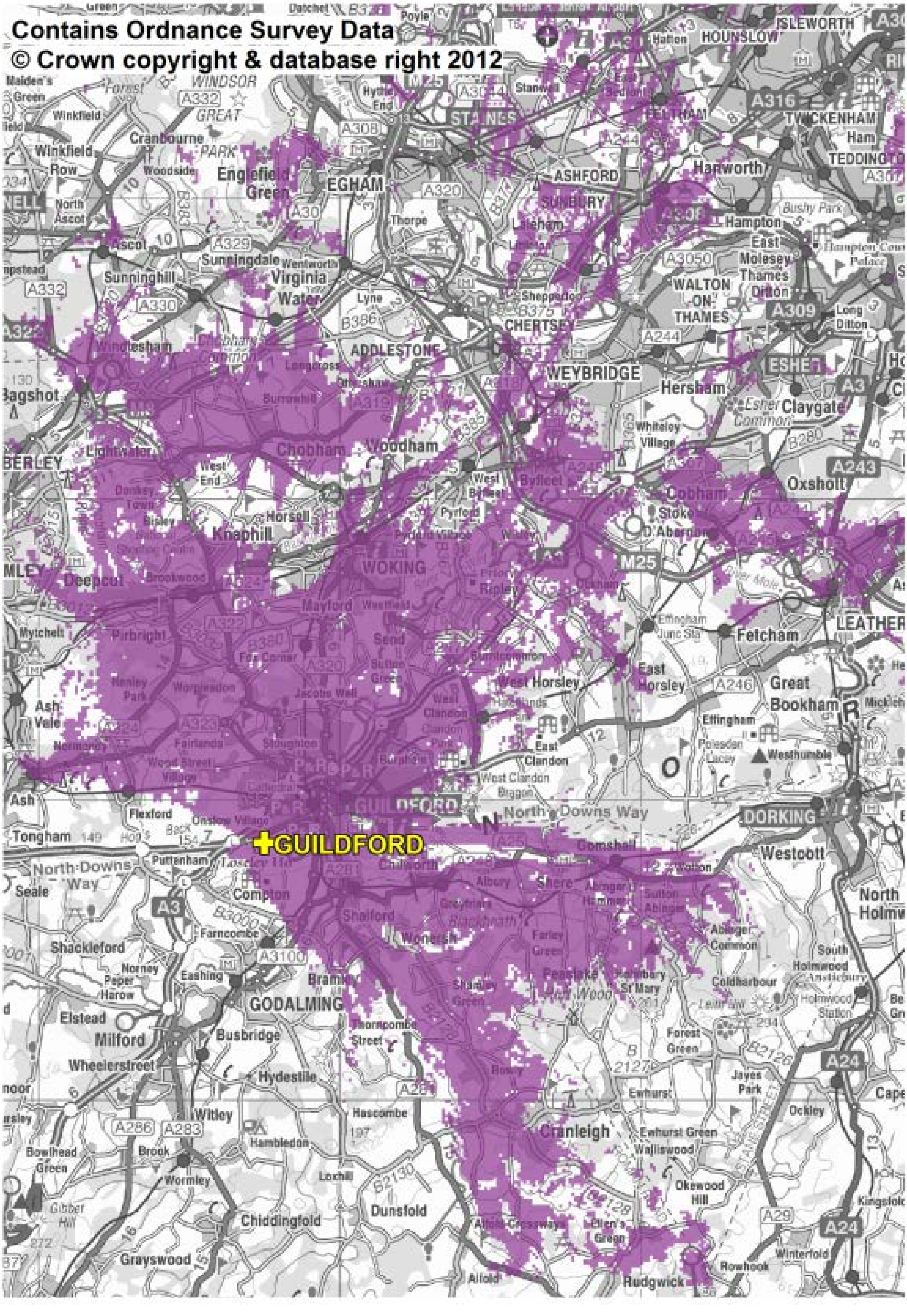
Location	Grimsby
Station	Belmont
Channel	27
Effective Radiated Power	5 kW
Assumed Antenna Height	222m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

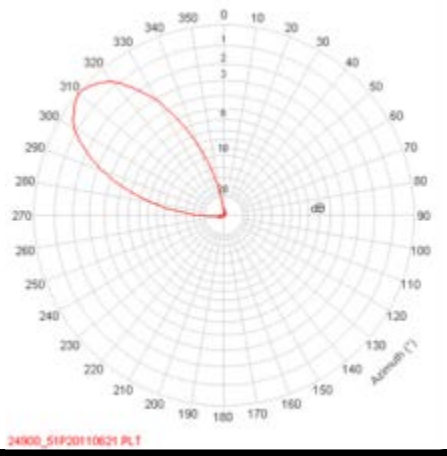
Grimsby Indicative Coverage Map (assuming QPSK 2/3)



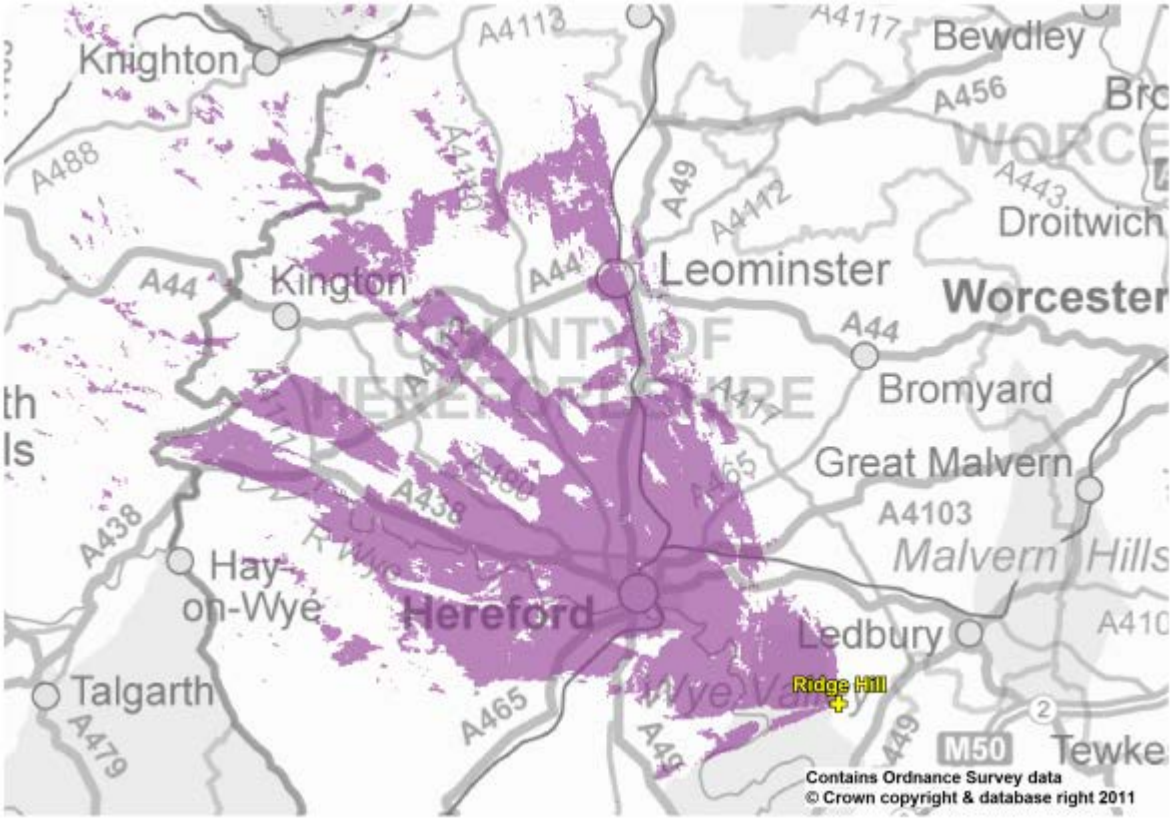
Location	Guildford
Station	Guildford
Channel	51
Effective Radiated Power	0.1 kW
Assumed Antenna Height	45m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

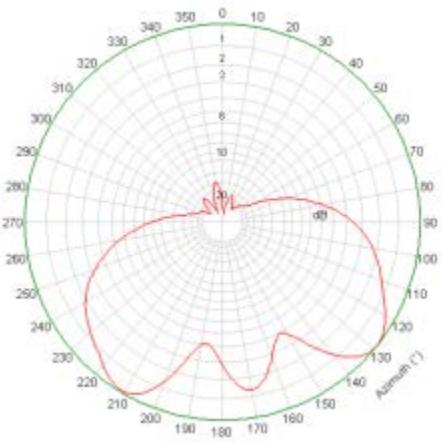
Guildford Indicative Coverage Map (assuming QPSK 2/3)



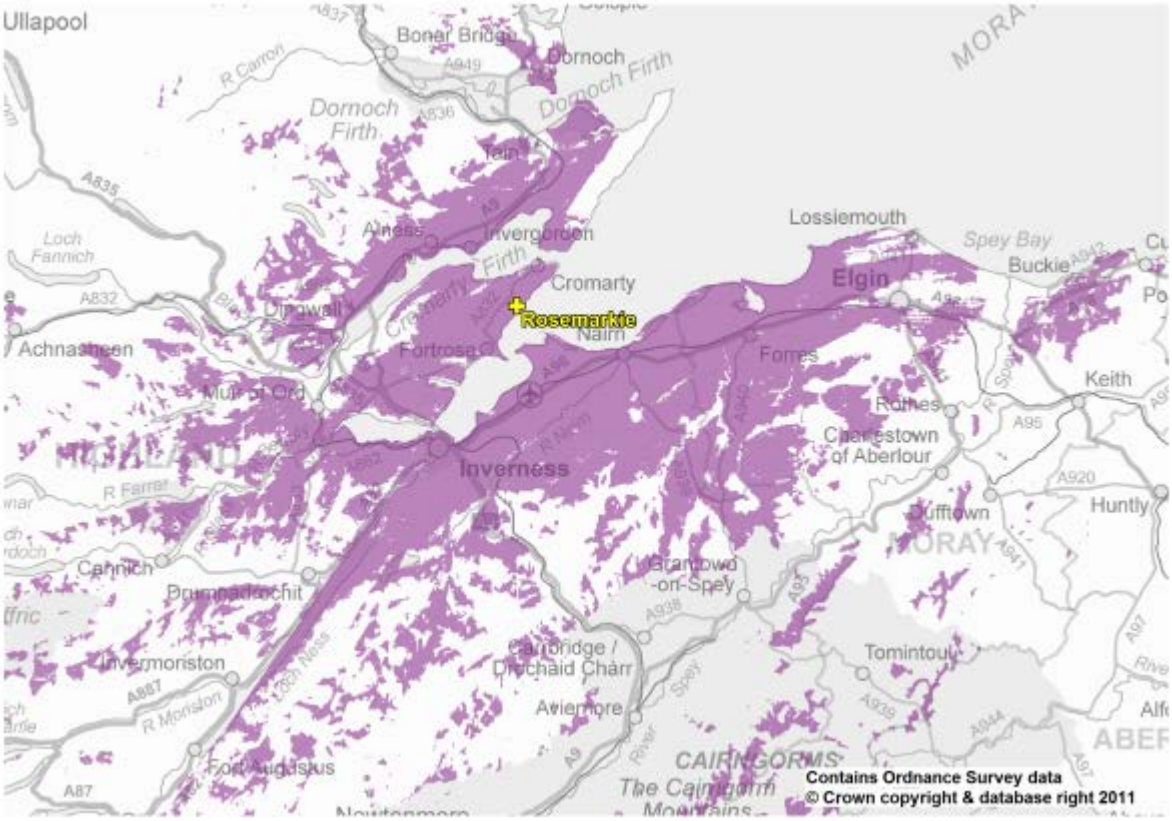
Location	Hereford
Station	Ridge Hill
Channel	51
Effective Radiated Power	1 kW
Assumed Antenna Height	79m
Planning Status	Provisional
Assumed Practical Antenna Pattern	

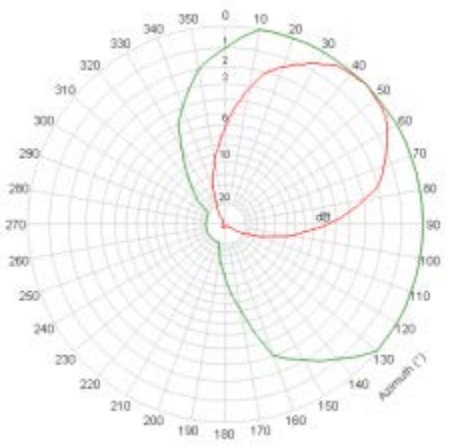
Hereford Indicative Coverage Map (assuming QPSK 2/3)



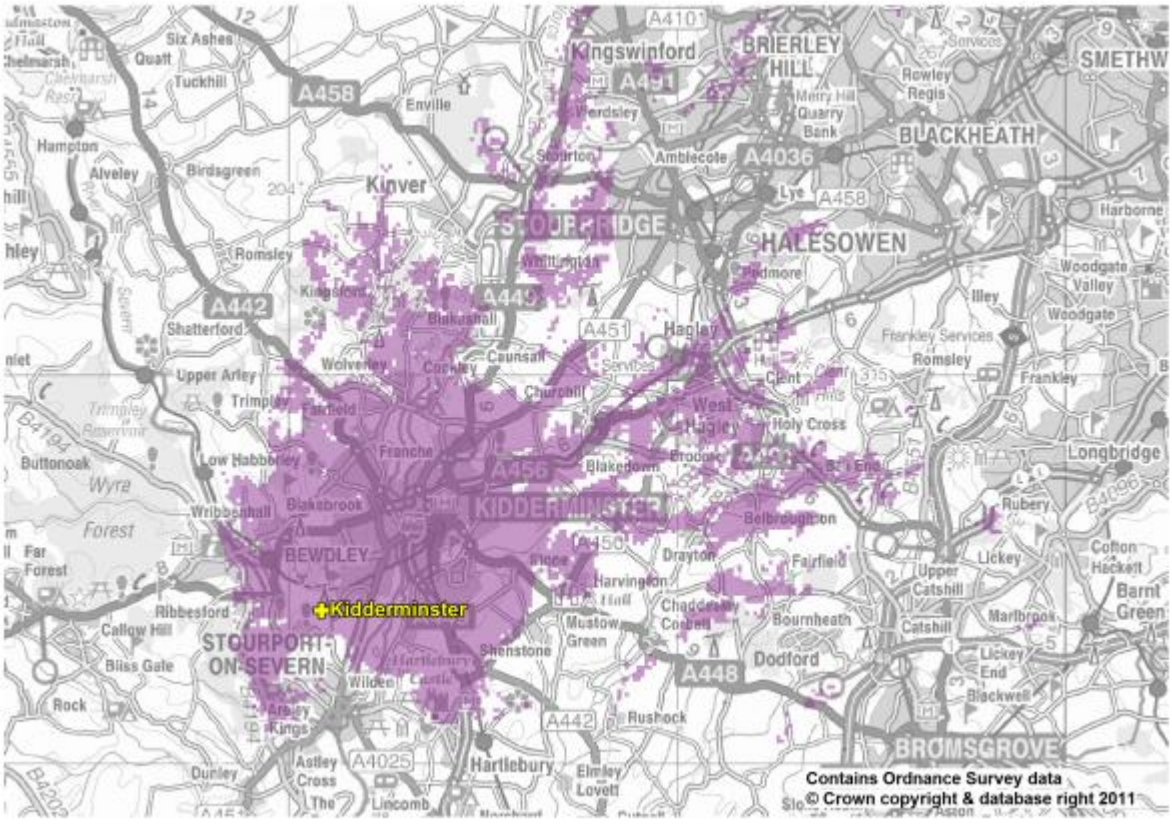
Location	Inverness
Station	Rosemarkie
Channel	52
Effective Radiated Power	1 kW
Assumed Antenna Height	60m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

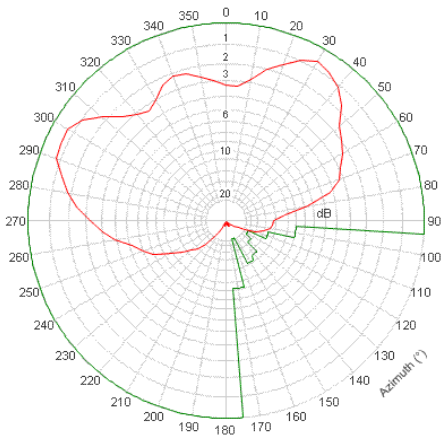
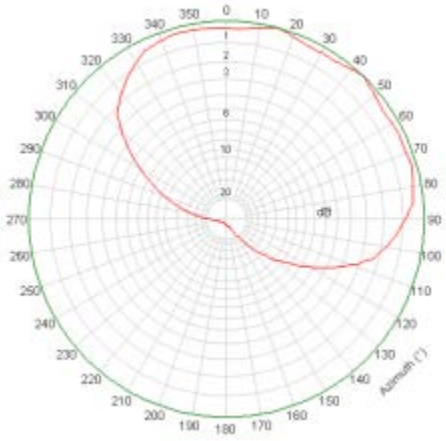
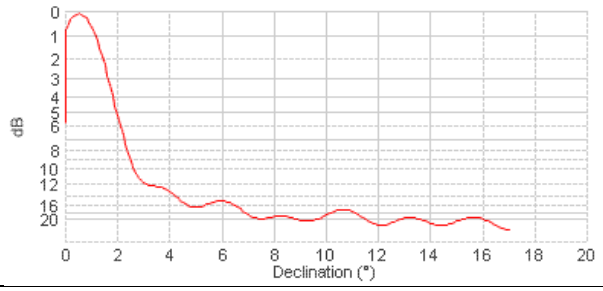
Inverness Indicative Coverage Map (assuming QPSK 2/3)



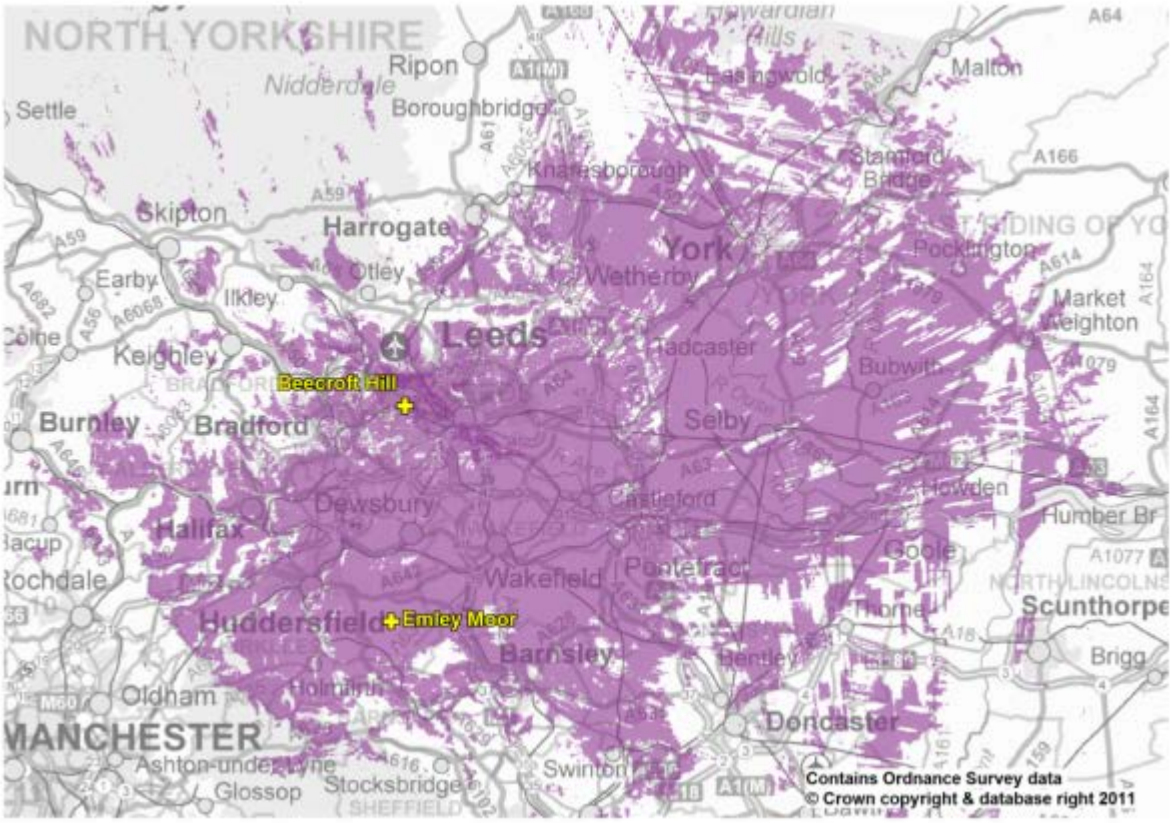
Location	Kidderminster
Station	Kidderminster
Channel	56
Effective Radiated Power	0.04 kW
Assumed Antenna Height	45m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

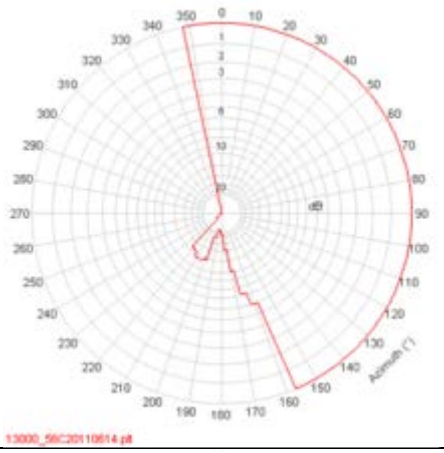
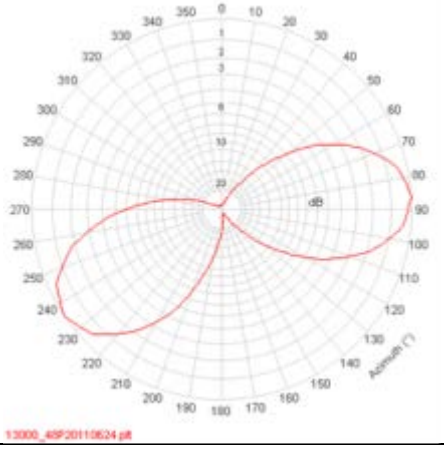
Kidderminster Indicative Coverage Map (assuming QPSK 2/3)



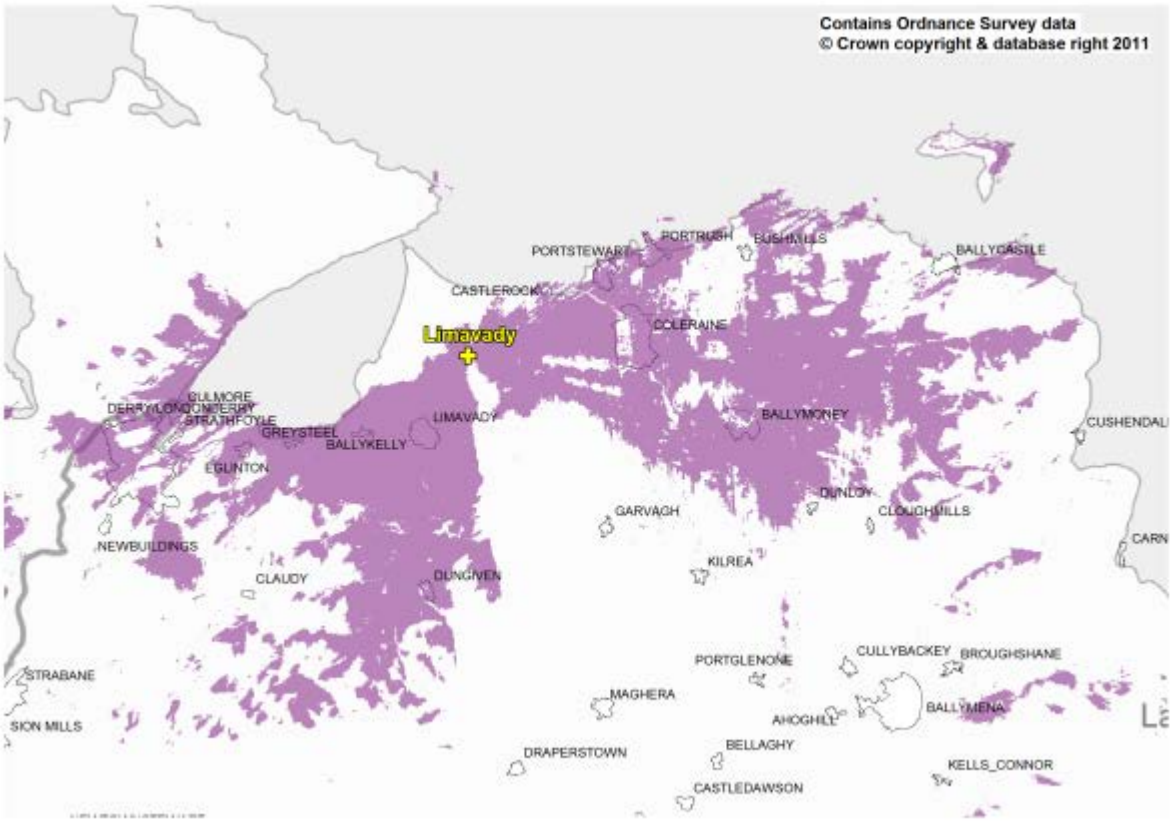
Location	Leeds	
Station	Emley Moor	Beecroft Hill
Channel	56	56
Effective Radiated Power	5 kW	0.02 kW
Assumed Antenna Height	161m	43m
Planning Status	Baseline	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Emley Moor  Beecroft Hill 	
Suggested Vertical Radiation Pattern	Emley Moor 	

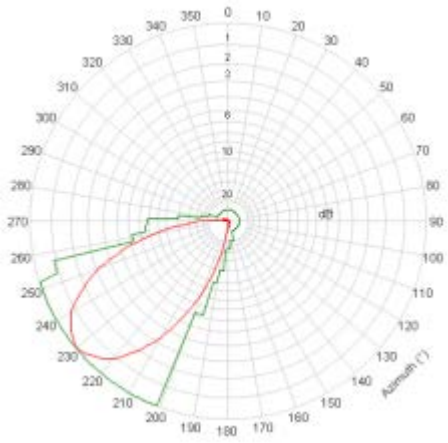
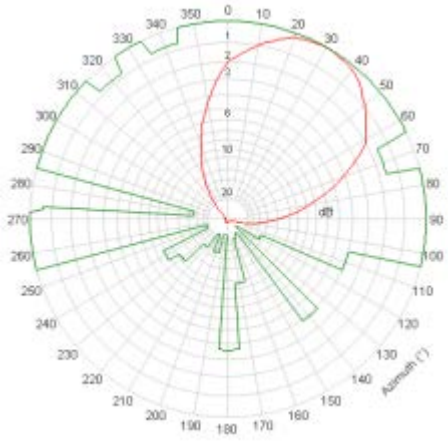
Leeds Indicative Coverage Map (assuming QPSK 2/3)



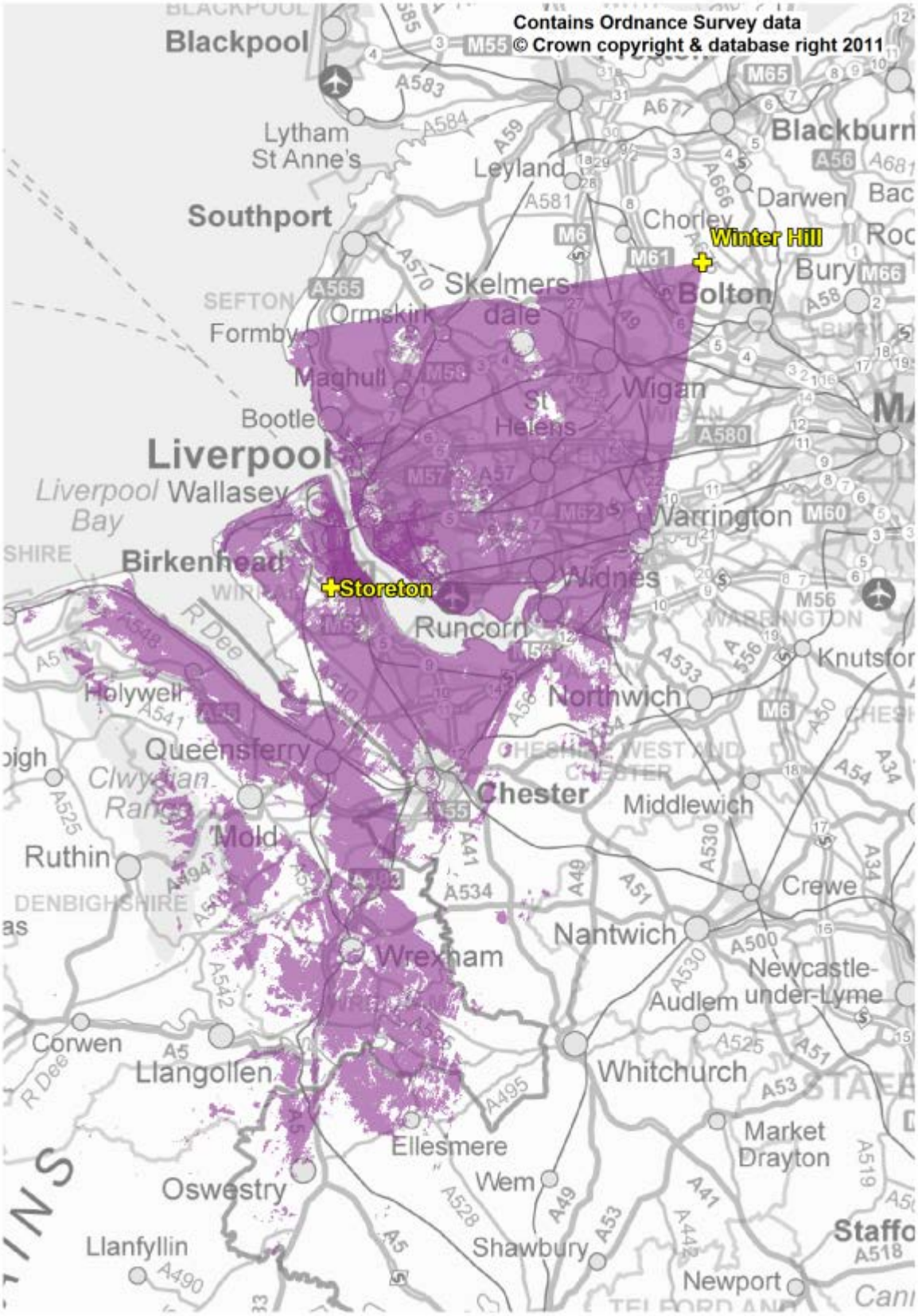
Location	Limavady
Station	Limavady
Channel	48
Effective Radiated Power	2 kW
Assumed Antenna Height	35m
Planning Status	Provisional
Indicative Antenna Template	With respect to 10kW 
Assumed Practical Antenna Pattern	

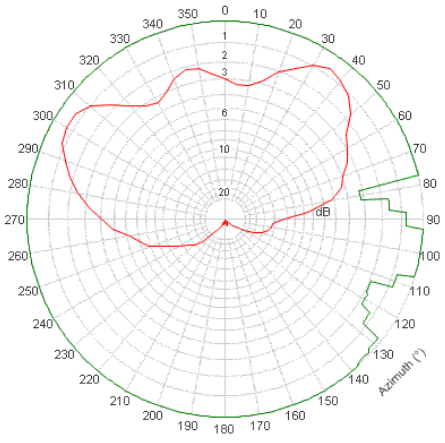
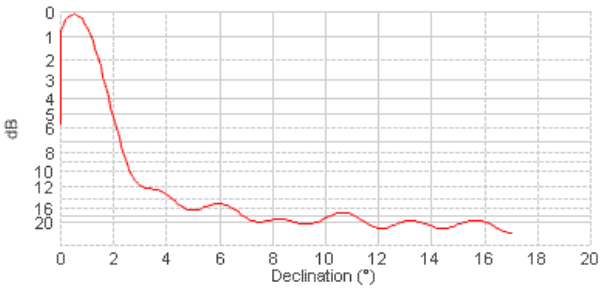
Limavady Indicative Coverage Map (assuming QPSK 2/3)



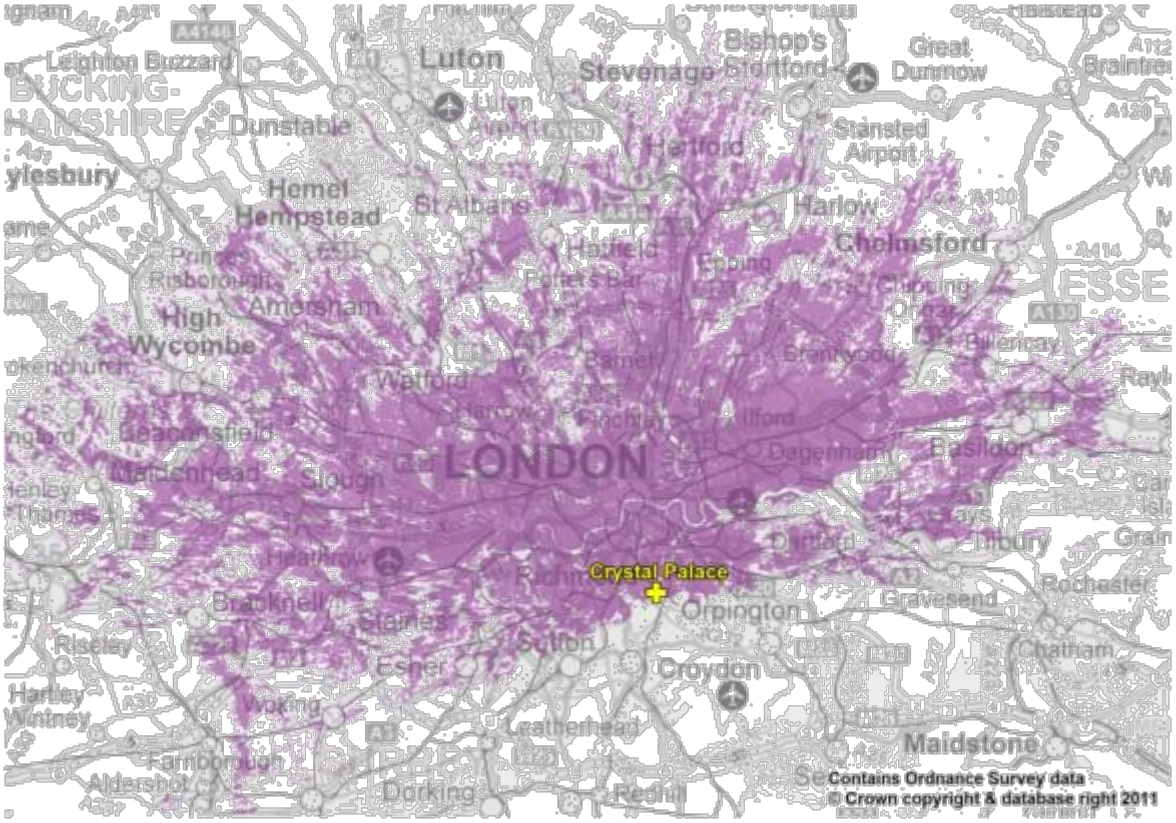
Location	Liverpool	
Station	Winter Hill	Storeton
Channel	56	30
Effective Radiated Power	2 kW	0.06 kW
Assumed Antenna Height	144m	43m
Planning Status	Baseline	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Winter Hill  Storeton 	

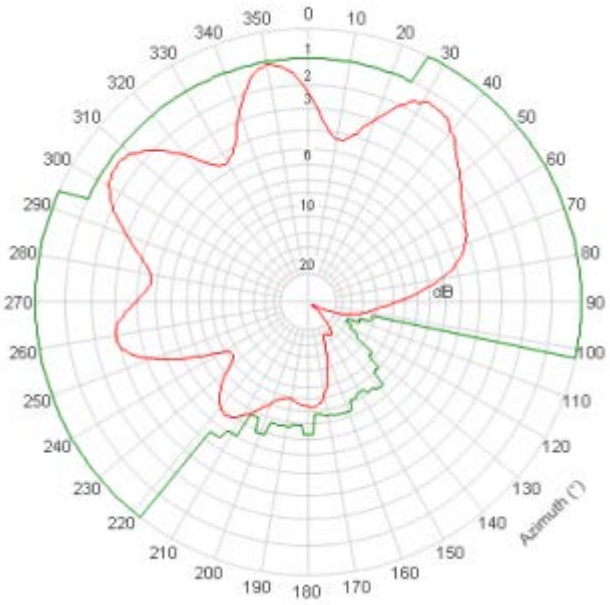
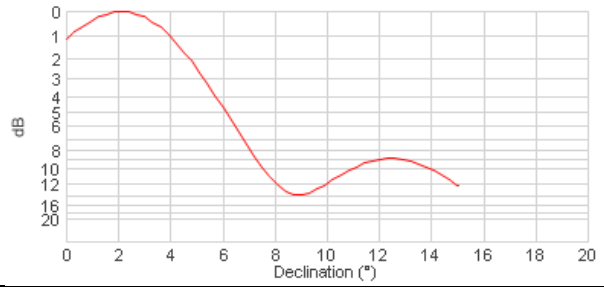
Liverpool Indicative Coverage Map (assuming QPSK 2/3)



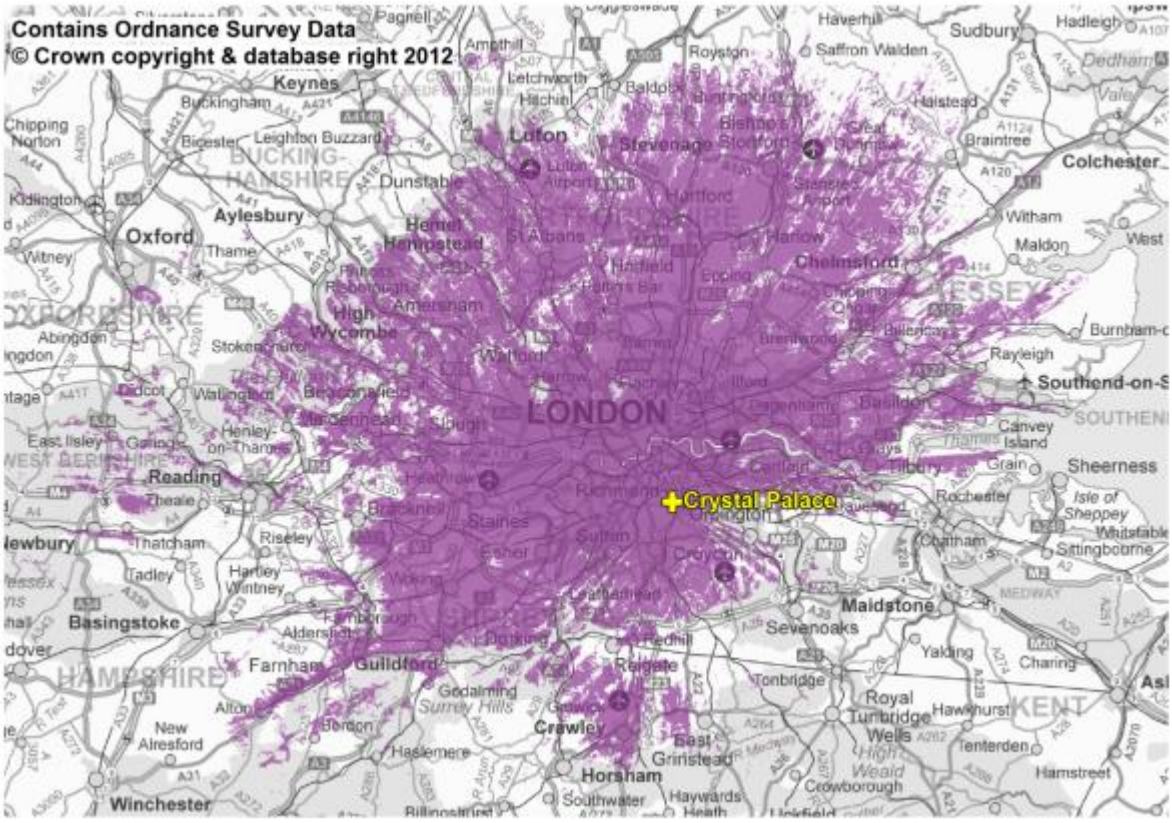
Location	London (Baseline)
Station	Crystal Palace
Channel	29
Effective Radiated Power	2 kW
Assumed Antenna Height	106m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	
Suggested Vertical Radiation Pattern	

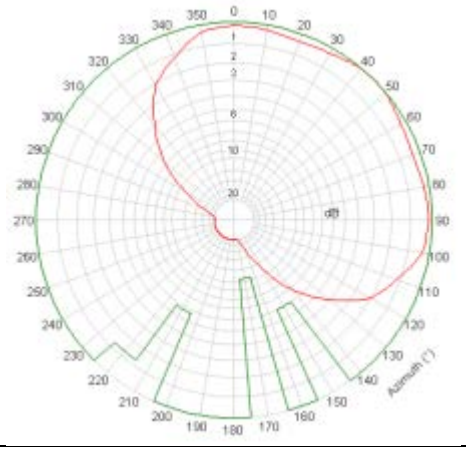
London (Baseline) Indicative Coverage Map (assuming QPSK 2/3)



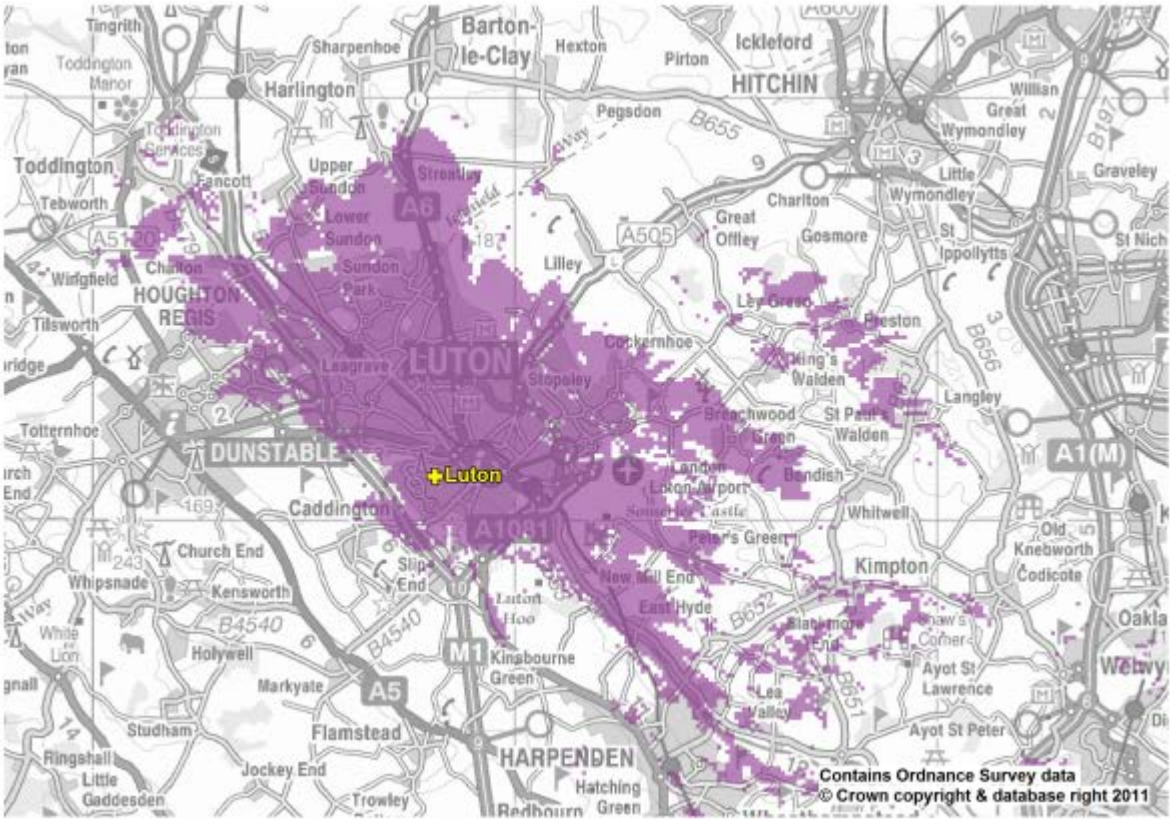
Location	London (Enhanced)
Station	Crystal Palace
Channel	29
Effective Radiated Power	20 kW
Assumed Antenna Height	127 m
Planning Status	Provisional
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	
Suggested Vertical Radiation Pattern	

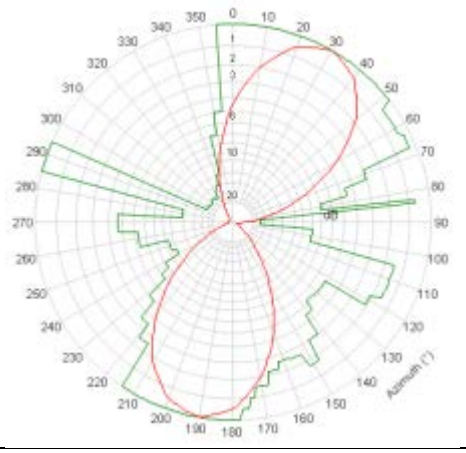
London (Enhanced) Indicative Coverage Map (assuming QPSK 2/3)



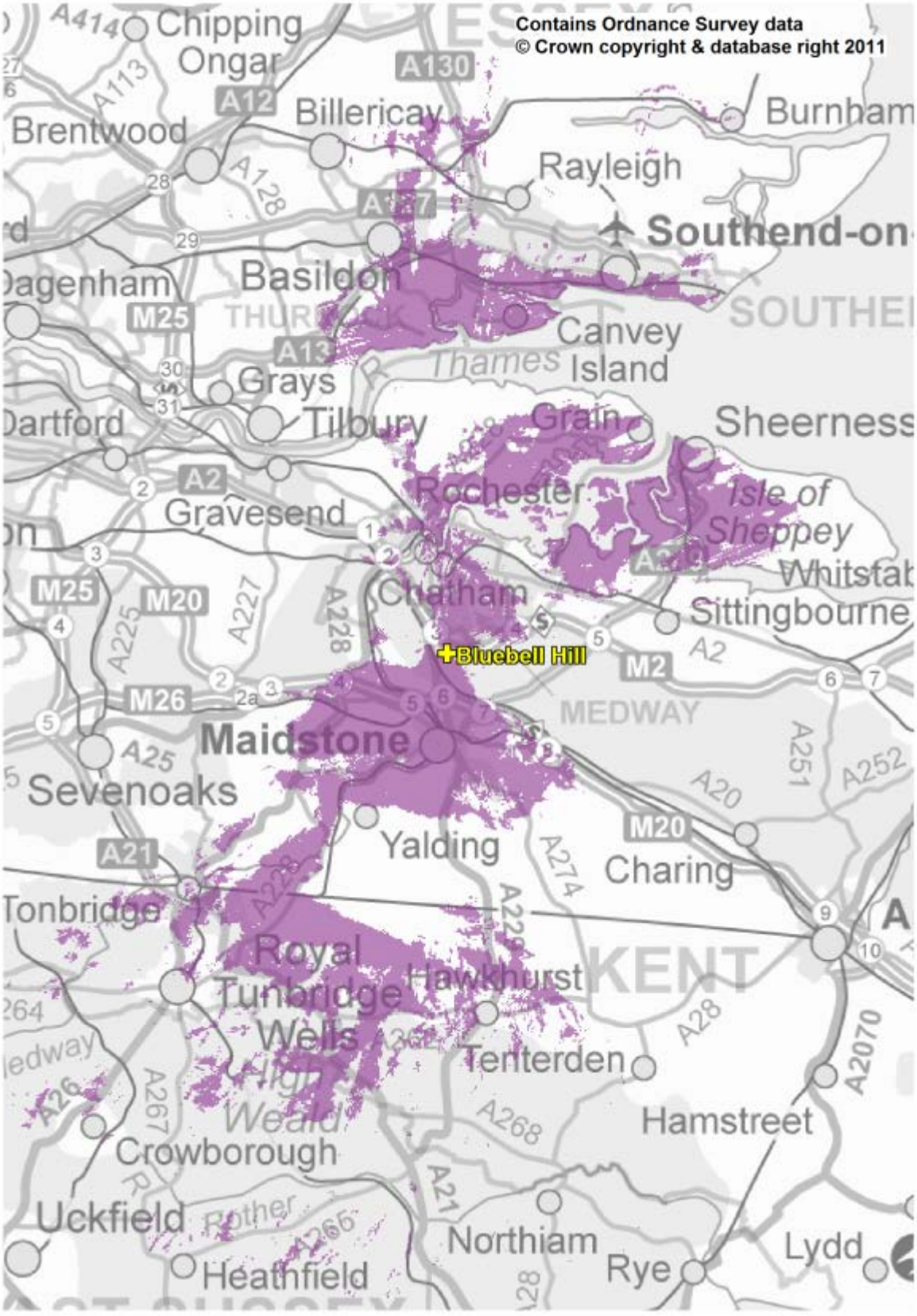
Location	Luton
Station	Luton
Channel	45
Effective Radiated Power	0.05 kW
Assumed Antenna Height	42m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

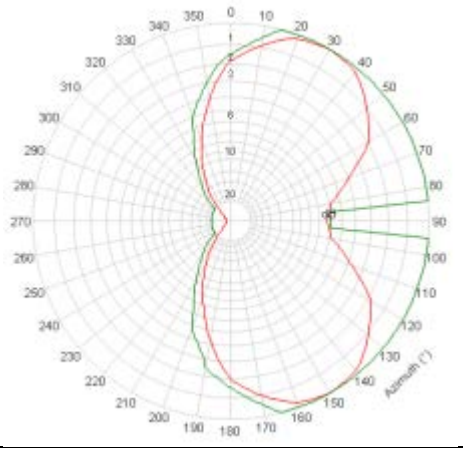
Luton Indicative Coverage Map (assuming QPSK 2/3)



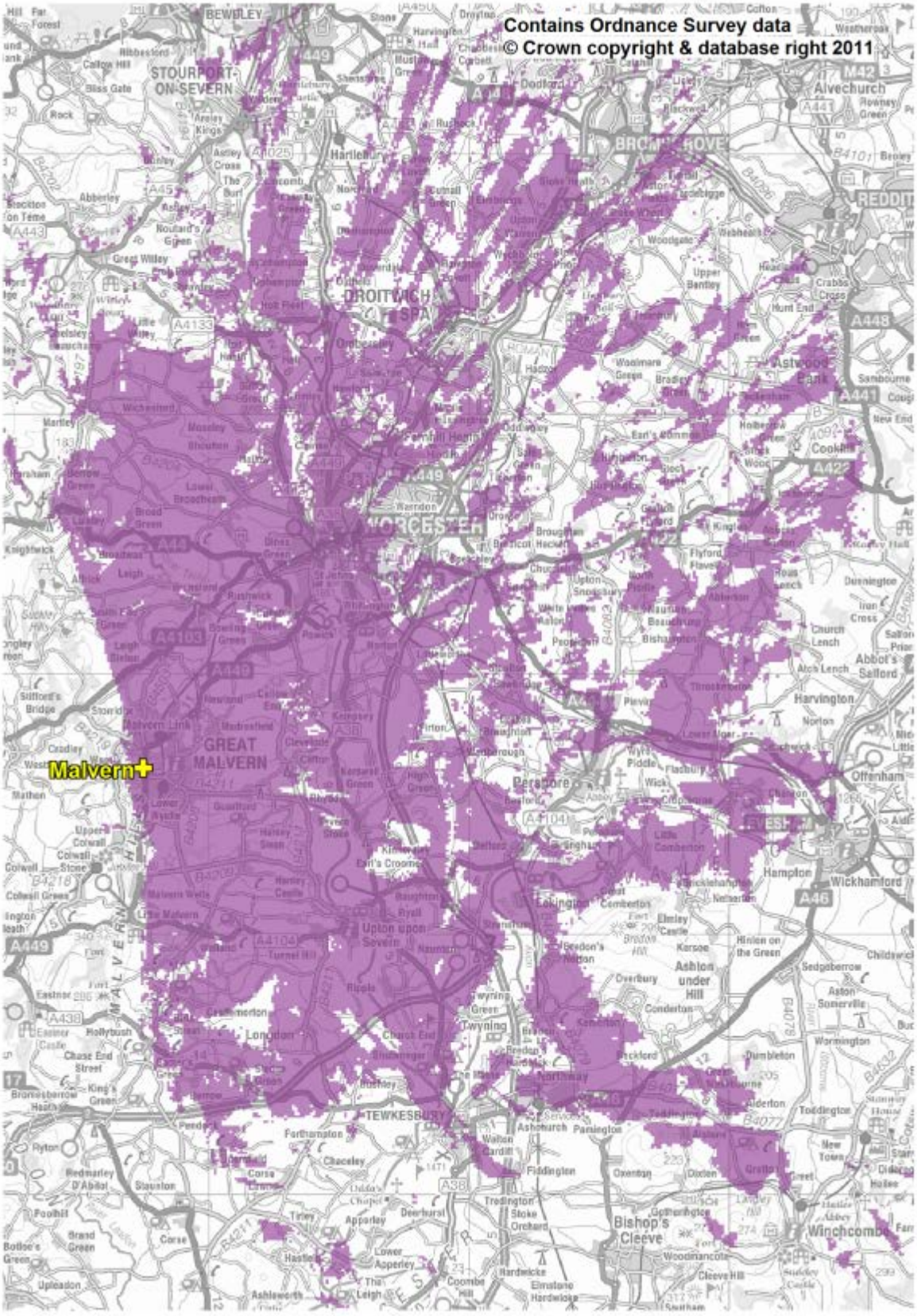
Location	Maidstone
Station	Bluebell Hill
Channel	27
Effective Radiated Power	1 kW
Assumed Antenna Height	44m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

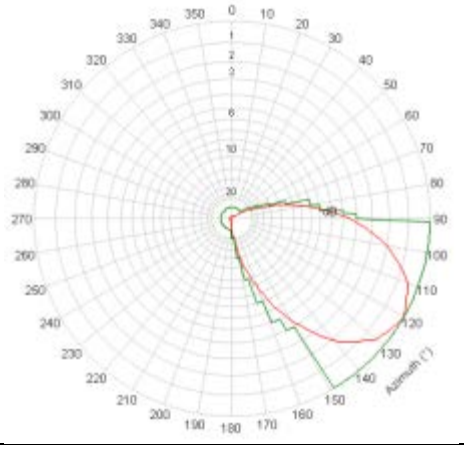
Maidstone Indicative Coverage Map (assuming QPSK 2/3)



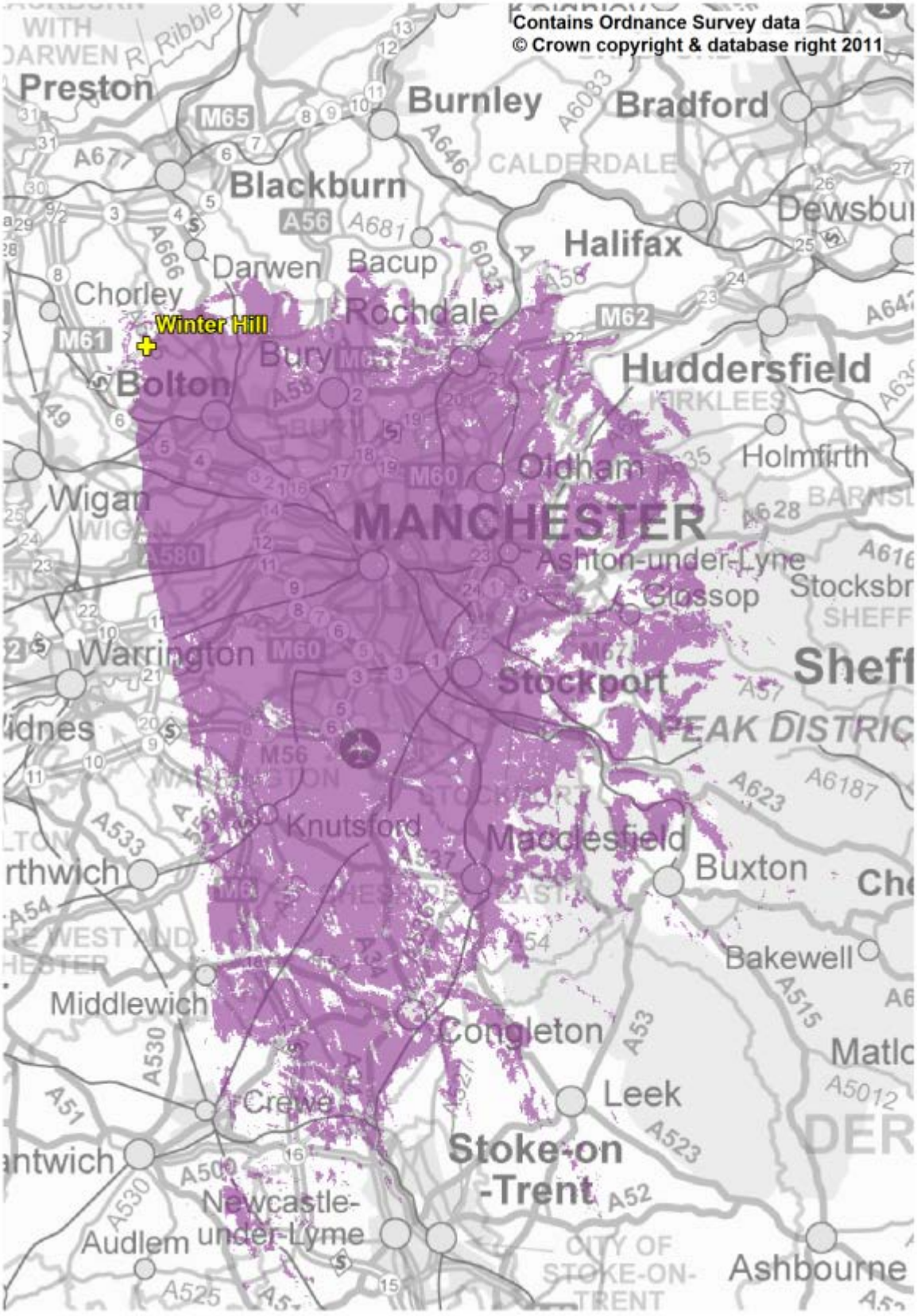
Location	Malvern
Station	Malvern
Channel	51
Effective Radiated Power	0.04 kW
Assumed Antenna Height	38m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

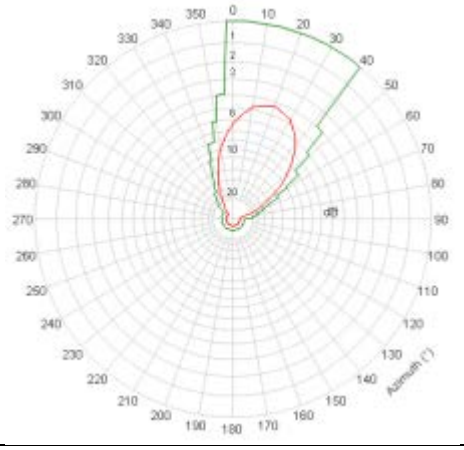
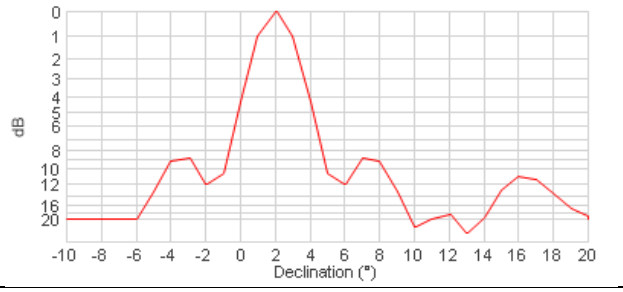
Malvern Indicative Coverage Map (assuming QPSK 2/3)



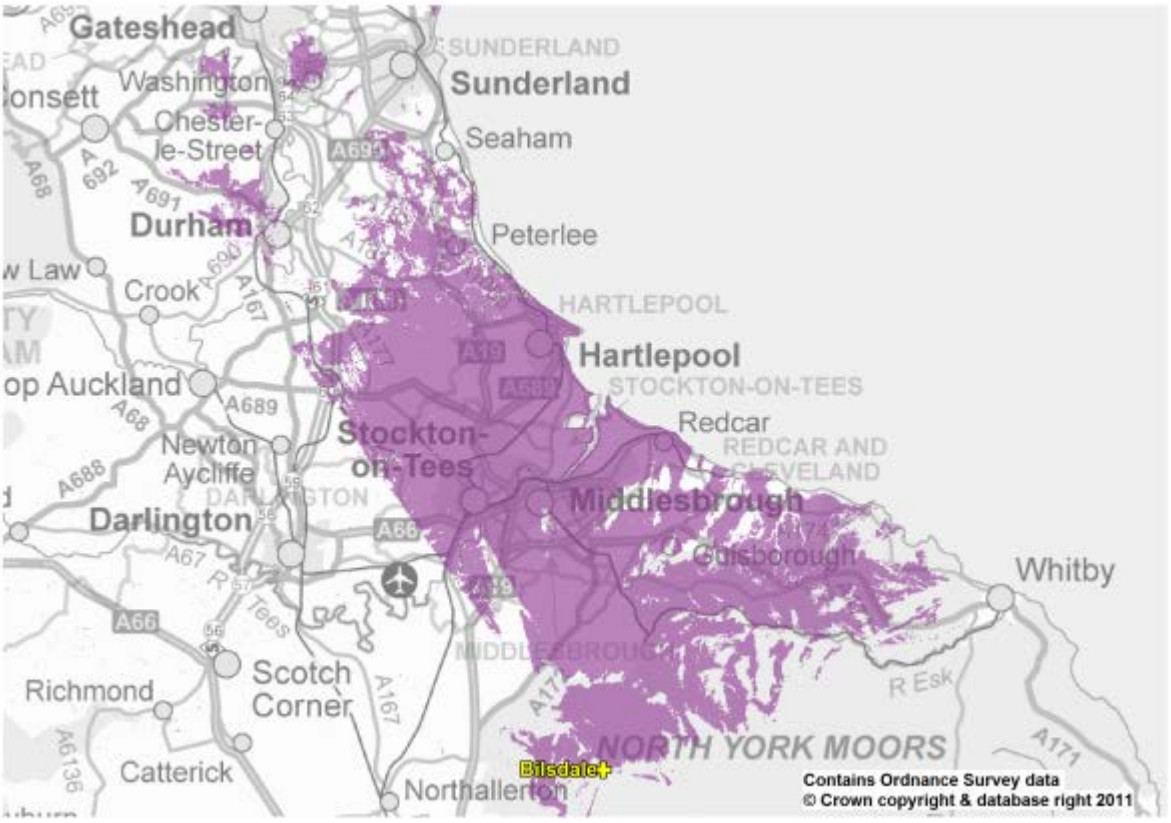
Location	Manchester
Station	Winter Hill
Channel	56
Effective Radiated Power	2 kW
Assumed Antenna Height	144m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

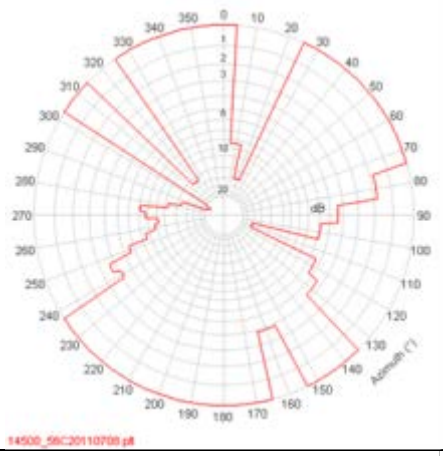
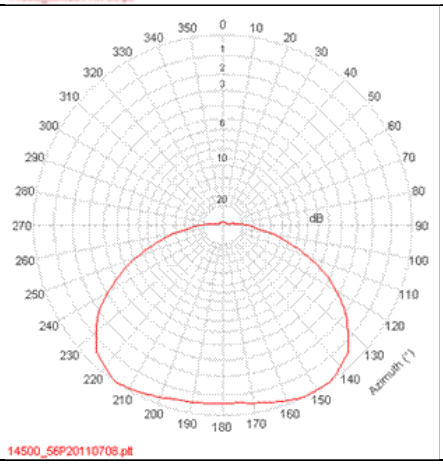
Manchester Indicative Coverage Map (assuming QPSK 2/3)



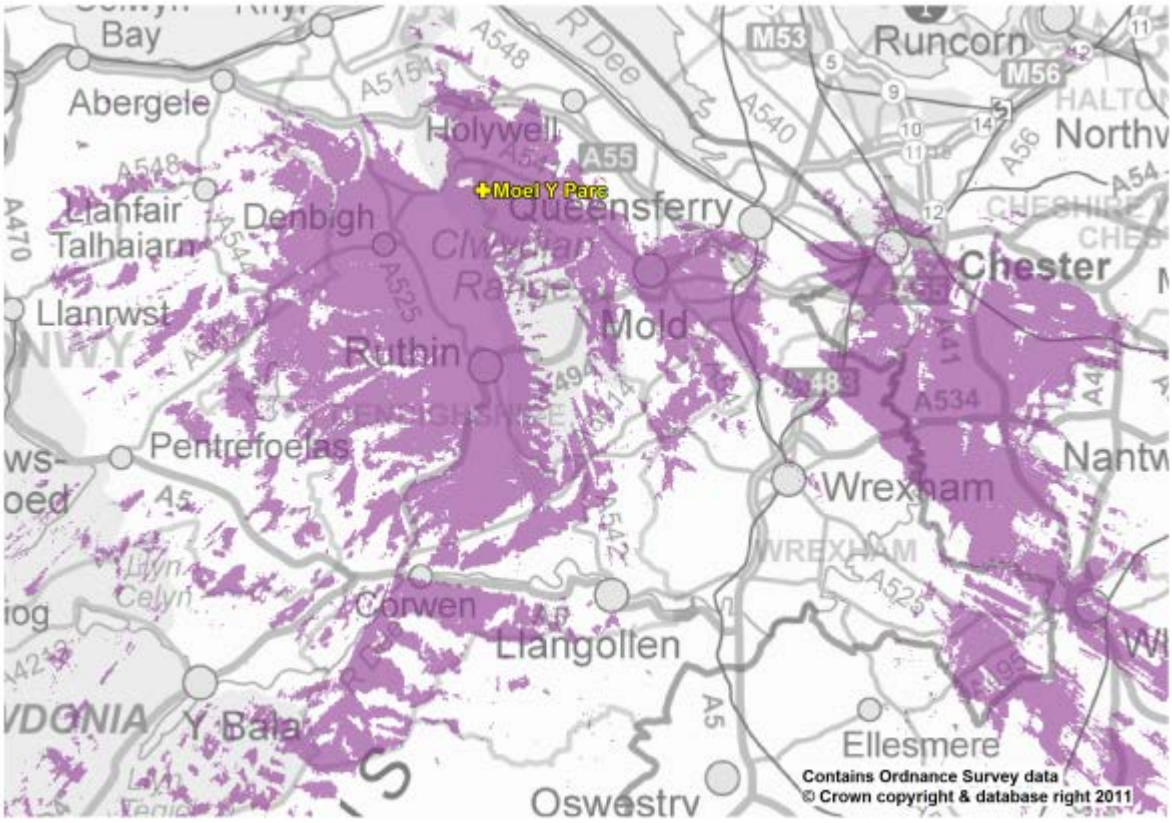
Location	Middlesbrough
Station	Bilsdale
Channel	24
Effective Radiated Power	5 kW
Assumed Antenna Height	200 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	
Suggested Vertical Radiation Pattern	

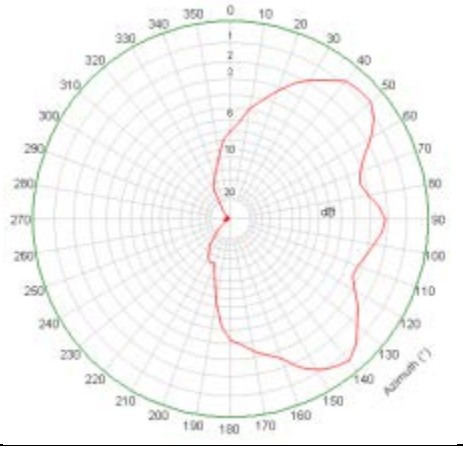
Middlesbrough Indicative Coverage Map (assuming QPSK 2/3)



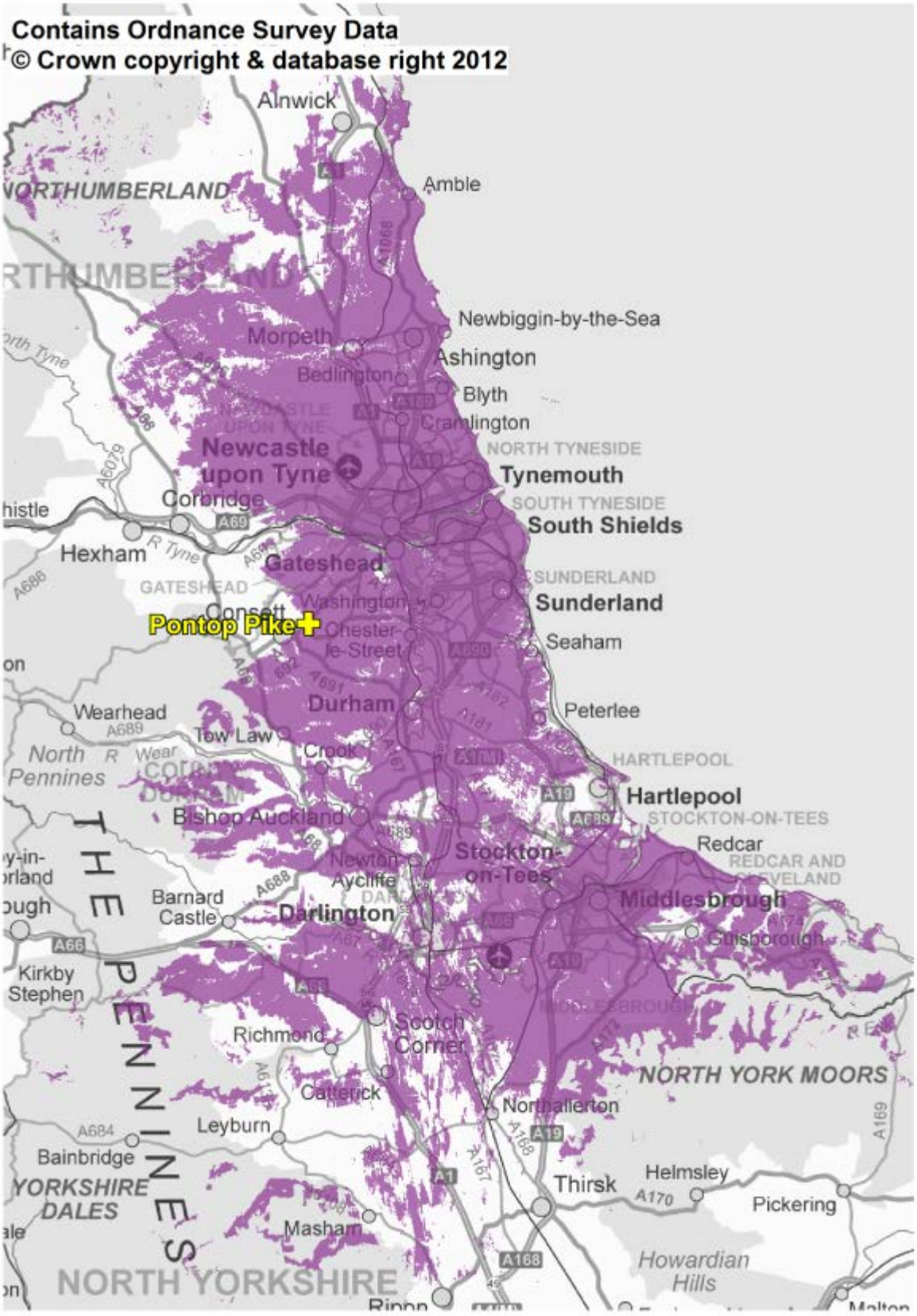
Location	Mold
Station	Moel y Parc
Channel	56
Effective Radiated Power	2 kW
Assumed Antenna Height	118m
Planning Status	Provisional
Indicative Antenna Template	With respect to 10kW 
Assumed Practical Antenna Pattern	

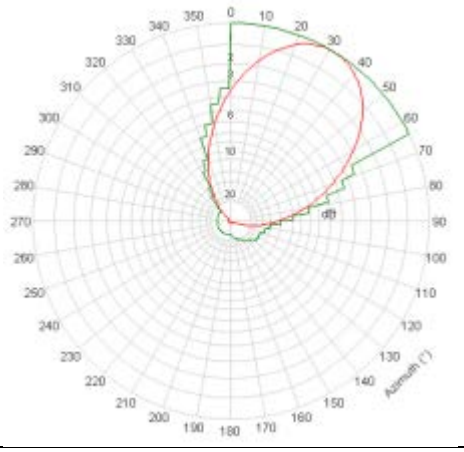
Mold Indicative Coverage Map (assuming QPSK 2/3)



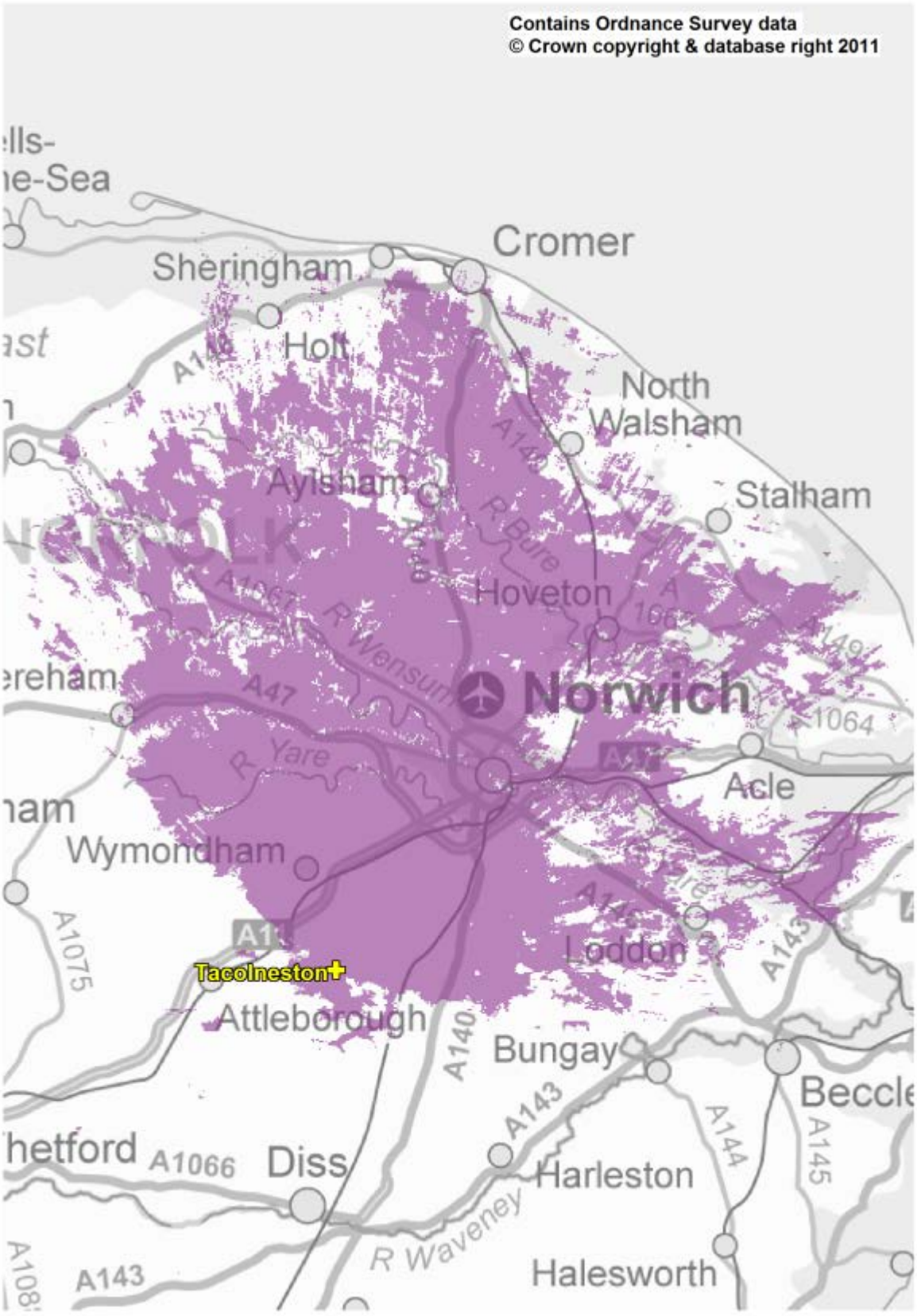
Location	Newcastle
Station	Pontop Pike
Channel	56
Effective Radiated Power	5 kW
Assumed Antenna Height	73m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

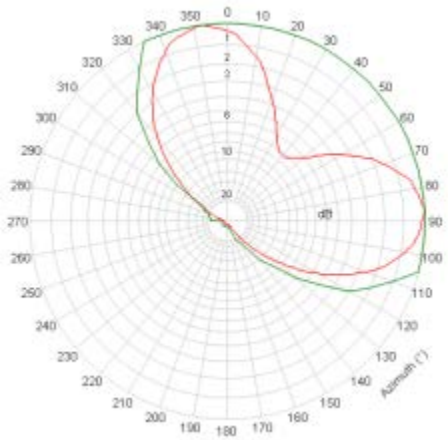
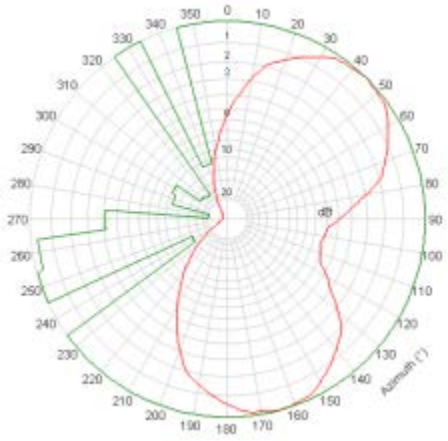
Newcastle Indicative Coverage Map (assuming QPSK 2/3)



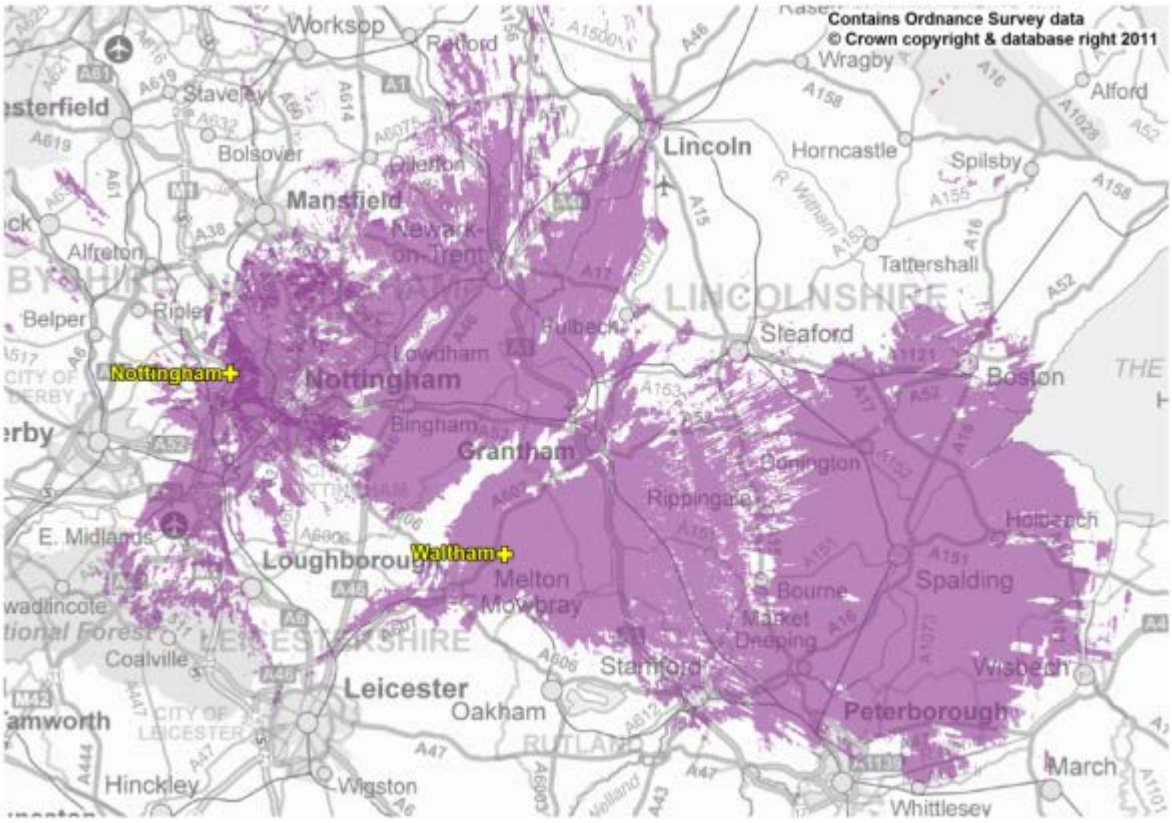
Location	Norwich
Station	Tacolneston
Channel	57
Effective Radiated Power	10 kW
Assumed Antenna Height	100m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

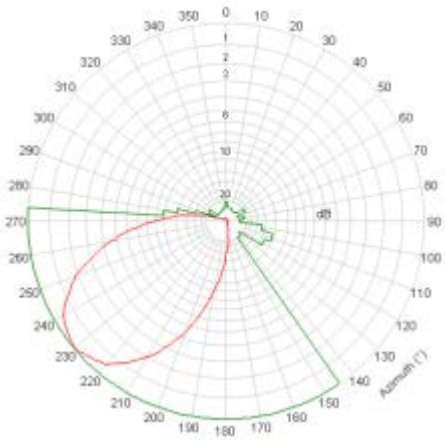
Norwich Indicative Coverage Map (assuming QPSK 2/3)



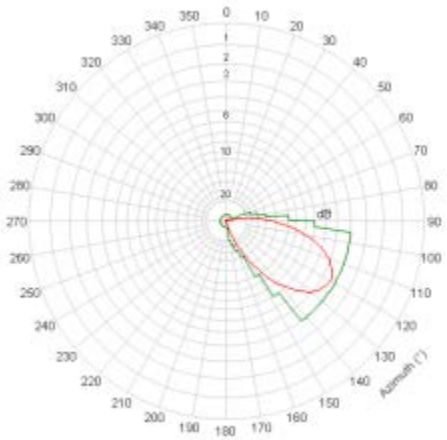
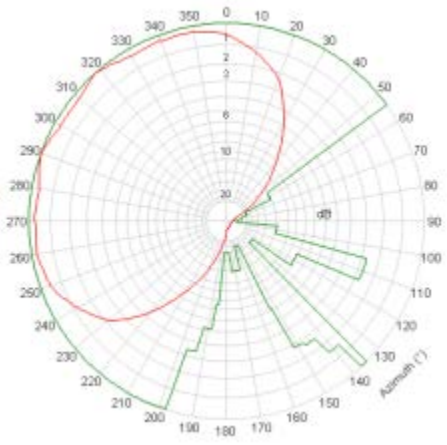
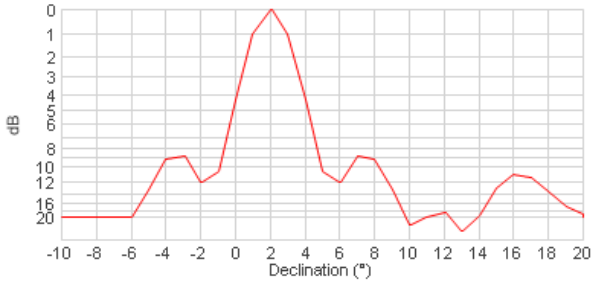
Location	Nottingham	
Station	Waltham	Nottingham
Channel	26	50
Effective Radiated Power	5 kW	0.1 kW
Assumed Antenna Height	151m	41m
Planning Status	Baseline	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Waltham  Nottingham 	

Nottingham Indicative Coverage Map (assuming QPSK 2/3)

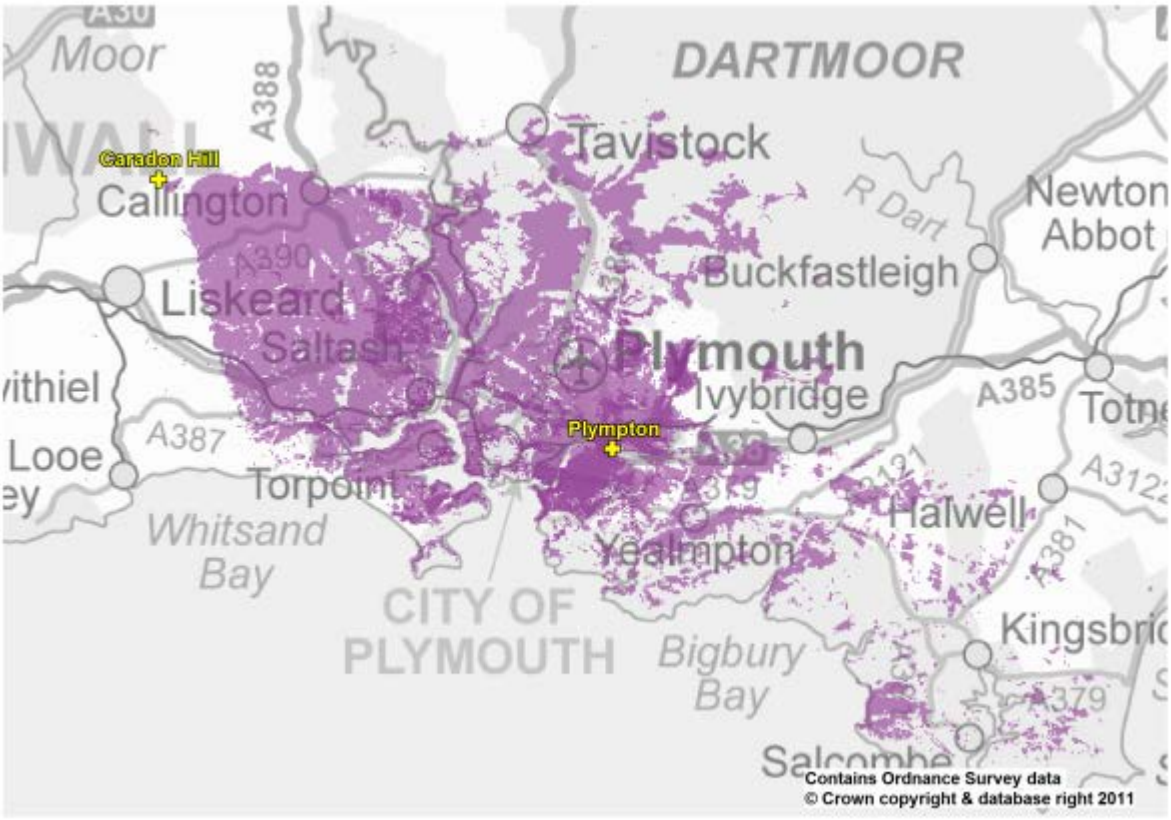


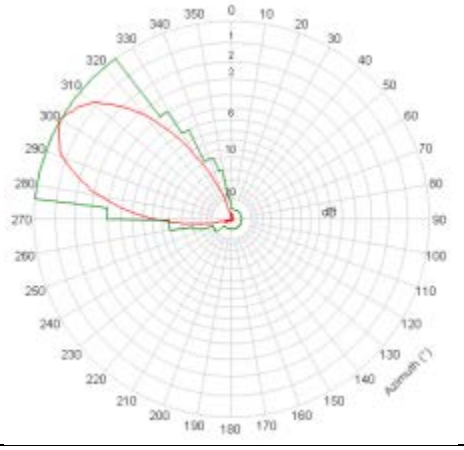
Location	Oxford
Station	Oxford
Channel	51
Effective Radiated Power	10 kW
Assumed Antenna Height	80m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

Oxford Indicative Coverage Map (assuming QPSK 2/3)

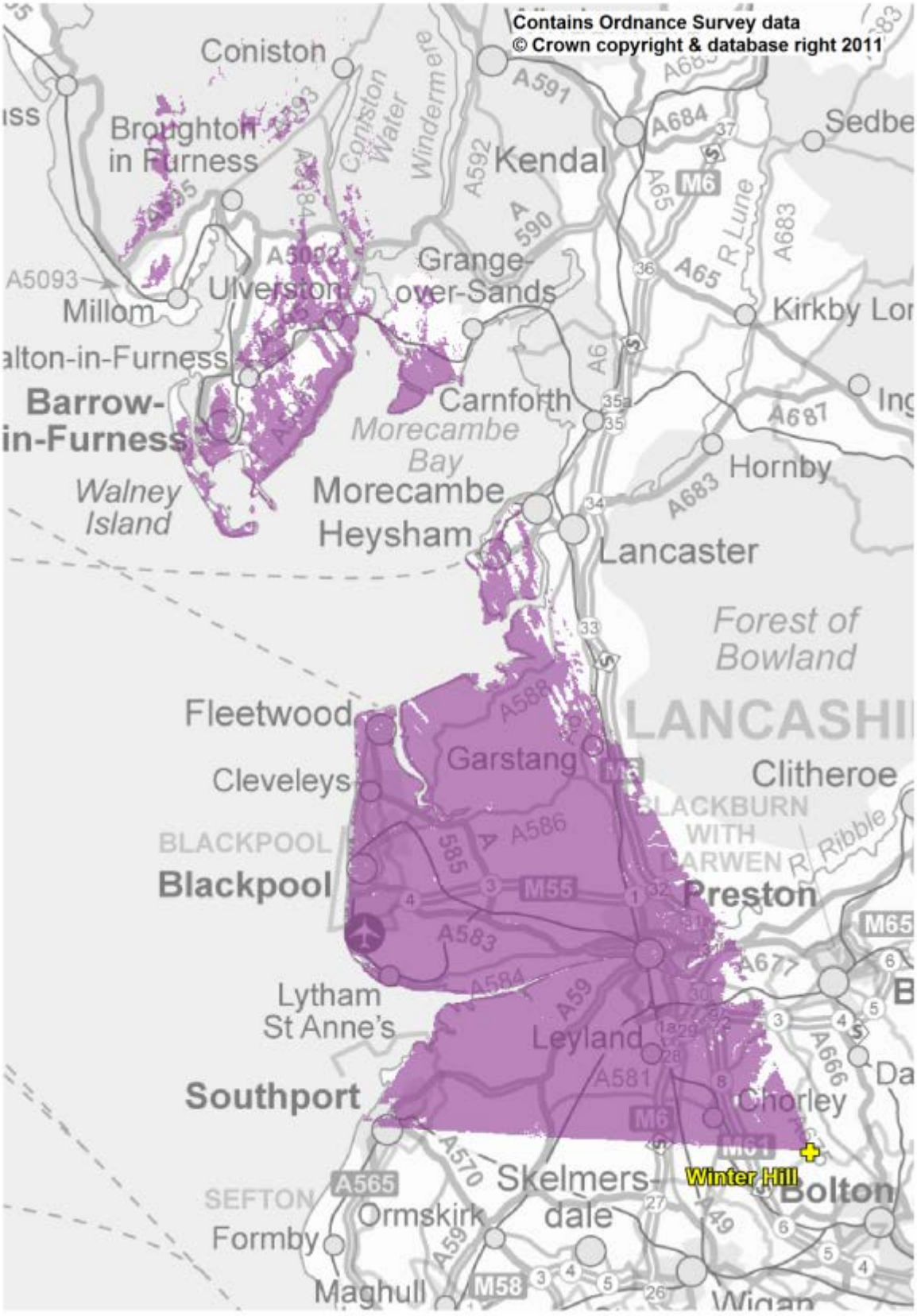
Location	Plymouth	
Station	Caradon Hill	Plympton
Channel	30	39
Effective Radiated Power	2 kW	0.1 kW
Assumed Antenna Height	182m	45m
Planning Status	Baseline	
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	Caradon Hill  Plympton 	
Suggested Vertical Radiation Pattern	Caradon Hill 	

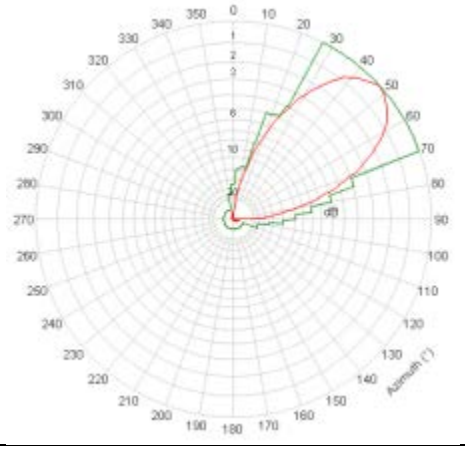
Plymouth Indicative Coverage Map (assuming QPSK 2/3)



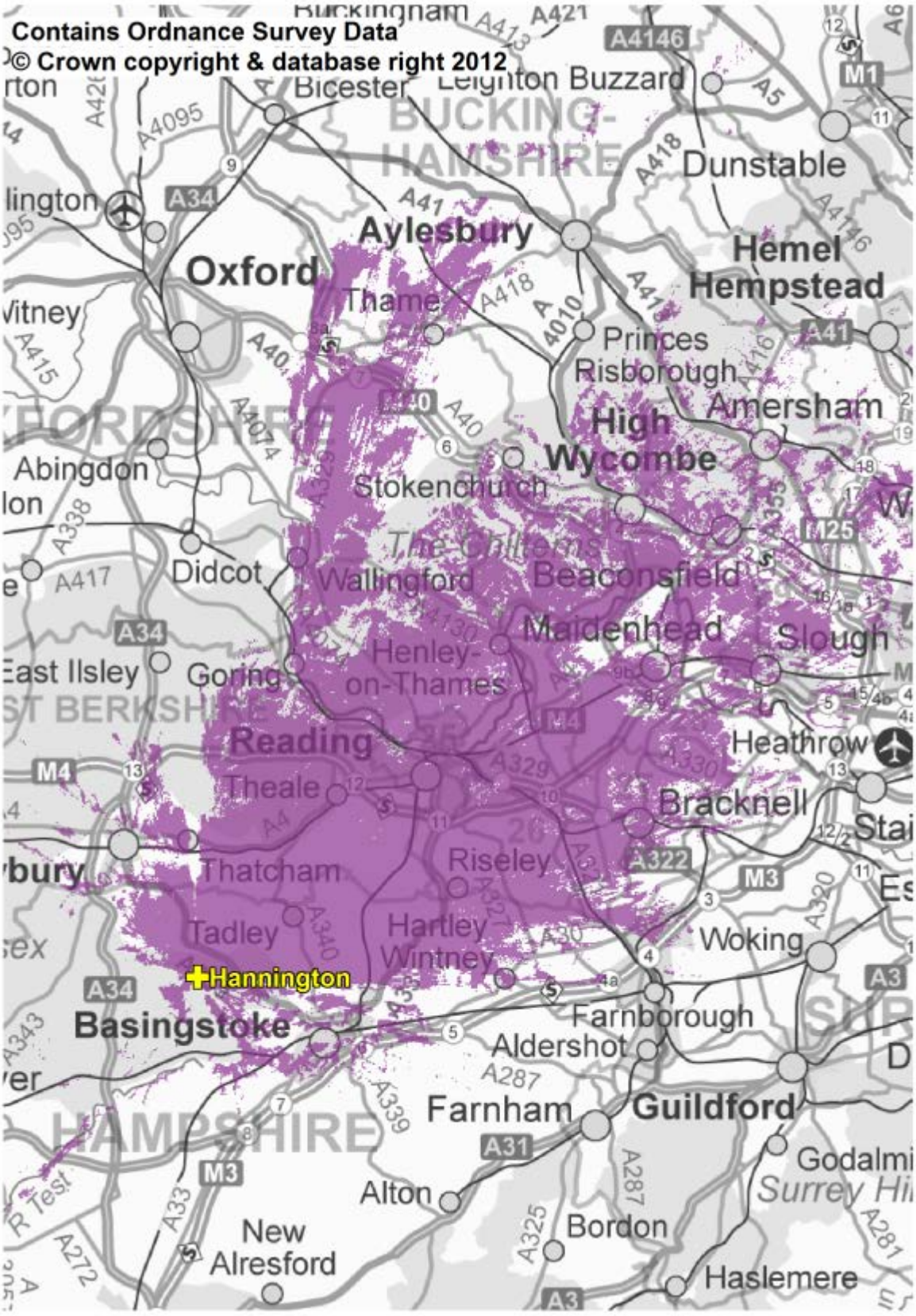
Location	Preston
Station	Winter Hill
Channel	56
Effective Radiated Power	1 kW
Assumed Antenna Height	144m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

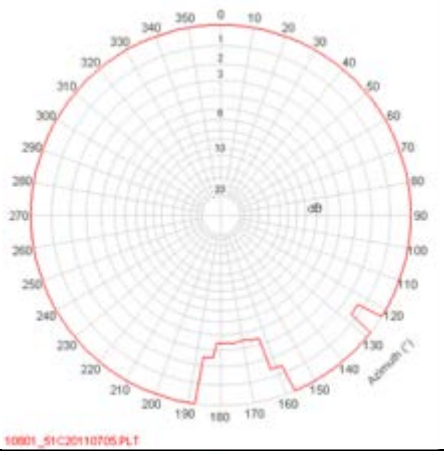
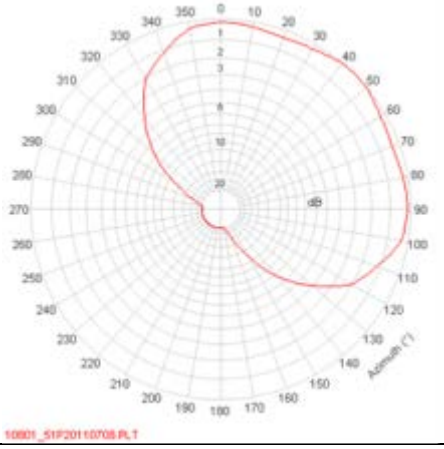
Preston Indicative Coverage Map (assuming QPSK 2/3)



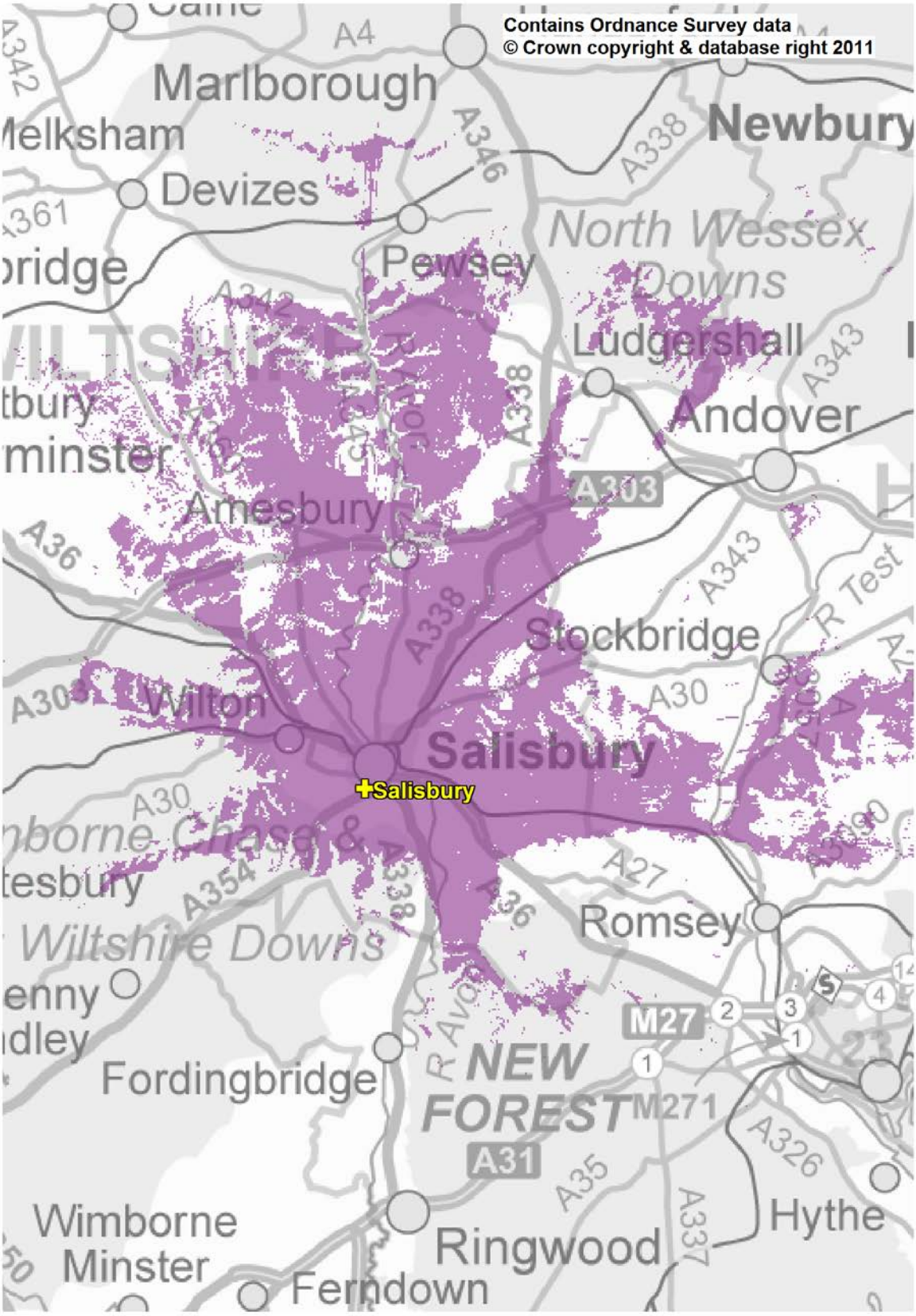
Location	Reading
Station	Hannington
Channel	29
Effective Radiated Power	10 kW
Assumed Antenna Height	71 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

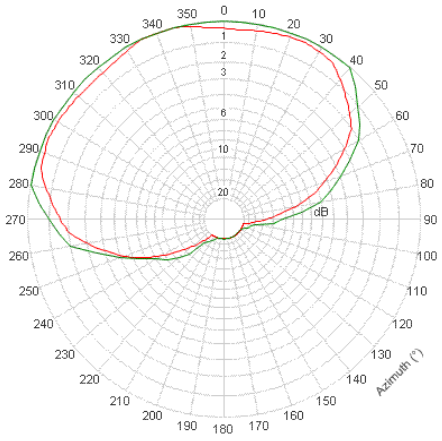
Reading Indicative Coverage Map (assuming QPSK 2/3)



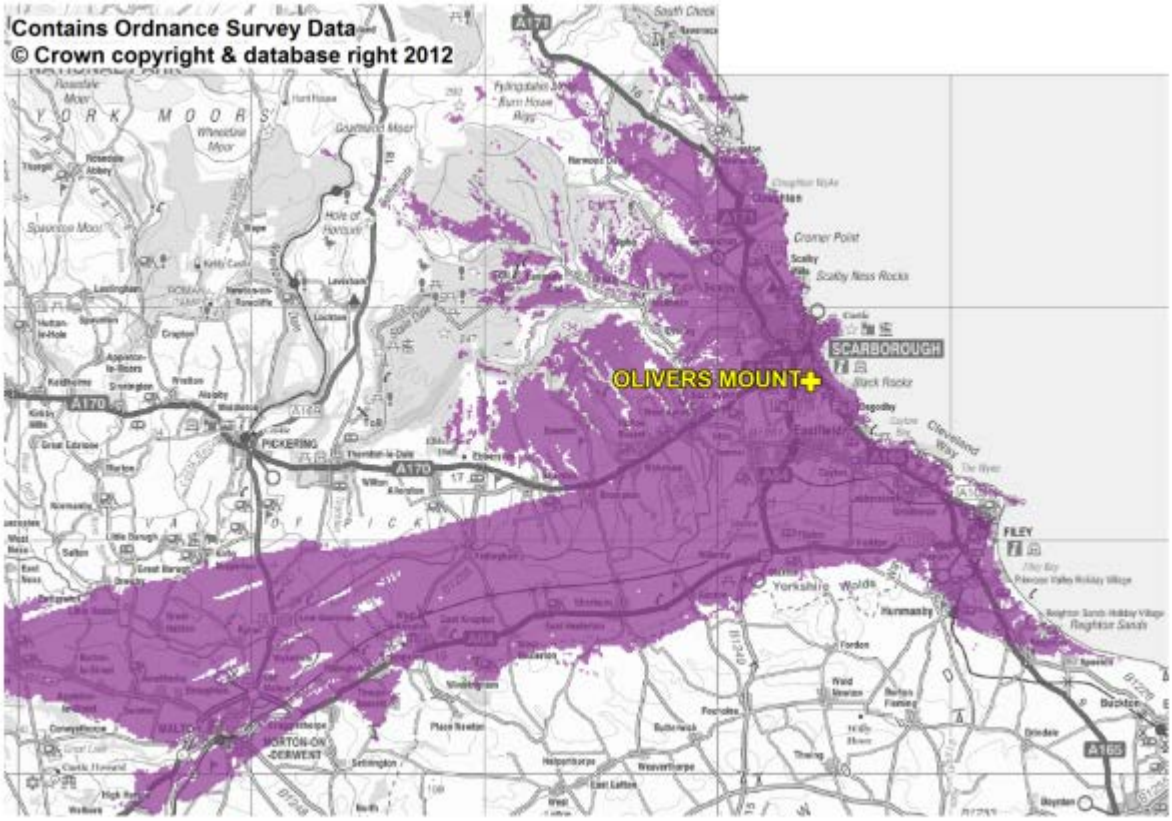
Location	Salisbury
Station	Salisbury
Channel	51
Effective Radiated Power	0.2 kW
Assumed Antenna Height	45m
Planning Status	Provisional
Indicative Antenna Template	With respect to 1kW 
Assumed Practical Antenna Pattern	

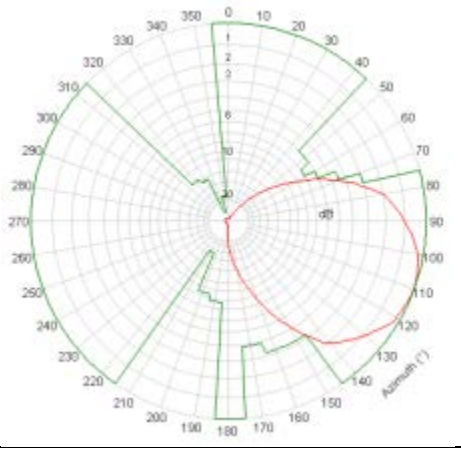
Salisbury Indicative Coverage Map (assuming QPSK 2/3)



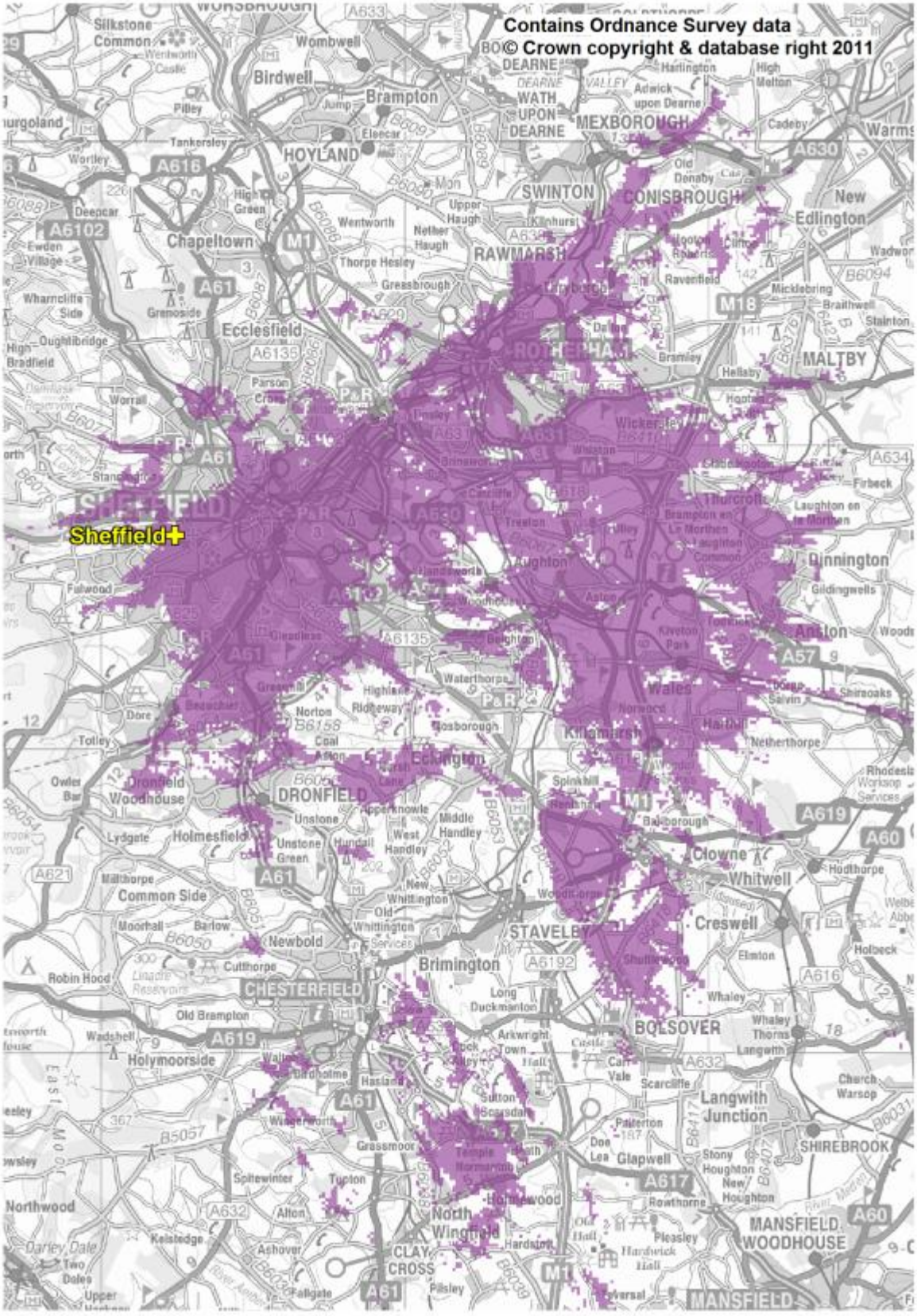
Location	Scarborough
Station	Olivers Mount
Channel	56
Effective Radiated Power	0.2 kW
Assumed Antenna Height	33 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

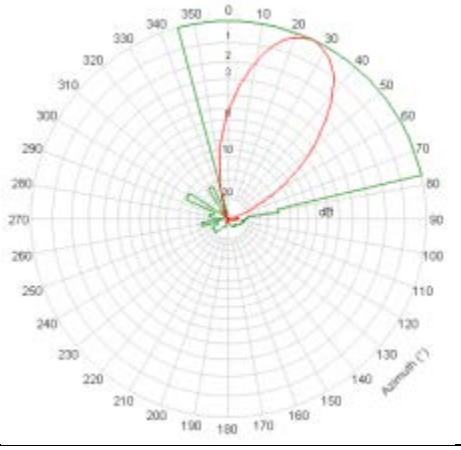
Scarborough Indicative Coverage Map (assuming QPSK 2/3)



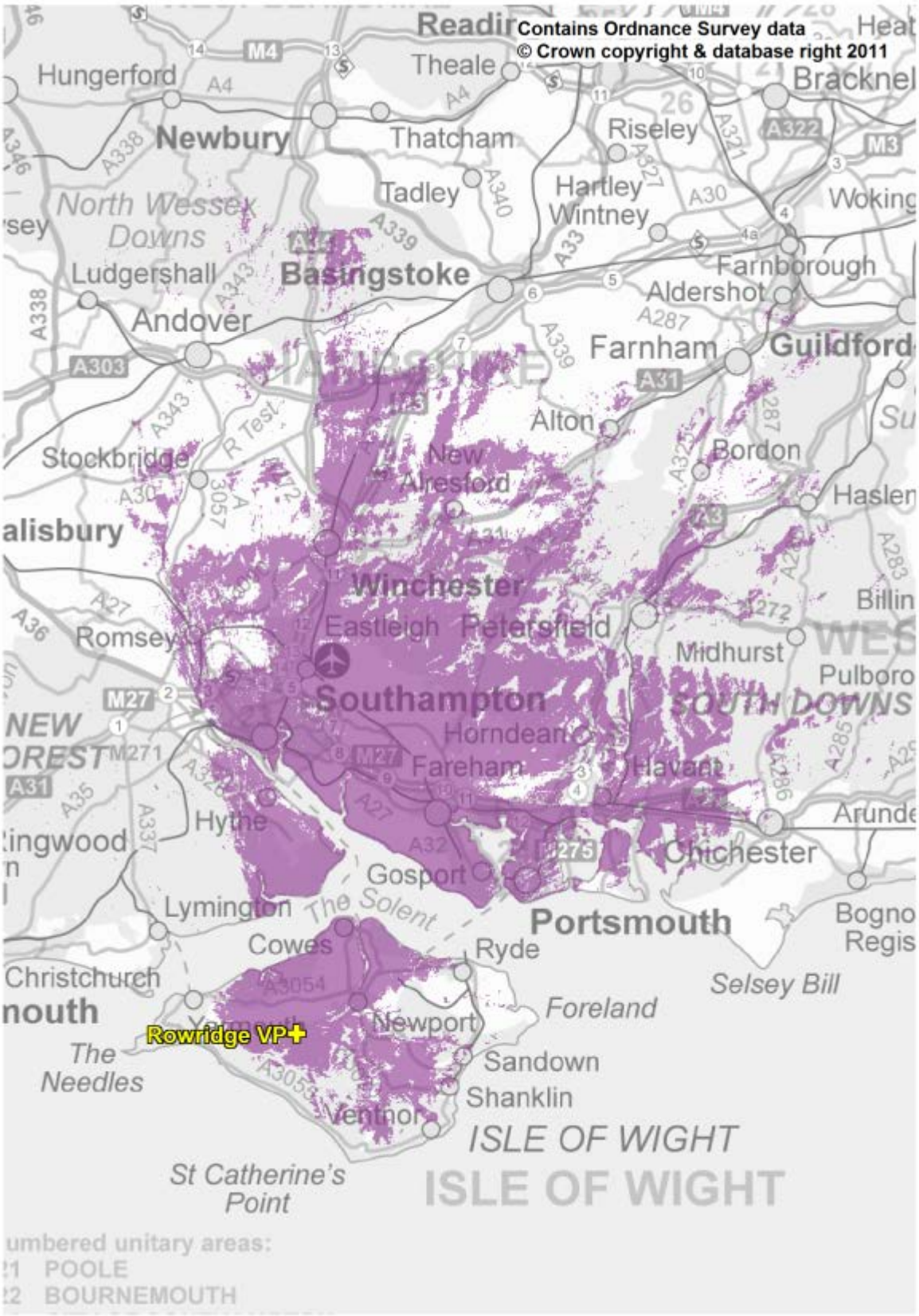
Location	Sheffield
Station	Sheffield
Channel	55
Effective Radiated Power	0.1 kW
Assumed Antenna Height	43m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

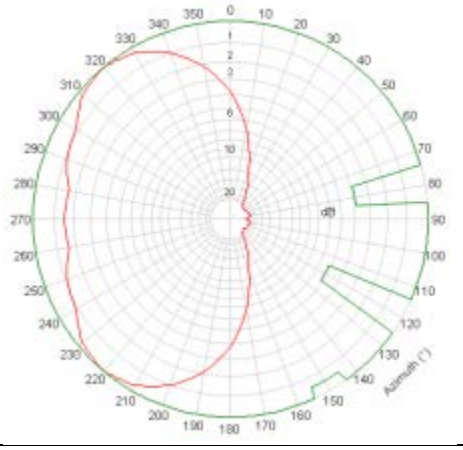
Sheffield Indicative Coverage Map (assuming QPSK 2/3)



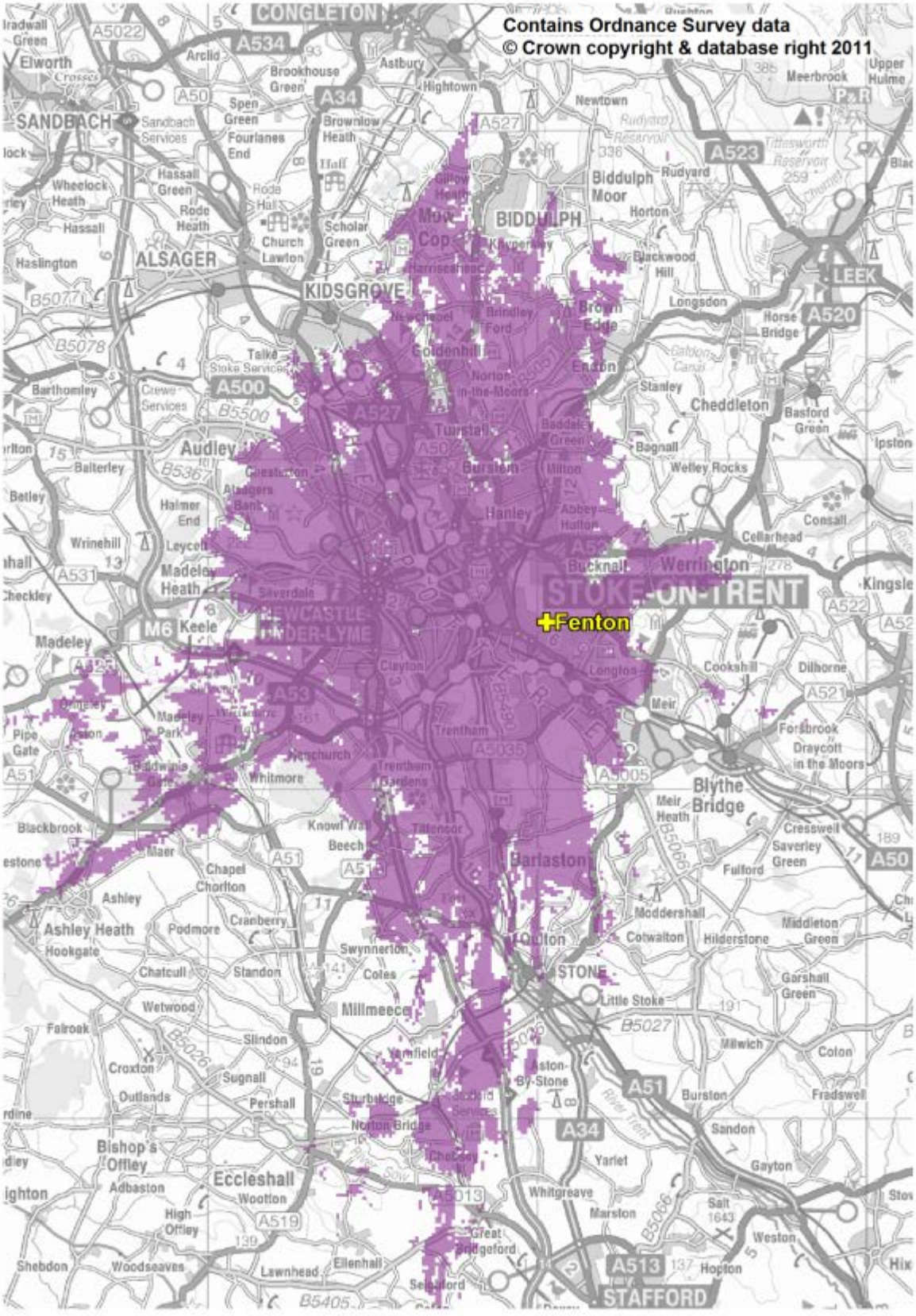
Location	Southampton
Station	Rowridge VP
Channel	29
Effective Radiated Power	10 kW
Assumed Antenna Height	89m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

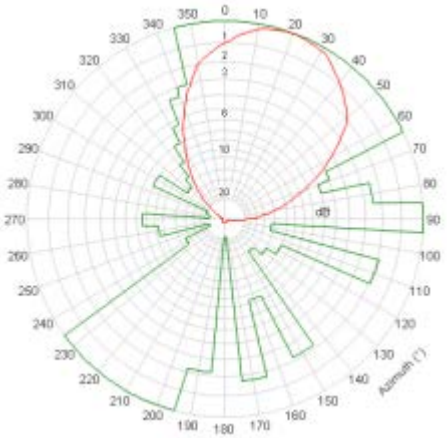
Southampton Indicative Coverage Map (assuming QPSK 2/3)



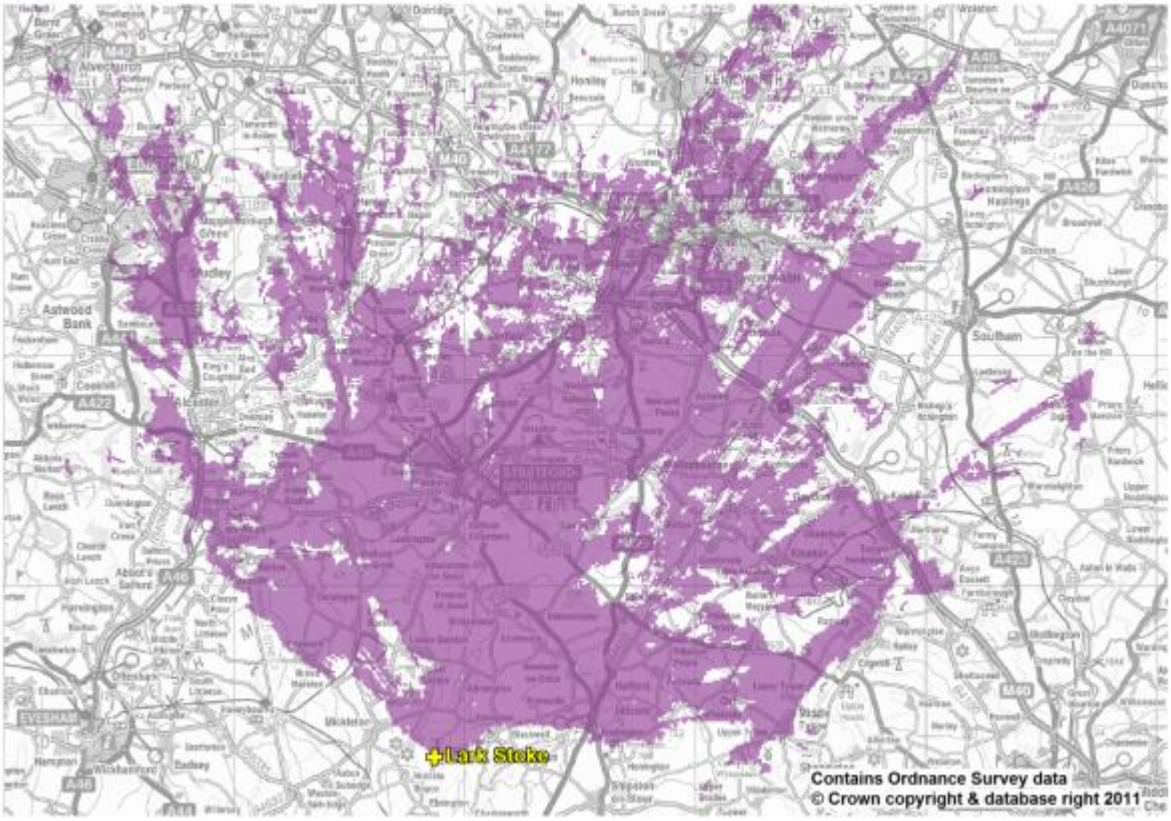
Location	Stoke On Trent
Station	Fenton
Channel	29
Effective Radiated Power	0.05 kW
Assumed Antenna Height	45m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

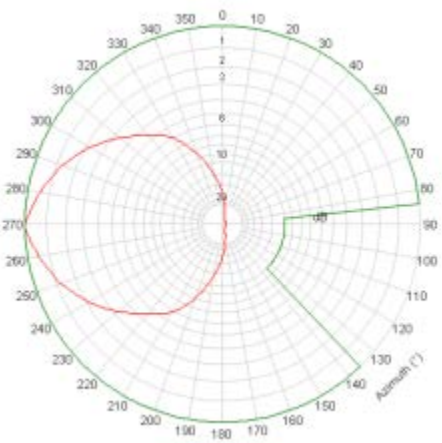
Stoke On Trent Indicative Coverage Map (assuming QPSK 2/3)



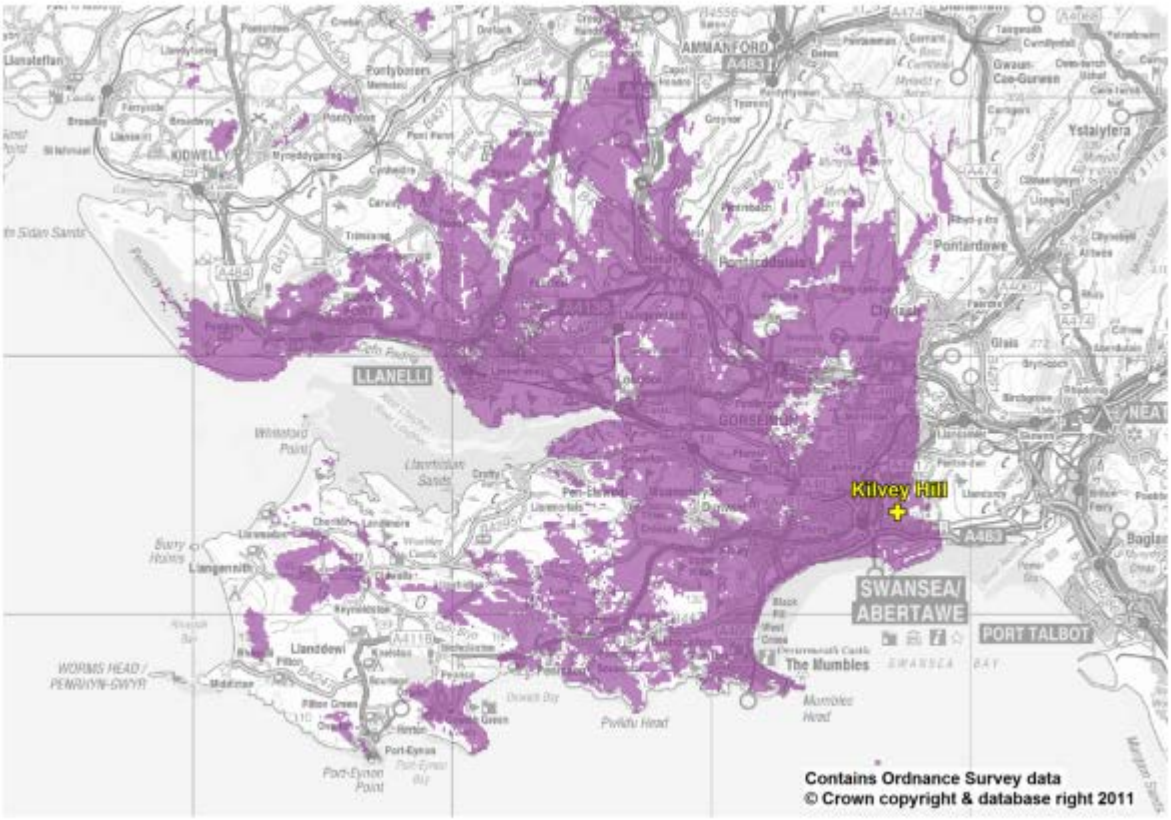
Location	Stratford Upon Avon
Station	Lark Stoke
Channel	48
Effective Radiated Power	0.1 kW
Assumed Antenna Height	10m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

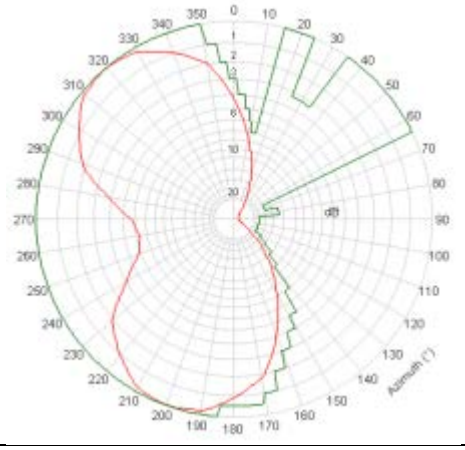
Stratford Upon Avon Indicative Coverage Map (assuming QPSK 2/3)



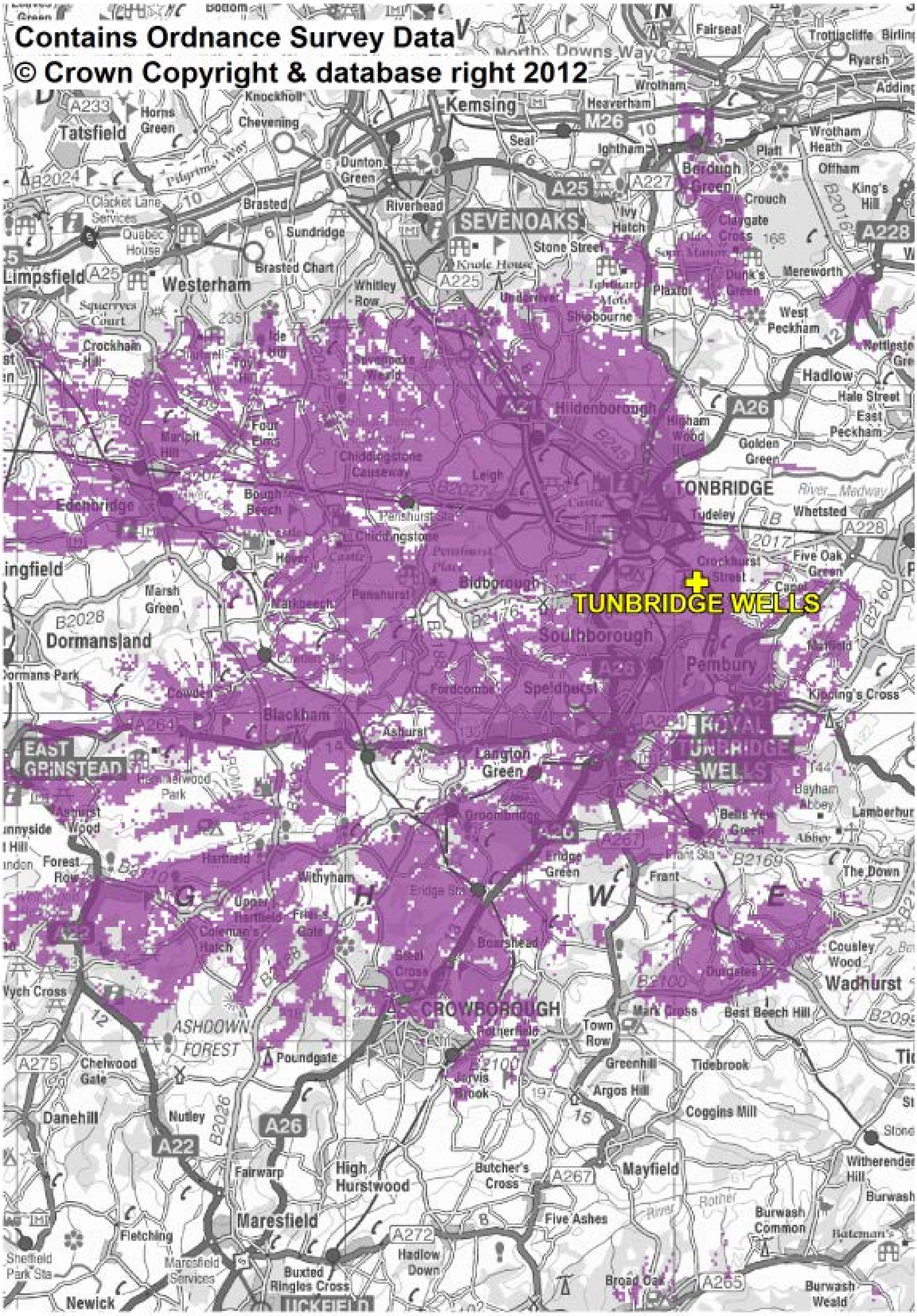
Location	Swansea
Station	Kilvey Hill
Channel	30
Effective Radiated Power	0.1 kW
Assumed Antenna Height	45m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

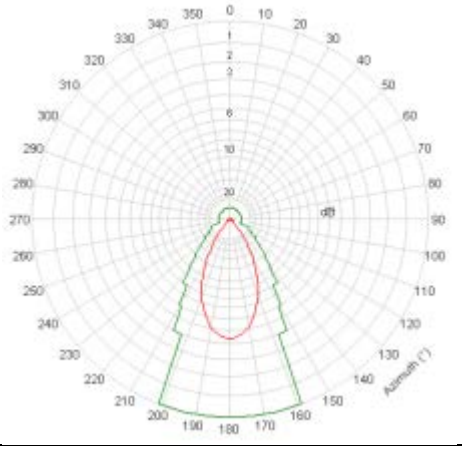
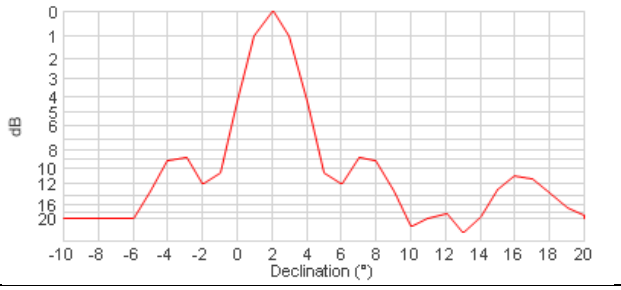
Swansea Indicative Coverage Map (assuming QPSK 2/3)



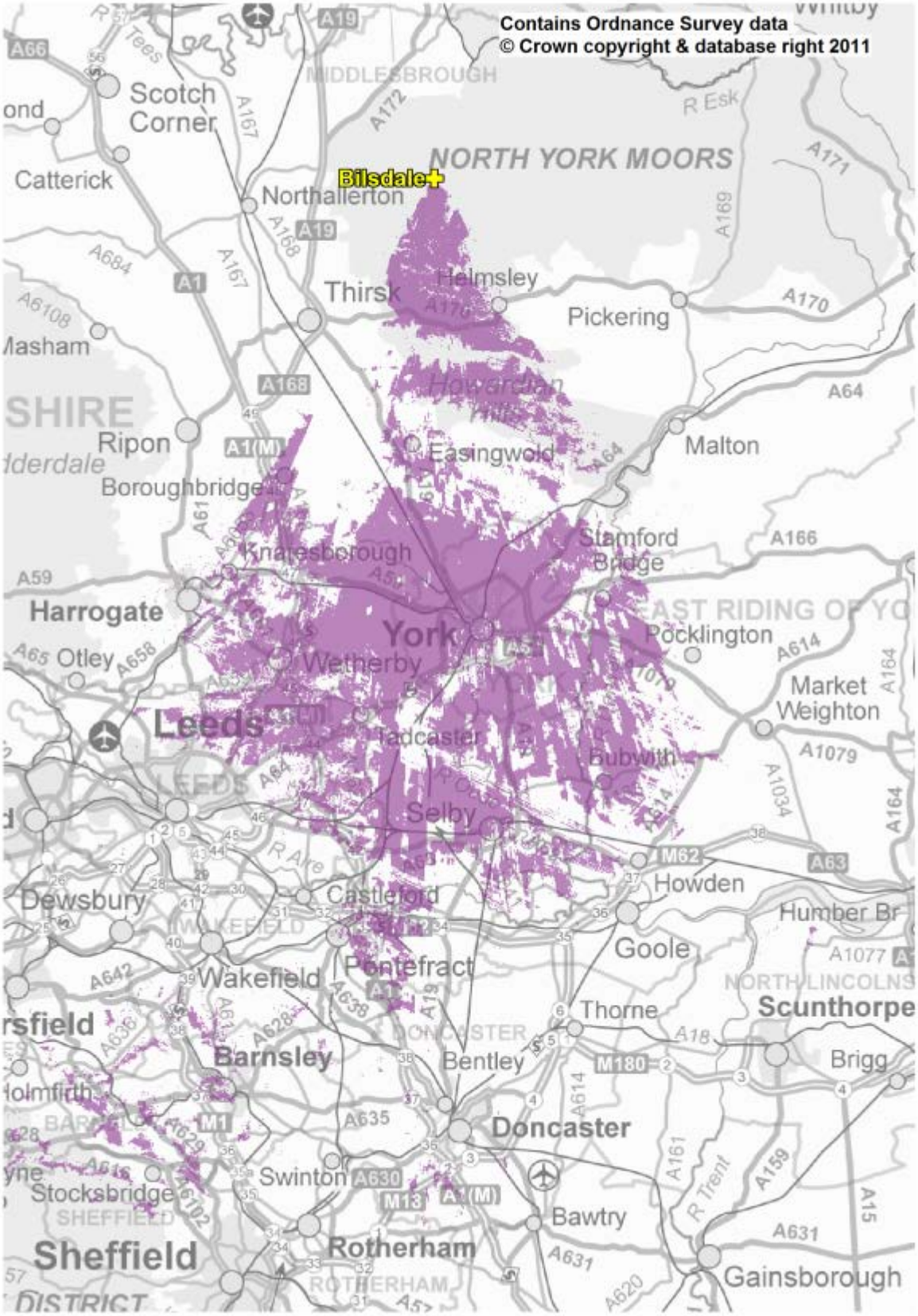
Location	Tonbridge
Station	Tunbridge Wells
Channel	51
Effective Radiated Power	0.4 kW
Assumed Antenna Height	45 m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	

Indicative Coverage Map (assuming QPSK 2/3)



Location	York
Station	Bilsdale
Channel	24
Effective Radiated Power	2 kW
Assumed Antenna Height	148m
Planning Status	Baseline
Indicative Antenna Template (Green) & Assumed Practical Antenna Pattern (Red)	
Suggested Vertical Radiation Pattern	

York Indicative Coverage Map (assuming QPSK 2/3)



Annex 2

Indicative Household Coverage Figures: Comparison of Transmission Modes

A2.1 Asterisked locations have provisional planning status and indicative QPSK rate 1/2 and rate 3/4 figures are not available. QPSK rate 2/3 has been assumed for these locations for the purpose of providing population totals for the possible Phase 2 sites.

Location	QPSK Rate 1/2		QPSK Rate 2/3		QPSK Rate 3/4	
	Gross	DPSA	Gross	DPSA	Gross	DPSA
Phase 1						
Belfast	210,000	200,000	200,000	200,000	190,000	190,000
Birmingham	1,100,000	1,100,000	1,000,000	1,000,000	1,000,000	1,000,000
Brighton & Hove	150,000	97,000	150,000	97,000	140,000	97,000
Bristol	410,000	340,000	380,000	330,000	370,000	320,000
Cardiff	540,000	360,000	500,000	350,000	480,000	340,000
Edinburgh	620,000	420,000	600,000	420,000	590,000	420,000
Glasgow	830,000	740,000	810,000	720,000	800,000	720,000
Grimsby	290,000	280,000	260,000	260,000	250,000	250,000
Leeds	1,100,000	930,000	1,000,000	880,000	980,000	840,000
Liverpool	960,000	930,000	920,000	900,000	900,000	890,000
London - Baseline	3,300,000	3,100,000	3,100,000	3,000,000	3,000,000	3,000,000
London - Enhanced	4,800,000	4,300,000	4,600,000	4,200,000	4,500,000	4,100,000
Manchester	1,100,000	1,000,000	1,100,000	1,000,000	1,100,000	1,000,000
Newcastle	1,000,000	570,000	1,000,000	570,000	980,000	570,000
Norwich	160,000	150,000	150,000	140,000	150,000	140,000
Nottingham	380,000	320,000	310,000	290,000	270,000	270,000
Oxford	110,000	110,000	100,000	100,000	100,000	100,000
Plymouth	110,000	110,000	100,000	110,000	100,000	100,000
Preston	390,000	380,000	380,000	370,000	370,000	370,000

Sheffield	210,000	120,000	190,000	120,000	180,000	110,000
Southampton	490,000	250,000	460,000	240,000	440,000	230,000
Swansea	120,000	72,000	110,000	72,000	110,000	72,000
Total Phase 1		**12,700,000**		**12,300,000**		**12,100,000**
Phase 2						
Aberdeen	130,000	120,000	130,000	120,000	120,000	120,000
Ayr	130,000	110,000	120,000	110,000	120,000	110,000
Bangor*			21,000	16,000		
Barnstaple*			34,000	32,000		
Basingstoke*			88,000	63,000		
Bedford	67,000	67,000	64,000	64,000	62,000	62,000
Bromsgrove	86,000	28,000	73,000	27,000	67,000	27,000
Cambridge*			83,000	83,000		
Carlisle*			110,000	90,000		
Derry/Londonderry*			40,000	36,000		
Dundee	420,000	140,000	390,000	140,000	370,000	140,000
Guildford	240,000	56,000	180,000	55,000	150,000	54,000
Hereford*			44,000	43,000		
Inverness	74,000	50,000	71,000	49,000	69,000	49,000
Kidderminster	39,000	22,000	36,000	21,000	34,000	21,000
Limavady*			54,000	35,000		
Luton	84,000	22,000	80,000	22,000	78,000	22,000
Maidstone	240,000	150,000	210,000	140,000	190,000	130,000
Malvern	140,000	55,000	130,000	54,000	120,000	53,000
Middlesbrough	300,000	210,000	290,000	210,000	280,000	210,000
Mold*			88,000	25,000		

Reading	500,000	190,000	410,000	180,000	370,000	170,000
Salisbury*			41,000	30,000		
Scarborough	45,000	31,000	44,000	31,000	43,000	31,000
Stoke on Trent	150,000	120,000	150,000	120,000	140,000	120,000
Stratford upon Avon	78,000	29,000	68,000	28,000	62,000	28,000
Tonbridge	70,000	47,000	65,000	46,000	62,000	45,000
York	320,000	100,000	270,000	100,000	240,000	100,000
Total Phases 1 and 2[22]		**14,700,000**		**14,300,000**		**14,000,000**

[22] Assuming QPSK Rate 2/3 Modulation at asterisked locations.