# HOW DO WIND TURBINES IMPACT UPON AVIATION?

Wind turbines have a substantial impact on aviation and airspace. Turbines are significant physical structures that can penetrate volumes of airspace designed to be clear of obstacles 'Obstacle Limitation Surfaces'.

Aircraft departure and arrival routes 'Instrument Flight Procedures' also have protected zones around them that may be compromised.

Rotating turbine blades interfere with radar causing loss of target detection and may even result in incorrect target positions.

Away from aerodromes, low-flying General Aviation and Military aircraft need to avoid wind turbines, resulting in the channelling and concentration of traffic into narrow corridors. If inappropriately lit or marked, wind turbines can pose a hazard to low-level aircraft, particularly at night.

## HOW CAN CYRRUS HELP?

Cyrrus has over15 years' experience of working with the wind energy and aviation industry.

Working with developers, we identify aviation and airspace issues and offer cost effective and innovative solutions.

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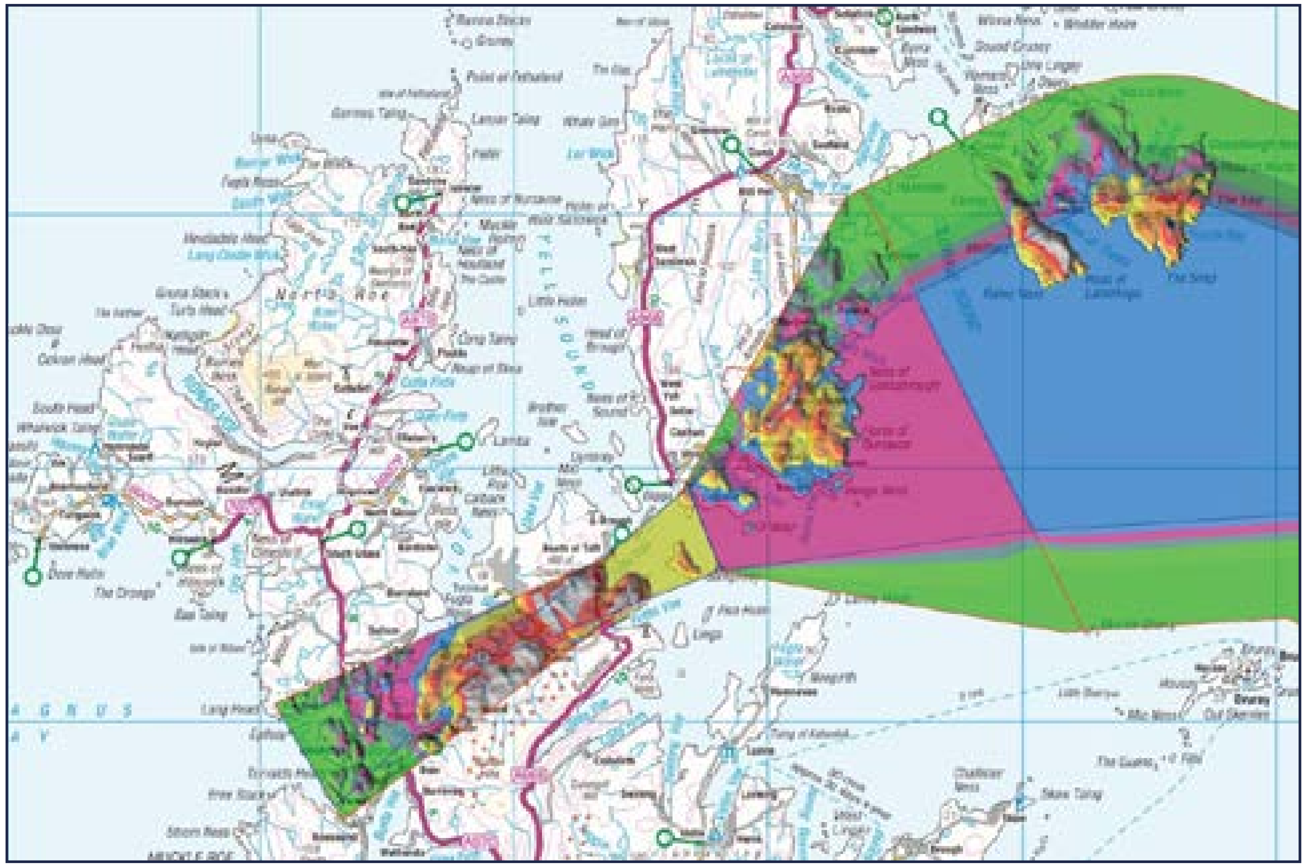
# ENVIRONMENTAL IMPACT ASSESSMENTS

The planning process for wind farms typically starts with ‘Scoping’ or ‘Screening’ studies, followed by an initial engagement or consultation exercise with key stakeholders.

The next stage is the development of the Environmental Impact Assessment (EIA) as mandated by planning authorities.

An EIA Report has an Aviation Chapter focusing on the impact on Aviation, Airspace and Military operations. *These topics are then addressed in more detail in an accompanying Technical Appendix.*

Collectively Cyrrus has the expertise and knowledge to conduct assessments required to populate the EIA chapter and technical appendix including identifying mitigation solutions. Our team comprises of Air Traffic Controllers from Military and Civilian backgrounds, Safeguarding Specialists, Radar Specialist Engineers and Instrument Flight Procedure Designers.





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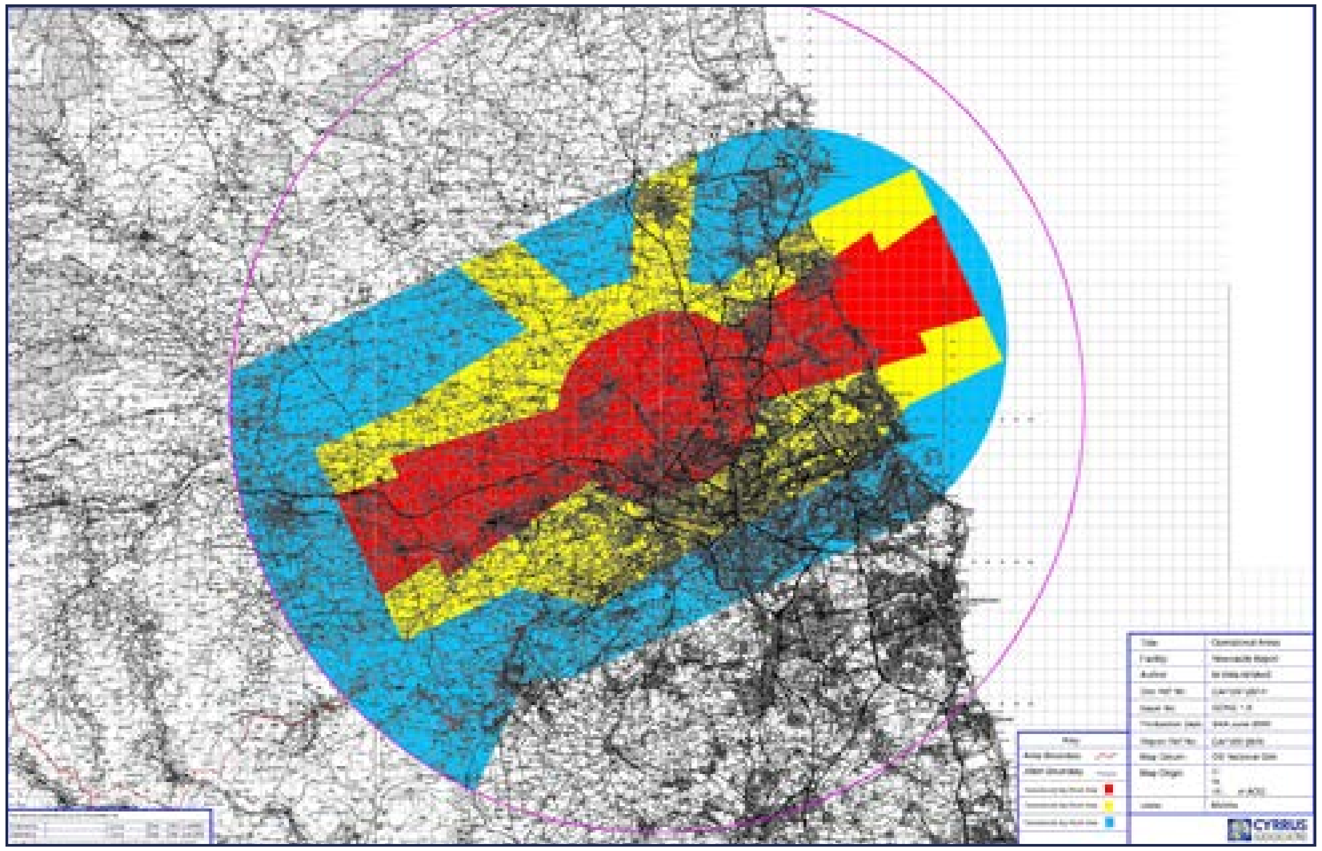
# ENVIRONMENTAL IMPACT ASSESSMENTS

Pioneering the use of colour coded maps showing the constraints near airports, Cyrrus has enabled airports and developers to understand the severity of the safeguarding restrictions near airports.



During the initial development stages, our radar line-of-sight maps assist designers with determining the location and acceptable heights of turbines.

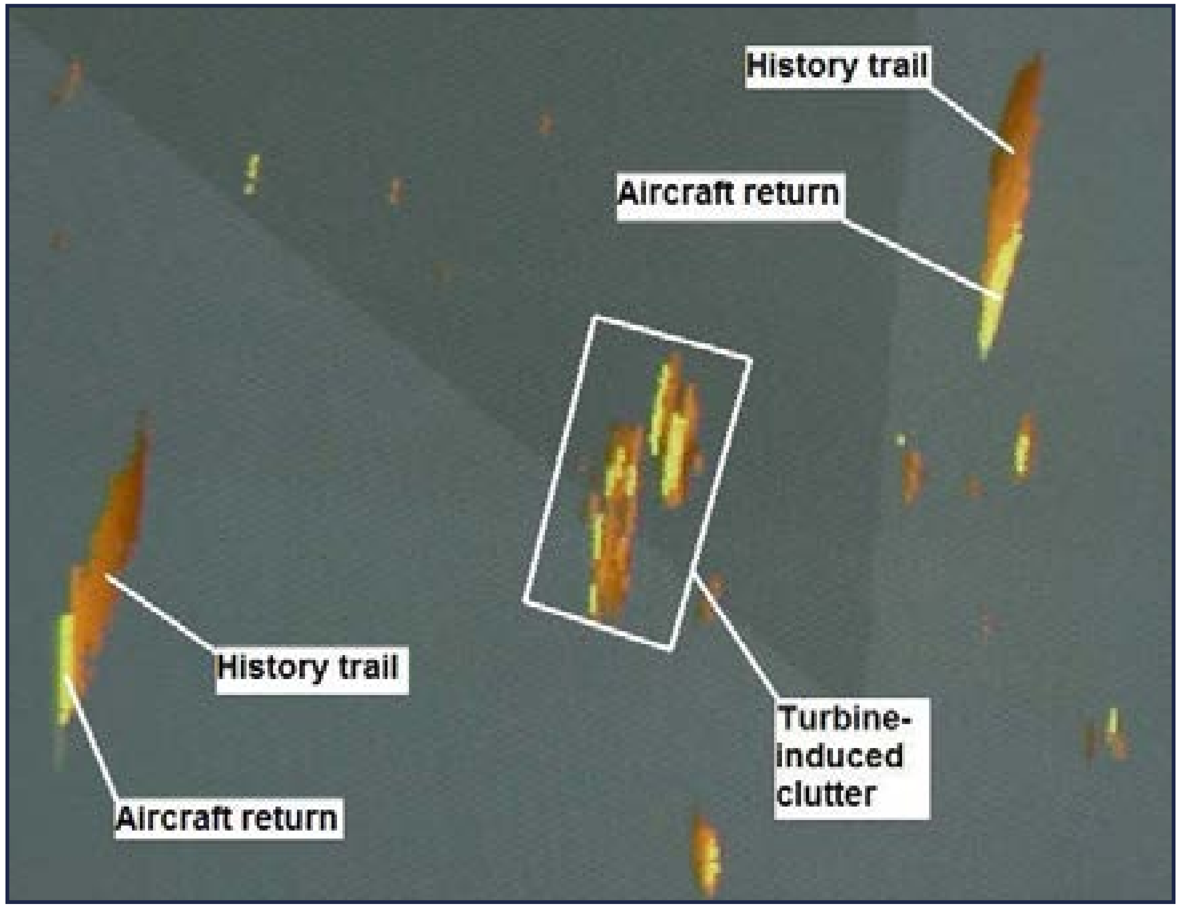
Several iterations of wind farm layouts are often required to accommodate all the constraints on wind turbine locations.

Our specialists work with the development team to ensure optimised locations.

# HOW ARE RADARS AFFECTED BY WIND TURBINES?

The characteristics of a radar return from an aircraft and wind turbine are very similar. Radars are unable to differentiate between them, resulting in loss or incorrect position of aircraft on radar displays. The impact on Air Traffic Services varies depending on the airspace and traffic in the vicinity of the wind farm.  In most cases, there is a requirement to offer a technical solution that mitigates the effect on the radar to enable Air Traffic Services to safely continue.

Cyrrus has extensive expertise in defining the impact on radars and specifying technical mitigation solutions. Our airspace design team can assess the operational impact of compromised radar coverage and the potential for non-technical mitigations.



# RADAR COVERAGE - MODELLING

Digital Terrain Modelling 'DTM' is used to assess the radar line-of-sight coverage. This doesn't include shielding already present from buildings or trees. Therefore, the assessment is worst case.

Where more detailed analysis is required a Surface Terrain Model 'SRM' is used. This provides a more definitive radar line-of-sight coverage assessment.

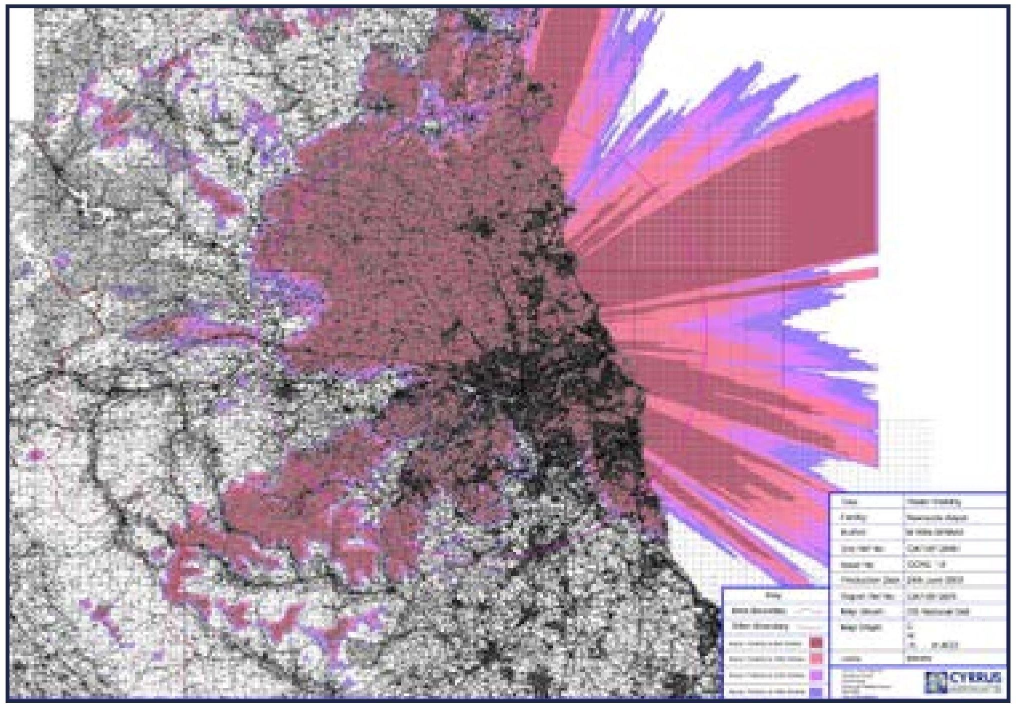
For our most complex assessments, the radar target detection capability is included. The assessment considers several radar performance parameters including transmitter power and receiver sensitivity.

Our radar and mapping specialists provide advice and guidance on the most appropriate assessment method.

# RADAR COVERAGE - TECHNICAL MITIGATION

For over 15 years, Cyrrus has actively worked with radar mitigation solution providers and wind farm developers. We are founding members for Project Green Blade with the aim of enabling major off-shore wind farm developments by using a range of mitigation technologies https://projectgreenblade.co.uk/ .

Industry offers several technical mitigation solutions, but the cost, performance and applications vary. It is vital that developers use the most appropriate solution for their wind farm. Using up to date industry knowledge, Cyrrus assessments consider the range of industry mitigation solutions and their suitability for proposed wind farm developments.



Cyrrus identified a more cost-effective system-level solution, suitable for mitigating some wind farms. The solution is also capable of bridging the gap between new radar mitigation technologies and Airport systems. Customers can extend the use of existing airport radar display systems, while taking advantage of new radar sensor technologies.

The AERIUM™ product range provides flexible and future proof solutions for surveillance data integration. It supports multiple surveillance formats and sources (RDIF, ASTERIX, PSR, SSR,3D PSR, Mode S, MLAT, ADS-B etc).

# RADAR COVERAGE - TECHNICAL MITIGATION

## AERIUM™

AERIUM™

Operating on the high reliability Cyrrus Universal Surveillance Platform (CUSP) hardware, AERIUM™ has several product variants, including:

**Aerium i1** – Surveillance Data Converter;

**Aerium i2** – Plot Assignor Combiner;

**Aerium i3** – Integrated Seamless Infill;

**Aerium i3+** - Integrated Intelligent Infill (incorporates SMARTENER™ technology).

Maintaining true aircraft target positions, the patented SMARTENER™ algorithm removes radar clutter caused by wind turbines.

## SMARTENER™

SMARTENER™ is an innovative technology without the disadvantages associated with many infill solutions. With the AERIUM™ and SMARTENER™ algorithm, seamless tracking of aircraft across boundaries is a reality; no reduction in surveillance radar coverage, no boundary issues, no track discontinuities and radar performance is maintained. In addition, SMARTENER™ meets all the safety assurance requirements of the European and US aviation industry.

AERIUM™ products enable wind farm developers to avoid costly mitigation projects and lifetime maintenance costs, while providing safety assured surveillance for airports.



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# INSTRUMENT FLIGHT PROCEDURE SAFEGUARDING

Instrument Flight Procedures comprise a series of predetermined tracks to or from a runway, using flight instruments. These procedures have protection areas to ensure safety from obstacles.

The controlling obstacle is a DVOF obstacle 'UK0105A504F'. This is a Tower, Metal and lighting undetermined.

Controlling obstacle in the Final phase of the Missed approach

It is commonly believed that the Obstacle Limitation Surfaces (OLS) protect the IFPs, however this is not the case and developments that are below the OLS can still adversely affect IFPs, resulting in increased sector altitudes, increased approach minima or changes to IFP profiles.

Should an assessment be necessary, Cyrrus' extensive expertise can evaluate the potential effects, identify mitigations and provide robust advice to airports and developers.

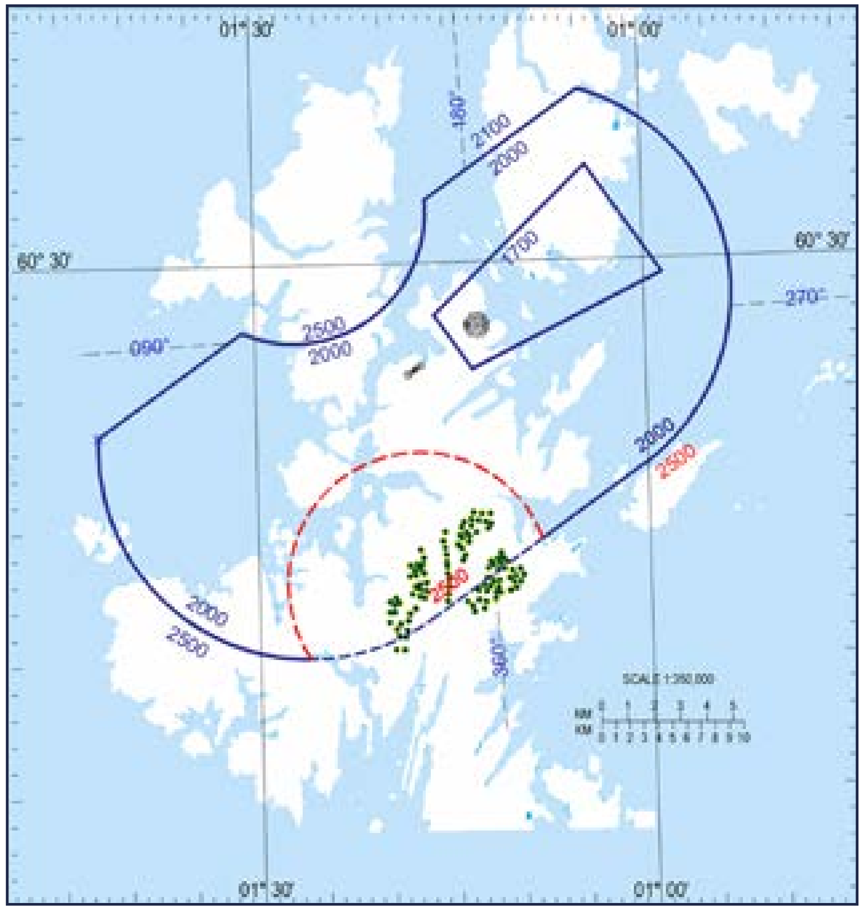
As an accredited IFP Design organisation, Cyrrus produces bespoke IFP Safeguarding maps (including maintenance thereof), based on on 3D obstacle protection surfaces. Not only do we provide a printable, safeguarding map with an embedded large scale 1:50 000 OS Map, we also provide an interactive safeguarding map to better understand the surrounding environment, IFP limitations and improved position accuracy when assessing a request for obstacle placement.

# IFP MITIGATIONS AND AIRSPACE CHANGE

Where a wind farm design is found to have impacts on IFPs one solution can be to amend the impacted IFP design.  Any amendment to IFPs usually requires and Airspace Change that will involving following the relevant Aviation Regulators processes.

Cyrrus delivers both the IFP design and consultancy services required to progress such changes through the Regulatory process including engagement with all affected stakeholders.

We can work with both the developer and affected airport to ensure the interests of each party are looked after.



# TRANSPONDER MANDATORY ZONES AND AIRSPACE CHANGE

One possible mitigation that can be deployed is 'radar blanking' deployed over the area of a wind farm to prevent primary radar detecting the turbines.

Whilst this can be very effective, it will also remove primary radar returns of aircraft within the blanked area. To combat this, another form of radar (less susceptible to the impacts of wind turbines) can be deployed to enable ATC to see the aircraft. Secondary Surveillance Radar (SSR) relies upon aircraft having a serviceable transponder (a tracking device that relays information to the SSR).

A Transponder Mandatory Zone (TMZ) can be established in the same area requiring aircraft to employ a serviceable transponder so that aircraft will be visible to ATC using SSR. The establishment of any new airspace structure will usually trigger an airspace change process. Cyrrus has an enviable track record in the successful delivery of ACPs and we can meet the requirements that will satisfy the process.

# WHY CHOOSE CYRRUS

**Cyrrus – Your Safeguarding Specialist**

- Extensive experience in all aspects of aviation safeguarding.
- Cyrrus recognises that safeguarding is not about preventing development. Safeguarding is about facilitating development whilst maintaining aviation safety.
- Cyrrus works with airports and developers to identify optimal solutions to meet conflicting objectives.
- Cyrrus provides consultancy and advice on safeguarding processes in addition to specific assessment commissions.
- Cyrrus provides training courses in all aspects of aviation safeguarding.

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