

# **nationalgrid**

Wireless

## **ENGINEERING REPORT**

### **The Potential Effects of the Reaps Moss Wind Farm on Domestic Television Reception and Broadcast Infrastructure in the Todmorden area**

#### **CHANGE CONTROL**

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<b>Author: K Gurr</b>		<b>Reviewer: A Briggs, P Williams</b>

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## **1. INTRODUCTION**

This study assesses the potential effects of the proposed wind farm at Reaps Moss on the re-broadcast link from the Winter Hill main transmitter (NGR SD 660 144) to the Todmorden relay (NGR SD 958 241).

The proposed wind farm will be located on Reaps Moss, an area 2 km east of Bacup on the Lancashire side of the West Yorkshire / Lancashire border. It will consist of 4 wind turbines at the following locations:

SD 89301 23159

SD 89317 22872

SD 89300 22486

SD 89026 22516

From earlier studies it has been found that the site of the proposed wind farm lies along the path of the UHF programme feed of BBC1 and BBC2 to the Todmorden relay (NGR SD 958 241) from Winter Hill (NGR SD 660 144). Consequently, it has the potential to have an adverse effect on the distribution of BBC programming to local transmitter sites. ITV and Channel 4 programme feeds into the Todmorden relay are from the Cornholme relay (NGR SD 918 264) which obtains its feeds from Emley Moor (NGR SE 222 128). The proposed wind farm does not lie on this transmit path and will therefore will pose no risk to ITV and C4 programme feeds.

The different feed sources at Todmorden reflect different editorial regions between the BBC and ITV. BBC programming is for BBC North West originating from Manchester whilst ITV programming is Yorkshire based originating from Leeds. As part of the Digital Switchover programme the BBC services are reported to be re-assigned to BBC North, originating from Leeds.

## 2. The Mechanism of Interference to Terrestrial Television Reception

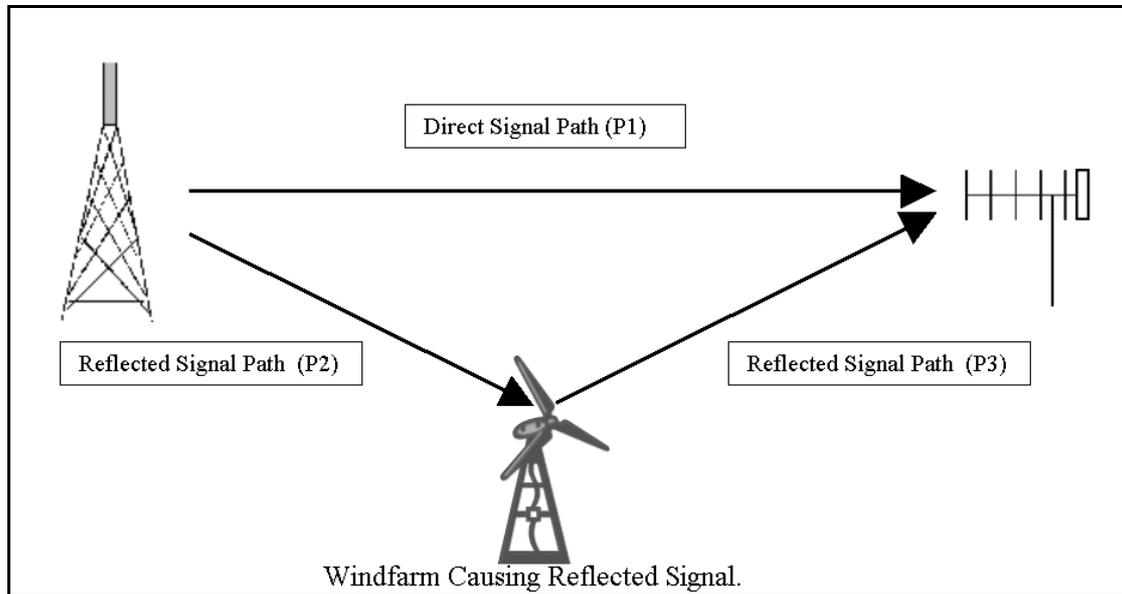


Figure 1. Illustration of signal reflections from a structure.

Figure 1 illustrates the basic mechanism by which structures can cause interference to television signals.

There is a direct signal path from the transmitter to the receiver, P1. There is also a secondary path via the reflecting surface (rotating blades) of the wind farm, P2+P3. As the signal takes a longer time to travel the distance P2+P3 than the distance P1, there are now two signals, one of which is delayed (P2+P3). The effect of more than one signal path is described as 'multi-path', and it causes 'ghosting' on received analogue television transmissions. The relative level of the reflected component is dependent upon the composition of the reflecting surface, the orientation of the reflecting surface, the frequency of the transmission and the directional properties of the receive antenna system.

As the wind turbine blades are moving the composition of the multiple reflected signals is constantly changing. It is this constant change in signals that can cause interference from wind turbines to be particularly annoying to television viewers. A guide to picture quality assessment is described in Appendix 1.

To avoid interference, it is necessary to ensure that the ratio of wanted signal level along the direct path (P1) to the unwanted signal level along indirect paths (P2+P3) is sufficiently high

Receiving antennas generally have a directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver. This is shown in Figure 2.

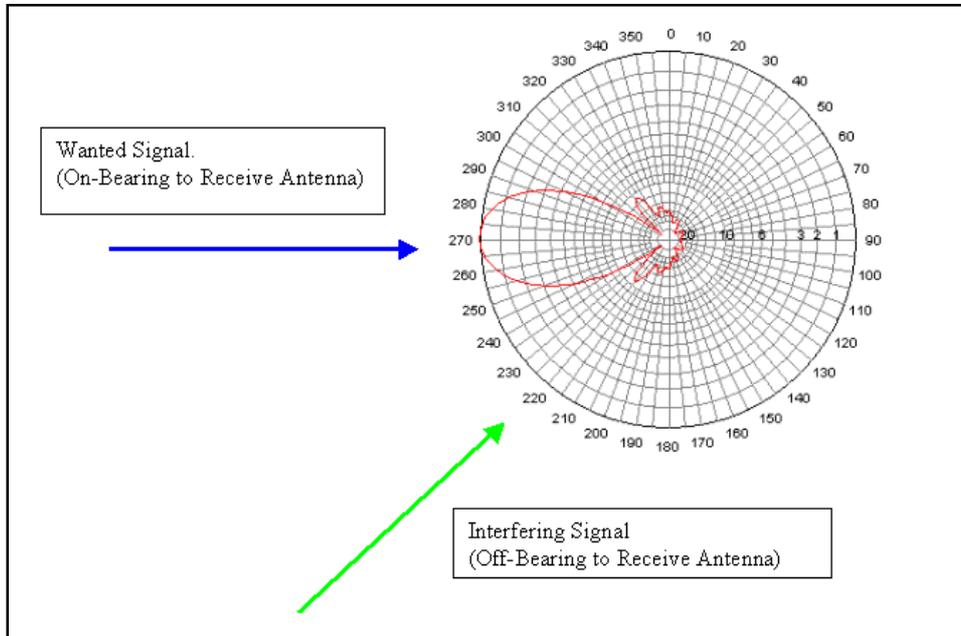


Figure 2. Receive Antenna Response

If there is a significant obstruction in the signal path, the level of the received signal is reduced. Often television signal levels will be reduced due to effects of hills, however wind farms tend to be sited on the top of hills, where signals are clear of obstructions. In some cases, the situation highlighted in Figure 3 can arise. The direct path is obstructed, whereas the indirect path via the wind farm is un-obstructed. This reduces the ratio of the wanted to interfering signal.

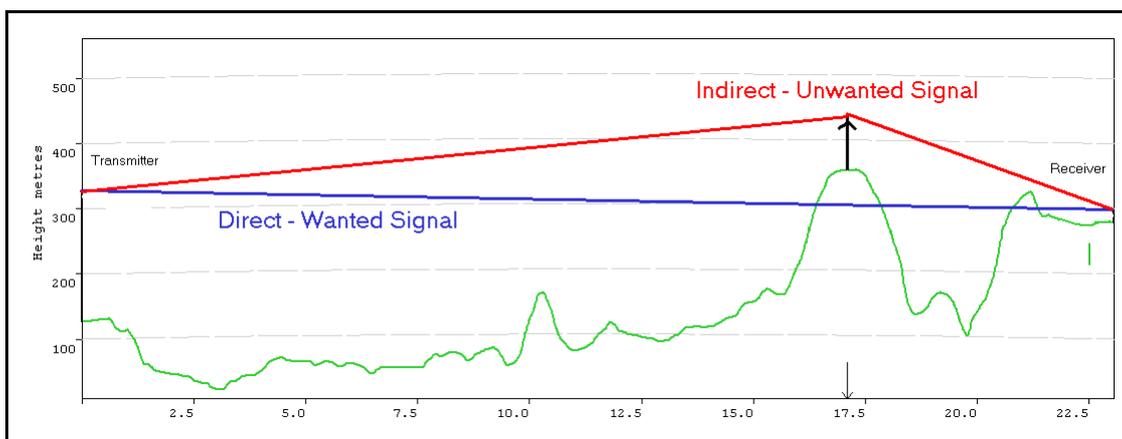


Figure 3. Direct and Indirect Signal Paths

### 3. The Proposed Wind Farm at Reaps Moss

Figure 4 shows the general arrangement of the proposed development of wind farm in relation to the surrounding transmitter sites and relays. The main transmit path from Winter Hill to Todmorden is included and the subsequent BBC feeds to other TV relays.

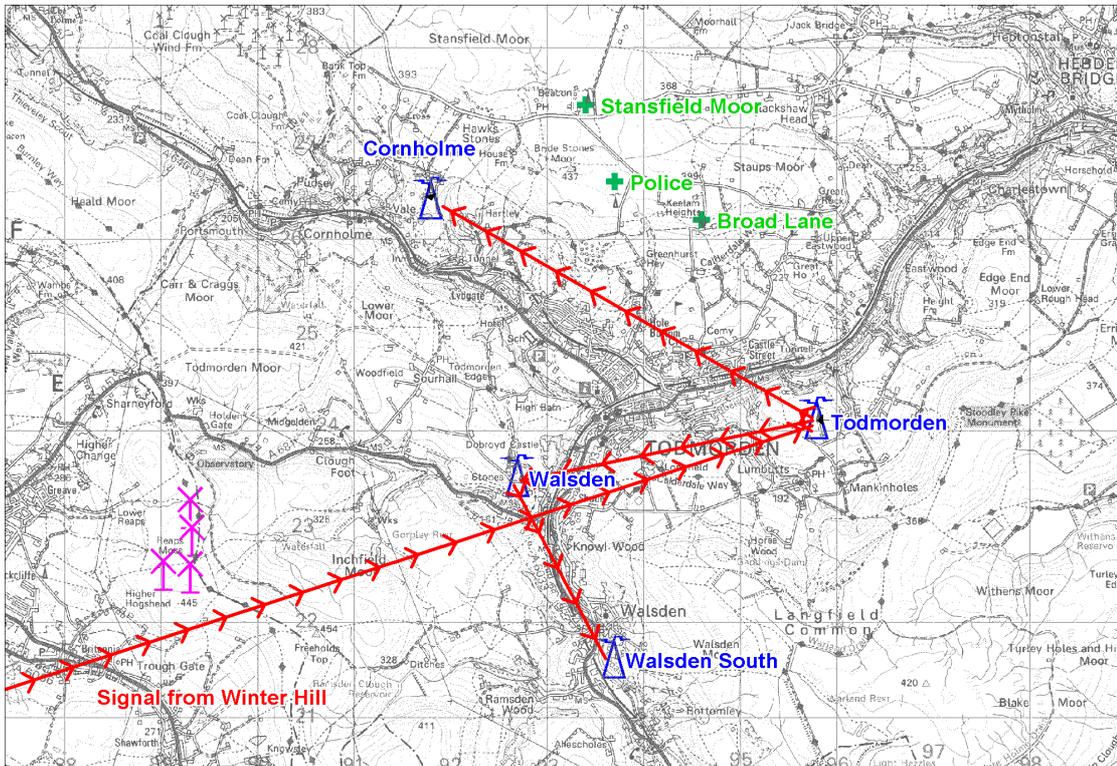


Figure 4: Relative locations of the Reaps Moss wind farm, current TV transmitter sites and potential mid-point sites.

Given the relative position of the wind farm to the transmit path from Winter Hill, it is highly likely that the re-broadcast link from Winter Hill to Todmorden will suffer from interference caused by the mechanism previously described. In the event of interference, an alternative feed will be required.

One solution would be to provide an alternative feed from Winter Hill via an intermediate site, that receives signals and re-transmits them towards Todmorden via a diversionary route around the site of the wind farm.

There are many hills and valleys within the area surrounding Reaps Moss. The Todmorden transmitter site is in an unusually low position in relation to the surrounding terrain for a television relay station. This places additional constraints on the ability of this site to pick up feeds from alternative sources.

#### **4. Field Survey**

A field survey was carried out on the 14<sup>th</sup> and 15<sup>th</sup> September 2006 with two primary objectives. The first objective was to confirm the location of the wind farm in relation to the path between Winter Hill and Todmorden relay. The second objective was to identify potential mid-points to facilitate alternative feeds into the Todmorden relay.

The transmitter site at Todmorden was visited to determine the scale of any potential disruption. The site is surrounded by higher land in most directions. The transmit antenna height is 273m aod, the receive antenna is a few metres below that height. Much of the surrounding land exceeds 300m aod. This immediately restricts the possibility of obtaining an alternative programme source from another established broadcast site. Todmorden has dependent relays at Cornholme, Lydgate and Walsden. Walsden has a further dependent relay at Walsden South. By definition none of these sites has a direct signal path from Winter Hill. The only site within this group with a useful alternative feed source is Cornholme where Arqiva use Emley Moor as a source for ITV and Channel 4.

As illustrated in figure 4, the proposed wind farm has the potential to disrupt the domestic reception of television signals from the Todmorden transmitter and its relays at Cornholme, Walsden, Walsden South and Lydgate. From maps and a visual inspection of the terrain, it is not possible to find an alternative feed into Todmorden via a mid-point to the south of the site. Therefore alternative sites were investigated to the north.

Prior to the field survey, three sites were identified for further investigation. These alternative sites are also shown in figure 4 and have the following locations:

- Tower on Stansfield Moor (NGR SD 934 274)
- Todmorden Broad Lane (Keelam Heights) (NGR SD 946 262)
- Police site (NGR SD 937 266)

For each location, the following observations were made.

##### **Stansfield Moor**

The tower on Stansfield Moor was eliminated on visual inspection because the Todmorden site was not visible by line of sight from this location.

##### **Todmorden Broad Lane**

The Todmorden Broad Lane (Keelam Heights) site is useable and the TV relay at Todmorden is directly visible. Therefore measurements were taken using National Grid Wireless's survey vehicle with a nominal receive antenna height of 10m. The measurements (shown in table 1) showed a satisfactory receive signal level from both Winter Hill and Emley Moor. Consequently, it is feasible that this site could be used as a mid-point for either a UHF in-band link or a UHF receive point for onward transmission by SHF link to the Todmorden site.

The site is owned by National Grid Wireless (NGW). However, as the tower is well used, there are known capacity limitations for mounting additional equipment on the

tower. It is likely that the tower would need to be replaced and planning permission would have to be obtained for an upgraded structure.

**Police site**

It is believed that this site is managed by the local Police force. It has a substantial stone building for equipment accommodation and a substantial tower that is lightly loaded. The infrastructure of the site is up to broadcast standard.

The site has unobstructed line of sight to the Todmorden site. Receive signal level measurements from both Winter Hill and Emley Moor taken at the site are similar to those taken at Todmorden Broad Lane and were satisfactory as shown in table 1. These results show that this site could be used as a mid-point for either a UHF in-band link or a UHF receive point for onward transmission by SHF link to the Todmorden site.

Finally, measurements were taken at the Todmorden relay site of receive levels from Winter Hill and Cornholme. Measurements were also taken from the two viable midpoint sites.

All measurements from the field survey are shown below

Measurement point	NGR	Winter Hill (dBuV)				Emley Moor (dBuV)				Cornholme (dBuV)			
		Ch 55	Ch 62	Ch 59	Ch 65	Ch 44	Ch 51	Ch 47	Ch 41	Ch 58	Ch 64	Ch 61	Ch 54
		BBC1	BBC2	ITV	Ch 4	BBC1	BBC2	ITV	Ch 4	BBC1	BBC2	ITV	Ch 4
<b>Todmorden transmitter</b>	SD958241	68.5	69.5	68.3	67.8	*****not receiveable*****				79.4	76.2	79.7	78.5
<b>Cornholme transmitter</b>	SD918264	60	60	63.2	62.7	83.9	82.4	78.1	79.8	N/A			
<b>Police site</b>	SD937263	100.4	97.7	102.1	100.9	100.1	100	95.8	96.4	*****			
<b>Keelam Heights</b>	SD946262	98.1	94.5	96.1	100.1	101.1	98.8	95.4	98.3	*****			

Table1 : Received Signal Level Measurements

## **5. Options for Mitigating the Effects of Interference**

Wind farms in the path of RBL feeds to UHF transmitter sites have been shown to degrade the signals passing through. There is a high probability that the proposed development at Reaps Moss will degrade television in the area which will be unacceptable to the broadcasters and their customers. In the event of interference, action will need to be taken to restore the service. This section proposes possible outline solutions and estimated costs in each case.

### **▪ In-Band UHF Feed via an Intermediate Site.**

The solution is to build a 2 channel relay site at an intermediate site located where the programme feed from Winter Hill is received without degradation by the wind farm and such that the transmission from this site can be received by an antenna located at Todmorden. Measurements taken at Todmorden Broad Lane (Keelam Heights) and the Police site show that these two sites are appropriate. Both sites would require significant infrastructure upgrades. A new tower, cabin, transmitter equipment, antennas and associated feeders would be required in addition to a new receive antenna and feeders at Todmorden. There would also be additional site share costs incurred. The new intermediate site would need OFCOM agreement which is by no means guaranteed.

A budgetary estimate for such a solution is £93,000.

### **▪ Provide an SHF link via an Intermediate Site**

This option also requires the use of an intermediate site. However the final link to the Todmorden site would be via an SHF microwave point to point system. Again, infrastructure upgrades would be required at the intermediate site, along with additional microwave link equipment. OFCOM licensing would be required for the microwave link.

A budgetary estimate for such a solution is £195,000.

### **▪ Re-Parent Cornholme and Todmorden**

There is a proven broadcast quality UHF feed from Cornholme to Todmorden as utilised by ITV and CH4. Measurements at Todmorden of signals from Cornholme have been confirmed and measurements at Cornholme of BBC1 and BBC2 signals from Emley Moor are also satisfactory.

BBC2 transmissions from Cornholme suffer from co-channel interference due to its parent feed from Todmorden being interfered with by BBC2 transmissions from Saddleworth transmitter. Re-parenting Cornholme to Emley Moor will also eliminate this problem.

To implement this option, a new splitter would be required at Cornholme and additional site share costs would be incurred for the site. Initial investigations by NGW Spectrum Planning Engineers indicate that this solution has sufficient protection to provide the required level of availability and service in the event of interference.

A budgetary estimate for such a solution is £12,500.

## 6. RISKS

The following table contains a description of potential risks with the possible options described in section 5.

Risk Description	Probability	Mitigation
Future wind farm development may further degrade television reception in the area, e.g. Coronation Power wind farm development on Todmorden Moor.	Medium	Progress option 4
Difficulty acquiring intermediate site	Medium	Use NGW owned Todmorden Broad Lane site
Unable to gain planning permission for intermediate site	High	Progress option 4
High cost of infrastructure upgrades at intermediate site	High	Progress option 4
OFCOM reject proposal for UHF in band link	High	Progress options 3 and 4
OFCOM reject SHF link proposal	Low	Many microwave frequencies exist for SHF link.
BBC reject re-parenting proposal	Low	BBC have already agreed to this in principle. Re-parenting due to happen during digital switchover

## **7. CONCLUSIONS**

From the field survey, it is the opinion of National Grid Wireless that the wind farm at Reaps Moss is likely to cause disruption to the re-broadcast link feeding the Todmorden relay from the main station at Winter Hill.

The options that involve mid-points will incur extra infrastructure and equipment costs. Access to the intermediate sites is not guaranteed and gaining planning permission may be problematic. The Coronation Power proposal to develop a wind farm on Todmorden Moor has the potential to further compromise the effectiveness of any such option which re-routes the main programme feed.

The option of re-parenting Cornholme and Todmorden sites to Emley Moor transmitter would be the most cost effective solution of solving potential interference caused by the proposed Reaps Moss Wind Farm Development. Following this option would be subject to the agreement of the BBC.

Budgetary estimates for each option have been provided.

**APPENDIX I : PICTURE QUALITY ASSESSMENT**

The perception of picture quality is subjective and will vary from person to person. Although a number of ways exist for assessing picture degradation there is agreement on the methods adopted and defined by the ITU\*. For a definitive study, picture degradation is assessed statistically because impressions are subjective and assessments are based on either the impairment or quality scales given below. For the purpose of this report picture assessment is based upon the ITU scale but, because of the number of measurements undertaken, a statistical analysis would not be valid.

Grade	Impairment Scale	Quality Scale
5	Imperceptible	Excellent
4	Perceptible but not annoying	Good
3	Slightly annoying	Fair
2	Annoying	Poor
1	Very annoying	Bad

**Interference Impairments**

In a correctly installed domestic analogue television receive system, picture quality degradation may be as a result of any, or a combination of, the following more common causes: -

**Poor signal to noise ratio.**

This is when the level of the received signal relative to sources of unwanted noise (e.g. noise generated within the receive system or sources of local interference) becomes unacceptable. Ultimately a signal may become too weak to overcome sources of noise.

**Co-channel Interference. (CCI)**

Perceptible interference patterning caused by another transmission source on the same channel.

**Adjacent Channel Interference. (ACI)**

Perceptible interference patterning caused by a transmission source on an adjacent channel.

**Multi-Path Interference. (MPI)**

The observation of a delayed image or 'ghost'. This is caused either by obstruction to the line of sight path from the transmitter or reflection of the wanted signal by objects or terrain. In either case unwanted delayed signals are received in addition to a wanted signal.

\*ITU – International Telecommunications Union