NORTH WEST BIRD CONTROL

BIRD HAZARD RISK ASSESSMENT
Produced for Cuadrilla Resources Limited
In respect of safeguarding for Blackpool Airport

January 2013

Certificate Number 8401

ISO 9001

CONTENTS

INTRODUCTION

This Bird Hazard Risk Assessment has been produced on behalf of Cuadrilla Resources Limited (CRL), in order to address a number of potential issues associated with proposed management practices at a site at Anna's Road, Westby, Lancashire.

The site

Lytham Moss. Land under and adjacent to Approach to Runway 28 Blackpool Airport

Personnel

Ian Whittaker is the director of North West Bird Control Ltd.

Ian has been working as a Bird, Wildlife and Habitat Advisor for over 15 years. His current role is Bird, Wildlife and Habitat Manager at Blackpool Airport.

Ian has extensive experience of the bird life and behaviour on and around Blackpool Airport including Lytham Moss

1.0. BACKGROUND

1.1. This document is designed to highlight the potential risks to aircraft which may be created by CRL's mitigation plan (Ecology Services UK Ltd (2012) *Impact Assessment and Method Statement – Anna's Road, Westby*. CRL). To summarise, it is proposed to provide supplementary feeding in the form of Potatoes, Carrots, and Grain in fields under and immediately adjacent to the aircraft approach for Runway 28 and the departure for runway 10 (fields 29 and 30).

This additional feeding will introduce a change to the food availability for this area of land and as a result, there is potential for an increase in the bird strike risk for aircraft using the airport. This risk assessment document examines the potential for an increase in bird strike risk as a result of this proposed change.
The Bird Hazard Risk Mitigation document attached outlines the approach to each of the likely risks, including appropriate measures required to reduce or remove the risks.

1.2. Blackpool Airport is located on the Lancashire coast, with the coastline less than 1 km West of the end of the main runway, urban areas and a Gullery immediately to the Northwest and mixed farmland to the north and east. Local bird populations are significantly higher than "average" for a UK airport and the fleet mix and movement frequency of aircraft using the airport require that the local birdstrike hazard is assessed and appropriate mitigation measures are put in place. This document aims to achieve this requirement and considers the following:-

- An introductory application of Civil Aviation Authority (CAA) risk assessment methodology to the bird hazard to aircraft in general.
- Assessment of the bird hazard at Blackpool Airport from historical data.
- Refinement of the risk assessment with reference to the historical birdstrike records for aircraft types operated from the airport.
- Updating the `local knowledge' risk assessment by site visits to review changes on the airport and in the local area.

- Recommendation of mitigation measures appropriate to the scale of operations and specifically designed for the conditions at Blackpool.

1.3 Current arrangements for bird hazard management

- Continuous monitoring.
- Assessment of risk to aircraft, bird height, numbers, flight line/pattern, species, regularity of appearance, reason for being in the area.
- Use of lure to scare off.
- Distress calls.
- Use of Falcons.
- Use of Laser.
- Use of guns shoot to scare.

2.0. CAA RISK ASSESSMENT METHODOLOGY

2.1. ELEMENTS OF RISK ASSESSMENT AND MANAGEMENT

2.2. The procedures applied are described in Reference 1, a constantly evolving document produced by CAA Safety Regulation Group in consultation with the industry as guidance to aerodrome operators and air traffic service units on the development of safety management systems. CAA SRG's approach to safety management is necessarily different in some ways from that used by the Health and Safety Executive. For example, in HSE terms, hazard `means the potential to cause harm, including ill health or injury; damage to property, plant, products or the environment, production losses or increased liabilities' whereas SRG define hazard as a `physical situation, often following some initiating event, that can lead to an accident'. Risk management is an essential part of safety management, and risk assessment is the process by which risks are evaluated and, where necessary, policies for their mitigation determined, as follows:

- Identification of all possible hazards.
- Hazard review, in which the identified hazards are reviewed critically and re-defined as necessary.
- Hazard severity assignment for each of the hazards identified.
- Estimation of probability of each hazard arising.
- Risk tolerability determination in which severity and probability of hazards are combined risk reduction as required by action to mitigate the severity or likelihood of occurrence.

Basic Risk Concepts and Measures

2.3 Risk assessment is often used in support of the regulation of activities that may pose a risk to life. Formal techniques for assessing risk in quantitative terms were first developed to evaluate the safety implications of major hazard activities such as the nuclear and chemical process industries and have subsequently been applied to the assessment of risks associated with a wide variety of activities, including aviation. The approach adopted here is based on well-established principles and practices.

2.4 In the first instance, it is useful to define the basic concepts of hazard and risk. A hazard is something with the potential to cause harm. A risk is conceptually distinct from a hazard and arises when that potential is realised. Risk may formally be characterised in terms of two key parameters:

- The probability of occurrence (or frequency) of the hazardous event.
- The severity of the consequence, for example in terms of the severity of injury to those affected and the numbers of individuals killed or injured.

2.5 A key reference point in this assessment is the risk of fatalities. For the current purposes, we are concerned primary with “individual risk”: the probability of a fatality being suffered by a hypothetical individual exposed to the hazard in question, typically expressed as the probability of fatality per year of exposure. I adopt this reference point due to the availability of relevant fatality risk criteria identified by the HSE, as discussed further below. It should be recognised that there may be other significant adverse impacts associated bird strikes. Serious injury may arise in the event of a successful ejection in which fatality is avoided, for example. Programme disruption through loss of assets may have consequential impacts that have human safety implications. Fatality risk is a convenient metric for use here since there are clearly defined criteria for risk acceptability characterised in those terms. That is not to say that other impacts which do not receive as much attention in my assessment are not important.

Evaluation of Risk Significance

2.6 Using the results of risk assessment to support risk management decision making requires that the significance of risks is evaluated. Decisions can then be made regarding the need for risk management actions, taking account of the measures that may be available to reduce risks.

2.7 A general framework for assessing the significance of the fatality risks associated with any given activity is provided by reference to other risks encountered in modern society. For example, the HSE has developed a clearly defined policy on land use planning in the vicinity of major industrial hazard sites using these principles, as set out in the HSE guidance document on risk criteria for land-use planning in the vicinity of major industrial hazards [1]. Quantitative risk criteria have been applied in a variety of contexts, as described in various other HSE guidance documents, including the paper on *Quantified risk assessment: Its input to decision making* [2], the paper on *The tolerability of risk from nuclear power stations* [3] and the HSE’s latest general guidance on public risk management decision making, *Reducing risks, protecting people* [4].

2.8 Under the HSE’s approach, risks may be tolerated in return for the benefits of industrial activities within a “risk tolerability” framework [ref. 4, para 121] developed in the context of UK health and safety legislation. In order to identify quantitative criteria against which to assess the significance of any quantified risk estimate, the HSE made reference to the levels of risk [ref. 2, para 58] that are encountered and tolerated for a range of activities that are undertaken in modern society. An example risk of relevance to most people would be the risk of death from a road traffic accident which was estimated to be approximately 1 in 10,000 per annum. Within the HSE’s risk tolerability framework, risks that lie below a lower (negligible) risk level of 1 in a million per annum will generally be identified as being of essentially no regulatory concern or “broadly acceptable” [ref 4, para 130]. Risks above an upper (significant) risk level of 1 in 10,000 per annum may be considered “intolerable” [ref 4, para 132] and would certainly not be accepted without considerable scrutiny. Risks between these two limits are normally subject to regulatory scrutiny, increasingly so the higher the risk and the closer that it approaches the upper limit. In accordance with UK health and safety legislation, such risks should be managed to be “as low as reasonably practicable” (ALARP).

2.9 Under UK health and safety legislation [5], the term “reasonably practicable” has a specific meaning, derived from its interpretation in case law [6] by Lord Asquith in 1949, as follows:

“Reasonably practicable” is a narrower term than “physically possible.” It seems to me to imply that a computation must be made by the owner in which the quantum of risk is placed on one scale and the sacrifice involved in the measure necessary for averting the risk (whether in money, time or trouble) is placed in the other, and that, if it be shown that there is a gross disproportion between them - the risk being insignificant in relation to the sacrifice - the defendants discharged the onus on them. Moreover, this computation falls to be made by the owner at a point in time anterior to the accident. The questions he has to answer are, firstly, what measures are necessary and sufficient to prevent any breach (of the statute), and secondly, are these measures reasonably practicable.”

2.10 The HSE believes [ref. 4, Appendix 3, para. 5] that the statutory duties of those managing a facility giving rise to risks have not been complied with if the safety management regime introduced by duty holders to control risks fails the above “gross disproportion” test. The legal requirements under UK health and safety law may therefore be summarised as follows; first, hazards and potential mitigating measures should be assessed to determine which of any potentially available safety measures would provide a safety benefit that outweighs their cost; second, measures that are found to be cost-beneficial should be taken. Justification should also be provided for any decisions not to implement other measures on the basis that the cost would be disproportionate to the benefit and it should also be shown that the benefit of the activity justifies the residual risk that cannot be avoided.

CAA Regulation of Aircraft Operations

2.11 Both Civil, military, and GA operations take place at Blackpool. The civil operations give rise to a requirement for regulation under the licensing regime administered by the UK Civil Aviation Authority. The licensing regime implements international obligations defined in Standards and Recommended Practices of the International Civil Aviation Authority, through the provisions of the Air Navigation Order, within the framework established by the Civil Aviation Act.

2.12 In order to gain an aerodrome licence, an applicant must demonstrate to the CAA’s Safety Regulation Group (SRG) that he is competent to conduct aerodrome operations safely. Overall responsibility for securing the safe operation of an aerodrome rests with the aerodrome licence holder who should act in accordance with the arrangements he provides or makes (for example, aerodrome manual procedures) to ensure that aircraft using the aerodrome can operate safely.

2.13 Bird hazard management is recognised as an integral part of aerodrome safety management. The requirements for bird hazard management at aerodromes are set out in Civil Aviation Publication (CAP) 168 [7] on the licensing of aerodromes and related guidance is provided in CAP 772 [8]. CAP 772 states that aerodrome operators should develop a Bird Control Management Plan (BCMP) to assess the birdstrike risk, and to define and implement the appropriate bird control measures to reduce or mitigate the risk. The objective of birdstrike risk management identified in CAP 772 is to implement a birdstrike risk management policy and those measures necessary to reduce the birdstrike risk to the lowest practicable level.

2.14 The SRG and HSE both have safety related roles within the aviation industry. In order to address the potential for duplication of safety regulatory effort, a memorandum of understanding has been drawn up that sets out the framework for liaison between them. The operational safety of aircraft, including bird strike related safety issues, is the responsibility of SRG. In assessing the bird hazard management performance of an aerodrome operator, within the UK regime for aerodrome licensing, compliance with the requirements of CAP 772 will be a primary consideration of SRG. Nevertheless, the general duties of care under UK Health and Safety legislation apply and the HSE guidance on the significance of risk, as set out above in Section 2.2, will be relevant considerations.

3 Approaches to Bird Strike Risk Management

3.1 The hazard represented by bird strike has been recognised for many years. In response, there are well-developed approaches to minimising the associated risk to aircraft and occupants. The two primary approaches available are as follows:

- Aircraft design and certification requirements that seek to maximise the tolerance of aircraft to birdstrike with the objective of minimising the likelihood of catastrophic consequences in the event of a strike;
- Aerodrome bird hazard management measures, in particular bird dispersal at aerodromes and planning controls to avoid features in the vicinity of aerodromes that are likely to attract birds. These measures seek to minimise the numbers of birds that aircraft may encounter during take-off and landing and hence minimise the likelihood of a bird strike occurring.

These two approaches are outlined below.

Aircraft Design and Certification

3.2 Civil aircraft design and certification requirements specify the necessary tolerance of aircraft to defined birdstrike events. Key elements of these standards include the ability of an engine to withstand ingestion of birds without catching fire, suffering uncontained failure or becoming impossible to shut down and whilst retaining some partial thrust for a specified period after the strike. In addition there are airframe certification requirements that an aeroplane must be capable of continued safe flight and landing after hitting a 4 lb bird when travelling at cruise speed and that windshield integrity must be maintained in the event of a single impact of a large (4 lb / 1.8 kg) bird at cruise speed.

3.3 Essentially, these standards should ensure that any multi-engine civil aircraft will be able to withstand engine ingestion of a single large bird without endangering the aircraft, even if the engine is destroyed beyond economic repair, and similarly to withstand ingestion of a certain number of small and medium sized birds without endangering the aircraft. Airframe impacts of a large bird should similarly not endanger an aircraft. Recent operating experience indicates that these certification standards are effective at essentially eliminating the risk of loss of a civil aircraft in the event of impact with a single large bird.

3.4 Review of bird strikes worldwide that have led to total loss of aircraft indicates that the only types of incidents that would normally lead to the loss of civil aircraft of the types operating at Warton will be either those involving flocks of birds or those involving birds that are unusually large. The loss of a Nimrod at Kinloss in 1980, shortly after take-off, involved flight into a dense flock of Canada Geese flying in arrowhead formation between overnight roosting and daily feeding grounds. This aircraft suffered numerous bird-strikes and multiple engine failures. The recent Hudson River bird strike event is understood also to have involved a flock of Canada Geese flying in dense formation. The relatively large size of the Canada Goose (4.6 kg) is expected to have been a significant factor in these accidents.

3.6 A defence standard, DEF STAN 00-970 PART 1/6 Section 4.9, reproduced in Appendix 5, specifies the minimum requirements for the resistance of airframes of military aeroplanes (other than derivatives of civil types) to damage caused by birdstrikes. The maximum threat, for the purpose of these requirements, is a single strike by a bird of 1.0 kg mass. The effect of a single birdstrike shall not degrade the flying qualities of the aeroplane below Level 2 in all flight categories. The 1 kg mass identified in the standard compares with typical weights of 0.7 – 1.0 kg for the Lesser Black-backed Gull and 0.75 – 1.25 kg Herring Gull. Some individuals of these species and all species of Geese will therefore exceed the weight identified in the standard and, for some impact scenarios, weights at the limit of the standard may lead to potentially significant damage.

3.7 DEF STAN 00-970 Part 11 Section 3, reproduced in Appendix 6, defines engine requirements for bird strike and ingestion applicable to military aircraft. This states that the civil aircraft standards (CS-E 800) apply, as written, to military transport and reconnaissance aircraft. This DEF STAN states that these requirements apply to engines for use in high performance Combat or Trainer aircraft and also provides additional guidance applicable in this case. Essentially, the engine tests prescribed by CS-E 800 define the sizes and numbers of small and medium sized flocking birds that an engine must be able to withstand, according to the engine inlet throat area. For the sizes of engine concerned in this context the requirements in respect of medium sized flocking birds will be typically be that ingestion of 2 to 3 birds of 700 grms must not cause more than a sustained 25% power or thrust loss or the engine to be shut down during the test.

3.8 Larger than average individuals of Geese or the Lesser Black-backed or Herring Gull species are at or above the limiting mass specified in the relevant airframe standard. The weights of both these species are slightly above the limiting mass of "medium" sized birds specified in the relevant engine ingestion standard though the requirement in that respect is the tolerance of an event involving strikes with two separate birds. According to the precise circumstances of a strike and the extent to which the actual performance in withstanding an impact may exceed the minimum specification, aircraft may be able to tolerate some strikes involving these species. However, this cannot be expected to be the case in all such strikes

Aerodrome Bird Hazard Management

3.9 Several catastrophic accidents involving multiple birdstrikes on take-off occurred in the 1970s and focused attention on bird hazard management at aerodromes. These incidents were caused by relatively large numbers of birds that had gathered on the aerodrome being disturbed by the aircraft on take-off and rising up in a flock that led to multiple strikes. Dispersal of birds that gather on aerodromes, in particular the removal of birds that have gathered over night, prior to commencement of operations, is an effective means of addressing this risk. Increasingly sophisticated dispersal techniques have since been developed to minimise the numbers of birds on aerodromes at all times of operation.

3.10 Management of the aerodrome environment to reduce its attractiveness to birds for feeding or roosting is another important element of the overall approach to aerodrome safeguarding.

Aerodrome safeguarding, the process by which development near airports is controlled in order to maintain aircraft safety, includes the consideration of features that might attract birds. Many of the design features of building developments and their associated landscaping may be attractive to birds, for example tree and shrub planting, and the creation or enhancement of water features. Through involvement of aerodromes as statutory consultees in the planning process, such potentially adverse impacts are kept to a minimum.

3.11 In addition to the above measures of bird dispersal and habitat management in the vicinity of aerodromes the killing or taking of birds under licence is sometimes undertaken to reduce bird numbers. General licence WML / GEN L06 in relation to killing or taking certain wild birds to preserve air safety, issued by Natural England, permits aerodrome managers to carry out a range of otherwise prohibited activities against the species of wild birds listed on the licence, including Lesser Black-backed and Herring Gull, provided that other methods of resolving the problem are ineffective or impracticable.

Bird Hazard Management at Blackpool

3.12 Blackpool Aerodrome implements a bird hazard control and wildlife management plan, in accordance with CAA guidance, that includes the above types of control measure. This relies primarily on dispersal measures undertaken on the airfield and habitat management measures. To date the killing or taking of birds under licence has been undertaken within the aerodrome boundary and to a limited extent only.

3.13 Bird activity and bird strike incidents are systematically recorded as part of the bird hazard control activities at Blackpool in a hand written log kept by those responsible for day to day bird hazard management. This bird activity log shows that a wide variety of species occur at and around the airfield. Gulls are the largest species that occur most commonly on the aerodrome. Large gulls (Herring Gull and Lesser Black-backed Gull) are recorded on the airfield, as is the smaller Black-headed Gull. Geese are never seen on the airfield but are present in large numbers off airfield especially to the East.

The issues of bird hazard management are explained in more detail in the Bird Hazard Risk Mitigation plan (North West Bird Control 2013).

4.0 HAZARD IDENTIFICATION

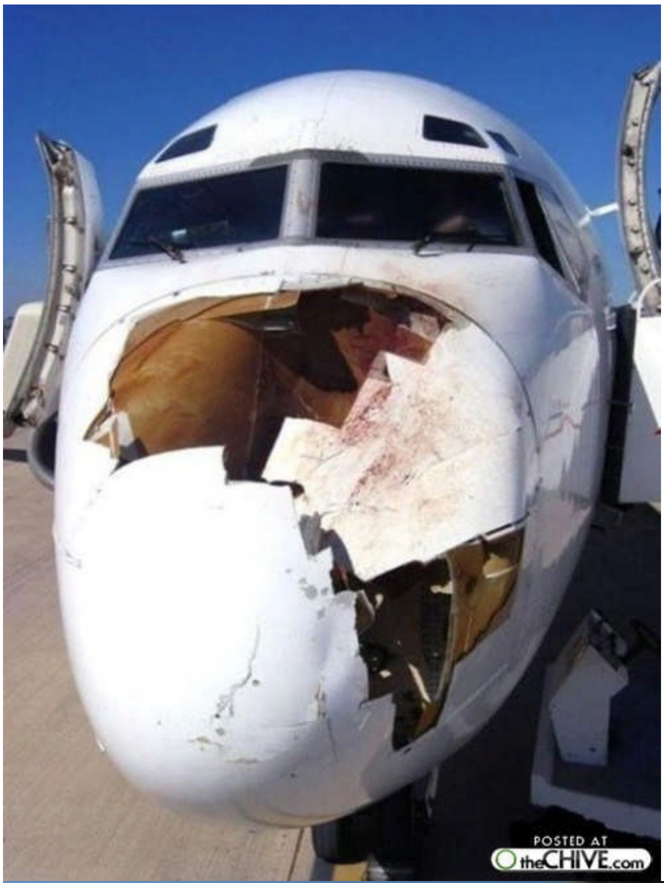
One approach here would be to list all the bird species that could be attracted by all the habitats and activities associated with the development and operation of the civil airport at Blackpool, and assess, for each, the potential hazard level and likelihood of it arising. This would be a very lengthy and repetitive procedure. Therefore, it is proposed instead to examine the potential hazard of birds to aircraft in more general terms, to apply the findings to those species likely to visit the airport and, thus, to determine tolerability and need for mitigation action.

Worldwide, at least 58 civil aircraft have been destroyed by birdstrikes, with more than 34 fatal accidents and over 200 deaths. Many more aircraft have been damaged, and turbine engines are particularly vulnerable. The following table, including data from a number of sources, shows relevant details from a selection of birdstrike accidents.

BIRDSTRIKE ACCIDENTS

YEAR/LOCATION	AIRCRAFT	ACTIVITY	BIRD SPECIES	CONSEQUENCES
1960/Boston, USA	Electra	Take-off	Starlings	3 engines ingested, crashed in harbour, 62 killed
1973/Norwich	Falcon 20	Take-off	80 BHG/CG	Ingested, crashed in field, 1 injury
1975/Dunsfold	HS125	Take-off	20 Lapwings	Ingested both engines, crashed on car, 6 killed
1975/New York	DC10	Take-off	Gulls	Ingested, wing engine exploded, a/c burned out
1978/Michigan	CV 580	Take-off	Kestrel	Ingested, auto feathered, crashed, 3 injured
1978/Belgium	737	Touch & go	Woodpigeon	Ingested, aborted takeoff, over-ran, burnt out
1979/USA	Merlin	Approach	Gulls	Lost control, crashed, 2 killed, hit 7 parked a/c
1980/Kinloss	Nimrod	Take-off	80 BHG/CG	Multiple ingestions, crashed in forest, 2 killed
1981/Canada	Bell 206	Low level	Raven	Windshield penetration, crashed, 4 killed
1983/USA	Lear 25	Take-off	Starlings	Both engines failed. Forced, landing struck trees.
1984NVales	Hawk	Touch & go	Lapwing	Ingested, pilot ejected, a/c destroyed
1984/USA	PA18	Finals	Cormorant	Holed windshield, injuring pilot, crashed in lake
1986/India	A300	Take-off	Black kite	Aborted take-off, over-ran, destroyed
1995/Le Bourget	Falcon 20	Take-off	Lapwings	Ingested, engine fire, crashed, 10 killed
1996/Alaska	E3A	Take-off	Canada Geese	Ingested 2 engines, crashed, 24 killed
1996/Greece	E3A	Take-off	Not available	Abandoned t/o, over-ran into sea, destroyed
1996/Netherlands	C130	Landing	Starlings	Crashed off runway, burned, 34 killed, 5 injured
2003/Milan	Lear 45	Take-off	Domestic pigeons	Crashed in industrial estate. 2 killed.
2003/Illinois	Lear 35	Take-off	Not known	Crashed and burned, 1 injury.
2004/Amsterdam & Barcelona	B737	Landing	1 Buzzard	Nose wheel strike on takeoff, continued to Barcelona, steering malfunction on landing, ran into drainage canal, a/c total loss, 5 injuries.
2005/USA	Falcon 20	Take-off	Mourning Doves (2 flocks)	Crashed, sliding through a ditch and airport perimeter fence, crossing a road and ending in a cornfield. Aircraft beyond economical repairs. Both crew hospitalized.

All types from light aircraft, through business jets and short/medium haul airliners, to wide-bodied transport aircraft have been destroyed by modest numbers of the types of birds that commonly occur around and on aerodromes.



Over the last two decades, around 800 birdstrikes on UK-registered civil aircraft were reported to the CAA annually. Since the mandating of birdstrike reports in November 2004, this number has more than doubled, confirming the suspicions of significant under-reporting of the true situation. The majority of reported strikes cause little or no damage but, otherwise, are very similar to those casing aircraft losses described above, i.e. they involved common aircraft types, standard aerodrome activities; and modest numbers of the species that commonly frequent airfields. The consequences were catastrophic for those listed in the table because of chance factors: birds were ingested into one or more engines and caused a sufficient loss of power for the aircraft to crash; or the pilot lost control. Even single, relatively small birds (American Kestrel, Woodpigeon and Lapwing, for example) have the proven potential to cause accidents. However, there are clear relationships between bird weight and numbers struck and the risk that the aircraft will be damaged (data from Reference 9): -

Bird weight	% damaging strikes (% causing engine damage)	
<100g (small)	2.7	(0.7)
101-1000g (medium)	12.0	(3.96)
>1000g (large)	22.7	(4.97)

No of birds struck	% damaging strikes
1	8.12 (2.1)
2-10	14.6 (4.6)
11-100	40.3 (22.6)

Thus, species which are larger than 100g, or occur in flocks (e.g. Geese, Gulls, Lapwings, Corvids, Curlew, Pigeons, Starlings, etc.), are most likely to cause damage to aircraft, and have the potential to cause accidents. This has given rise to the defining of a "priority group" of bird species which fit either or both these categories and are attracted to the airfield environment, and generally these are the main target of our preventive measures.

5.0. HAZARD SEVERITY

There is no fixed formula for degrees of hazard. However, the following four-level system and definitions are used by the CAA.

Classification	**Results: one or more of the following:**
CATASTROPHIC	• Loss of aircraft • Multiple fatalities
HAZARDOUS	• Large reduction in safety margins • Physical distress or workload such that flight crew cannot be relied upon to perform their tasks accurately or completely • Serious injury or death of a relatively small proportion of occupants
MAJOR	• Significant reduction in safety margins • Reduction in ability of flight crew to cope with adverse operating condition as a result of increase in workload or as a result of conditions impairing their efficiency • Injury to occupants
MINOR	• Nuisance • Operating limitations • Emergency procedures

Applying these criteria to the potential results of birdstrikes with flocks of small birds and individuals or flocks of medium-sized and large birds, it is apparent that the hazard severity for birdstrikes includes all levels up to and including 'catastrophic'.

6.0. HAZARD PROBABILITY

The following definitions originate from Joint Airworthiness Requirement 25, which quantifies probability in terms of flight hours. However, CAA SRG considers that the definitions are equally valid for aircraft movements and birdstrikes at an aerodrome.

Classification	**Qualitative & quantitative definitions:**
EXTREMELY IMPROBABLE	Should virtually never occur in the whole life of the fleet. <10-^{9} per movement
EXTREMELY REMOTE	Unlikely to occur when considering several systems of the same type but, nevertheless, has to be considered as being possible. 10-^{7} to 10-^{9} per movement.
REMOTE	Unlikely to occur during total operational life of each system but may occur several times when considering several systems of the same type. 10-^{5} to 10-^{7} per movement
REASONABLY PROBABLE	May occur once during total operational life of a single system. 10-^{3} to 10-^{5}
FREQUENT	May occur once or several times during operational life. 1 to 10-^{3} per movement.

High safety standards are imposed on civil air transport both by regulation and by public demand. Accidents from all causes are expected to occur at a frequency of 1 x 10-^{7}, or lower. Thus, individual hazards should pose a considerably lower risk, perhaps in the order of 1 x 10-^{9}. Given the very low frequency with which accidents occur, it is difficult to quantify risks from individual causes, such as birdstrikes.

For example, aircraft movements at UK airports are commonly in the order of tens of thousand per annum. Thus, although the indications are that the risk of a major birdstrike accident is probably below 1 in 10-^{7} for UK civil aerodromes as a whole, it is impossible to determine the situation at individual airports (all of which have different hazard levels because of local conditions), because insufficient aircraft movements have been accrued and most airports have not suffered a major accident caused by birds.

However, the examples at 4.0 above show that accidents can occur to all types of aircraft following strikes with common birds. Also, strikes with the potential for catastrophic results occur relatively frequently. Therefore, the probability must be, at best, `extremely remote' and may possibly be 'remote'. Also, major incidents, such as loss of an engine on take-off, probably occur sufficiently frequently to fall into the `reasonably probable' category.

7.0. RISK ASSESSMENT

7.1. A risk level is determined by combining the severity and probability of the hazard. The purpose of assessing risk is to determine its tolerability and whether it must be reduced. Numerical values (e.g. 1-4) may be assigned for the severity and probabilities as defined above, with higher numbers for greater hazards and severity, and added or multiplied together to arrive at a numerical value that can be compared with predetermined and agreed values for safety in general. However, for some types of occurrence, such as serious birdstrikes, the data are insufficient to determine quantitative risk assessments for specific examples such as an individual aerodrome. This is not a serious problem because the next stage, assessing tolerability (7.0 below), tends to `smooth out' the numerical boundaries between hazard and probability levels.

7.0. RISK TOLERABILITY

7.1. When the risk has been determined, the score can then be used to determine whether the risk is acceptable, at a level that requires on-going review, or is unacceptable and must be reduced to a lower category. This way of looking at hazard, probability and tolerability can be expressed as a matrix: -

CATASTROPHIC	Review	Unacceptable	Unacceptable	Unacceptable	Unacceptable
HAZARDOUS	Review	Review	Unacceptable	Unacceptable	Unacceptable
MAJOR	Acceptable	Review	Review	Review	Review
MINOR	Acceptable	Acceptable	Acceptable	Acceptable	Review
	EXTREMELY IMPROBABLE	**EXTREMELY REMOTE**	**REMOTE**	**REASONABLY PROBABLE**	**FREQUENT**

7.2. When the birdstrike hazard is considered in the above terms, it can be seen that, in principle, effective mitigation measures are always required to reduce it to a lower category, because of the possibility of a catastrophic accident.

8.0. RISK REDUCTION

8.1. An `unacceptable' risk assessment must be reduced, and, where it falls between `acceptable' and unacceptable, it should be reduced to a level As Low As Reasonably Possible (ALARP principle). Mitigating action may be aimed at reducing the severity of the hazard, its probability, or both. To reduce the hazard of birds on aerodromes, the approach is to reduce the probability of birdstrikes by removing birds from the vicinity of aircraft.

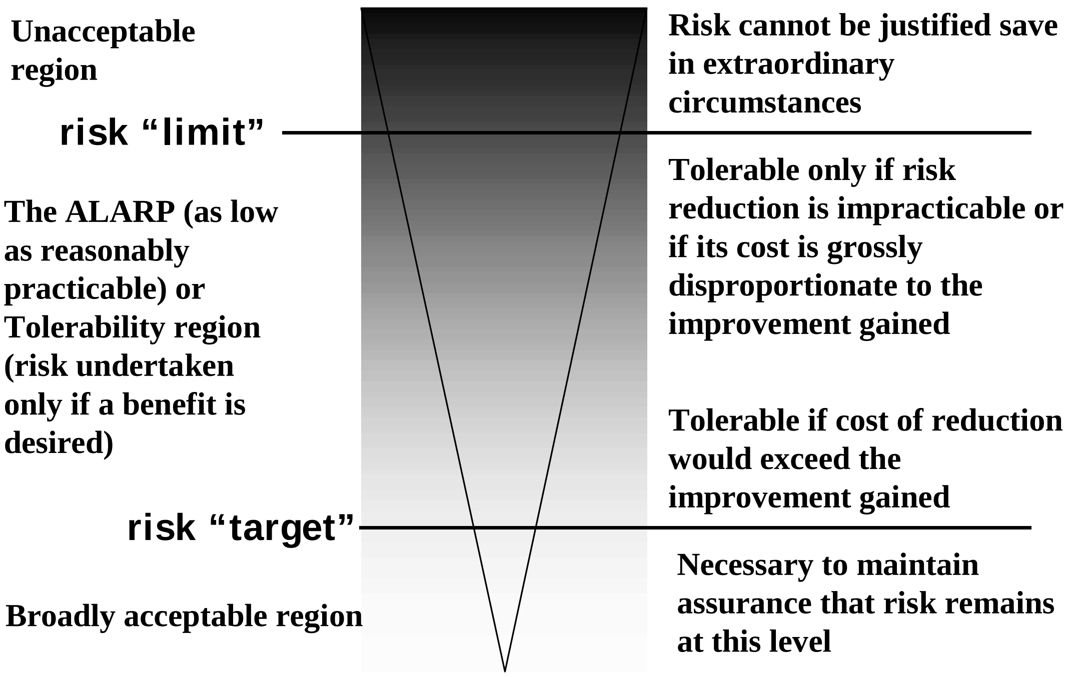
ALARP (As Low As Reasonably Practical)

An objective of the Safety Management System is to reduce the risk to As Low As Reasonably Practical.

What does this mean?

The following figure can be used to illustrate the principle:

Figure.



One must establish a risk limit.

If a certain scenario is deemed to have a risk greater than the limit, mitigating measures must be put in place to reduce the risk below this level.

One must also establish a risk target.

If a certain scenario is deemed to have a risk lower than the target, fine. Concentrate your efforts on other scenarios.

The risk target could for example be set one order of magnitude below the risk limit.

If a certain scenario is deemed to have a risk below the limit, but above the target, one should review the case. If it is relatively simple (in practical and economical terms) to put in place mitigating measures to reduce the risk towards the target, please do so. If not, accept and concentrate on other scenarios.

9.0. HISTORICAL BIRDSTRIKE HAZARD AT BLACKPOOL

9.1. The pattern of reported birdstrikes is largely as might be anticipated for any coastal airport, with gulls figuring prominently (and also, being a coastal site, large and small gulls frequently involved), and, Hirundines also reported in recent years

9.2. Although Blackpool Airport's recent historical birdstrike record is not large enough to validate any thorough statistical analysis, and reporting criteria have changed over the last 6 years, the indications are of a birdstrike profile with a disproportionate number of Gulls and Hirundines on or near the airfield.

9.3. In terms of risk management, the historical birdstrike records suggest that the prevention of birdstrikes with Geese and Gulls should be given the highest priority, followed by Starlings, Pigeons, Hirundines and Corvids.

9.4. Pink footed Geese have recently been the cause of aircraft having to “go around” when using 28 approach.

9.5. Bird strike risk is not necessarily defined by numbers of birds, but rather by a mixture of numbers, species, flight height, time, direction, also by behaviour, - feeding, breeding, loafing, roosting, flight line behaviour, and also by topographical and environmental issues. Any change in the environment which may change any of the behavioural and species specific key elements as defined above needs to be assessed as to its potential to increase or decrease the bird strike risk.

10.0. BIRDSTRIKE HAZARD TO AIRCRAFT TYPES OPERATING AT BLACKPOOL

10.1. Reported birdstrike numbers at an aerodrome increase proportionately to aircraft movement rates. The statistical relationship is unclear, as there are so many local variables, but the relationship is not linear and the birdstrike rates corrected for aircraft movements actually shows an inverse relationship with growth in aircraft movements. None of the aircraft types that operate from Blackpool are invulnerable to birdstrikes, as can be seen from Table 1 above, and airliners with two, three and four engined configurations have all been lost to birdstrikes. The three worst birdstrikes in history with respect to loss of human life all involved turboprop aircraft (a combined total of more than 110 fatalities), two of them four-engined types. Military combat aircraft and business jets certainly constitute the most high-risk aircraft groups, but General Aviation aircraft and helicopters are also vulnerable, and several crashes have occurred.

10.2. On average, around 10% of reported UK birdstrikes cause aircraft damage, and around 1% cause engine damage. Around 0.5% cause serious engine damage leading to shut-down or loss of power in one engine. Rates of serious damage to more than one engine simultaneously (i.e. incidents most likely to lead to the loss of a twin-engined commercial aircraft) cannot be calculated with any accuracy (there have been none reported in the UK for more than a decade) but are certainly less than 0.0001% of all birdstrikes, and probably less than 0.00005%.

10.3. It is a recognised fact by the CAA that OFF FIELD BIRD HAZARDS are probably a greater hazard than on field.

Chapters 11 to 13 deal with the potential off field hazard which may be created by supplementary feeding in the fields indicated in Cuadrilla's mitigation plan.
Although it is recognised that birds are currently in the area and feeding in various fields within the 13 kilometre safeguarding zone, the mitigation/supplementary feeding as proposed by Cuadrilla has the potential to concentrate significant numbers of birds in the defined high risk species into a localised area under or immediately adjacent to the approach to runway 28 and the departure zone for runway 10.

11.0. SPECIFIC BIRD HAZARDS AT BLACKPOOL AIRPORT

11.1. GULLS.

11.1.1 In a coastal location, gulls are inevitably numerous and are the most significant element of the local birdstrike hazard. As a group they represent the most high-risk category in the UK due to their habit of settling on paved surfaces in dense flocks and because of their poor reaction to aircraft encounters. At Blackpool, gulls are the most serious birdstrike hazard both in terms of frequency and risk of damage, and several incidents have occurred in recent years. Flocks may be sufficiently large to damage multiple engines with potentially serious consequences, and prevention of such incidents is the highest priority in bird hazard control at this airport.

11.1.2 Blackpool has a very significant Gull problem, particularly due to the increasing Gull colony on the Buildings to the North, the breeding ground on Abbeystead to the North East, and the breeding ground on Banks Marsh to the South. These colonies not only pose a threat due to the number of Gulls rising vertically to gain height to travel, but also due to the fact that various sub groups within the colonies disperse in small and large flocks to various points on the compass at different times of day and at various heights. The dispersal heights depend on the weather conditions and on how far the Gulls are proposing to travel. The returning Gulls then create a risk to aircraft later in the day.

11.1.3 Gulls - Distribution of Risk by Time: Gulls are present in the area year-round, with many Herring, Black headed, and Lesser Black-backed Gulls breeding locally to the East, South and North East. However, numbers are significantly higher in spring, autumn and winter and most of the strikes have occurred during these seasons. On a daily basis, gulls may occur on the airport throughout the day and night, with particular "gull pressure" from just before dawn to around 1 hour after dawn and a less intense increase from late afternoon to sunset. The "small gull (black-headed Gull)" activity is fairly typical of any UK airport, and seems to involve a broad-front dispersal from a local roost on Banks Marsh. Gull movements depend on many factors, most of which are impossible to predict with accuracy.

11.1.4 Wet weather is particularly associated with high gull numbers at Blackpool. This is normal behaviour when waterlogging of the soil brings earthworms and other invertebrates to the surface and onto the paved areas where they provide an easy food source. Wet and windy weather usually means a greater concentration of Gulls crossing the airfield to and from the Marsh at a lower level than in hot weather.

11.1.5 Tidal influences on and around Banks Marsh affect Gull movement to a large degree.

11.1.6 The local playing fields to the North, South and North West also create a significant issue in that they represent a natural food source, people feed them there, and they are a daytime roosting site.

11.1.7 **<u>Off Field</u>**

Fields to the East all around Queensway, Buildings to the North, Banks Marsh to the South, and the Coast to the East all represent breeding, feeding, roosting and bathing areas. Flight lines develop between them all which can intersect with aircraft flight lines.

Gulls, already breeding and feeding in the local area, would soon recognise a new fresh food source such as the supplementary food proposed by CRL. In previous years, where food resources for bird species have been limited and often available in specific locations (as shown by fields in which bird species have been most frequently recorded), the provision of supplementary food would likely have been associated with a change in gull flight lines and feeding habits, along with gulls congregating in large numbers, possible thousands, to take advantage of this change to the environment. This change in flight lines, and the probability that any disturbance such as dog walkers, bird watchers, shooting activities nearby may well move large numbers of Gulls into the flight path of an aircraft approaching overhead at approximately 600 – 800 feet would increase the bird strike risk. The situation in winter 2012-2013, however, is atypical, in that food resources have been abundant and widespread, particularly during the first part of the winter; this is partly due to heavy rainfall in the late autumn curtailing or preventing some farming activities. As a result of the change to the more usual farming activities, significant amounts and concentrations of grain and waste root crops have been available to wintering bird species. It is recognised that supplementary feeding in 2013 and in future years may well create or increase risks as regards bird strike; the use of supplementary feeding will therefore require careful consideration and planning in future years. Close liaison between the Bird Control Unit and CRL will be a key part of this informed decision making.

11.1.8 Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the recent gull hazard and associated birdstrikes at BLACKPOOL would fall into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable" frequency levels.

11.1.9

11.1.10 The supplementary feeding as proposed by CRL would move the Gull risk factor in the tolerability matrix into the "unacceptable" category

12.0.

12.1. <u>GRASSLAND PLOVERS AND OTHER WADERS</u>

12.2. The arable and pasture mixture of farmland around the airport provide ideal wintering habitats for Lapwing, Curlew and Oystercatcher.

12.3. The Ribble estuary is a major breeding and feeding area for many different types of waders.

12.4. The nearby football fields also provide food and roosting areas, and, when these are disturbed for football games, this causes an influx of birds onto the airfield. Curlews and Oystercatchers occur on the airport in significant flocks (100+ birds) in the autumn and winter months and present a significant birdstrike hazard due to their large size (average almost 800g), flocking behaviour and their habit of occasionally settling in flocks on runways. As with the gulls, flocks are sometimes sufficiently large enough to potentially affect multiple engines.

12.5. Peregrine Falcons roost and nest in Preston, Pilling, Southport and Kirkham. These wild Falcons use Lytham Moss as their hunting ground. This causes large scale acute but short lived bird activity to the East of the airfield at anything up to 2000’

12.6. Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the recent review hazard and associated birdstrikes at BLACKPOOL would fall into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable” frequency levels.

12.7. The supplementary feeding as proposed by Cuadrilla would move the Plover/Wader risk factor in the tolerability matrix into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable” frequency levels.

It is recognised that there is potential for use by some bird species e.g. geese, to change the habitat in favour of other species; for example, it is possible that disturbance of the ground surface by geese could make the habitat more suitable for wader species such as lapwing. Although there is no specific evidence for this to date, such a change could create or increase risks as regards bird strike; the use of supplementary feeding will require careful consideration, and any use of such measures will require careful and detailed surveillance to check for any changes to wader activity, behaviour and numbers. Close liaison between The Bird Control Unit and other surveyors will be a key part of this informed decision making.

13.0. Corvids

Corvids are present in the area in large numbers, - in excess of one thousand. It is recognised that the presence of new or increased food sources would create a risk of increasing corvid activity in a localised area which would probably change their flight behaviour and patterns. For example, large numbers of Corvids under the approach to 28 would be regarded as a potential risk, particularly as they are known to be easily scared into the path of approaching or departing aircraft. The situation in winter 2012-2013, however, is atypical, in that food resources have been abundant and widespread, particularly during the first part of the winter; this is partly due to heavy rainfall in the late autumn curtailing or preventing some farming activities. As a result of the change to the more usual farming activities, significant amounts and concentrations of grain and waste root crops have been available to wintering bird species. It is recognised that supplementary feeding in 2013 and future years may well create or increase risks as regards bird strike; the use of supplementary feeding will therefore require careful consideration and planning in future years. Close liaison between The Bird Control Unit and CRL will be a key part of this informed decision making.

In terms of the tolerability matrix at 7.0, the hazard and associated birdstrikes at Blackpool would fall into the "acceptable" category - incidents in the "minor" risk category occurring with low frequency levels.

The mitigation as proposed by Cuadrilla would move the Corvid risk factor in the tolerability matrix into the “unacceptable” category.

13.1. RAPTORS

The involvement of diurnal raptors (day-flying birds of prey) and owls in UK birdstrikes appears to be increasing, perhaps as a consequence of ecological pressures such as shortages of permanent rough grassland "forcing" them to hunt on airfields but some cases of local population increases, particularly of Buzzards, are involved. Even the Kestrel, the most common raptor involved in birdstrikes, is sufficiently large (averaging just over 200g) to cause engine damage (at least to turboprops and business jets), but numbers are fairly low and, being solitary hunters, multiple strikes do not occur. Buzzards are more problematic, being much heavier (often exceed 1 kg) and in Europe (and with similar species elsewhere in the world) are considered a significant hazard. Although Blackpool does not have large numbers of Raptors visiting the airfield, Kestrels, Peregrines and Buzzards are present and anything affecting their presence, numbers and behaviour should be given very careful consideration; this will require regular surveillance.

It is recognised that the availability of foodstuffs has the potential to support rodent activity which could, in turn, potentially lead to an increase in Buzzard and Kestrel soaring activity in the approach to runway 28. It is also recognised that the situation in winter 2012-2013 is atypical, in that food resources have been abundant and widespread, particularly during the first part of the winter; this is partly due to heavy rainfall in the late autumn curtailing or preventing some farming activities. As a result of the change to the more usual farming activities, significant amounts and concentrations of grain and waste root crops have been available to wintering bird species.

It is recognised that supplementary feeding in future years may well create or increase risks as regards bird strike; the use of supplementary feeding will therefore require careful consideration and planning in 2013 and future years. Close liaison between The Bird Control Unit and CRL will be a key part of this informed decision making.

In terms of the current tolerability matrix at 7.0, the hazard and associated birdstrikes at Blackpool would fall into the "acceptable" category - incidents in the "minor" risk category occurring with low frequency levels.

The mitigation as proposed by Cuadrilla would move the Raptor risk factor in the tolerability matrix into the “unacceptable” category

14.0 Geese

Geese have been flying across the approach to runway 28 for many years. Numbers seen by the airport and Fylde Bird Club have been increasing lately. Geese arrive and depart from Lytham Moss via a number of routes; one regularly used is from Southport Marshes across Lytham Moss and on to feeding grounds near Pilling to the North. These birds fly at all times of the day and night depending on the moon phase and also other factors. The flight height of geese is also influenced by a number of factors, particularly when the birds are moving between fields on Lytham Moss. When travelling to and from Lytham Moss, flight heights are often in excess of 2000ft as shown by records from the airfield BCU which takes them over approaching aircraft. The airport has a system in place for warning pilots of this problem. The Geese tend to arrive in September and depart in April. Numbers in winter 2012-2013 are at an all-time high - BCU records.

Geese are attracted by a range of features, including food sources, open space and bird accumulations. Any food source such as potatoes, carrots or grain will result in these birds dropping out of the flight line and forming a horizontal curtain of birds which aircraft cannot fly through without serious risk of a multiple bird strike. Large numbers of geese which move about frequently are therefore regarded as a serious potential risk to aircraft. Blackpool Airport currently has a program in place to move these birds out of fields adjacent to the approach in which potatoes are present and rendered non harvestable due to flooding. The significant amounts and concentrations of grain and waste root crops available in winter 2012-2013, along with other factors, have enabled geese to gather on various fields within Lytham Moss on a regular basis. It is recognised that supplementary feeding in future years may well create or increase risks as regards bird strike; the use of supplementary feeding will therefore require careful consideration and planning in 2013 and future years. Close liaison between the Bird Control Unit and CRL will be a key part of this informed decision making.

Any supplementary feeding of Potatoes or grain on fields which are suitable for use by geese and which do not already have abundant food available, would result in Geese dropping out of the flight line and causing significant risk to aircraft. There is also always the risk of Geese on the ground being startled by human activity and so rising up in front of approaching or departing aircraft.

Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the current Goose hazard and associated birdstrikes at Blackpool would fall into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable” frequency levels.

The mitigation as proposed by Cuadrilla would move the Goose risk factor in the tolerability matrix into the “unacceptable” category

15.0 STARLING

With a history of causing birdstrike accidents, the Starling is the smallest species regarded as a significant risk to air safety in the UK, and worldwide they have caused the two worst birdstrikes in history in terms of loss of life. Both involved 4-engined aircraft, one of which lost power on three engines, the other two (on the same wing). The local risk from this species is highest in the spring and summer months after young birds have fledged.

Numbers in the area, especially the roosts under Blackpool’s North and South piers are relatively high – tens of thousands, but measures have been taken to deal with these numbers by the airport BCC and current starling figures to date on and off air field are lower than normal.

Any supplementary feeding on fields which are suitable for use by starlings and which do not already have abundant food available, would risk encouraging starlings into a localised area resulting in an unacceptable risk to approaching aircraft. Supplementary feeding would probably encourage Starlings into a localised area resulting in an unacceptable risk to approaching aircraft.

Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the current Starling hazard and associated birdstrikes at Blackpool would fall into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable” frequency levels.

The mitigation as proposed by Cuadrilla would move the Starling risk factor in the tolerability matrix into the “unacceptable” category.

15.1 WOOD PIGEONS

Woodpigeons, Racing Pigeons and Stock Doves are numerous in the local area. Woodpigeons occasionally feed on weeds in the airfield grass areas. All pigeons are hazardous and their involvement in UK birdstrikes has increased in recent years.

Any supplementary feeding on fields which are suitable for use by wood pigeons and which do not already have abundant food available, would risk encouraging wood pigeons into a localised area resulting in an unacceptable risk to approaching aircraft. Wood pigeons already are numerous to the East of the airfield. Any supplementary feeding would probably concentrate, localise and increase these numbers.

Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the Current Pigeon hazard and associated birdstrikes at Blackpool would fall into the "review" category - incidents in the major/hazardous risk category occurring with "remote/reasonably probable” frequency levels.

The mitigation as proposed by Cuadrilla would move the Wood pigeon risk factor in the tolerability matrix into the “unacceptable” category

16.0 SWANS

Whooper Swans are the main target species for the supplementary feeding proposed by CRL. These birds, although present in the area, are almost never seen from the airfield and rarely fly higher than 100 ft. which puts them under the approach height for all aircraft using 28 approach.

Although there is potential for the swans to become more localised and concentrated as a result of supplementary feeding, it is recognised that this would have benefits in terms of reducing swan movements throughout each day when they are present on Lytham Moss.

Although this cannot be taken as an indicator of future risk, in terms of the tolerability matrix at 7.0, the Current Swan hazard and associated birdstrikes at Blackpool would fall into the acceptable category - incidents in the major/hazardous risk category occurring with "remote" frequency levels. This would appear not be increased by supplementary feeding.

17.00 CONCLUSION

There are four main risk factors which potentially could be affected by supplementary feeding as described in Ecology Services UK Ltd (2012)

- Flight lines of birds attracted by the feeding flying through the approach.
- Flight lines of birds attracted by the feeding flying out of the approach.
- Uncontrolled dispersion of birds from the feeding area rising in front of approaching/departing aircraft.
- Raptors soaring in the approach hunting rodents which are feeding on the supplementary food.

Supplementary feeding, at the rate proposed by CRL for winter 2012-2013, adds insignificant amounts of food to the existing food already available, in respect of the percentage amount of overall food. The impact on bird species presence and behaviour is therefore not expected to change significantly as a result of the CRL supplementary feeding. This situation may change throughout the course of winter 2012-2013 as waste food becomes more limited; this will require careful surveillance and associated risk assessment to make informed decisions about safeguarding works that may be required. The position of Blackpool Airport is that any additional food provision for birds creates a potential associated risk for aircraft, and that the standard approach to managing this situation is to prepare bird control measures which can be implemented as and when necessary.

It is recognised that supplementary feeding in future years may well create or increase risks as regards bird strike; the use of supplementary feeding will therefore require careful consideration and planning in future years. Close liaison between Blackpool Airport and CRL will be a key part of this informed decision making.

The mitigation measures considered appropriate to this Bird Hazard Risk Assessment are described in detail in the Bird Hazard Risk Mitigation Plan (North West Bird Control (2013))

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