

wardell-armstrong.com

ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
MINERAL ESTATES
WASTE RESOURCE MANAGEMENT



GREEN SWITCH DEVELOPMENTS LTD

PROPOSED SOLAR FARM AT TAWDSIDE FARM, ORMSKIRK, LANCASHIRE

HABITATS REGULATIONS ASSESSMENT

APRIL 2015

your earth our world



DATE ISSUED: April 2015

JOB NUMBER: LE12333

REPORT NUMBER: 001

GREEN SWITCH DEVELOPMENTS LTD

PROPOSED SOLAR FARM AT TAWDSIDE FARM, ORMSKIRK, LANCASHIRE

HABITATS REGULATIONS ASSESSMENT

APRIL 2015

PREPARED BY:

Phil Preston Principal Ecologist



APPROVED BY:

Estelle Linney Technical Director (Ecology)



This report has been prepared by Wardell Armstrong LLP with all reasonable skill, care and diligence, within the terms of the Contract with the Client. The report is confidential to the Client and Wardell Armstrong LLP accepts no responsibility of whatever nature to third parties to whom this report may be made known.

No part of this document may be reproduced without the prior written approval of Wardell Armstrong LLP.



CONTENTS

1	INTRODUCTION	1-9
2	CURRENT LEGISLATION	10--11
3	METHODOLOGY	12-13
4	PATHWAYS OF IMPACT	14-17
5	DESIGNATED SITES	18-27
6	LIKELY SIGNIFICANT EFFECT TEST	28-30
7	'IN COMBINATION' CONSIDERATION OF OTHER PLANS AND PROJECTS	31
8	CONCLUSIONS	32

APPENDICES

APPENDIX 1 – Tawdside Farm, Wintering Bird Survey

APPENDIX 2 – Wind turbine, Sensitive Bird Populations and Peat Soil: A Spatial Planning Guide for on-shore wind farm developments in Lancashire, Cheshire, greater Manchester and Merseyside. RSPB 2008.

1 INTRODUCTION

Background

1.1 Wardell Armstrong LLP (WA) were appointed by Green Switch Developments Ltd to produce a report to inform a Habitats Regulations Assessment (HRA) of a proposed solar farm facility at Tawdside Farm, located in Lathom, near Ormskirk, to the east of Wanes Blades Road (grid reference SD476116). The objective of the assessment is to identify any aspects of the project that would cause 'likely significant effects' on the interest features of Natura 2000 sites, specifically Martin Mere (SPA, RAMSAR), Sefton Coast (SAC) and Ribble and Alt estuaries (SPA, RAMSAR). In order to fully assess the likely significant effects of works upon these internationally designated sites this project has been assessed both in isolation and in combination with other plans and projects. This report also advises on appropriate mechanisms for delivering mitigation where such effects would otherwise occur.

Summary of the proposed development

- 1.2 The site covers approximately 38.75 hectares and is located to the east of Wanes Blades Road and Deans Lane, approximately 1.5km northwest of the centre of Parbold.
- 1.3 The proposed development comprises a solar PV array with a total installed capacity of 15.12 MW. PV arrays would be ground mounted and erected in multiple rows. They are not expected to exceed 3m in height.
- 1.4 Site access will utilise the existing field access to the south-west corner of the development, off Deans Lane and a new access track would run northwards, through the centre of the site. The development will require the installation of 14 inverter cabins, a substation, a switchroom and a communications building. The site will be secured by the erection of 2.4m high security fencing, within the field boundary.
- 1.5 The development is expected to be operational for 25 years. At the end of this period, the development would be dismantled and the site restored to arable land or an application would be submitted to extend the life of the development. For the purposes of this report, it has been assumed that the development would be dismantled and the site restored.

Works within the designated site

- 1.6 No works are scheduled to take place within internationally designated sites.

Timescale

- 1.7 No fixed construction timetable has been defined at this stage however, it is envisaged that all construction works will take place during the summer months in order to avoid causing a negative effect to overwintering wildfowl.

Scope of the Project

- 1.6 There is no pre-defined guidance that dictates the physical scope of an HRA for a project such as the solar farm facility at Tawdside Farm. This is due to there being very little previous studies regarding the effects of solar farms on qualifying features of internationally designated sites. Three documents have been taken into consideration when actioning work and surveys; Solar Energy RSPB Policy Briefing December 2014 and Wind Turbines (RSPB 2014), BRE National Solar Centre Biodiversity Guidance for Solar Developments (BRE 2014) and Sensitive Bird Population and Peat Soils: A Spatial Planning guide for on-shore wind farms developments in Lancashire, Cheshire, Greater Manchester and Merseyside (RSPB et al 2008). While the latter does not directly consider the effect of solar farms upon qualifying features of designated sites this document is referenced by Natural England as the relevant reference document in relation to this project (Camilla Davidge (Natural England) email to Therese Maguire (West Lancashire Borough Council) on 26th September 2014). In considering the physical scope of the assessment, we were guided primarily by the identified impact pathways rather than by arbitrary 'zones'. Current guidance suggests that the following aspects of a proposed development which may affect a European site be included in the scope of assessment:

- All works within the designated site boundary; and
- Construction and operational phases of the development outwith designated site boundary but linked through a known 'pathway' (discussed below).

- 1.7 Briefly, defined pathways are routes by which a change in activity within the project scope can lead to an effect upon a European site. Due to the scale and nature of this project it is considered that Martin Mere (SPA and, RAMSAR), Sefton Coast (SAC) and Ribble and Alt estuaries (SPA and, RAMSAR) could be affected by the works being

undertaken at the site. This is due to the fact that the site is located within 5km of the designated sites and has the potential to have a significant effect on qualifying features of these sites (either alone or in combination with other plans or projects) and is not directly connected with or necessary to the management of the European site.

Site description

- 1.8 All natural habitats within the proposed solar farm are described within the Preliminary Ecological Appraisal (PEA) (WA 2014) and summarised in Table 1, together with an indication of their Biodiversity Action Plan (BAP) status, according to the definitions given in UK BAP Priority Habitat Descriptions (Anon 2008 updated 2010) and within the LBAP for Lancashire.

Table 1: Habitat Description and Evaluation

Phase 1 Habitats	UK BAP	LBAP
<p>Intact hedgerow - Species poor (T2)</p> <p>Well maintained, species poor, intact hedgerows were recorded in the site, dominated by hawthorn <i>Crataegus monogyna</i>, with bramble <i>Rubus fruticosus</i>, blackthorn <i>Prunus spinosa</i>, elder <i>Sambucus nigra</i> and occasional dog-rose <i>Rosa canina</i>.</p>	✓	X
<p>Ditches (T3)</p> <p>A ditch is located adjacent to the field boundary between the two fields. It was not possible to view the ditch fully due to the presence of dense vegetation along the embankments. Common reed <i>Phragmites australis</i> and soft rush <i>Juncus effusus</i> were recorded in the ditch. The ditch adjoins the River Douglas to the north of the site.</p>	X	X
<p>Tall Ruderal (T4)</p> <p>A tall ruderal buffer strip was recorded beneath the hedgerows in the site and adjacent to the ditch and both the embankments of the River Douglas and the River Tawd. Measuring approximately 1 – 4m, species included bramble, common nettle <i>Urtica dioica</i>, common hogweed <i>Heracleum sphondylium</i>, broadleaved dock <i>Rumex obtusifolius</i>, yarrow <i>Achillea millefolium</i>, creeping buttercup <i>Ranunculus repens</i>, spear thistle <i>Cirsium vulgare</i>, rosebay willowherb <i>Chamerion angustifolium</i>, great willowherb <i>Epilobium hirsutum</i> and cleaver <i>Galium aparine</i>. Grass species present within this habitat included Yorkshire fog <i>Holcus lanatus</i>, creeping bent <i>Agrostis stolonifera</i> and false oat-grass <i>Arrhenatherum elatius</i>.</p> <p>Abandoned clay pipes were located in the tall ruderal vegetation, adjacent to the River Douglas, at the eastern end of the ditch.</p>	X	X
<p>Rivers (T5a and T5b)</p> <p>The River Douglas abuts the northern boundary of the site and the River Tawd abuts the western boundary of the site. The River Tawd joins the River Douglas at the north western corner of the site. It was not possible to access either river due to dense vegetation along the embankments of both rivers.</p>	✓	✓
<p>Scattered broadleaved Trees (T8)</p>	X	X

Phase 1 Habitats	UK BAP	LBAP
<p>The northern and western boundaries of the arable fields were characterised by scattered broadleaved trees with the dominant species being ash <i>Fraxinus excelsior</i>, alder <i>Alnus glutinosa</i> and hawthorn, with occasional sycamore <i>Acer pseudoplatanus</i>, willow <i>Salix</i> spp. and elder also present.</p> <p>The trees recorded were only visible from within the site, with full access to each tree not possible due to dense vegetation and steep embankments. As such the trees were assessed as groups rather than as individual trees. The trees adjacent to the River Douglas were generally immature specimens. The trees adjacent to the River Tawd were semi-mature and mature. Two dead semi-mature trees (T7 and T10) were recorded along the western edge of the site, adjacent to the River Tawd.</p>		
<p>Invasive species (T9 and T11)</p> <p>Two stands of Japanese knotweed <i>Fallopia japonica</i> (T9) were recorded on the embankment of the River Tawd and Himalayan balsam <i>Impatiens glandulifera</i> (T11) was recorded in the tall ruderal habitat adjacent to the ditch, the River Douglas and the River Tawd.</p>	X	X
<p>Arable Fields (TN12)</p> <p>Arable crops were present in all three fields within the site, comprising wheat and barley crops.</p>	✓	✓
<p>Dense scrub</p> <p>A patch of dense scrub was situated at the base of a pylon in the site. Species present included hawthorn and elder.</p>	X	X

Wintering Bird Survey

- 1.9 In addition to the extended phase 1 habitat survey of the site a detailed wintering bird survey was undertaken from October 2014 to March 2015 (WA 2015). This survey was undertaken in recognition of the fact that the proposed development site is located on the boundary of the alert area for pink footed geese associated with internationally designated sites highlighted above. Field survey methods were based upon, and adapted from generic wintering bird monitoring methods given in Gilbert et al. (1998), details of which are presented within the wintering bird survey report (WA 2015). Table 2 provides an overview of key species recorded throughout the wintering bird surveying season which are sensitive to development. The table also gives an overview of the survey method alongside activity of the bird and location of the record.
- 1.10 In addition to the above a review of Wetland Bird Survey (WeBS) data was undertaken. Table 3 presents five years' worth of data records for key wintering bird species associated with the designated sites and illustrates the annual species counts for each year including the peak month and the 5year average. Bewick's swans are omitted from this data review due to the fact that this species has not been recorded during wintering bird surveys.

This data has been used in comparison to data collected during wintering bird surveys undertaken during 2014/2015.

Table 2: Bird Species and Records

Month	Survey	Dusk/Dawn	Species	Number of Individuals	Activity	Direction / Location	Onsite / Offsite
March 2015	Vantage Point	Dawn	-	-	-	-	-
	Vantage Point	Dusk	-	-	-	-	-
	Walking Transect	Morning	-	-	-	-	-
	Drive Around Survey		Pink-footed geese	36	Field	Martin Mere	
			Pink-footed geese	87	Field	3.5KM south east	
February 2015	Vantage Point	Dawn	Pink footed geese	31	Flight	South East – Landed in field c.3.5km North West	Offsite
	Vantage Point	Dusk	-	-	-	-	-
	Walking Transect	Morning	-	-	-	-	-
	Drive Around Survey	Day	Whooper swan	53	Field	c.2.2km North West	Offsite
		Whooper swan	141	Field	c.1.8km West	Offsite	
		Pink-footed geese	59	Field	c.1.8km West	Offsite	
		Pink-footed geese	12	Flight	North West – c.3.5km South West	Offsite	
January 2015	Vantage Point	Dawn	Pink-footed geese	500	Flight	North West – Landed in field c.1.5km North	Offsite
			Pink-footed geese	200	Flight	North West – Landed in field c.1.5km North	Offsite
	Vantage Point	Dusk	-	-	-	-	-
	Walking Transect	Morning	Pink-footed geese	250	Flight	North West	Offsite
			Pink-footed geese	110	Flight	North West	Offsite
		Pink-footed geese	40	Flight	North West	Offsite	

			Pink-footed geese	30	Flight	North West	Offsite
	Drive Around Survey	Day	Pink-footed geese	1200+	Field	Field - c.1.5 North	Offsite
				17	Field	Flooded field – c.2km West	Offsite
December	Vantage Point	Dawn	Pink-footed geese	400+	Flight	North 1km	Offsite
	Vantage Point	Dusk	-	-	-	-	-
	Walking Transect	Dawn	Whooper swan	2	Flight	South and North West	Offsite
	Drive Around Survey	Day	Whooper swan	25+	Field	Flooded field –c.1.5km North	Offsite
			Whooper swan	82	Field	Flooded field – c.2.5km North	Offsite
			Whooper swan	60	Field	Flooded field – c.2.5km North West	Offsite
			Whooper swan	10	Field	Flooded field – c.3km North West	Offsite
			Pink-footed geese	200+	Flight	c.5km North West	Offsite
			Pink-footed geese	30	Flight	c.3km East	Offsite
			Pink Footed-geese	30	Field	c.3.5km East	Offsite
November	Vantage Point	Dawn	Pink Footed Geese	55	Flight	West – Flying North West	Offsite
			Pink-footed geese	100	Flight	East – Flying South. Landed c.2-2.5km South	Offsite
			Whooper swan	5	Flight	West	Offsite
			Whooper swan	4	Flight	North – North West	Offsite
	Vantage Point	Dusk	-	-	-	-	-

	Walking Transect	Dawn	-	-	-	-	-
	Drive Around Survey	Day	Whooper swan	400+	Field	c.1.5 -2km North East	Offsite.
October	Vantage Point	Dawn	Pink-footed geese	12	Flight	South West	Offsite
	Vantage Point	Dusk	Whooper swan	46	Flight	East	Offsite
			Whooper swan	15	Flight	East	Offsite
	Walking Transect	Dawn	Whooper swan	1	Flight	South West	Offsite
	Drive Around Survey	Day	Pink-footed geese	134	Field	Martin Mere	Offsite
			Whooper swan	5	Field	Martin Mere	Offsite

Table 3: Bird 5 year data count

Martin Mere (SPA & RAMSAR) - Annual Peaks							
Species	Year 08/09	Year 09/10	Year 10/11	Year 11/12	Year 12/13	Month	5yr Average
Whooper Swan	1,600	1,654	1,800	1,530	1,600	February	1,637
Pink-footed geese	17,000	16,000	12,200	16,000	11,700	September	14,580
Ribble and Alt Estuaries (SPA & RAMSAR) - Annual Peaks							
Species	Year 08/09	Year 09/10	Year 10/11	Year 11/12	Year 12/13	Month	5yr Average
Whooper Swan	137	203	192	180	616	December	266
Pink-footed geese	14,697	12,783	17,160	24,554	8,217	October	15,482

2 CURRENT LEGISLATION

- 2.1 The need for an assessment of impacts on Natura 2000 sites is set out within Article 6 of the EC Habitats Directive 1992, and interpreted into British law by the Conservation of Habitats and Species Regulations 2010. The ultimate aim of the Directive is to “maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest” (Habitats Directive, Article 2(2)). This aim relates to habitats and species, not the European sites themselves, although the sites have a significant role in delivering favourable conservation status.
- 2.2 The Habitats Directive applies the precautionary principle to European sites. Plans and projects can only be permitted having ascertained that there will be no adverse effect on the integrity of the site(s) in question. Plans and projects with predicted adverse impacts on European sites may still be permitted if there are no alternatives to them and there are Imperative Reasons of Overriding Public Interest (IROPI) as to why they should go ahead. In such cases, compensation would be necessary to ensure the overall integrity of the site network.
- 2.3 In order to ascertain whether or not site integrity will be affected, an assessment should be undertaken of the plan or project in question. While the competent authority (e.g. Natural England) makes the formal decision as to whether adverse effects will result, they are entitled to request the applicant to produce necessary information to assist them. That is the purpose of this report.

Box 1. The legislative basis for Appropriate Assessment

Habitats Directive 1992

Article 6 (3) states that:

“Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site’s conservation objectives.”

Conservation of Habitats and Species Regulations 2010

The Regulations state that:

“A competent authority, before deciding to ... give any consent for a plan or project which is likely to have a significant effect on a European site ... shall make an appropriate assessment of the implications for the site in view of that sites conservation objectives... The authority shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site”.

2.4 O

Over the years the phrase ‘Habitats Regulations Assessment’ (HRA) has come into wide currency to describe the overall process set out in the Conservation of Habitats and Species Regulations from screening through to Imperative Reasons of Overriding Public Interest (IROPI). This has arisen in order to distinguish the process from the individual stage described in the law as an ‘appropriate assessment’. Throughout this report we use the term Habitat Regulations Assessment for the overall process and restrict the use of Appropriate Assessment to the specific stage of that name.

3 METHODOLOGY

3.1 Habitats Regulations Assessment of projects can be broken down into three discrete stages, each of which effectively culminates in a test. The stages are sequential, and it is only necessary to progress to the following stage if a test is failed. The stages are:

Stage 1 – Likely Significant Effect Test

This is essentially a risk assessment, typically utilising existing data, records and specialist knowledge. The purpose of the test is to decide whether ‘full’ Appropriate Assessment is required. The essential question is:

“Is the project, either alone or in combination with other relevant projects and plans, likely to result in a significant [adverse] effect upon European sites?”

If it can be demonstrated that significant effects are unlikely, no further assessment is required.

Stage 2 – Appropriate Assessment

If it cannot be satisfactorily demonstrated that significant effects are unlikely, a full “Appropriate Assessment” will be required. In many ways this is analogous to an Ecological Impact Assessment, but is focussed entirely upon the designated interest features of the European sites in question. Bespoke survey work and original modelling and data collation are usually required. The essential question here is:

“Will the project, either alone or in combination with other relevant projects and plans, actually result in an adverse effect upon the integrity of any European sites, without mitigation?”

If it is concluded that adverse effects will occur, measures will be required to either avoid the impact in the first place, or to mitigate the ecological effect to such an extent that it is no longer significant. Note that, unlike standard Ecological Impact Assessment, compensation for adverse effects (i.e. creation of alternative habitat) is not permitted at the Appropriate Assessment stage.

Stage 3 – Imperative Reasons of Overriding Public Interest (IROPI) Test

If a project will have a significant adverse effect upon a European site, and this effect cannot be either avoided or mitigated, the project cannot proceed unless it passes the IROPI test. In order to pass the test it must be objectively concluded that no alternative solutions exist. The project must be referred to Secretary of State on the

grounds that there are Imperative Reasons of Overriding Public Interest as to why the plan should nonetheless proceed.

- 3.2 This report deals with the first stage of Habitat Regulations Assessment – the Likely Significant Effect Test.

Confirming Other Plans and Projects That May Act In Combination

- 3.3 It is a requirement of the Regulations that the impacts of any land use plan being assessed are not considered in isolation but in combination with other plans and projects that may also be affecting the European site(s) in question.

- 3.4 The principal other plans and projects have been chosen for consideration in combination with this project due to their location in relation to the works area within west Lancashire and their potential effect upon the designated site. Documents and data sources used to inform this HRA are:

- West Lancashire Local Plan 2012 - 2027 (July 2014);
- Wind turbines, Sensitive Bird populations and Peat Soil: A spatial Planning Guide for on-shore wind farm developments in Lancashire, Cheshire, Greater Manchester and Merseyside (RSPB 2008);
- West Lancashire Planning Portal (in order to locate planning applications for proposed solar farm and wind farm developments within West Lancashire);
- And Nature on the Map and its links to internationally designated site citations (www.natureonthemap.org.uk).

4 PATHWAYS OF IMPACT

4.1 In carrying out an HRA it is important to determine the various ways in which the project in question can impact on European sites by following the pathways along which development can be connected with those sites, in some cases many kilometres distance. Briefly defined, pathways are routes by which a change in activity associated with a development can lead to an effect upon a European site. Due to the nature of the site and the lack of previous study/surveys undertaken on solar farm sites it is important to highlight the possible implications that the proposed works may have on such pathways.

Effects of solar farms on wintering birds

4.2 There is little evidence for fatal consequences associated with solar farms and birds due to the lack of monitoring and lack of site developments requiring such surveys. However, it cannot be disregarded that any fixed objects can create a boundary and therefore cause potential hazard to collision risk. The overhead wires and designs should also be carefully constructed as these could cause flight path issues and electric issues. Mitigation such as bird deflectors may be required, there is also opportunity to enhance the habitats by adding alternative perches and foraging grounds. As the solar farms are a relatively new development there is much scope to monitor the impacts and mitigations that takes place post development.

In addition to the above, solar farm carry the potential to cause burn injuries when birds look to perch or fly close to the panels and when foraging in close proximity. However, detailed research regarding such effects within the UK are yet to provide a solid evidence base for use within assessments such as Habitats Regulations Assessment.

Effects of disturbance on wintering/migratory birds

The potential for disturbance may be less in late summer/early autumn and winter than in summer, in that there are often a smaller number of recreational users. In addition, the consequences of disturbance at a population level may be reduced because birds are not breeding. However, late summer/early autumn winter activity can still cause important disturbance, especially as birds are particularly vulnerable at this time of year due to food shortages, such that disturbance which results in abandonment of suitable feeding areas through disturbance can have severe consequences. Several empirical studies have, through correlative analysis,

demonstrated that out-of-season (October-March) recreational activity can result in quantifiable disturbance :

- Underhill et al¹ counted waterfowl and all disturbance events on 54 water bodies within the South West London Water bodies Special Protection Area and clearly correlated disturbance with a decrease in bird numbers at weekends in smaller sites and with the movement of birds within larger sites from disturbed to less disturbed areas.
- Evans & Warrington² found that on Sundays total water bird numbers (including shoveler and gadwall) were 19% higher on Stocker's Lake LNR in Hertfordshire, and attributed this to displacement of birds resulting from greater recreational activity on surrounding water bodies at weekends relative to week days.
- Eileen et al 2006 found that disturbance thresholds for whooper swan varied considerably during the course of a 3 year study depending upon the type and frequency of disturbance events along with the size of the flock present in association with disturbance events.
- In a three-year study of wetland birds at the Stour and Orwell SPA, Ravenscroft³ found that walkers, boats and dogs were the most regular source of disturbance. Despite this, the greatest responses came from relatively infrequent events, such as gun shots and aircraft noise. Birds seemed to habituate to frequent 'benign' events such as vehicles, sailing and horses, but there was evidence that apparent habituation to more disruptive events related to reduced bird numbers – i.e. birds were avoiding the most frequently disturbed areas. Disturbance was greatest at high tide and on the Orwell, but birds on the Stour showed greatest sensitivity.

It is recognised that some of the above studies may not directly correlate to the proposed solar farm development however, the potential effects of disturbance

1 Underhill, M.C. *et al.* 1993. Use of Waterbodies in South West London by Waterfowl. An Investigation of the Factors Affecting Distribution, Abundance and Community Structure. Report to Thames Water Utilities Ltd. and English Nature. Wetlands Advisory Service, Slimbridge

2 Evans, D.M. & Warrington, S. 1997. The effects of recreational disturbance on wintering waterbirds on a mature gravel pit lake near London. *International Journal of Environmental Studies* 53: 167-182

3 Ravenscroft, N. (2005) Pilot study into disturbance of waders and wildfowl on the Stour-Orwell SPA: analysis of 2004/05 data. Era report 44, Report to Suffolk Coast & Heaths Unit.

effects such as vehicular movement is considered likely to relate to the effects of the construction phase of the proposed development.

Direct Landtake

Land take from European sites can result in adverse effects if it is sufficiently extensive to affect the structure and function (i.e. the integrity) of that site. In some cases any landtake at all may affect the functionality of the site, in other cases the scale of landtake may be sufficiently small that it will not do so, and/or may affect an area of the site which is less important for the functioning of the site. Moreover, 'landtake' may have a positive effect if it concerns replacing a habitat of lesser value for the integrity of the site with one of a higher value. The removal of any habitats to facilitate this project is considered within this HRA.

Disturbance - Mechanical/abrasive damage

Most types of terrestrial European sites can be affected by trampling, which in turn causes soil compaction and erosion. Walkers with dogs contribute to pressure on sites through nutrient enrichment via dog fouling and also have potential to cause greater disturbance to fauna as dogs are less likely to keep to marked footpaths and move more erratically. Off-road vehicle use can cause serious erosion, as well as disturbance to sensitive species.

There have been several papers published that empirically demonstrate that damage to vegetation in woodlands and other habitats can be caused by vehicles, walkers, horses and cyclists:

- Wilson & Seney (1994)⁴ examined the degree of track erosion caused by hikers, motorcycles, horses and cyclists from 108 plots along tracks in the Gallatin National Forest, Montana. Although the results proved difficult to interpret, It was concluded that horses and hikers disturbed more sediment on wet tracks, and therefore caused more erosion, than motorcycles and bicycles.
- Cole et al (1995a, b)⁵ conducted experimental off-track trampling in 18 closed forest, dwarf scrub and meadow and grassland communities

⁴ Wilson, J.P. & J.P. Seney. 1994. Erosional impact of hikers, horses, motorcycles and off road bicycles on mountain trails in Montana. *Mountain Research and Development* 14:77-88

⁵ Cole, D.N. 1995a. Experimental trampling of vegetation. I. Relationship between trampling intensity and vegetation response. *Journal of Applied Ecology* 32: 203-214

Cole, D.N. 1995b. Experimental trampling of vegetation. II. Predictors of resistance and resilience. *Journal of Applied Ecology* 32: 215-224

(each tramped between 0 – 500 times) over five mountain regions in the US. Vegetation cover was assessed two weeks and one year after trampling, and an inverse relationship with trampling intensity was discovered, although this relationship was weaker after one year than two weeks indicating some recovery of the vegetation. Differences in plant morphological characteristics were found to explain more variation in response between different vegetation types than soil and topographic factors. Low-growing, mat-forming grasses regained their cover best after two weeks and were considered most resistant to trampling, while tall forbs (non-woody vascular plants other than grasses, sedges, rushes and ferns) were considered least resistant. Cover of hemicryptophytes and geophytes (plants with buds below the soil surface) was heavily reduced after two weeks, but had recovered well after one year and as such these were considered most resilient to trampling. Chamaephytes (plants with buds above the soil surface) were least resilient to trampling. It was concluded that these would be the least tolerant of a regular cycle of disturbance.

- Cole (1995c)⁶ conducted a follow-up study (in 4 vegetation types) in which shoe type (trainers or walking boots) and trampler weight were varied. Although immediate damage was greater with walking boots, there was no significant difference after one year. Heavier trampers caused a greater reduction in vegetation height than lighter trampers, but there was no difference in effect on cover.

While the above studies focus on the effects of trampling and vehicle use in woodland habitats, and therefore do not directly relate to habitats of the designated sites associated with this HRA, the principals of erosion through public pressure are similar and therefore can be applied to this project.

⁶ Cole, D.N. (1995c) Recreational trampling experiments: effects of trampler weight and shoe type. Research Note INT-RN-425. U.S. Forest Service, Intermountain Research Station, Utah.

5 DESIGNATED SITES

5.1 Internationally designated sites associated with this project are discussed below.

Martin Mere (SPA & RAMSAR)

Martin Mere is located north of Ormskirk in West Lancashire, north-west England. It occupies part of a former lake and mire that extended over some 1,300 ha of the Lancashire Coastal Plain during the 17th century. The complex comprises open water, seasonally flooded marsh and damp, neutral hay meadows overlying deep peat. It includes a wildfowl refuge of international importance, with a large and diverse wintering, passage and breeding bird community. In particular, there are significant wintering populations of Bewick's Swan *Cygnus Columbianus bewickii* and Whooper Swan *Cygnus cygnus*, Pink-footed Goose *Anser brachyrhynchus* and Pintail *Anas acuta*. There is considerable movement of wintering birds between this site and the nearby Ribble and Alt Estuaries SPA

Designation qualifying features:

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

Over winter;

- Bewick's Swan *Cygnus columbianus bewickii*, 449 individuals representing at least 6.4% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).
- Whooper Swan *Cygnus cygnus*, 621 individuals representing at least 11.3% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Over winter;

- Pink-footed Goose *Anser brachyrhynchus*, 25,779 individuals representing at least 11.5% of the wintering Eastern Greenland/Iceland/UK population (5 year peak mean 1991/2 - 1995/6).
- Pintail *Anas acuta*, 978 individuals representing at least 1.6% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6).

Assemblage qualification: A wetland of international importance.

The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl.

Over winter, the area regularly supports 46,196 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Pochard *Aythya ferina*, Mallard *Anas platyrhynchos*, Teal *Anas crecca*, Wigeon *Anas penelope*, Pintail *Anas acuta*, Pink-footed Goose, Whooper Swan *Cygnus cygnus*, Bewick's Swan.

(Source: JNCC – Martin Mere, 2015)

Sefton Coast (SAC)

The Sefton Coast lies between the estuaries of the Mersey and Ribble in north-west England. The sand dunes, beaches and marshes of the Sefton Coast are one of the most important areas for nature conservation in Europe. The Sefton Coast is also an important visitor destination with popular bathing beaches, open countryside, and the seaside resort of Southport.

Designation qualifying features:

Tidal rivers, estuaries, mud flats, sand flats, lagoons (including saltwork basins) (50%) coastal sand dunes, sand beaches, machair (30%) heath, scrub, maquis and garrigue, phygrana (10%) coniferous woodland (10%).

Annex I habitats that are a primary reason for selection of this site:

- 2110 Embryonic shifting dunes.
- 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes).
- 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes).
- Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*).
- 2190 Humid dune slacks.

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site:

- 2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*).

Annex II species that are a primary reason for selection of this site:

- 1395 Petalwort *Petalophyllum ralfsii*: A large population of petalwort

Petalophyllum ralfsii occurs at Sefton Coast, the only site chosen for this species in north-west England. The plant was first recorded on the Sefton Coast at Ainsdale in 1861 and it is still found within the dune system between Southport and Ainsdale. It seems to prefer damp ground around the edges of dune slacks of fairly recent origin, with the largest populations found in slacks of less than 25 years old. The plant is often found in association with footpaths, where light trampling keeps the ground vegetation sparse; infrequently-used paths or less-trampled edges of pathways seem to be favoured. Although the preferred habitat is short damp turf with plenty of bare patches, populations have been found growing amongst dense marram with few other associated species.

- Source: JNCC Sefton Coast, 2015. Sefton Coast Partnership 2015)

Ribble and Alt Estuaries (SPA, RAMSAR)

The Ribble and Alt Estuaries SPA lies on the coast of Lancashire and Merseyside in north-west England. It comprises two estuaries, of which the Ribble Estuary is by far the larger, together with an extensive area of sandy foreshore along the Sefton Coast. It forms part of the chain of western SPAs that fringe the Irish Sea. There is considerable interchange in the movements of wintering birds between this site and Morecambe Bay, the Mersey Estuary, the Dee Estuary and Martin Mere. A large proportion of the SPA is within the Ribble Estuary National Nature Reserve. The site consists of extensive sand- and mud-flats and, particularly in the Ribble Estuary, large areas of saltmarsh. There are also areas of coastal grazing marsh located behind the sea embankments. The intertidal flats are rich in invertebrates, on which waders and some of the wildfowl feed. The highest densities of feeding birds are on the muddier substrates of the Ribble, though sandy shores throughout are also used. The saltmarshes and coastal grazing marshes support high densities of grazing and seed-eating wildfowl and these, together with the intertidal sand- and mud-flats, are used as high-tide roosts. Important populations of waterbirds occur in winter, including swans, geese, ducks and waders. The SPA is also of major importance during the spring and autumn migration periods, especially for wader populations moving along the west coast of Britain. The larger expanses of saltmarsh and areas of coastal grazing marsh support breeding birds during the summer, including large concentrations of gulls and terns. These seabirds feed both offshore and inland, outside the SPA. Several species of waterbirds (notably Pink-footed Goose) utilise feeding areas on agricultural land outside the SPA boundary.

Designation qualifying features:

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season;

- Common Tern *Sterna hirundo*, 182 pairs representing at least 1.5% of the breeding population in Great Britain (Count, as at 1996).
- Ruff *Philomachus pugnax*, 1 pairs representing at least 9.1% of the breeding population in Great Britain (Count as at late 1980's).

Over winter;

- Bar-tailed Godwit *Limosa lapponica*, 18,958 individuals representing at least 35.8% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).
- Bewick's Swan *Cygnus*, 229 individuals representing at least 3.3% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).
- Golden Plover *Pluvialis apricaria*, 4,277 individuals representing at least 1.7% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).
- Whooper Swan, 159 individuals representing at least 2.9% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6).

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

During the breeding season;

- Lesser Black-backed Gull *Larus fuscus*, 1,800 pairs representing at least 1.5% of the breeding Western Europe/Mediterranean/Western Africa population (Count, as at 1993).

On passage;

- Ringed Plover *Charadrius hiaticula*, 995 individuals representing at least 2.0% of the Europe/Northern Africa - wintering population (5 year peak mean 1991/2 - 1995/6).

- Sanderling *Calidris alba*, 6,172 individuals representing at least 6.2% of the Eastern Atlantic/Western & Southern Africa - wintering population (3 year mean May 1993 - 1995).

Over winter;

- Black-tailed Godwit *Limosa limosa islandica*, 819 individuals representing at least 1.2% of the wintering Iceland - breeding population (5 year peak mean 1991/2 - 1995/6).
- Dunlin *Calidris alpina alpina*, 39,952 individuals representing at least 2.9% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6).
- Grey Plover *Pluvialis squatarola*, 6,073 individuals representing at least 4.0% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6).
- Knot *Calidris canutus*, 57,865 individuals representing at least 16.5% of the wintering North Eastern Canada/Greenland/Iceland/North Western Europe population (5 year peak mean 1991/2 - 1995/6).
- Oystercatcher *Haematopus ostralegus*, 16,159 individuals representing at least 1.8% of the wintering Europe & Northern/Western Africa population (5 year peak mean 1991/2 - 1995/6).
- Pink-footed Goose *Anser brachyrhynchus*, 23,860 individuals representing at least 10.6% of the wintering Eastern Greenland/Iceland/UK population (5 year peak mean 1991/2 - 1995/6).
- Pintail *Anas acuta*, 3,333 individuals representing at least 5.6% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)
- Redshank *Tringa totanus*, 2,708 individuals representing at least 1.8% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6).
- Sanderling *Calidris alba*, 2,859 individuals representing at least 2.9% of the wintering Eastern Atlantic/Western & Southern Africa - wintering population (5 year peak mean 1991/2 - 1995/6).

- Shelduck *Tadorna tadorna*, 4,103 individuals representing at least 1.4% of the wintering North Western Europe population (5 year peak mean 1991/2 - 1995/6).
- Teal *Anas crecca*, 7,641 individuals representing at least 1.9% of the wintering North Western Europe population (5 year peak mean 1991/2 - 1995/6).
- Wigeon *Anas penelope*, 84,699 individuals representing at least 6.8% of the wintering Western Siberia/North Western/North Eastern Europe population (5 year peak mean 1991/2 - 1995/6).

(Source: JNCC, Ribble and Alt Esuaries, 2015).

Likely Significant Effect Test

Table 4 indicates the aspects of the proposed scheme that could in theory create adverse effects on the qualifying features of the designated site. Consideration of interactions with other projects and plans takes place in Section 6.

Table 4. Evaluation of likely Significant Effects of the proposed development		
Aspect of Scheme Assessed	Potential Pathways of Impact	HRA Assessment regarding Likely Significant Effects
Undertaking enabling and construction works within the site.	Direct loss and degradation of qualifying features (habitats) as a result of works	<p>The proposed development site will not be located within the boundary of the designated site. The nearest designated site (Martin Mere) is located approximately 5.2KM. It is therefore considered highly unlikely that the proposed development will result in the direct or indirect loss and/or degradation of habitats which form qualifying features for such sites.</p> <p>Therefore the findings of the HRA are that the activity can be screened out as being likely to have a significant effect on the integrity of the designated sites.</p>
<p>Undertaking enabling and construction works within the site. Timing as follows:</p> <p>October - March (inclusive).</p>	Disturbance of species relevant to the designated site – wintering wildfowl.	<p>Construction works will aim to avoid the wintering bird period and will take place from April - September on the year of construction. Should construction works extend into the wintering bird season it is considered highly unlikely that this phase of works will result in the disturbance of wintering whoopers swan, Bewick's swan or pink footed geese. This is due to the fact that the results of the wintering bird surveys on site indicate that none of the qualifying features of the designated sites used the proposed development site for foraging resting or loafing during the winter period. The closest record of qualifying species during surveys was noted in February (500m north west from the site boundary). When such results are compared to data gathered during drive around surveys and Wetland Bird Survey (WeBS) core counts for the designated sites highlighted above this indicates that habitats within and immediately surrounding the proposed development are of limited interest to qualifying species of wintering waterfowl in comparison to areas associated with the designated sites.</p> <p>It is considered likely than in the short term construction activities may have an adverse effect on qualifying species. However, a study of the effects of disturbance on whopper swans over a 3 year period determined that this species is unlikely to be disturbed by farm traffic or construction vehicles at a distance greater than 500m (Scottish Natural Heritage 2006), in addition this study indicates that</p>

		<p>whooper swans become less sensitive to disturbance with increased frequency. In addition, numerous studies undertaken in relation to disturbance and displacement of geese (including pink-footed geese) (Larsen & Madsen, 2000 and Birdlife International 2003) indicate that flocks of such birds can be disturbed or avoid areas of disturbance at distances between 250- 600m (however, some degree of habituation to disturbance events may occur in the long term).</p> <p>It is therefore considered that in the short term the construction phase may cause disturbance to foraging qualifying features using arable fields within 500m of the site. However, such disturbance is considered likely to be temporary as swans and geese become accustomed to daily activities and therefore reduce alert and abandonment behavior in relation to construction activities. In addition any whooper swans, pink-footed geese or Bewick’s swans foraging beyond 500m are highly unlikely to be disturbed during the construction phase of the proposed development.</p> <p>Therefore the finding of the HRA is that disturbance to nesting birds which form qualifying features of the designated site can be screened out as being likely to have a significant effect on the integrity of the designated site.</p>
Operational phase of the proposed development	Loss of foraging and roosting/loafing habitat (arable land) likely to be used by qualifying species of the designated sites.	<p>The wintering bird survey undertaken during 2014 to 2015 has determined that although suitable habitat exists within the proposed development site, foraging, roosting and loafing activity by qualifying features of the designated sites has not been recorded within the site and its immediate environs. This indicates that habitats within and immediately surrounding the proposed development are of limited interest to qualifying species of wintering waterfowl in comparison to the designated sites. It is therefore considered that the permanent loss of suitable habitat within the proposed development site is unlikely to have any significant effect upon the qualifying species.</p> <p>Therefore the finding of the HRA is that loss of foraging, roosting and loafing habitat for wintering wildfowl which form qualifying features of the designated sites can be screened out as being likely to have a significant effect on the integrity of the designated sites.</p>

Operational phase of the proposed development	Disturbance to wintering wildfowl	<p>The proposed development site will have no moving parts, produce no audible sound and have no continued site operative presence. Site maintenance will be carried out periodically throughout the year however this will be timed to avoid the wintering bird season where ever possible. In the event that maintenance is required during the winter months this would be performed using small scale vehicles (no more than 5 tonne) and would be undertaken within a short time frame in order to ensure the site remains as productive as possible during its operational phase.</p> <p>Therefore the finding of the HRA is that disturbance to wintering birds which form qualifying features of the designated site can be screened out as being likely to have a significant effect on the integrity of the designated site.</p>
Operation phase of the proposed development	Creation of barrier to commuting and/or migrating wintering birds.	<p>The wintering bird surveys undertaken during 2014 – 2015 recorded minimal flyover events indicating that the majority of the migrant population of whooper swans and pink-footed geese were concentrated to the north west of the site at Martin Mere. As the site is not located between Martin Mere and any of the international designated sites it is considered highly unlikely that the proposed development is likely to act as a barrier to movement between designated sites.</p> <p>While the proposed development site is located beyond the boundary of sensitivity areas for qualifying species it is noted that it is situated between the north west and southern most sensitivity area for pink-footed geese. It is recognised that there may be some interchange of flocks of pink-footed geese between these sensitivity areas over the course of the winter period, however the proposed development site is considered unlikely to cause a barrier to movement of this species. This is due to the fact that the proposed development will be low lying with a maximum height of 2.33m with no moving parts or above ground cable installations. In addition the construction phase of the development will involve the sowing of wildflower seed mix between panels which will then be managed to form a wildflower grassland habitat during the operational phase of the development. Such habitat is considered poor quality foraging habitat for pink-footed geese and whooper swans in comparison the surrounding arable landscape. The risk of collision between flying pink-footed geese and solar panels</p>

	<p>within the proposed development is therefore considered negligible.</p> <p>It is recognised that the proposed development will be visible from the air for a considerable distance and that this change in the local landscape may affect direction of flying geese or swans in the short term. However, given the size of the proposed development in comparison to the wider environment incorporated into sensitivity areas for each qualifying species it is considered unlikely that the proposed development will cause any significant alteration in flight patterns of qualifying species in the long term. In addition it is considered likely that as the site matures over the course of the operational phase that qualifying species will become accustomed to the proposed development as part of the landscape therefore any changes to flight pattern which occur in the short term are unlikely to have any significant long-term effect.</p> <p>Therefore the finding of the HRA is that the operational solar farm is unlikely to have any long-term effect on migrating/commuting for wintering wildfowl which form qualifying features of the designated sites can be screened out as being likely to have a significant effect on the integrity of the designated sites.</p>
--	--

6 IN COMBINATION' CONSIDERATION OF OTHER PLANS AND PROJECTS

6.1 The possible impacts associated with this project will be small and localised, therefore only those plans or project types which are considered likely to have similar impacts upon qualifying features of designated sites are considered within the HRA:

- West Lancashire local plan - Policy EN1: Low Carbon Development and Energy infrastructure;
- Sustainable developments in west Lancashire.

The following sections discuss these in further detail.

West Lancashire local plan

The West Lancashire local plan 2012-2027 does not appear to consider proposals for solar energy. Policy EN1: Low Carbon Development and Energy infrastructure aims to achieve 15% of energy consumption from renewable sources by 2020. This policy indicates that such energy sources will primarily come from wind farms however, the local plan provides no indication of key areas to be allocated to such development. The effects of future wind farm development in relation to this policy when considered in combination with the proposed development has therefore been omitted from this HRA.

Sustainable development in west Lancashire

The Wind turbines, sensitive Bird Populations and Peat Soils: a spatial planning guide for onshore wind farm developments in Lancashire, Cheshire and Greater Manchester and Merseyside (RSPB 2008) specifically highlights wind farms but also notes solar farms and biomass energy crops as developments that may have a negative effect upon qualifying features of the designated sites. Therefore, a search of the west Lancashire planning portal has been completed which has highlighted the presence of a number of solar farm projects which are at various stages of the planning application process. These projects have been considered in combination with the potential effects of the proposed development and are displayed in table 5. At the time of writing this HRA the West Lancashire Planning Portal did not highlight the presence of any wind farms or biomass facilities. These have therefore been omitted from the in combination assessment.

Table 5: Summary of solar farm planning applications within West Lancashire			
Site name	Planning ref	Distance from proposed development site	Within Bird sensitivity alert area? (Y/N)
Proposed solar park. Land To The East Side Of Lathom Park Lathom Lancashire	2014/0182/SCR	2km southwest	No
Proposed solar park. Land To The South-west Of Gerard Hall Prescott Road Aughton Lancashire	2014/0601/FUL	10.85km south west	No
Proposed Solar PV Project at Land West of Aughton, North East of Lydiate.	2014/1351/SCR	10.7 Km	No
Land To The North Of Pippin Street Burscough Lancashire	2014/0321/SCO	4.5km west	No
Proposed Solar PV Project at Land adjoining A570 and A5147, Scarisbrick	2014/0066/SCR	9.1km west	Yes - whooper swan
Proposed Solar PV Project at Land East of Heathfield Road, South of New Cut Lane.	2014/0067/SCR	14km	Yes – pink footed goose

It can be noted from table 5 that of the 6 proposed solar farms located within west Lancashire 4 of these are located beyond the boundaries of the sensitivity areas for all three qualifying features of the designated sites. In addition two sites are located within sensitivity areas for whopper swan and Pink-goose however these are located over 10km from the proposed development site. The west Lancashire planning portal did not provide any wintering bird information from these sites, it is therefore not possible to compare the value of such areas for wintering birds in comparison to the proposed development. However, given the location of these proposed solar farm sites (either beyond the boundaries of bird sensitivity areas or located over

10km from the proposed development site it is considered highly unlikely that the effect of proposed solar farms in West Lancashire in combination with the proposed development site would have a negative effect upon the qualifying features of the designated sites.

In addition to the above Online reviews of existing wind farm developments (www.renewableuk.com, <http://www.telegraph.co.uk/news/earth/energy/9645593/Interactive-map-every-wind-farm-site-in-the-UK.html>) indicates that there are no existing wind farm developments within sensitivity areas for whooper swans, pink-footed geese and Bewick's swans. And therefore such developments are unlikely to act in combination with the proposed solar farm. **In combination effects can therefore be screened out as being likely to have a significant effect on the integrity of the designated sites.**

7 CONCLUSIONS

- 7.1 The proposed development has been assessed as being highly unlikely to have a significant negative effect upon the above designated sites either in isolation or combination with relevant plans and projects within West Lancashire. It is therefore considered that development can proceed without the requirement for further assessment or mitigation measures which relate to qualifying features of the designated sites.

8 REFERENCES

Wardell Armstrong (2015). Tawdside Farm, Wintering Bird Survey.

Wardell Armstrong (2014). Preliminary Ecological Appraisal.

Scottish Natural Heritage (2006) White Variation in the behavioural responses of Whooper Swans *Cygnus cygnus* to different types of human activity.

Jesper Kyed Larsen* and Jesper Madsen (2000) Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): A landscape perspective

Birdlife International (2003) Windfarms and Birds : An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues.

APPENDIX 1:

Tawdside Farm, Wintering Bird Survey 2015

APPENDIX 2:

Wind turbine, Sensitive Bird Populations and Peat Soil: A Spatial Planning Guide for on-shore wind farm developments in Lancashire, Cheshire, greater Manchester and Merseyside. RSPB 2008.

STOKE-ON-TRENT
Sir Henry Doulton House
Forge Lane
Etruria
Stoke-on-Trent
ST1 5BD
Tel: +44 (0)845 111 7777

CARDIFF
22 Windsor Place
Cardiff
CF10 3BY
Tel: +44 (0)292 072 9191

EDINBURGH
Suite 2/3
Great Michael House
14 Links Place
Edinburgh
EH6 7EZ
Tel: +44 (0)131 555 3311

GREATER MANCHESTER
2 The Avenue
Leigh
Greater Manchester
WN7 1ES
Tel: +44 (0)194 226 0101

LONDON
Third Floor
46 Chancery Lane
London
WC2A 1JE
Tel: +44 (0)207 242 3243

NEWCASTLE UPON TYNE
City Quadrant
11 Waterloo Square
Newcastle upon Tyne
NE1 4DP
Tel: +44 (0)191 232 0943

SHEFFIELD
Unit 5
Newton Business Centre
Newton Chambers Road
Thorncliffe Park
Chapelton
Sheffield
S35 2PH
Tel: +44 (0)114 245 6244

TAUNTON
Suite E1
Victoria House
Victoria Street
Taunton
Somerset
TA1 3JA
Tel: +44 (0)182 370 3100

TRURO
Baldhu House
Wheal Jane Earth Science Park
Baldhu
Truro
TR3 6EH
Tel: +44 (0)187 256 0738

WEST BROMWICH
Thynne Court
Thynne Street
West Bromwich
West Midlands
B70 6PH
Tel: +44 (0)121 580 0909

International offices:

ALMATY
29/6 Satpaev Avenue
Hyatt Regency Hotel
Office Tower, 7th Floor
Almaty
Kazakhstan
050040
Tel: +7(727) 334 1310

MOSCOW
Suite 2, Block 10
Letnikovskaya Street
Moscow
Russia
115114
Tel: +7(495) 980 0767

**Wardell Armstrong
Archaeology:**

CUMBRIA
Cocklakes Yard
Carlisle
Cumbria
CA4 0BQ
Tel: +44 (0)122 856 4820

SHAFTESBURY
Unit 3
Chaldicott Barns
Tokes Lane
Semley
Nr. Shaftesbury
SP7 9AW
Tel: +44 (0)174 783 0603