RiverOak Strategic Partners

5.2-7 Environmental Statement Volume 7: Appendices 7.3 – 8.1

TR020002/APP/5.2-7

Project Name:	Manston Airport Development Consent Order
Regulation:	Regulation 5(2)(a) and 5(2)(e) (Appendix 8.2) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, as amended
Date:	July 2018

Appendix 7.7
Invertebrate Scoping Survey

March 2018

Technical note:
Manston Airport DCO EIA: Invertebrate Scoping Survey 2017

1. Introduction

RiverOak Strategic Partners (RSP) is planning to reopen Manston Airport as a new air freight and cargo hub for the South East. This site is located within the district of Thanet in the county of Kent, close to the coastal town of Margate (the approximate central point of the site is at National Grid Reference [NGR] TR 330 657).

There was an operational airport at the site between 1916 and 2014. Until 1998 it was operated by the Royal Air Force as RAF Manston, and, for a period in the 1950s, was also a base for the United States Air Force (USAF). From 1998 it was operated as a private commercial airport with a range of services including scheduled passenger flights, charter flights, air freight and cargo, a flight training school, flight crew training and aircraft testing; in the most recent years it was operating as a specialist air freight and cargo hub servicing a range of operators. Although the airport was closed in May 2014 much of the airport infrastructure, including the runway, taxiways, aprons, cargo facilities and passenger terminal remain intact.

The proposed Manston Airport development involves the development of an air freight and cargo facility with the capacity to handle more than 10,000 air transport movements (ATMs) of cargo aircraft per year as part of the provision of air cargo transport services.

This technical note details the results of a scoping assessment to identify the potential of the proposed development Site for terrestrial invertebrates.

2. Methods

The site was assessed on the 22nd of August 2017, between 09.00 and 17.00. The weather was moderately warm but continuously overcast and humid. An initial overview of the site from a car was followed by a walkover survey which took a meandering route through the grassland and visited enclosed and marginal features of potential interest as invertebrate habitats. Invertebrates were sampled by sweep-netting. Any conspicuous species identifiable without capture, such as butterflies and bumblebees, were also noted, and opportunity was occasionally taken to search for individual species of interest when apparently suitable habitat was encountered. This report provides an assessment of the invertebrate potential of the site, lists and briefly assesses the invertebrates recorded, and proposes further work to establish the character and level of interest of the invertebrate fauna. It is based almost entirely on observations made on the day of survey, but historical images on Google Earth have been used to provide background information

2.1 Limitations

The survey was undertaken late in the year, after the grassland which occupies most of the site had been cut, but sufficiently late for there to have been considerable re-growth. Such re-growth cannot give an accurate impression of the character of the grassland in spring and early summer, and although allowance is made for this in the assessment, some uncertainty as to its potential must remain. In uncut areas, many plants had long finished flowering, and though it was possible to gain a good impression of the floristic composition of such areas, it was not possible to form a reliable impression of, for example, the scale of the

spring nectar resource they offer, which might profoundly affect the spring bee fauna. Sampling of invertebrates was inevitably somewhat superficial. The list obtained is quite short, and its composition reflects ease of capture more than any other attribute. The visit was made late in the season for invertebrates, and many species and groups with peaks of activity in the spring and early summer are necessarily absent from the list. Overcast conditions throughout the survey meant that some groups which might have been informative, notably late-flying bees and wasps, were found only in small numbers.

3. Results

3.1 Assessment of Habitats and Invertebrate Potential

Introduction

Most of the site is of very simple character: mown grassland on level ground or very gentle slopes, and hard surfaces provided by the runway, roadways and parking areas. Of the hard surfacing, the runway is overwhelmingly the most substantial and the most varied in terms of the habitats it provides. There are additional, and quite varied, habitats around the site periphery, including areas of brownfield character on cleared ground and rubble and around unused buildings, uncut grassland, a bank supporting tall ruderal vegetation, tall vegetation along the boundary fence, stretches of hedge and some trees. The largest single area of such additional habitat is associated with the site of a former car park, and could not be visited for the scoping survey but was seen through its boundary fence. For current purposes, and for the planning of further survey work, it is convenient to divide the site into four: the mown grassland; the runway and its margins; the former car park and associated habitats; and additional features, including all hard surfaces and their margins within the grassland, other than the runway, as well as peripheral features.

The grassland

Semi-improved grassland of rather uniform structure and management occupies most of the site, and is managed by mowing. In 2017, it appeared to have been cut in July, and was showing considerable re-growth by the time of the scoping survey. Limited invertebrate potential would normally be expected of grassland fitting this description. Two factors may raise the potential in this case: the area involved is very large, so species reduced to low density by the management regime may still have viable populations; and the cut is high, to maintain a sward length which will discourage birds, thereby maintaining more habitat through the cut than would be the case in conventional cutting. Cuts of this type are rare, and the way in which the invertebrate fauna is affected is not known. Simple logic would suggest that the impact would be considerable, but less than that of a conventional low cut, and that invertebrate interest might therefore be higher than in a conventional hay meadow.

The re-growth included good flowering populations of a number of plants, but the character of the grassland cannot be fully determined by post-cut assessment alone. It is noteworthy that an earlier Phase 1 survey (June 2015[1]) identified areas of relatively species-rich grassland at the east and west ends of the runway; assessment in August 2017 would tend to place the richest (though patchily variable) grassland towards the centre. It seems rather likely that survey in spring would give a different impression.

The grassland was fairly uniform in height and formed an almost continuous sward, except in areas of very recent disturbance. It may be less uniform, at least in height, before cutting. Some areas were also relatively uniform in composition, but elsewhere there was considerable variation in detail, and the degree of patchiness was noteworthy. Some of the variation was at a fairly large scale: thus, for example, bird's-foot trefoil was abundant in one substantial area, but almost absent from much of the grassland; and burnet saxifrage, generally at most a scarce component, was abundant over one broad band to the extent of being dominant over areas of several square metres. More widely, single species of flowering plants tended to be abundant or to dominate over areas measurable in square metres but be virtually absent from the surrounding grassland. Some apparent absences from the plant list are interesting: neither common nor

[1] WSP| PB. April 2016. Stone Hill Park. Extended Phase 1 habitat Survey. Report 001 Project No: 70009799. OL-TH-016-0550. ES Vol II.

chalk knapweed were seen, though greater knapweed was present in very small quantity; and over most of the grassland there were no clovers.

In the areas of lowest potential, the sward consisted entirely of coarse grasses over a moderate thatch of dead material. Generally, the sward was more varied and somewhat more open-structured with only a thin covering of dead dry material. Bare ground, however, was scarce over most of the grassland. Recent archaeological excavations had locally increased the area of bare soil, but the excavations are too recent for invertebrates to have been likely to take full advantage, and the vegetation is closing rapidly.

The large populations of some important invertebrate foodplants should favour a varied phytophagous fauna. Structural uniformity may limit the fauna generally, however, and the shortage of very open-structured vegetation and bare ground, coupled with the limited topographical variation, is likely to restrict the range of ground-dwelling and ground-nesting fauna. The potential for the flower-associated fauna is uncertain; mowing will effectively rule out any interest in species associated for the whole of their life-history with the flowering parts of tall plants, but the high cut may retain shorter plants intact; the bee fauna will be affected by the limited availability of nesting sites for ground-nesting species, but also by the exact pattern of availability of nectar and pollen sources through the year.

The runway and its fringes

Though most of the runway is still tarmac with negligible potential for invertebrates, part is now vegetated, though quite thinly in places, and provides an unusual habitat of considerable area. Some of the vegetation is little more than well-separated flowering stems emerging directly from holes in the tarmac, but some mat-forming species, such as black medick, bird's-foot trefoil and white clover, have grown sufficiently to accumulate leaf litter and debris and to support dense colonies of woodlice and other invertebrates.

A narrow fringe of vegetation along the edge of the runway varies in detail but is always very different in character to that of the surrounding grassland. In places it is quite coarse, dominated by common mallow and yellow crucifers which reach to, and spread over, the edge of the tarmac. Elsewhere, the vegetation is shorter and finer, in places with bare ground and sometimes with a small but very definite slope at the runway fringe. Mats of vegetation, especially of stonecrops, spread out over the tarmac in places. Plants with good populations in this narrow fringe, but absent from, or very scarce in, the grassland include common stork's-bill, buck's-horn plantain and spiny restharrow, and more widespread plants such as yarrow grow here in more stressed conditions and provide better invertebrate habitat than elsewhere. Though the fringe is narrow, rarely more than a metre in width, the runway is so long that the total area of habitat is large. It is generally fairly abruptly distinct from the adjoining grassland, but in places the grassland is somewhat more herb-rich for a few metres beyond the runway boundary. The fringe provides sufficient habitat in itself for many species, and may also provide a nesting site for solitary bees and wasps which forage more widely in the grassland.

The car park and associated habitats

The former car park and its associated habitats could not be visited for the scoping survey, so this opinion of its character and potential is based solely on views from the boundary.

Habitats within this area are quite varied, but are dominated in the north by the tarmac surfacing of the car park, assumed to be of negligible potential, and in the south by a grass-scrub mosaic. This mosaic has developed on former arable land, taken out of cultivation somewhere between 2003 and 2007, and seemingly then allowed to colonise naturally, though an apparent decline in scrub density between 2009 and 2013 suggests at least occasional management. Structurally, the mosaic appears to be of high potential, with a mix of bare and sparsely vegetated ground, taller grassy vegetation and scattered invasive scrub. This state, though usually transitory in unmanaged habitats, is often associated with high invertebrate diversity and interest. However, the details of vegetation composition and substrate character, and the extent of bare ground, could not be determined, except for a very limited area close to the fence-line, so it is possible that this general impression over-estimates the area's potential. The remaining habitats within this can probably all eventually be added to the "additional features" category, and include trees, small areas of grassland, and

narrow vegetated fringes beside hard substrates. Varied structure, absence of recent management, rabbit activity, and a moderately rich flora suggest the likelihood of some invertebrate interest in these areas.

Additional features

Additional habitat features are varied in character and occupy a small proportion of the site. Individually, few have the potential to be of high interest, but collectively they may add many species to the overall site list, including species with formal status, and they may be important in providing nesting sites for species which forage in the mown grassland. Some noteworthy features can be identified.

- Tall ruderal vegetation along the perimeter fence. This was noteworthy at the time of the scoping survey for an abundance of tall yellow crucifers and local stands of Alexanders. Though this vegetation occupies only a thin band along the site margin, the perimeter is long and the total habitat area large. This vegetation may be important not only for crucifer-feeding species, for example, but also for flower-visiting species breeding elsewhere, for stem-nesting bees and wasps, and as a hibernation site and refugium for species breeding in the grassland.
- The tall earth bank immediately south of Manston Road. This appears to be composed of nutrient-rich soil and supports coarse ruderal vegetation, and as such its potential is limited. However, it supports, for example, a large population of annual mercury, the foodplant of the nationally scarce seed weevil *Kalcapion semivittatum*.
- Uncut grassland north of the runway towards the eastern end of the site. This uncut area is not of especially high quality, and is noteworthy for the abundance of ragwort. However, the absence of cutting enables it to support species absent from the wider area of mown grassland.
- Disturbed ground, banks and rubble south of the Avman buildings. This is a very interesting area, though small in the context of the site overall. Bare ground on well-drained substrates, earth banks, varied vegetation structure and a range of nectar plants make this potentially very useful as a nesting and foraging areas for solitary bees and wasps, many of which may range more widely over the grassland.
- The margins of roads, tracks and other hard-standing within the mown grassland. This is a rather widespread and scattered category, though of fairly uniform character. The highest potential appears to be along the track to the south of the main runway, especially in its western half, which in places has similar character to the habitats along the runway margin. Other hard surfaces tend to have a rather more abrupt margin with little distinction from the surrounding grassland, and many are managed to their edges. A visit after the summer cut may have exaggerated the uniformity, however.
- Peripheral hedges and trees. There are recently planted mixed hedges, older hedges, and a number of trees at various points around the site periphery. None of those seen is of a character likely to support substantial invertebrate interest. Some uncommon species could be present and they are likely collectively to support many species not found elsewhere, but they are considered a relatively trivial feature.

Other, often very small, features include patches of tall uncut vegetation around buildings; small patches of vegetation on broken concrete or other artificial substrates; mats of vegetation over tarmac tracks, and scattered plants growing through cracks in tarmac or concrete. The floristic composition of such areas can be very different from that of the grassland, and the vegetation structure more open and more varied.

3.2 Invertebrate Records

A total of 169 invertebrate species was recorded during the survey, of which nineteen have a formal (red data book or nationally scarce) conservation status and two are new to Britain. Appendix 1 gives definitions of the formal conservation statuses; Appendix 2 provides short accounts for red data book and nationally scarce species, and appendix 3 is a complete list of species recorded. These are listed under three broad area/habitat categories: the grassland, the runway and its margins; and peripheral habitats.

The sample of invertebrates taken is too small and too selective to provide a basis for even a preliminary assessment of interest, but is sufficient to demonstrate that such interest is not negligible. The fact that species with formal conservation status comprise more than 10% of the recorded fauna suggests high species quality, but in practice a large proportion of these species are in groups which have not been recently reviewed and the formal status of some is open to doubt. The accounts in Appendix 2 provide more details. Kent is, anyway, rather rich in species with formal conservation status simply because of its geographical location, and relatively ordinary places can support multiple nationally scarce species.

None of the species with formal status is very unexpected for the area or the habitats. Nonetheless, they are collectively informative. Unsurprisingly, they are all associated with open habitats, but some are characteristic of very open and well-insulated habitats, and many are familiar components of rich assemblages on open calcareous habitats elsewhere in the south-east. Given the limited recording effort so far expended, it is very possible that these form the tip of a faunal iceberg of species with similar requirements. Considering that the survey was made late in the season and under poor conditions for bees and wasps, and that few of the group, in terms of either species or individuals, were encountered, the number of scarce aculeates with restricted distribution is impressive and suggests that this group might prove of substantial interest.

The populations of some of the scarcer species appeared to be large. The small heath, admittedly a species possessing formal status because it is declining rather than because it is, as yet, actually rare, was widespread in the grassland and was seen in large numbers despite the rather poor weather conditions; and the gall fly *Acanthiophilus helianthi*, a species usually found in very small numbers, was common in some areas. This is especially interesting because its usual foodplant, common knapweed, appears to be absent.

The two species new to Britain are both leafhoppers of the genus *Tettigometra*. Both are assumed to be recent colonists, and to have limited conservation significance. Newly arrived species of Hemiptera are recorded in Britain in most years, but these are somewhat unexpected, in that *Tettigometra* do not seem particularly mobile species, and do not appear to be spreading in mainland Europe. However, the facts that they are distinctive animals, that Kent is an historically well-studied county, and that they were found in close proximity to the tarmac of a former runway seems to rule out the possibility of them being overlooked long term natives and perhaps provide a hint as to their possible means of arrival.

3.3 Overall Assessment

The site is considered to have high potential for invertebrates of open habitats. Factors favouring high interest are:

- large area;
- favourable geographical location;
- long history of open conditions;
- high floristic diversity;
- large populations of some important invertebrate foodplants;
- varied structure, including bare and sparsely vegetated ground, managed grassland, and unmanaged or lightly managed tall herbs.

The managed grassland which comprises most of the habitat on the site is compromised in its potential by:

- uniform structure;
- limited topographical variation;
- limited area of bare ground;
- semi-improved character.

Though substantial invertebrate interest may be present, the expectation is that this will not prove exceptional, and some species, especially solitary bees and wasps, may be in part dependent on peripheral features and habitats, especially for nesting sites.

Diversity and interest are considered likely to be higher in other open habitats than in the mown grassland. Higher interest overall in these areas is favoured by:

- varied structure, including bare and sparsely vegetated ground, unmanaged tall herbs, and complex mosaics;
- varied substrates;
- locally varied topography;
- varied floristic composition, including good populations of a number of important foodplants not present, or rare, in the grassland.

4. References

Agassiz, D.J.L., Beavan, S.D. & Heckford, R.J. 2013. *Checklist of the Lepidoptera of the British Isles.* Field Studies Council, for the Royal Entomological Society.

Archer, M. (ed.) 2004. *BWARS (Bees, Wasps and Ants Recording Society) Members' Handbook*. Centre for Ecology & Hydrology.

Aukema, B. & Rieger, C. 1995-2006. *Cataloge of the Heteroptera of the Palaearctic region*. 5 volumes. Wageningen: The Netherlands Entomological Society.

Biedermann, R. & Niedringhaus, R. 2009. *The plant- and leaf-hoppers of Germany*. Scheeßel: WABV.

Biodiversity Reporting and Information Group. 2007. *Report on the Species and Habitat Review*. Report to the UK Biodiversity Partnership.

Chandler, P. 2012. *An update of the 1998 checklist of the Diptera of the British Isles*. www.dipteristsforum.org.uk/documents/BRITISH_ISLES_CHECKLIST.pdf.

Duff, A. G. (ed.) 2012. *Checklist of beetles of the British Isles*. 2nd edition. Iver: Pemberley Books

Falk, S. 1991a. *A review of the scarce and threatened bees, wasps and ants of Great Britain*.

Peterborough: Nature Conservancy Council. (Research & Survey in Nature Conservation, no. 35).

Falk, S. 1991b. *A review of the scarce and threatened flies of Great Britain (part 1)*. Peterborough:

Nature Conservancy Council. (Research and Survey in Nature Conservation, no. 39).

Fox, R., Warren, M.S. & Brereton, T.M. 2010. A new Red List of British Butterflies. Peterborough: Joint Nature Conservation Committee. (Species Status, no.12).

Hubble, D.S. 2014. *A review of the scarce and threatened beetles of Great Britain. The leaf beetles and their allies: Chrysomelidae, Megalopodidae and Orsodacnidae.* Natural England Commissioned Report NECR161 (Species Status no. 19).

Hyman, P.S. & Parsons, M.S. 1992. *A review of the scarce and threatened Coleoptera of Great Britain. Part 1*. Peterborough: Joint Nature Conservation Committee. (UK Nature Conservation, no. 3).

Kirby, P. 1992. *A review of the scarce and threatened Hemiptera of Great Britain*. Peterborough: Joint Nature Conservation Committee. (UK Nature Conservation, 2).

Merrett, P., Russell-Smith, A. & Harvey, P. 2014. A revised check list of British spiders. *Arachnology*, 16(4): 134-144.

Plant, C.W. 1997. *A key to the adults of British lacewings and their allies (Neuroptera, Megaloptera, Raphidioptera and Mecoptera.* Shrewsbury: Field Studies Council.

Sutton, P.G. 2015. *A review of the Orthoptera (grasshoppers and crickets) and allied species of Great Britain (Orthoptera, Dictyoptera, Dermaptera, Phasmida)*. Natural England Commissioned Report NECR187 (Species Status no. 24).

Waring, P. & Townsend, M. 2017. *A field guide to the moths of Great Britain and Ireland*.3rd edition. London: Bloomsbury Publishing.

Author	Reviewer
Mike Raven	Mark"Linsley ·

Copyright and non-disclosure notice

Third party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Appendix A
Status Definitions and Abbreviations

Each of the species recorded has been assigned a status. The better-known groups of invertebrates were assessed for formal conservation status in Red Data Books and National Reviews from the mid-1980s onwards, using criteria from the IUCN for the rarest (Red Data Book) species, and defining species believed to occur in 100 or fewer 10-kilometres squares of the National Grid as Notable (now known as Nationally Scarce). The earlier IUCN criteria have been superseded, but only a fraction of the fauna has as yet been assessed, in published reviews, under the newer criteria. The following formal statuses and abbreviations from the older system are used in this report:

Red Data Book category 3 – Rare (RDB3)

Taxa with small populations in Great Britain that are not at present Endangered or Vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. Included are species which are estimated to exist in only fifteen or fewer hectads. This criterion may be relaxed where populations are likely to exist in over fifteen hectads but occupy small areas of especially vulnerable habitat.

Nationally Scarce category A (Na)

Taxa which do not fall within RDB categories but which are nonetheless uncommon in Great Britain and are thought to occur in 30 or fewer hectads of the National Grid or, for less well-recorded groups, within seven or fewer vice-counties.

Nationally Scarce category B (Nb)

Taxa which do not fall within RDB categories but which are nonetheless uncommon in Great Britain and are thought to occur in between 31 and 100 hectads of the National Grid or, for less-well recorded groups, between eight and twenty vice-counties.

Nationally Scarce (N)

For some less well-recorded groups and species, it has not been possible to determine which of the Nationally Scarce categories (A or B) is most appropriate for scarce species. These species have been assigned to an undivided Nationally Scarce category.

A single category from the new IUCN criteria is used in this report:

Lower Risk (LR)

A taxon is Lower Risk where it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the LR category can be separated into four subcategories, of which only one is relevant to the current survey.

Near Threatened (NT). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable – in Britain, defined as occurring in 15 or fewer hectads but not CR, EN or VU.

Under the revised criteria, at the national level, countries are permitted to refine the definitions for the non-threatened categories and to define additional ones of their own. The Nationally Rare (NR) category is defined as species recorded from 15 or fewer hectads of the Ordnance Survey national grid in Great Britain. The Nationally Scarce (NS) category is defined in the same way but the species is recorded from between 16 and 100 hectads since 1980. These correspond respectively to the former Red Data Book Categories 1-3 and the former Nationally Scarce (or Nationally Notable) categories A and B. Collectively, they are referred to as the GB Rarity status. Although in this section a distinction is made between the Nationally Scarce species defined under the older system and those defined under the newer system, since the two categories are for all usual purposes identical they are combined under the name “Nationally Scarce” in assessment and discussion. The different abbreviations are, however, maintained in tables and lists of species, so that their origins are clear.

Species not falling into any formal conservation category have been assessed as either local or common. Neither “local” nor “common” have precise definitions, and are used in the context of this report only to distinguish between species of wide distribution and either broad or very commonly met habitat requirements, and those which, because of more specialised habitat requirements, lesser mobility, or other

cause, are of less frequent occurrence. These categories have been applied according to personal experience and the opinions of standard texts, and must be considered in part subjective.

Formal conservation categories used are the most recent published statuses applied by the Nature Conservancy Council and the Joint Nature Conservation Committee, obtained from the following sources:

- Coleoptera Hubble, 2014; Hyman & Parsons, 1992
- Diptera Falk, 1991b
- Hemiptera Kirby, 1992
- Hymenoptera Falk, 1991a
- Lepidoptera Fox et al., 2012; Waring & Townsend, 2017

The list has also been checked for any species included in Section 41 of the NERC Act 2006 ("species of principal importance for the conservation of biodiversity in England") (**S41**). Such species are, however, a rather eclectic mix, and are largely irrelevant to assessment.

The abbreviations in bold are those used in tables and species lists in this report.

Nomenclature

Checklists and other sources used for names have been selected as far as possible on the basis of easy availability, broad coverage, specific reference to the British fauna, of being reasonably recent, and of their availability in printed form. There are few occasions when all these criteria are met. The following main sources have been used, but in some cases names have been updated from more recent sources:

- Araneae Merrett *et al.*, 2014
- Coleoptera Duff, 2012
- Dermaptera Sutton, 2015
- Diptera Chandler, 2012
- Hemiptera Auchenorrhyncha Biedermann & Niedringhaus, 2009
- Hemiptera Heteroptera Aukema & Rieger, 1995-2006
- Hymenoptera Aculeata Archer, 2004
- Lepidoptera Agassiz *et al.*, 2013
- Neuroptera Plant, 1997
- Orthoptera Sutton, 2015

Appendix B
Notes on Species with Formal Conservation Status

Scientific name	English name	Status	Notes
Kalcapion semivittatum	a seed weevil	Na	Local and with a very restricted distribution in southern counties, but gradually increasing in range; the foodplant is annual mercury, the larvae feeding in the stems, and the beetle can occur almost wherever there is a good and persistent population of the host.
Podagrica fuscipes	a leaf beetle	NS	Local but increasing in southern counties; recorded from a range of habitats, especially disturbed grassland, arable field margins, and weedy ground in urban and suburban areas; on mallows.
Hippodamia variegata	Adonis' ladybird	Nb	Frequent and increasing, no longer worthy of formal status; found amongst open-structured or sparse vegetation in dry habitats, including arable field margins.
Tychius pusillus	a weevil	Nb	Fairly common, but restricted to southern England, probably under-recorded; in short, open-structured to sparse vegetation in grasslands, roadsides, brownfield sites, sand dunes and other open areas on well-drained substrates; on lesser trefoil.
Olibrus millefolii	a shining flower beetle	Nb	Somewhat local but widely distributed and by no means scarce in south-eastern England. Larvae develop in the flowerheads of yarrow; small plants growing in open swards on well-drained substrates are preferred.
Acanthiophilus helianthi	a gall fly	N	Local in south-eastern counties, and often at low density. Larvae develop in the flowerheads of Asteraceae. Knapweeds are the most frequently recorded hosts, but it can occur on other members of the family.
Merzomyia westermanni	a gall fly	N	Frequent but rather local in southern and midland counties of England, and seemingly commoner than in the recent past; the formal status is open to doubt; associated chiefly with hoary ragwort growing on poorly-drained clay soils, but occasionally recorded from common ragwort; larvae develop in the flower-heads.
Asiraca clavicornis	a planthopper	Nb	Currently seems to be expanding and locally not uncommon, but seemingly prone to large population fluctuations with unknown causes; found in a wide range of open habitats and grasslands, including species-poor tall grassland at arable field margins.
Nysius graminicola	a groundbug	RDB3	Until recently rare and very local with a few sites scattered across southern England, but more frequently recorded in recent years and of rather uncertain status; easily under-recorded amongst large populations of its commoner relatives; open-structured vegetation in dry, sandy places; ecology poorly understood, but probably a seed-feeder associated with members of the daisy family in unshaded dry habitats.
Lygus pratensis	a capsid bug	RDB3	Now widespread throughout southern Britain following a dramatic range expansion, and no longer deserving a formal conservation status; in a wide range of grassy and ruderal habitats, often common on agricultural land.
Mimumesa unicolor	a solitary wasp	Na	A species of restricted distribution, found mainly around the Thames Estuary and the coasts of Hampshire and West Sussex; a recent addition to the British list, easily confused with others of the genus, possibly overlooked and perhaps spreading slowly inland; its habitat requirements are rather poorly known, but it seems to be associated mainly with damp areas such as seepage areas on soft-rock cliffs and the vicinity of reed-beds; it nests in burrows in exposed soil.
Myrmica schencki	a red ant	Nb	Scarce and mostly restricted to the south-east of England; in hot, dry, sheltered sites, including dunes, cliffs, unimproved pasture and downland, heaths, banks and railway cuttings; warmth-loving and usually found among sparse vegetation or in short turf.
Ponera coarctata	indolent ant	Nb	Local and restricted to southern England and the south-east coast of Wales, but probably under-recorded; warm, sheltered habitats, including open stony ground, grassland, landslips, crumbling cliffs and open woodland as well as waste ground, scrub and large gardens in urban areas; favours damp soils.
Lasioglossum malachurum	sharp-collared furrow bee	Nb	Has expanded dramatically since 1990; now common in much of southern England and no longer deserving of a formal conservation status; found in a range of open habitats, including coastal cliffs and landslips, abandoned quarries, commons, chalk grassland and private gardens; ground-nesting.

Scientific name	English name	Status	Notes
Lasioglossum pauperatum	squat furrow bee	RDB3	Rare and restricted to southern England, mostly the Thames Gateway and Hampshire; open flowery habitats including soft-rock cliffs and dry coastal grassland; ground-nesting.
Lasioglossum pauxillum	lobe-spurred furrow bee	Na	Has expanded dramatically in recent decades and is now locally common across southern England and into the midlands; no longer deserving of a formal conservation status; in a wide range of dry habitats but perhaps especially calcareous grasslands and brownfield sites.
Lasioglossum puncticolle	ridge-cheeked furrow bee	Nb	Scarce and restricted to south-east England; in a wide range of habitats including open, broad-leaved woodland, but most frequent in coastal habitats such as coastal land slips, soft-rock cliffs and estuarine fore-shores.
Calophasia lunula	toadflax brocade	RDB	Formerly a rarity confined to a few localities on the south coast, this species has expanded greatly in range and frequency, especially in urban and brownfield locations, and is now a widespread and frequent species in the south-east, though still somewhat local.
Coenonympha pamphilus	small heath	NT	Declining, but still a more or less common species over much of Britain; dry, well-drained grassland with a short to medium sward.

Appendix C
Complete List of Species Recorded 22nd August 2017

Group	Family	Species	Status	Grassland	Runway/ tracks	Peripheral habitats
Araneae	Araneidae	*Araneus diadematus*	common	x	x	x
Araneae	Araneidae	*Araneus quadratus*	common			x
Araneae	Araneidae	*Neoscona adianta*	local			x
Coleoptera	Anthicidae	*Omonadus formicarius*	common		x	
Coleoptera	Apionidae	*Aspidapion aeneum*	common		x	x
Coleoptera	Apionidae	*Aspidapion radiolus*	common		x	x
Coleoptera	Apionidae	*Ceratapion gibbirostre*	common		x	
Coleoptera	Apionidae	*Ischnopterapion loti*	common		x	
Coleoptera	Apionidae	*Ischnopterapion virens*	common		x	
Coleoptera	Apionidae	*Kalcapion semivittatum*	Na			x
Coleoptera	Apionidae	*Malvapion malvae*	common		x	x
Coleoptera	Apionidae	*Omphalapion hookerorum*	local	x		
Coleoptera	Apionidae	*Protapion fulvipes*	common		x	
Coleoptera	Byrrhidae	*Byrrhus pilula*	common		x	
Coleoptera	Carabidae	*Amara ovata*	common		x	
Coleoptera	Carabidae	*Paradromius linearis*	common		x	
Coleoptera	Carabidae	*Philorhizus melanocephalus*	common		x	
Coleoptera	Carabidae	*Pterostichus madidus*	common		x	
Coleoptera	Chrysomelidae	*Chaetocnema hortensis*	common	x		
Coleoptera	Chrysomelidae	*Chrysolina banksi*	local	x		
Coleoptera	Chrysomelidae	*Derocrepis rufipes*	local	x		
Coleoptera	Chrysomelidae	*Longitarsus flavicornis*	common		x	
Coleoptera	Chrysomelidae	*Longitarsus succineus*	common	x	x	
Coleoptera	Chrysomelidae	*Neocrepidodera ferruginea*	common	x		
Coleoptera	Chrysomelidae	*Neocrepidodera transversa*	common	x	x	
Coleoptera	Chrysomelidae	*Phyllotreta atra*	common			x
Coleoptera	Chrysomelidae	*Phyllotreta nigripes*	common	x	x	x
Coleoptera	Chrysomelidae	*Phyllotreta nodicornis*	local	x		
Coleoptera	Chrysomelidae	*Podagrica fuscipes*	NS		x	
Coleoptera	Chrysomelidae	*Sphaeroderma testacea*	common		x	
Coleoptera	Coccinellidae	*Coccinella septempunctata*	common	x	x	x
Coleoptera	Coccinellidae	*Hippodamia variegata*	Nb		x	
Coleoptera	Coccinellidae	*Nephus redtenbacheri*	common	x		
Coleoptera	Coccinellidae	*Propylea quattuordecimpunctata*	common	x	x	x
Coleoptera	Coccinellidae	*Psyllobora vigintiduopunctata*	common	x		
Coleoptera	Coccinellidae	*Rhyzobius litura*	common		x	
Coleoptera	Coccinellidae	*Subcoccinella vigintiquattuorpunctata*	common			x
Coleoptera	Coccinellidae	*Tytthaspis sedecimpunctata*	common	x		x
Coleoptera	Curculionidae	*Anthonomus rubi*	common		x	
Coleoptera	Curculionidae	*Ceutorhynchus contractus*	common	x		x
Coleoptera	Curculionidae	*Ceutorhynchus obstrictus*	common	x	x	
Coleoptera	Curculionidae	*Mecinus pascuorum*	common		x	
Coleoptera	Curculionidae	*Rhinusa antirrhini*	local	x		
Coleoptera	Curculionidae	*Sitona hispidulus*	common		x	
Coleoptera	Curculionidae	*Sitona humeralis*	common	x	x	

Group	Family	Species	Status	Grassland	Runway/ tracks	Peripheral habitats
Coleoptera	Curculionidae	*Sitona lineatus*	common	x	x	x
Coleoptera	Curculionidae	*Tychius picirostris*	common			x
Coleoptera	Curculionidae	*Tychius pusillus*	Nb			x
Coleoptera	Delphacidae	*Xantholinus linearis*	common		x	
Coleoptera	Kateretidae	*Brachypterolus pulicarius*	common	x		
Coleoptera	Phalacridae	*Olibrus aeneus*	common		x	
Coleoptera	Phalacridae	*Olibrus liquidus*	common	x	x	x
Coleoptera	Phalacridae	*Olibrus millefolii*	Nb	x	x	
Coleoptera	Phalacridae	*Phalacrus fimetarius*	local	x		
Coleoptera	Phalacridae	*Stilbus testaceus*	common		x	
Coleoptera	Silphidae	*Silpha laevigata*	local		x	
Crustacea	Armadillidiidae	*Armadillidium vulgare*	common		x	
Crustacea	Philosciidae	*Philoscia muscorum*	common		x	
Dermaptera	Forficulidae	*Forficula auricularia*	common		x	x
Diptera	Dolichopodidae	*Dolichopus griseipennis*	common	x		
Diptera	Limoniidae	*Symplecta stictica*	common	x		
Diptera	Sciomyzidae	*Pherbellia cinerella*	common	x		x
Diptera	Syrphidae	*Episyrphus balteatus*	common	x		
Diptera	Syrphidae	*Eristalis pertinax*	common	x		
Diptera	Syrphidae	*Melanostoma mellinum*	common	x		x
Diptera	Syrphidae	*Scaeva pyrastri*	common	x		
Diptera	Syrphidae	*Sphaerophoria ruepellii*	local		x	x
Diptera	Syrphidae	*Sphaerophoria scripta*	common	x	x	
Diptera	Syrphidae	*Syritta pipiens*	common	x	x	x
Diptera	Syrphidae	*Xanthogramma pedissequum*	local	x		
Diptera	Tachinidae	*Eriothrix rufomaculatus*	common	x		
Diptera	Tachinidae	*Tachina fera*	common	x		
Diptera	Tephritidae	*Acanthiophilus helianthi*	N	x		x
Diptera	Tephritidae	*Merzomyia westermanni*	N			x
Diptera	Tephritidae	*Sphenella marginata*	common	x	x	
Diptera	Tephritidae	*Tephritis formosa*	common	x	x	x
Diptera	Tephritidae	*Terellia ruficauda*	common		x	
Diptera	Tephritidae	*Terellia serratulae*	common		x	
Diptera	Tephritidae	*Trupanea stellata*	local		x	
Hemiptera	Anthocoridae	*Orius niger*	common	x	x	
Hemiptera	Aphrophoridae	*Neophilaenus lineatus*	common	x		x
Hemiptera	Aphrophoridae	*Philaenus spumarius*	common	x	x	x
Hemiptera	Cicadellidae	*Anoscopus serratulae*	common	x		
Hemiptera	Cicadellidae	*Aphrodes makarovi*	common	x		
Hemiptera	Cicadellidae	*Arthaldeus pascuellus*	common	x		
Hemiptera	Cicadellidae	*Macrosteles laevis*	common	x		
Hemiptera	Cicadellidae	*Mocydia crocea*	common	x		
Hemiptera	Cicadellidae	*Psammotettix nodosus*	common	x		
Hemiptera	Cicadellidae	*Zyginidia scutellaris*	common	x		
Hemiptera	Cydnidae	*Tritomegas sexmaculatus*	?			x

Group	Family	Species	Status	Grassland	Runway/ tracks	Peripheral habitats
Hemiptera	Delphacidae	*Asiraca clavicornis*	Nb		x	
Hemiptera	Delphacidae	*Javesella pellucida*	common	x	x	x
Hemiptera	Delphacidae	*Stenocranus minutus*	common	x		
Hemiptera	Delphacidae	*Xanthodelphax stramineus*	local	x		
Hemiptera	Lygaeidae	*Nysius graminicola*	RDB3		x	
Hemiptera	Lygaeidae	*Nysius huttoni*	common		x	
Hemiptera	Lygaeidae	*Nysius senecionis*	common		x	
Hemiptera	Lygaeidae	*Scolopostethus affinis*	common		x	
Hemiptera	Lygaeidae	*Stygnocoris fuligineus*	common	x	x	
Hemiptera	Lygaeidae	*Stygnocoris rusticus*	local	x		
Hemiptera	Miridae	*Adelphocoris lineolatus*	common		x	
Hemiptera	Miridae	*Campylomma verbasci*	local		x	
Hemiptera	Miridae	*Charagochilus gyllenhalii*	local	x	x	
Hemiptera	Miridae	*Chlamydatus pullus*	local		x	
Hemiptera	Miridae	*Dicyphus annulatus*	local		x	
Hemiptera	Miridae	*Dicyphus epilobii*	common			x
Hemiptera	Miridae	*Europiella artemisiae*	common	x	x	
Hemiptera	Miridae	*Lygus maritimus*	common		x	x
Hemiptera	Miridae	*Lygus pratensis*	RDB3	x	x	x
Hemiptera	Miridae	*Notostira elongata*	common	x		x
Hemiptera	Miridae	*Orthops campestris*	common	x		
Hemiptera	Miridae	*Phytocoris varipes*	common	x	x	x
Hemiptera	Miridae	*Plagiognathus arbustorum*	common		x	
Hemiptera	Miridae	*Trigonotylus coelestialium*	common	x		
Hemiptera	Nabidae	*Himacerus mirmicoides*	common		x	
Hemiptera	Nabidae	*Nabis flavomarginatus*	common	x		
Hemiptera	Nabidae	*Nabis rugosus*	common	x		
Hemiptera	Pentatomidae	*Dolycoris baccarum*	common			x
Hemiptera	Pentatomidae	*Eurydema oleracea*	common	x		
Hemiptera	Rhopalidae	*Corizus hyoscyami*	local		x	
Hemiptera	Tettigometridae	*Tettigometra ?laeta*	new to Britain		x	
Hemiptera	Tettigometridae	*Tettigometra ?virescens*	new to Britain		x	
Hemiptera	Tingidae	*Kalama tricornis*	local		x	
Hymenoptera	Andrenidae	*Andrena minutula*	common	x		
Hymenoptera	Apidae	*Apis mellifera*	common	x	x	x
Hymenoptera	Apidae	*Bombus lapidarius*	common	x	x	x
Hymenoptera	Apidae	*Bombus pascuorum*	common	x	x	x
Hymenoptera	Colletidae	*Colletes hederae*	local	x		
Hymenoptera	Crabronidae	*Mimumesa unicolor*	Na	x		
Hymenoptera	Crabronidae	*Pemphredon lethifer*	common			x
Hymenoptera	Formicidae	*Formica cunicularia*	local	x	x	x
Hymenoptera	Formicidae	*Formica fusca*	common	x	x	x
Hymenoptera	Formicidae	*Lasius niger*	common	x	x	x
Hymenoptera	Formicidae	*Myrmica sabuleti*	common	x	x	
Hymenoptera	Formicidae	*Myrmica scabrinodis*	common	x	x	

Group	Family	Species	Status	Grassland	Runway/ tracks	Peripheral habitats
Hymenoptera	Formicidae	*Myrmica schencki*	Nb	x	x	
Hymenoptera	Formicidae	*Ponera coarctata*	Nb		x	
Hymenoptera	Halictidae	*Halictus rubicundus*	common	x		
Hymenoptera	Halictidae	*Halictus tumulorum*	common	x	x	
Hymenoptera	Halictidae	*Lasioglossum albipes*	common	x		
Hymenoptera	Halictidae	*Lasioglossum calceatum*	common	x	x	
Hymenoptera	Halictidae	*Lasioglossum malachurum*	Nb	x		x
Hymenoptera	Halictidae	*Lasioglossum morio*	common	x	x	
Hymenoptera	Halictidae	*Lasioglossum pauperatum*	RDB3			x
Hymenoptera	Halictidae	*Lasioglossum pauxillum*	Na		x	
Hymenoptera	Halictidae	*Lasioglossum puncticolle*	Nb			x
Hymenoptera	Halictidae	*Lasioglossum villosulum*	common	x		
Lepidoptera	Lycaenidae	*Aricia agestis*	local	x		
Lepidoptera	Lycaenidae	*Polyommatus icarus*	local	x		
Lepidoptera	Noctuidae	*Autographa gamma*	common	x		
Lepidoptera	Noctuidae	*Calophasia lunula*	RDB	x		
Lepidoptera	Nymphalidae	*Aglais io*	common			x
Lepidoptera	Nymphalidae	*Coenonympha pamphilus*	NT	x		
Lepidoptera	Nymphalidae	*Maniola jurtina*	common	x		
Lepidoptera	Nymphalidae	*Pyronia tithonus*	common	x		
Lepidoptera	Nymphalidae	*Vanessa atalanta*	common			x
Lepidoptera	Nymphalidae	*Vanessa cardui*	common			x
Lepidoptera	Pieridae	*Pieris brassicae*	common	x		
Lepidoptera	Pieridae	*Pieris napi*	common	x		
Lepidoptera	Pieridae	*Pieris rapae*	common	x		
Lepidoptera	Sphingidae	*Deilephila porcellus*	local	x		
Lepidoptera	Sphingidae	*Macroglossum stellatarum*	migrant			x
Mollusca	Helicidae	*Cernuella virgata*	common			x
Mollusca	Hygromiidae	*Monacha cantiana*	common			x
Mollusca	Pupillidae	*Pupilla muscorum*	local		x	
Neuroptera	Chrysopidae	*Chysoperla carnea*	common	x	x	
Orthoptera	Acrididae	*Chorthippus brunneus*	common	x	x	x
Orthoptera	Tettigoniidae	*Conocephalus fuscus*	common	x		
		Number of recorded species	169	97	88	53
		Number of NS/RDB species	19	8	8	8

Appendix 7.8
Preliminary Ecological Appraisal Report 2017

RiverOak Strategic Partners

Manston Airport Outfall Corridor

Preliminary Ecological Appraisal Report 2017

March 2018

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Author	Reviewer
Mike Raven	MarK Linsley

Copyright and non-disclosure notice

Third party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Contents

1. Introduction

1.1 Background

Manston supported an operational airport between 1916 and 2014. Until 1998 it was operated by the Royal Air Force as RAF Manston, and, for a period in the 1950s, was also a base for the United States Air Force (USAF). From 1998 it was operated as a private commercial airport with a range of services including scheduled passenger flights, charter flights, air freight and cargo, a flight training school, flight crew training and aircraft testing. In the most recent years it was operating as a specialist air freight and cargo hub servicing a range of operators. Although the airport was closed in May 2014, much of the airport infrastructure, including the runway, taxiways, aprons, cargo facilities and passenger terminal remain intact.

RiverOak Strategic Partners is planning to redevelop and reopen Manston Airport as a new air freight and cargo hub for the South East. Ecological surveys were carried out to establish a baseline and to assess the potential impact that any associated works and subsequent operation may have on ecological receptors, these results formed the biodiversity chapter of the Preliminary Environmental Information Report (PIER) as part of the requirements of the consultation process under Sections 42 and 47 of the Planning Act 2008 ("the 2008 Act"), as part of the application for Development Consent Order (DCO) under the 2008 Act to authorise the redevelopment[1]. The Order Limits of the application have recently been extended to include the outfall pipeline corridor that runs from the south-east corner of the former airport to a discharge point at Pegwell Bay. It is proposed that the outfall is used for surface water drainage from the proposed development site.

1.2 Purpose of Report

The purpose of this report is to provide baseline ecological information to support a DCO application for the future re-opening and development of Manston Airport. Our approach is in accordance with industry standard practice[2],[3], which initially comprises a desk-based study and extended Phase 1 habitat survey of the Site and its immediate surroundings. The extended Phase 1 habitat survey approach aims to identify the presence, or potential presence of legally protected[4] / priority species[5]. The methods used in carrying out the ecological work at the Site are detailed in Section 3 with the results presented in Section 4. Section 5 makes recommendations for any further work deemed to be necessary.

1.3 Site Context

The survey area was linear and comprised a buffer of 30 m either side of the line of the existing underground pipeline, resulting in a survey corridor of 60 m width and approximately 1.34 km in length, hereafter referred to as 'the Site'. The Site is located within the district of Thanet in Kent, close to the coastal town of Ramsgate. The approximate central point of the Site is at National Grid Reference (NGR) TR 330 657.

The outfall pipeline runs from the former Manston Airport site boundary, south east to the discharge point at Pegwell Bay (see Figure 1, Appendix A for location). The Site is situated predominantly within urban habitats, including residential buildings and associated amenity grassland and scrub along Foads Lane and Clive Road in the north and Meverall Avenue and Sandwich Road in the south. The southern extent of the Site consists of chalk cliffs which separate the Pegwell Bay amenity grassland and the hardstanding associated with a disused helipad which meets the sea. Access to the underground pipeline is from a series of manholes along its length.

[1] Amec Foster Wheeler (May 2017). Manston Airport DCO EIA. Preliminary Environmental Information Report: Chapter 7 Biodiversity. Doc No: 38199CR019i3 PEIR 22052017.
[2] IEA (1995). Guidelines for Baseline Ecological Assessment. E & F Spon, London.
[3] CIEEM (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland. 2ND Edition. Available at www.cieem.net.
[4] See Appendix B for summary protected species legislation information.
[5] Scientific names for all species referred to in the main text of this report are provided in Appendix E.

2. Legislative and Policy Context

A number of sites, habitats and species are protected through either statute or national or local policy: details of these are provided in Boxes 1 and 2.

Box 1 Designated Wildlife Sites, and Priority Habitats and Species

Statutory nature conservation sites

Internationally important Sites: Special Areas of Conservation (SACs) and candidate SACs, Special Protection Areas (SPAs) and proposed SPAs, Sites of Community Importance, Ramsar Sites and European offshore marine Sites.

Nationally important Sites: Sites of Special Scientific Interest (SSSIs) that are not subject to international designations and National Nature Reserves (NNRs)

Local Nature Reserves (LNRs) are statutory Sites that are of importance for recreation and education as well as nature conservation. Their level of importance is defined by their other statutory or any non-statutory designation (e.g. if an LNR is also an SSSI but is not an internationally important Site, it will be of national importance). If an LNR has no other statutory or non-statutory designation it should be treated as being of district-level importance for biodiversity (although it may be of greater socio-economic value).

Non-statutory nature conservation sites

Local Wildlife Sites (LWS): In Kent LWS are designated on a county level, by a specialist panel that includes representatives from that includes amongst others Kent County Council, Natural England and the Kent Wildlife Trust. Kent LWS were previously known as Sites of Nature Conservation Importance (SNCIs).

Priority habitats and species

In this report, the geographic level at which a species/habitat has been identified as a priority for biodiversity conservation is referred to as its level of 'species/habitat importance'. For example, habitats and species of principal importance for the conservation of biological diversity in England (see the third bullet point below) are identified as of national species/habitat importance reflecting the fact that these species/habitats have been defined at a national level. The level of importance therefore pertains to the species/habitat as a whole rather than to individual areas of habitat or species populations, which cannot be objectively valued, other than for waterfowl, for which thresholds have been defined for national/international 'population importance'.

- International importance: populations of species or areas of habitat for which European Sites are designated;
- International importance: populations of birds meeting the threshold for European importance (1% of the relevant international population);
- National importance: habitats and species of principal importance for the conservation of biological diversity in England, and listed under Section 41 (s41) of the Natural Environment and Rural Communities (NERC) Act 2006. These habitats and species are listed on: http://jncc.defra.gov.uk/page-5705 They include those former UK Biodiversity Action Plan (UK BAP) priority habitats and species that occur in England;
- National importance: Species listed as being of conservation concern in the relevant UK Red Data Book (RDB) or Birds of Conservation Concern (BoCC) Red List[6];
- National importance: Nationally Scarce species, which are species recorded from 16-100 10x10km squares of the national grid;
- National importance: Populations of birds comprising at least 1% of the relevant British breeding/wintering population (where data are available);
- National importance: Ancient woodland (i.e. areas that have been under continuous woodland cover since at least 1600); and
- County importance: Species and habitats listed in the Kent local Biodiversity Action Plan (LBAP)[7].

Box 2 Legally Protected and Controlled Species

Legal protection

Many species of animal and plant receive some degree of legal protection. For the purposes of this study, legal protection refers to:

- Species included on Schedules 1, 5 and 8 of the *Wildlife and Countryside Act 1981* (as amended), excluding:
  - species that are only protected in relation to their sale (see Section 9[5] and 13[2]), reflecting the fact that the proposed development does not include any proposals relating to the sale of species; and
  - species that are listed on Schedule 1 but that are not likely to breed on or near the Site, given that this schedule is only applicable whilst birds are breeding;
- Species included on Schedules 2 and 5 of The *Conservation of Habitats and Species Regulations 2010* (as amended); and
- Badgers, which are protected under the *Protection of Badgers Act 1992*.

A summary of the legislation pertaining to faunal species that may occur on the Site is provided in Appendix B.

Legal control

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it an offence to release or allow to escape into the wild and species of plant that it is an offence to plant or otherwise cause to grow in the wild.

[6] Red-listed criteria include: historical decline in the breeding population; and/or severe breeding population decline over 25 years/longer term: severe non-breeding population decline over 25 years/longer term; severe breeding range decline over 25 years/longer term; severe non-breeding range decline over 25 years. Source: Eaton, M.A., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud D., and Gregory, R. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds, 108:708-746.
[7] Kent BAP (2016) [Online] Available from: http://www.kentbap.org.uk/

3. Methods

3.1 Desk Study

A data-gathering exercise was undertaken to obtain information relating to statutory and non-statutory nature conservation sites, priority habitats and species, and legally protected and controlled species (see Boxes 1 and 2).

Data were requested from Kent and Medway Biological Records Centre (KMBRC) and obtained through a review of the Multi-agency Geographic Information for the Countryside (Magic)[8] website, open access aerial mapping resources[9] and aerial photographs of the Site and surrounding area and from Ordnance Survey maps[10]. Data were gathered for:

- Statutory designated sites (national and international) on or within a 10 kilometre (km) radius of the Site;
- Non-statutory designated sites of nature conservation interest located on, or within 2 km of the Site;
- Ancient woodland and other national/local priority habitats on, or within 5 km of the Site (where not already covered by statutory and non-statutory sites);
- Records of legally protected and otherwise notable species made on, or within 5 km of the Site, including records of bats and bat roosts from the Kent Bat Group;
- Water bodies (potential great crested newt breeding habitat) within 500 metres (m)[11] of the Site, not separated from the Site by barriers (e.g. major roads, rivers, etc.) to great crested newt movement.

Analysis of species data focuses only on records from post 2000, as older records may not give an accurate picture of the current ecological interest on the Site. This contextual information is important as it may point to notable species that could occur on the Site itself.

This search was carried out for the Manston Airport redevelopment site which extends approximately 2.43 km north and 3.79 km west of the most northern point of the Site. The priority, legally protected and controlled species data was used to inform the outfall corridor desk study, however it should be noted that the search radius extends further west and north than the standard search area described above, and therefore records falling to the north and west may not be relevant to the Site itself.

Further data and contextual information was obtained from the following sources:

- Natural England (NE): studies commissioned by NE into the numbers and distribution of golden plover in the Sandwich Bay and Thanet area, the results of which are reported in Griffiths (2004)[12] and Henderson & Sutherland (2017)[13];
- Sandwich Bay Bird Observatory (SBBO): provided a map showing the main locations for wintering golden plover in the Sandwich Bay area, derived from ongoing studies into the species by the SBBO;

[8] http://magic.defra.gov.uk/MagicMap.aspx
[9] http://maps.google.co.uk
[10] https://www.ordnancesurvey.co.uk/osmaps
[11] English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough. This states that 500 m is generally accepted to be the dispersal distance of great crested newts over land between breeding ponds. English Nature is now Natural England.
[12] Griffiths, M. (2004). Numbers and distribution of the wintering golden plover population in and around the Thanet Coast and Sandwich Bay SPA in 2002/2003. English Nature Research Report Number 569. English Nature: Peterborough.
[13]Henderson, A. & Sutherland, M. (2017). Numbers and distribution of Golden Plovers in the Thanet Coast and Sandwich Bay SPA during the winter of 2016/2017. A report for Natural England in March 2017.

- Kent Ornithological Society (KOS): bird records were extracted from their online database, for all species within 5 km of the Site (http://birdgroups.co.uk/kos/default.asp, accessed in August 2016); and
- British Trust for Ornithology (BTO): Wetland Bird Survey (WeBS) core count data for 1995/96-2014/15 inclusive, and low tide data for 2002/03 and 2008/09 (the most recent winters for which data was available) was purchased from the BTO, for their Pegwell Bay count sector. In addition, further core count and low tide data for Pegwell Bay was from obtained from the BTO website (www.bto.org).

3.2 Field Survey

Habitats

An Extended Phase 1 survey of the Site and its surrounds was undertaken by an Amec Foster Wheeler ecologist on 6 September 2017; during the survey, distinct habitats were identified and any features of interest subjected to a more detailed description in a target note (TN)[14]. As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was Extended[15] to allow for the provision of information on other ecological features, including identification of the presence or potential presence of legally protected and otherwise notable species.

It should be noted that while every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey.

Protected or otherwise notable species

The methodologies used to establish the presence or potential presence of specific species and/ or species groups are summarised below. These relate to those species or biological taxa that the desk study and habitat types present indicated could occur on the Site.

Bats

A general assessment of the suitability of the habitats on the Site to support roosting, foraging and commuting bats was made. Buildings on the Site were inspected externally and any potential bat roost sites, such as gaps under roofing felt, were recorded, as were opportunities for bats to access potential roosts (e.g. cracks and holes, weatherboards). In addition, any evidence of bats (e.g. scratching, staining, lack of cobwebbing across potential bat access points, and droppings) around potential roost exits were noted.

Birds

The Site was assessed for its potential to provide nesting habitat for breeding birds or to support important assemblages of rare or notable bird species.

Great crested newt

Where access was possible, water bodies within 500 m of the Site and their associated terrestrial habitats, were assessed for their potential to support great crested newts. This excluded those water bodies that appeared to be separate from the Site by major barriers to great crested newt dispersal, as identified during the desk study (section 3.1). Suitable habitats include generally still, fish-free water bodies with adjacent woodland or grassland areas where there is optimal invertebrate prey potential.

[14] Joint Nature Conservation Committee (2010). Handbook for phase 1 habitat survey - a technique for environmental audit. JNCC, Peterborough.
[15] Institute of Environmental Assessment (1995). *Guidelines for Baseline Ecological Assessment*. E&FN Spon, London.

Reptiles

The Site and its surrounds were assessed for their potential to provide sheltering, foraging and breeding habitats for the four common reptile species: slow worm, viviparous lizard, grass snake and adder. These native reptile species generally require open areas with mixed-height vegetation, such as heathland, rough grassland, open scrub or (in the case of grass snake) water body margins. Suitable well drained and frost free areas are needed so that they can survive the winter.

Other species

In addition, an assessment was made of the potential for the Site to support any other species considered to be of value for biodiversity conservation, including those that were identified as occurring within the local area by the desk study.

Controlled species

Where legally controlled species were identified on the Site, a target note was made to record the location of the record, and extent of growth (in the case of plant species).

4. Results

4.1 Desk Study

Statutory Nature Conservation Sites

There are 11 statutory designated nature conservation sites within 10 km of the Site. Summary descriptions of these, with the approximate distances from the Site (in ascending order) are provided in Table 4.1, and their locations in relation to the Site are shown on Figure 4.1 (Appendix A).

Table 4.1 Statutory designated nature conservation sites within 10 km of the Site

Site name and designation	Site interest features	Distance (metres) and direction from Site boundary
International		
Sandwich Bay to Hacklinge Marshes – SSSI	The SSSI (covering 1,790 ha) contains the most important sand dune system and sandy coastal grassland in South East England. There are also a wide range of other habitats such as mudflats, saltmarsh, chalk cliffs, freshwater grazing marsh, scrub and woodland are found here. This SSSI comprises grazing marsh habitats within Minster Marshes and often supports large wintering populations of waders, some of which regularly reach levels of National Importance. Associated with the SSSI are outstanding assemblages of both terrestrial and marine plants and invertebrates. Notified features include: non-breeding populations of golden plover, grey plover, ringed plover and sanderling, and the assemblage of breeding birds within areas of lowland open waters and their margins.	On Site
Sandwich Bay – SAC	The SAC (covering 1,137 ha) has primarily been designated due to the presence of four Annex I habitats: embryonic shifting dunes; shifting dunes along the shoreline with European marram grass - 'white dunes'; fixed coastal dunes with herbaceous vegetation; and dunes with *Salix repens* ssp. *Argentea*.	On Site
Thanet Coast and Sandwich Bay – Ramsar	The Ramsar site (covering 2,169 ha) is designated for supporting internationally important numbers of non-breeding turnstone (under Ramsar Criterion 6), and 15 Red Data Book invertebrate species associated with wetlands (under Criterion 2). In addition, the Ramsar site supports nationally important numbers of ringed plover and greenshank during spring/autumn passage, and golden plover, sanderling, red-throated diver and great crested grebe in winter.	0 m south
Thanet Coast and Sandwich Bay – SPA	The SPA (covering 1,838 ha) is designated for populations of European importance of turnstone (non-breeding); golden plover (non-breeding) and little tern (breeding)	0 m south
Thanet Coast – Marine SAC	The Marine SAC (covering 2,816 ha) contains the longest continuous stretch of coastal chalk in the UK, and is primarily designated for two Annex I Habitats: Reefs, and submerged or partially submerged sea caves.	5,580 m north
Outer Thames Estuary – Marine SPA	This marine Sea inlet (covering 379,824 ha) regularly supports internationally important numbers of the Annex I Species (red-throated diver) in winter.	7,960 m North
Margate and Long Sands – SAC and Site of Community Importance SCI (Inshore Marine)	Margate and Long Sands starts to the north of the Thanet coast of Kent and proceeds in a north-easterly direction to the outer reaches of the Thames Estuary. It contains a number of sand banks (an Annex I habitat) slightly covered by seawater at all times, the largest of which is Long Sands itself.	7,960 m North
National		

Site name and designation	Site interest features	Distance (metres) and direction from Site boundary
Sandwich Bay to Hacklinge Marshes – SSSI	The SSSI (covering 1,790 ha) contains the most important sand dune system and sandy coastal grassland in South East England. There are also a wide range of other habitats such as mudflats, saltmarsh, chalk cliffs, freshwater grazing marsh, scrub and woodland are found here. This SSSI comprises grazing marsh habitats within Minster Marshes and often supports large wintering populations of waders, some of which regularly reach levels of National Importance. Associated with the SSSI are outstanding assemblages of both terrestrial and marine plants and invertebrates. Notified features include: non-breeding populations of golden plover, grey plover, ringed plover and sanderling, and the assemblage of breeding birds within areas of lowland open waters and their margins.	0 m south
Sandwich and Pegwell Bay – NNR	The NNR (covering 629 ha) contains a complex mosaic of habitats including inter-tidal mudflats, saltmarsh, shingle beach, sand dunes, ancient dune pastures, chalk cliffs, wave cut platform and coastal scrubland. It supports the only ancient dune pasture in Kent. The reserve is of international importance for its wader and wildfowl populations. 615 Hectares (ha) of the NNR is managed as a Kent Wildlife Trust Reserve.	0 m south
Thanet Coast - SSSI	The SSSI (covering 817 ha) is notified for its coastal habitats and the plant and invertebrate communities they support; geological features and breeding and non-breeding bird populations. Non-breeding populations of golden plover, grey plover, ringed plover and sanderling; breeding little tern; and the variety of passage bird species all form notified features of the SSSI.	5,580 m north
Local		
Prince's Beachlands LNR	A narrow coastal site located between two sections of Sandwich and Pegwell Bay NNR and within the Sandwich Bay to Hacklinge Marshes SSSI. A complex mosaic of habitats of international importance for its bird populations.	2,490 m south

Non-statutory nature conservation sites

There is one non-statutory site, Minster Marshes Local Wildlife Site (LWS ref. TH12), located within 2 km of the Site boundary. The LWS is located approximately 600 m to the south of the Site.

Priority habitats

National Priority habitats occur within the Site itself; chalk cliffs and intertidal mudflats associated with the Sandwich Bay to Hacklinge Marshes SSSI and Sandwich Bay SAC are located to the southern extent of the Site at the outfall location (intertidal mudflats) and intersecting the Site north of the helipad (chalk cliffs).. The following National and/ or Local Priority habitats are known to occur within 2 km of the Site:

- Embryonic shifting dunes, white dunes (containing herbaceous vegetation) and Dunes with Salix spp. are found within Sandwich Bay SAC, qualifying as an Annex I habitats.
- Reefs and submerged or partially submerged sea caves are found along Thanet coast.
- Intertidal mudflats, saltmarsh, shingle beach, ancient grazing dunes, chalk cliffs, wave-cut platforms and coastal scrub are all found within the Sandwich Bay to Hacklinge Marshes SSSI.
- Hedgerows and fresh standing water may also occur, though none were noted on the returned data search.

Water bodies

Three water bodies were identified within 500 m of the Site (see Figure 4.2 in Appendix A), of which one is located within the former Manston Airport site to the north; another is a reservoir which lies in an arable field to the west; and the third is a large garden pond to the west of the Site.

Protected or otherwise notable species

The following legally protected and otherwise notable species have been recorded within 5 km of the Site since 2000. Where possible, a measurement of the distance from the Site is provided, however this is in relation to the Manston Airport redevelopment site. Species with the potential to utilise the Site (for example, for foraging, roosting or breeding) are discussed further, as follows:

Birds

KMBRC provided a summary table of the bird records they hold within 5 km of the Site. Table C1 in Appendix C shows a summary of the records of protected or otherwise notable bird species provided. Further details of the numbers and occurrence of bird species that form the qualifying or notified interest of statutory designated sites of nature conservation value (shown in Table 4.1) are discussed, as follows:

Golden Plover

The Thanet Coast & Sandwich Bay SPA was originally designated in part for the internationally important non-breeding population of golden plover that it supports. Nationally important numbers of non-breeding golden plover are also notified features of the Sandwich Bay to Hacklinge Marshes SSSI and Thanet Coast SSSI. However, as part of the third JNCC SPA review[16], golden plover was removed as a designated species from the SPA (likely due to declining numbers), although this change is, as yet unratified. The UK population was estimated to be 420,000 birds in winter[17].

There is the potential for golden plover to use the arable land adjacent to the Site for foraging and roosting. These birds would be considered part of the SPA population. Data provided by the SBBO and KOS show that golden plover winter on both intertidal and inland areas around Pegwell Bay, with their main feeding habitats being the arable fields and grazing marshes located inland of the dunes at Sandwich Bay (south of the Site). Very few records of golden plover were located within 2 km to the south, west and north of the Site. Results from the surveys in 2002/03[8] and 2016/17[9] indicate that numbers of golden plover have declined in the Sandwich Bay / Thanet area during the intervening years, from a high tide peak count of 4,962 birds (in January 2003) to only 1,536 (in late January 2017).

KMBRC provided a summary of the 1,073 records of golden plover (within approximately 5 km of the Site) they hold, the most recent of which being in 2012 and the closest to the Site, occuring on the intertidal mudflats of Pegwell Bay.

Turnstone

The Thanet Coast & Sandwich Bay SPA and Ramsar site are designated for their internationally important non-breeding numbers of turnstone. The SPA qualifying population of turnstone (of 940 individuals, 5-year peak mean counts from 1991/2-1995/6) represent 1.4% of the Western Palearctic population. Turnstone almost exclusively occur in coastal habitats, foraging and resting on rocky shorelines and beaches, but will also forage along the tidelines on sandy beaches and on mudflats. The Site and surrounding farmland provide no opportunities for foraging or resting turnstone, and therefore the species is unlikely to occur in this area.

[16] Stroud, D.A., Bainbridge, I.P., Maddock, A., Anthony, S., Baker, H., Buxton, N., Chambers, D., Enlander, I., Hearn, R.D., Jennings, K.R, Mavor, R., Whitehead, S. & Wilson, J.D. - on behalf of the UK SPA & Ramsar Scientific Working Group (eds.) (2016). *The status of UK SPAs in the 2000s: the Third Network Review*. [c.1,108] pp. JNCC, Peterborough. http://jncc.defra.gov.uk/page-7309.
[17] Musgrove, A., Aebischer, N., Eaton, M., Hearn, R., Newson, S., Noble, D., Parsons, M., Risely, K. and Stroud, D. (2013). Population estimates of birds in Great Britain and the United Kingdom. *British Birds, 106*: 64-100.

Little Tern

A breeding population of six pairs of Little tern is a qualification feature of the Thanet Coast & Sandwich Bay SPA, and a notified feature of the Thanet Coast SSSI. However, as part of the third JNCC SPA review (Stroud *et al*., 2016), little tern was removed as a designated species of the SPA, due to recent extirpation from the SPA, although this change is as yet, unratified. The little tern almost exclusively occurs in coastal habitats, nesting and foraging along shorelines and beaches. The Site and surrounding farmland provides no opportunities for foraging, resting or nesting little tern, and therefore the species is unlikely to occur in this area.

Other SPA/Ramsar qualifying and SSSI notified species

The Sandwich Bay and Hacklinge Marshes SSSI and Thanet Coast SSSI (both constituent SSSIs of the Thanet Coast & Sandwich Bay SPA) are notified (as well as for golden plover) for their nationally important non-breeding numbers of grey plover, ringed plover and sanderling. **Error! Reference source not found.**As with turnstone and little tern, grey plover, ringed plover and sanderling primarily inhabit coastal habitats and the Site and surrounding farmland provide no foraging or resting opportunities for these species, and therefore they are unlikely to occur in this area.

Lapwing

Lapwing is not a qualifying or notified feature of the Thanet Coast and Sandwich Bay SPA and its constituent SSSIs, although it is a species of principal importance, and is also a BoCC red-listed species. Lapwing and golden plover occupy very similar habitats in winter (including farmland). KMBRC provided a summary of the 1,271 records of lapwing they hold, within 5 km of the Site, the closest of which is located within the same 10 km grid reference as the Site. A five-year peak mean count of 11,890 lapwing was recorded in Pegwell Bay for the period 2008/09-2012/13 (as obtained from WeBS core count data). Results from the 2016/17 surveys also indicated a decline in lapwing numbers in the area, with a peak count of 6,171 birds recorded in November 2016, and a distribution that was broadly similar to that of golden plover[8]. Data obtained from the KOS website (www.kentos.org.uk/) shows that lapwing occur year-round within Pegwell Bay (1.8 km south-east of the Site), with a peak count of 22,000 birds recorded there on the 5 January 2013.

Great crested newts

KMBRC data provided one record of great crested newt, in 2011 at Monkton Chalk Pit Nature Reserve, 2.9 km to the west of the Site.

Reptiles

KMBRC provided records of three species of reptile within 5 km of the Site, a summary of which is shown in Table 4.3.

Table 4.3 Summary of reptile records within 5 km of the Site

Species	Number of records since 2000	Distance and direction of the closest record to the Site
Grass snake	11	2.9 km west
Slow-worm	59	2.3 km north
Viviparous Lizard	21	1.85 km south-east

Badger

The location of Badger records is **0** and this information should not be made available in the public domain; such records are therefore located within confidential 0.

Bats

There were 125 records of bats (since 2000) within 5 km of the Site, including at least six species: common pipistrelle; Nathusius' pipistrelle; soprano pipistrelle; brown long-eared bat; Natterer's bat and serotine. Table 4.2 shows the summarised data received from Kent Bat Group.

Table 4.2 Summary of bat records from within 5 km of the Site.

Species	No. of Records	Date of most recent record	Distance and direction from Site of the nearest record
Brown long-eared bat	20	2015	2.5 km south-west
Common pipistrelle	44	2015	1.0 km north-west
Nathusius' pipistrelle	2	2015	2.9 km north-east
Soprano pipistrelle	14	2015	2.4 km south-west
Pipistrellus Spp.	15	2015	1.5 km south-west
Natterer's bat	23	2015	3.4 km north-west
Serotine	1	2001	2.2 km south-east
Chiroptera Spp.	6	2015	2.0 km north-east

The closest record was of three grounded common pipistrelles, 1 km north-west of the Site, in 2012. The closest roost is located, 2.4 km to the south-west of the Site, with a peak count of 668 individual soprano pipistrelles recorded; this count was undertaken in July and included juveniles on the wing suggesting its function as a maternity roost.

Dormouse

The desktop study revealed no records of dormouse since 2000 within the 5 km radius of the Site.

Other species

Notable mammals

Records for a further three mammal species were provided by KMBRC for within 5 km of the Site. These included 106 records of brown hare since 2000, the closest of which being 1.85 km south-east of the Site. A total of 88 records of hedgehog were received, with the closest being 0.2 km east of the Site. Four records of harvest mouse were provided, the closest being 4.3 km south-west of the Site. All three are species of principal importance.

Invertebrates

KMBRC provided records of 137 species of invertebrates within 5 km of the Site, since 2000. Ten of which are priority species, including three butterflies (wall brown, small heath and small blue), a robber-fly, wasp and bee, and four moth species.

Vascular plants

Table 4.4 provides a summary of the KMBRC records of protected or otherwise notable vascular plant species found within 5 km of the Site.

Table 4.4 Vascular plants recorded within 5 km of the Site since 2000

Species	Legal status	No. of records since 2000	Distance and direction (km) of nearest record to the Site
Basil Thyme	S41	5	2.6 west
Bedstraw Broomrape	WCA8	1	4.5 south
Cornflour	S41	4	1.85 south-east
Deptford Pink	S41	3	4.5 south
Divided Sedge	S41	20	1.5 south-west
Man Orchid	S41	2	2.7 west
Martin's Ramping-fumitory	WCA8	3	0.1 west
Prickly Saltwort	S41	9	1.8 south-east
Sea Barley	S41	1	3.3 east
Tubular water-dropwort	S41	12	1.5 south-west

Key: S41, Species of Principal Importance (Section 41 of NERC); WCA8, The Wildlife and Countryside Act (1981) (as amended) Schedule 8.

Controlled species

KMBRC provided records of 14 legally controlled species recorded within 5 km of the Site since 2000. Of those listed only three; Japanese knotweed, wall cotoneaster and Himalayan cotoneaster are likely to occur on or adjacent to the Site, based on habitats present.

4.2 Field Survey

Habitats

The dominant habitat on the Site, constituting approximately 450 m of the pipeline length, was urban, with hardstanding, buildings and amenity grassland recorded frequently. Areas of tall ruderal, dense continuous scrub and scattered scrub were recorded occasionally within the Site. Ephemeral/short perennial, hedgerow, arable, improved grassland and bare ground were also recorded rarely occurring on and adjacent to the Site. The outfall discharges into the maritime and inter-coastal habitats associated with Pegwell Bay. The mapped habitats are presented in Figure 4.3 (Appendix A). The following sections of this document describe the Site conditions at the time of the survey (6 September 2017) and appear in order of approximate abundance.

Hardstanding

Hardstanding constituted the majority of the Site. It was present throughout in the form of public roads, private driveways and a farmland track, railway and the former helipad in the south of the Site. Hardstanding was generally in good condition and regularly utilised except for the former helipad, which had significant tall ruderal growth and scattered scrub.

Amenity grassland

Gardens associated with private residential properties and grass verges along pavement were considered amenity grassland due to their function and regular cutting regime and were present in the north of the Site along Foads Lane and Clive Road and in the south along Meverall Avenue and Sandwich Road. These habitats were dominated by perennial rye-grass with frequent white clover, daisy and ribwort plantain.

Amenity grassland was also present in the south of the Site, surrounding the carpark for the Pegwell Bay National Nature Reserve, and was dominated by perennial rye-grass with frequent herb species such as yarrow, daisy, white clover and ribwort plantain and occasionally recorded shepherd's purse, dove's-foot crane's bill, groundsel, dandelion and bristly ox-tongue. Along the margin, between grassland and scrub habitat, where cutting appeared less frequent, species diversity was slightly higher and in addition to those species already recorded, were wall barley, cock's-foot, red clover, red fescue, false oat-grass, alexanders, creeping buttercup, sea plantain and red pimpernel.

Buildings/built structures

All buildings on the Site were 1960's style one or two storey residential properties. These were located within two areas of the Site; in the north along Foads Lane and Clive Road and in the south along Meverall Avenue and Sandwich Road. The rear of buildings lining the west of Cliff View Road were adjacent to the Site at its northern extent.

Photographs (from October 2017) of the engineered discharge structure at Pegwell Bay are provided in Appendix F.

Dense continuous, scattered scrub and non-native shrub

This habitat type lined either side of the railway track in the north of the Site and covered the chalk cliffs forming the Sandwich Bay to Hacklinge Marshes SSSI and was scattered throughout the helipad in the south of the Site. Species present were hawthorn, bramble, elder, ivy, traveller's joy and the non-native butterfly bush. In addition, in the south of the Site the species composition was more varied and included species more closely associated with coastal habitats, such as sea-buckthorn and non-native species including daisy bush and barberry.

Non-native and ornamental shrubs associated with private residences were present in the north of the Site along Foads Lane and Clive Road and in the south along Meverall Avenue. Species recorded included various cultivars of butterfly-bush, dogwood, laurel, hypericum, cotoneaster and box.

Tall ruderal

A margin of tall ruderal habitat was present along the eastern edge of the arable field in the north of the Site, adjacent to the rear gardens of the Clive Road properties, and along the margin of the continuous scrub associated with the railway line. Species present were typical of arable field margins, dominated by charlock, alexanders and common nettle, with cleavers, common mallow, smooth sow-thistle, bristly ox-tongue and Yorkshire fog also recorded. This habitat was also scattered throughout the degraded hardstanding that constituted the helipad in the south of the Site, and consisted of a more diverse range of species including abundant fennel and frequent oxeye daisy, perforate Saint John's-wort, common reed, mugwort, hemp agrimony, cock's-foot, common bent, yarrow spear thistle, English stonecrop, sea couch and lesser centaury.

Ephemeral/ short perennial

Ephemeral and short perennial vegetation was recorded to the south of the railway line, either side of the hardstanding farm track. Species recorded here included black medick, goat's beard, common bird's-foot-trefoil, shepherd's purse, field bindweed, field scabious, common knapweed bristly ox-tongue, teasel and creeping thistle.

Species-poor hedgerow

One species-poor hedgerow consisting of hawthorn, elder and blackthorn formed a border between arable land and an excavation site in the centre of the Site, north of Meverall Avenue.

Bare ground

A small area of bare ground was present in the centre of the Site, north of Meverall Avenue, where an active excavation was recorded. Two further areas; one consisting of shingle creating the base for the Viking Ship at Pegwell Bay; and the other of large rocks along the sea wall, neither supported any vegetation.

Cultivated land - Arable

One ploughed arable field was recorded in the northern extent of the Site. Two fields to the north of Meverall Avenue were also recorded as arable; with one field, to the west, supporting an asparagus crop, whilst the other, to the east, was stubble.

Species-poor improved grassland

One area supported this habitat; situated between the asparagus field and the railway line and forming a margin between track and arable field to the south. Perennial rye-grass was dominant with occasional records of those species already recorded within ephemeral/ short perennial habitat.

Protected or otherwise notable species

Badgers

In line with the legislation and best practice relating to badgers in the UK, results of badger survey work are contained within confidential Appendix D.

Bats

The buildings on the Site were found to be generally in good condition with no obvious broken soffits or tiles which would provide features for roosting bats or access to roof voids, however a full inspection of each building was not possible at the time of the survey. The buildings along the west side of Cliff View Road (TN2) had roofing of poorer condition providing features for roosting bats, however these buildings were not situated in the Site itself, sitting approximately 15m from the Site boundary.

Habitats on the Site provided limited commuting and foraging opportunities for bat species, the residential nature of the area would suggest that the area is well lit at night. However, the dense continuous and scattered scrub and tall ruderal vegetation in the south of the Site provided suitable habitat for commuting and foraging bat species which utilise edge habitats and clearings.

Birds

The tall ruderal (TN1), dense continuous and scattered scrub habitats (TN4), hedgerow (TN5) and non-native shrubs (TN6) provided foraging and nesting opportunities for birds. Due to the timing of the survey, the main breeding season for birds was finished and therefore breeding activity was not recorded.

Great crested newts

Habitats on the Site provided limited terrestrial habitat for great crested newt.

The three water bodies, as shown in Figure 4.2 (Appendix A), identified within 500 m of the Site were:

- Water body 1 was a small reservoir located within an arable field adjacent to the Site;
- Water body 2 was a large, garden pond with at least 20 ducks and no vegetation present; and
- Water body 3 (located within the main former airport site) was not assessed during the current survey.

Reptiles

The arable margins and area of semi-improved grassland along a south facing slope (TN3) and dense continuous scrub in the north of the Site provide limited opportunities to support the widespread reptile species, including viviparous lizard and slow worm.

Other species

Species of Principal Importance, such as hedgehog may occur on the Site, specifically foraging within grassland and gardens. Brown hare may utilise arable and grassland habitats within the Site.

No notable or protected plants were recorded during the survey. Habitats on the Site, including the tall ruderal and ephemeral growth scattered within the hardstanding of the helipad, did provide suitable vegetation to support those butterfly species identified during the desk study including the small blue.

Controlled species

Plants of the cotoneaster genus were recorded on the Site. There are five species listed under Schedule 9, however those recorded on Site were not identified to species level (there are 70 species within this genus). These survey records were restricted to private residential gardens and, as this legislation relates to those invasive species which have spread into the wild, are therefore not pertinent to this assessment.

5. Discussion and recommendations

Badgers

Recommendations are provided in Appendix D.

Bats

The desk study provided records of several bat species within 5 km of the Site, the habitats present on the Site have the potential to support all of these species but most likely common and soprano pipistrelle. Nathusius' pipistrelle is considered 'Rare' in the UK[18], and this species, although known to occur in the local area, is unlikely to regularly utilise habitats on the Site due to the lack of large water bodies with which this species is typically associated. Natterer's and brown long-eared bat are unlikely to utilise habitats recorded within the Site due to their preference for darker, continuous woodland habitats. The buildings on the Site may provide roosting opportunities for all species recorded within the desk study. However, due to the limited scope of works proposed with access to the outfall pipe restricted to the immediate vicinity of the manhole covers, no further surveys are required. However, where works surrounding manholes are required a best practice policy should be followed, including the restriction of works to daylight hours (to avoid the need for artificial lighting which may impact roosting, foraging and commuting bats). Should any works involve high levels of noise, this would require an assessment to determine the likelihood of disturbance to roosting bats.

Birds

Habitats suitable to support breeding and foraging bird species occur on and adjacent to the Site. Species likely to be present, as highlighted by the desk study, include widespread notable species; albeit the habitats are unlikely to support any population or assemblage of birds of importance to biodiversity conservation, due to their limited extent.

Although a breeding bird survey is not deemed to be necessary, there is a requirement to avoid contravention of the legislation relating to nesting birds in the UK (see Appendix B). As such it is recommended that any vegetation clearance is undertaken between late-August and late February to avoid the main nesting season. Caution should still be taken during this period, though, as birds occasionally breed outside the main nesting season. Alternatively, clearance must be preceded by an inspection of the vegetation by an experienced ecologist to check for nests, with any nests found left undisturbed and protected until young birds have fledged.

Any maintenance work to the outfall at the discharge point should be undertaken diurnally between May and late July when bird numbers of the adjacent designated site are at their lowest. In addition any works at that point should be undertaken diurnally at low tide when there is a large expanse of intertidal habitat available and birds are able to feed at distance from the discharge point, also preventing disturbance of any high tide roosts.

Great crested newts

No water bodies within a 500 m radius of the Site appear to offer breeding habitat for great crested newt, providing no vegetation for egg laying and supporting high levels of water fowl which predate newts and their eggs[19]. There is limited habitat to support terrestrial great crested newts and therefore no further survey work is deemed necessary.

Reptiles

Although there is a small area of habitat on Site which could support reptiles, the extent of the proposed works are limited to areas around the manhole covers which are mostly located on or adjacent to

[18] Bat Conservation Trust (2012). The state of the UK's bats; National Bat Monitoring Programme Population Trends 2012. Bat Conservation Trust, London.
[19] Beebee, T. J. C. & Griffiths, R. A. (2000). *Amphibians and Reptiles*. Harper-Collins, New Naturalist.

hardstanding, it if therefore unlikely that works would significantly impact this habitat. Should the scope of works change this assessment will require revision.

6. Conclusions

Eleven statutory designated sites are located within 10 km of the Site, the outfall corridor running from the former Manston Airport to a discharge point in the north of Pegwell Bay. Of the designated sites, the Thanet Coast and Sandwich Bay SPA/Ramsar site, Sandwich Bay SAC and Thanet Coast Marine SAC, are of international importance and are within or adjacent to the site at its southern extent. The constituent SSSIs of the SPA include the Thanet Coast SSSI and Sandwich Bay to Hacklinge Marshes SSSI, the latter also being located within the Site itself. These sites are designated for a variety of biodiversity including their habitats, flora and invertebrate interests, but also for non-breeding populations of birds, in particular, golden plover which could potentially occur within, or adjacent to the Site.

One Priority Habitat has been identified within the Site; chalk cliff, which constitutes part of the Sandwich Bay to Hacklinge Marshes SSSI. Three other Priority Habitats occurred within 2 km of the Site. These habitats consist of coastal embryonic shifting dune systems, intertidal mudflats, saltmarsh, grazing dunes, shingle beaches, wave-cut platforms and cliffs, located within the Sandwich Bay area; with submerged/partially submerged reefs and sea-caves along the Thanet coastline.

The desk study and field survey identified the potential for a number of legally protected and notable species to utilise the habitats within the Site:

- Badgers – refer to Appendix D for further details;
- Birds – potentially foraging and nesting within the Site;
- Bats – potentially foraging and commuting on the Site, and roosting in buildings on the Site; and
- Reptiles – potentially using suitable habitats in the north of the Site.

No further survey work is considered necessary in respect of these species/groups due to the limited extent of any works within the Site.

Appendix A
Figures

634000 634500 635000 635500

N

Depot

CANTERBURY ROAD W

KING ARTHUR CL

ARUNDEL CL

WINDSOR CL

CANTERBURY ROAD WEST

Hollins Bottom

A2

Reservoir

FOADS HILL

St

CLIVE ROAD

A299

A299

A299

Tunnel

Cliffsend Crossing

Cliffs End

Cliffsend Farm Cottages

CLIFFS END ROAD

SANDC

MEVERALL AVENUE

Cliffs End Farm

EARL

HALL

Fl

GREEN AVENUE

MOUNT

COURTLANDS

Cycle Track

The Viking Boat

Causew

Great Cliffsend Farm House

COTTINGTON ROAD

St Augustine's Cross

BEECH GROVE

CLIFFS END Gk

GROVE

Outfall

Outfall

Cliffsend Point

St Augustine's Well

Pegwell Bay

Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright 100001776.

file: H:\Projects\38199 LON Manston AirportDCO EIA\Drawings\ArcGIS\Figures\38199-Lon 144.mxd

Key

Site boundary

0 50 100 150 200 250m

Scale at A3: 1:5,000

Client

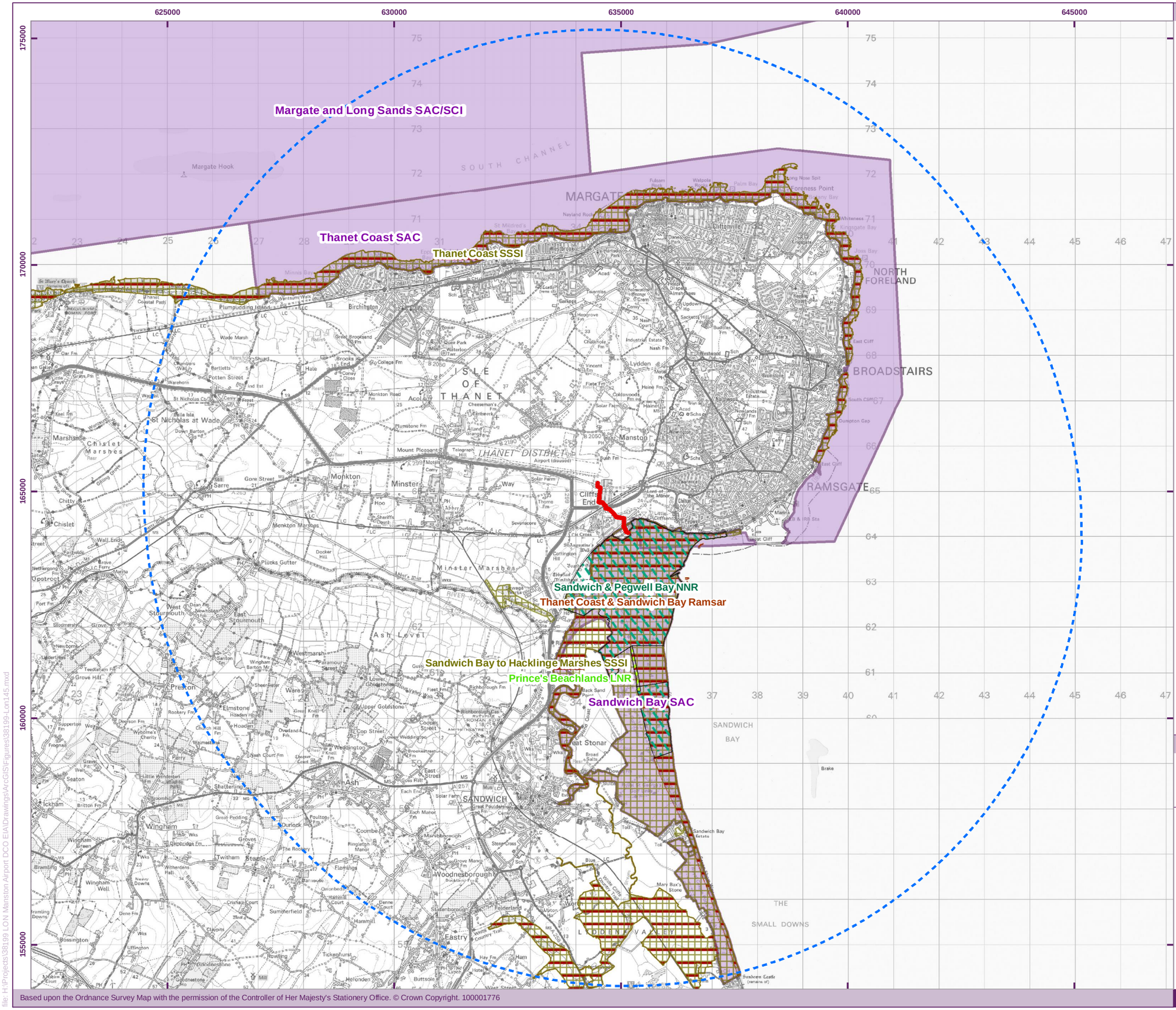
RSP

Manston AirportDCO
EIA
Outfall Corridor

amec foster wheeler

Figure 1.1
Site location

September 2017 38199-Lon 144.mxd parkj



Key

- Site boundary
- 10km study area
- Ramsar
- SSSI
- SAC
- Local Nature Reserve
- National Nature Reserve

0 1 2 3 4 5 km

Scale at A3: 1:80,000

Client

RSP

Manston Airport DCO
EIA
Outfall Corridor

amec foster wheeler

Figure 4.1
Statutory designated nature conservation sites

634000

635000

165000

164000

N

Key

Site boundary

500m buffer

Waterbody

0 200 400 m

Scale at A3: 1:8,000

Client

RSP

Manston Airport DCO
EIA
Outfall Corridor

amec foster wheeler

Figure 4.2
Waterbodies within 500 m of the Site

September 2017 38199-Lon146.mxd parkj

File: H:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon146.mxd

634300 634400 634500 634600 634700

165200 165100 165000 164900

N

Key

Manston Airportboundary

Surface water

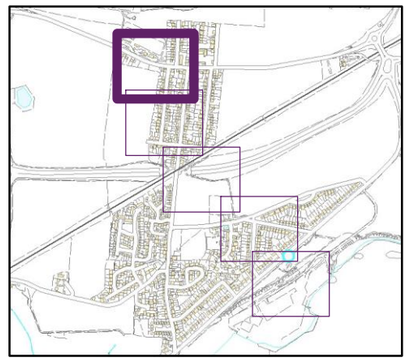
RPS -L-Subsoil Ownership

Tall ruderal

A A A Arable - ploughed

Targetnote

Index Map



0 20 40 60 80 m

Scale atA3: 1:1,500

Client

RSP

Manston AirportDCO
EIA
Outfall Corridor

amec foster wheeler

Figure 4.3
Extended Phase 1 habitat map

Page 1 of 5

634400 634500 634600 634700 634800

165000 164900 164800 164700

N

CLIFF VIEW

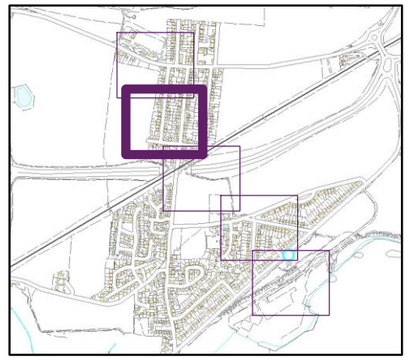
FOADS HILL

A299

Key

- Surface water
- R PS-L-SubsoilOwnership
- Scrub- dense/continous
- Tall ruderal
- A A A Arable - ploughed
- A A A Amenity grassland/garden
- D D D D Ephemeral/short perennial
- Introduced shrub
- Buildings
- Hardstanding
- Scattered tree
- Target note

Index Map



0 20 40 60 80m

Scale at A3: 1:1,500

Client

RSP

Manston Airport DCO
EIA
Outfall Corridor

amec foster wheeler

Figure 4.3
Extended Phase 1 habitat map

Page 2 of 5

634500 634600 634700 634800 634900

164800 164700 164600 164500

N

CLIFF VIE

FOA

A299

FOADS LANE

CLIFFS END R OAD

2 2 2 2 2 3 4 5

Key

- Surface water
- R PS-L-SubsoilOwnersh ip
- Scrub- dense/continous
- Im prov ed, species poor grassland
- Tallruderal
- Arable - ploug h ed
- Am enity g rassland/g arden
- Eph em eral/sh ortperennial
- Introduced sh rub
- Building s
- Hardstanding
- Intacth edg e species poor
- Scattered tree
- Targ etnote

Index Map

0 20 40 60 80m

Scale atA3: 1:1,500

Client

RSP

Manston AirportDCO
EIA
OutfallCorridor

amec foster wheeler

Figure 4.3
Extended Phase 1 habitat map

Page 3 of 5

634800 634900 635000 635100

164600 164500 164400 164300

N

5 6 4

CLIFFS END R OAD

MEVER ALL AVENUE

SANDWICH R OAD

THE VIKING BOAT

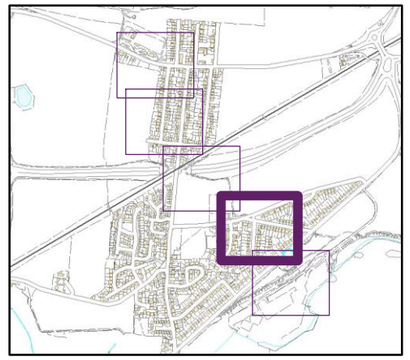
Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright 100001776.

file: H:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon140.mxd

Key

- Surface water
- RPS-L-Subsoil Ownership
- Scrub - dense/continuous
- Scrub - scattered
- Improved, species poor grassland
- Tall ruderal
- Shingles/rocks
- Arable - ploughed
- Amenity grassland/garden
- Ephemeral/short perennial
- Introduced shrub
- Buildings
- Hardstanding
- Intact hedge species poor
- Scattered tree
- Target note

Index Map



0 20 40 60 80m

Scale at A3: 1:1,500

Client

RSP

Manston Airport DCO
EIA
Outfall Corridor

amec foster wheeler

Figure 4.3
Extended Phase 1 habitat map

September 2017 38199-Lon140.mxd pakj

634900
635000
635100
635200
635300
164300
164200
164100
164000
N
THE VIKING BOAT
SANDWICH ROAD
Sea

Key

- Surface water
- RPS-L-Subsoil Ownership
- Scrub- dense/continous
- Scrub- scattered
- Tallrudderal
- Sea
- Shingles/rocks
- Amenity grassland/garden
- Buildings
- Hardstanding
- Targetnote

Index Map

0 20 40 60 80m

Scale atA3: 1:1,500

Client

RSP

Manston AirportDCO
EIA
OutfallCorridor

amec foster wheeler

Figure 4.3
Extended Phase 1 habitat map

Page 5 of 5

September 2017 38199-Lon140.mxd parkj

file: H:\Projects\38199 LON Manston AirportDCO EIA\Drawings\ArcGIS\Figures\38199-Lon140.mxd

Appendix B
Legislation

All wild mammals (including rabbits and foxes)

Under the *Wild Mammals (Protection) Act 1996* it is an offence intentionally to cause unnecessary suffering to any wild mammal.

Badger

The Protection of Badgers Act 1992 makes it an offence to:

- wilfully kill, injure or take a badger;
- attempt to kill, injure or take a badger; or
- cruelly ill-treat a badger.

It is also an offence to interfere with a badger set by:

- damaging a badger sett or any part of it
- destroying a badger sett;
- obstructing access to, or any entrance of, a badger sett;
- disturbing a badger when it is occupying a badger sett, or

intending to do any of those things or being reckless as to whether his actions would have any of those consequences.

Bats (Rhinolophidae and Vespertilionidae)

All British bat species are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of the *Conservation of Habitats and Species Regulations 2010* (as amended). They are afforded full protection under Section 9(4) of the Act and Regulation 41 of the Regulations. These make it an offence, *inter alia*, to:

- deliberately capture, injure or kill a bat;
- deliberately disturb a bat (this applies anywhere, not just at its roost), in particular in such a way as to be likely to:
  - impair their ability to survive, breed or reproduce, or rear or nurture their young;
  - impair their ability to hibernate or migrate.
- affect significantly the local distribution or abundance of that bat species;
- damage or destroy a breeding site or resting place of any bat;
- intentionally or recklessly disturb a bat while it is occupying a structure or place that it uses for shelter or protection; or
- intentionally or recklessly obstruct access to any place that a bat uses for shelter or protection (this is taken to mean all bat roosts whether bats are present or not).

In addition, five British bat species are listed on Annex II of the Habitats Directive. These are:

- Greater horseshoe bat (*Rhinolophus ferrumequinum*)
- Lesser horseshoe bat (*Rhinolophus hipposideros*)
- Bechstein's bat (*Myotis bechsteinii*)
- Barbastelle (*Barbastella barbastellus*)
- Greater mouse-eared bat (*Myotis myotis*)

In certain circumstances where these species are found the Directive requires the designation of Special Areas of Conservation (SACs) by EC member states to ensure that their populations are maintained at a favourable conservation status. Outside SACs, the level of legal protection that these species receive is the same as for other bat species.

Birds

With certain exceptions[20], all wild birds, their nests and eggs are protected by section 1 of the *Wildlife and Countryside Act 1981* (as amended). Therefore, it is an offence, *inter alia*, to:

- intentionally kill, injure or take any wild bird;
- intentionally take, damage or destroy the nest of any wild bird while it is in use or being built; or
- intentionally take or destroy the egg of any wild bird.

These offences do not apply to hunting of birds listed in Schedule 2 of the Act subject to various controls.

Bird species listed on Schedule 1 of the Act receive further protection, thus for these species it is also an offence to:

- intentionally or recklessly disturb any bird while it is nest building, or is at a nest containing eggs or young; or
- intentionally or recklessly disturb the dependent young of any such bird.

For golden eagle, white-tailed eagle and osprey, it is also an offence to:

- take, damage or destroy the nest of these species (this applies at any time, not only when the nest is in use or being built).

Dormouse

Dormouse is listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of the *Conservation of Habitats and Species Regulations 2010* (as amended). This species is afforded full protection under Section 9(4) of the Act and Regulation 41 of the Regulations. These make it an offence, *inter alia*, to:

- deliberately capture, injure or kill any such animal;
- deliberately disturb any such animal, in particular in such a way as to be likely to:
  - impair their ability to survive, breed or reproduce, or rear or nurture their young;
  - impair their ability to hibernate or migrate.
  - affect significantly the local distribution or abundance of that species;
- damage or destroy a breeding site or resting place of any such animal;
- intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection; or
- intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

Great crested newt

The great crested newt is listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of the *Conservation of Habitats and Species Regulations 2010* (as amended). It is afforded

[20] Some species, such as game birds, are exempt in certain circumstances.

protection under Section 9(4) of the Act and Regulation 41 of the Regulations. These make it an offence, *inter alia*, to:

- deliberately capture, injure or kill any such newt;
- deliberately disturb any such newt, in particular in such a way as to be likely to:
  - impair their ability to survive, breed or reproduce, or rear or nurture their young;
  - impair their ability to hibernate or migrate.
  - affect significantly the local distribution or abundance of that species;
- deliberately take or destroy the eggs of such a newt;
- damage or destroy a breeding site or resting place of any such newt;
- intentionally or recklessly disturb any such newt while it is occupying a structure or place that it uses for shelter or protection; or
- intentionally or recklessly obstruct access to any place that any such newt uses for shelter or protection.

This relates to both the aquatic and terrestrial habitat they occupy. The legislation applies to all life stages of this species.

Reptiles

The four widespread[21] species of reptile that are native to Britain, namely common or viviparous lizard, slow worm, adder and grass snake, are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and are afforded limited protection under Section 9 of this Act. This makes it an offence, *inter alia*, to:

- intentionally kill or injure any of these species.
- intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

Insects

The insects listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and afforded full protection under Section 9 of this Act are:

- the rainbow leaf beetle (*Chrysolina cerealis*), lesser silver water beetle (*Hydrochara craboides*) and violet click beetle (*Limoniscus violaceus*);
- the mire pill beetle (*Curimopsis nigrita*)*;
- the beetles *Graphoderus zonatus, Hypebaeus flavipes* and *Parcymus aeneus*;
- the large copper (*Lycaena dispar*), heath fritillary (*Mellicta athalia*), marsh fritillary (*Eurodryas aurinia*) and swallowtail (*Papilio machaon*) butterflies;
- the field (*Gryllus campestris*) and mole (*Gryyllotalpa gryllotalpa*) crickets;
- the New Forest cicada (*Cicadetta montana*);
- the southern damselfly (*Coenagrion mercuriale*) and Norfolk aeshna dragonfly (*Aeshna isosceles*);

[21] The other native species of British reptile (sand lizard and smooth snake) receive a higher level of protection in England and Wales under the *Conservation of Habitats and Species Regulations 2010* and the *Wildlife and Countryside Act 1981* (as amended). However, the distribution of these species is restricted to only a very few sites. All marine turtles (*Cheloniidae and Dermochelyidae*) are also protected.

- the wart-biter grasshopper (*Decticus verrucivorus*);
- the Barberry carpet (*Pareulype berberata*), black veined (*Siona lineata*), Essex emerald (*Thetida smaragdaria*), fiery clearwing (*Bembecia chrysidiformis*), Fisher's estuarine (*Gortyna borelii*), New Forest Burnet (*Zygaena viciae*), reddish buff (*Acosmetia caliginosa*) and Sussex emerald (*Thalera fimbrialis*) moths.

This makes it an offence, *inter alia*, to:

- intentionally kill, injure, or take (handle) any of these species (* except the mire pill beetle);
- intentionally or recklessly damage, destroy or obstruct access to any place that any of these species uses for shelter or protection; or
- intentionally or recklessly disturb any of these species while it is occupying a structure or place that it uses for shelter or protection.

Other terrestrial and freshwater invertebrates

In addition to crayfish, insects and spiders, the following terrestrial and freshwater invertebrates are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and afforded full protection under Section 9 of this Act:

- the medicinal leech (*Hirudo medicinalis*);
- a fairy shrimp (Chirocephalus diaphanus);
- the tadpole shrimp or apus (*Triops cancriformis*);
- the freshwater pearl mussel (*Margaritifera margaritifera*);
- the glutinous (*Myxas glutinosa*), sandbowl (*Catinella arenaria*) and Roman (*Helix pomatia*) snails.

This makes it an offence, *inter alia*, to:

- intentionally kill, injure, or take (handle) any of these species;
- intentionally or recklessly damage, destroy or obstruct access to any structure or place that any of these species uses for shelter or protection; or
- intentionally or recklessly disturb any of these species while it is occupying a structure or place that it uses for shelter or protection.

Directive 2009/147/EC (The Wild Birds Directive), 2009

Certain species receive protection at a European level due to appearing on Annex I of the Directive 2009/147/EC of The European Parliament and of The Council of 30 November 2009 on the conservation of wild birds (codified version).

Certain endangered, rare, or vulnerable bird species, which warrant special protection, are included on Annex I of the Directive 2009/147/EC of The European Parliament and of The Council of 30 November 2009 on the conservation of wild birds (codified version); also referred to as the *Wild Birds Directive*.

The *Wild Birds Directive* recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species. Together with Special Areas of Conservation (SACs) designated under *Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ('Habitats Directive')*, SPAs form a network of pan-European protected areas known as Natura 2000.

Ramsar sites

Ramsar sites are wetlands of international importance designated under the Ramsar Convention. Sites proposed for selection are advised by the UK statutory nature conservation agencies, or the relevant administration in the case of Overseas Territories and Crown Dependencies, co-ordinated through JNCC. In selecting sites, the relevant authorities are guided by the Criteria set out in the Convention. The Criteria pertaining specifically to birds are as follows:

- Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds; and
- Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

In the UK, the first Ramsar sites were designated in 1976 since which, many more have been designated. The initial emphasis was on selecting sites of importance to waterbirds within the UK, and consequently many Ramsar sites are also Special Protection Areas (SPAs) classified under the Birds Directive. However, greater attention is now being directed towards non-bird features which are increasingly being taken into account, both in the selection of new sites and when reviewing existing sites.

Natural Environment and Rural Communities Act 2006

Section 40 of the *Natural Environment and Rural Communities (NERC) Act 2006* places duties on public bodies to have regard to the conservation of biodiversity in the exercise of their normal functions. In particular, Section 41 of the NERC Act requires the Secretary of State to publish a list of species which are of Principal Importance for conservation in the UK. This list is largely derived from the 'Priority Species' listed under the former UK Biodiversity Action Plan (BAP), which continue to be regarded as Priority Species under the subsequent country-level biodiversity strategies. The Section 41 list replaces the list published by Defra in 2002 under Section 74 of the *Countryside and Rights of Way (CRoW) Act 2000*.

Birds of conservation concern: Red list birds

Red and Amber list bird are those listed as being of high or medium conservation concern (respectively) in Birds of Conservation Concern (BoCC) 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man (Eaton *et al*., 2015). Red list species are those that are Globally Threatened according to IUCN criteria; and/or those whose population or range has declined rapidly in recent years; and/or those that have declined historically and not shown a substantial recent recovery.

Appendix C
Desk Study Data Summary

Table C1 Protected and other notable bird species within 5 km of the Site (KMBRC summary table)

Species	Legal status	No. of records since 2000	Year of most recent record	Distance from site (km)
Red-throated diver	Annex 1; WCA1	319	2012	1.85
Black-throated diver	Annex 1; WCA1	171	2012	1.85
Great northern diver	Annex 1; WCA1	93	2012	4.13
Slavonian grebe	Annex 1; WCA1; BoCC (Red)	36	2011	1.85
Black-necked grebe	WCA1	10	2012	1.85
Balearic shearwater	S41; BoCC (Red)	13	2009	1.85
Storm petrel	Annex 1	11	2012	3.20
Leach's petrel	Annex 1; WCA1	32	2012	1.85
Bittern	Annex 1; WCA1; S41	14	2011	1.85
Little egret	Annex 1	1244	2012	1.85
Purple heron	Annex 1; WCA1	36	2013	0.50
Black stork	Annex 1	5	2006	1.85
White stork	Annex 1	30	2010	1.85
Glossy ibis	Annex 1	6	2010	1.85
Spoonbill	Annex 1; WCA1	87	2012	1.85
Bewick's swan	Annex 1; S41; WCA1	33	2012	1.85
Whooper swan	Annex 1; WCA1	40	2012	0.50
White-fronted goose	S41; BoCC (Red)	131	2012	1.86
Barnacle goose	Annex 1	25	2012	1.85
Brent goose	S41	817	2012	1.85
Shelduck	Annex 1	1021	2012	1.75
Pintail	WCA1	278	2012	1.85
Garganey	WCA1	125	2012	1.80
Pochard	BoCC (Red)	78	2012	2.80
Scaup	WCA1; S41; BoCC (Red)	28	2009	1.85
Long-tailed duck	WCA1; BoCC (Red)	32	2008	1.75
Common scoter	WCA1; S41; BoCC (Red)	371	2012	1.85
Velvet scoter	WCA1; BoCC (Red)	29	2012	1.85
Goldeneye	WCA1	49	2012	1.75
Smew	Annex 1	8	2012	3.80
Honey buzzard	Annex 1; WCA1	93	2012	1.75

Species	Legal status	No. of records since 2000	Year of most recent record	Distance from site (km)
Black kite	Annex 1	24	2012	1.85
Red kite	Annex 1; WCA1	99	2012	1.65
Marsh harrier	Annex 1; WCA1	596	2012	1.85
Hen harrier	Annex 1; WCA1; S41; BoCC (Red)	404	2012	1.75
Montagu's harrier	Annex 1; WCA1	120	2013	0.50
Goshawk	WCA1	6	2005	1.85
Osprey	Annex 1; WCA1	94	2012	1.75
Merlin	Annex 1; WCA1; BoCC (Red)	580	2012	1.85
Hobby	WCA1	457	2013	0.50
Peregrine	Annex 1; WCA1	807	2012	1.85
Grey partridge	S41; BoCC (Red)	369	2012	0.50
Quail	WCA1	88	2012	1.85
Corncrake	Annex 1; WCA1; S41; BoCC (Red)	20	2011	1.75
Crane	Annex 1	35	2012	1.75
Avocet	Annex 1; WCA1	290	2012	1.85
Little ringed plover	WCA1	173	2012	1.75
Ringed plover	Cited; BoCC (Red)	984	2012	1.85
Kentish plover	WCA1	100	2012	1.85
Dotterel	WCA1; BoCC (Red)	42	2009	1.85
Golden plover	Annex 1; Cited	1073	2012	1.85
Grey plover	Cited	985	2012	1.85
Lapwing	S41; BoCC (Red)	1271	2012	0.50
Sanderling	Cited	911	2012	1.85
Temminck's stint	WCA1	53	2012	1.85
Purple sandpiper	WCA1	198	2012	1.85
Ruff	Annex 1; WCA1; BoCC (Red)	163	2012	1.85
Woodcock	BoCC (Red)	340	2012	0.50
Black-tailed godwit	WCA1; S41; BoCC (Red)	505	2012	1.85
Bar-tailed godwit	Annex 1	1071	2012	1.85
Whimbrel	WCA1; BoCC (Red)	729	2013	1.85
Curlew	S41; BoCC (Red)	1066	2012	1.86
Greenshank	WCA1	747	2012	1.75

Species	Legal status	No. of records since 2000	Year of most recent record	Distance from site (km)
Green sandpiper	WCA1	435	2012	1.80
Wood sandpiper	Annex 1; WCA1	106	2012	1.75
Turnstone	Cited	850	2012	1.85
Arctic skua	BoCC (Red)	126	2012	1.85
Mediterranean gull	Annex 1; WCA1	369	2012	1.85
Little gull	WCA1	148	2012	1.85
Herring gull	S41; BoCC (Red)	842	2012	0.50
Kittiwake	BoCC (Red)	218	2012	1.85
Sandwich tern	Annex 1	1095	2012	1.85
Roseate tern	Annex 1; WCA1; S41; BoCC (Red)	86	2012	1.85
Common tern	Annex 1	531	2012	1.85
Arctic tern	Annex 1	111	2012	1.85
Little tern	Annex 1; Cited; WCA1	297	2012	1.85
Black tern	Annex 1; WCA1	114	2012	1.85
Puffin	BoCC (Red)	29	2006	1.85
Turtle dove	S41; BoCC (Red)	386	2012	0.50
Cuckoo	S41; BoCC (Red)	497	2012	0.50
Barn owl	WCA1	176	2012	0.50
Short-eared owl	Annex 1	543	2012	2.80
Nightjar	Annex 1; S41; BoCC (Red)	1	2004	1.85
Kingfisher	Annex 1; WCA1	343	2012	1.75
Bee-eater	WCA1	20	2012	1.85
Hoopoe	WCA1	47	2012	1.85
Wryneck	WCA1; BoCC (Red)	66	2012	1.85
Lesser spotted woodpecker	S41; BoCC (Red)	86	2005	1.75
Short-toed lark	Annex 1	7	2011	1.85
Woodlark	Annex 1; WCA1; S41	74	2012	4.83
Skylark	S41; BoCC (Red)	621	2012	0.50
Shorelark	WCA1	64	2012	1.85
Tawny pipit	Annex 1	34	2012	1.85
Tree pipit	S41; BoCC (Red)	140	2012	1.85

Species	Legal status	No. of records since 2000	Year of most recent record	Distance from site (km)
Yellow wagtail	S41; BoCC (Red)	534	2012	0.50
Grey wagtail	BoCC (Red)	367	2012	1.85
Dunnock	S41	584	2012	0.50
Nightingale	BoCC (Red)	96	2012	1.75
Bluethroat	Annex 1; WCA1	35	2007	1.85
Whinchat	BoCC (Red)	435	2012	1.85
Ring ouzel	S41; BoCC (Red)	295	2012	4.83
Fieldfare	WCA1; BoCC (Red)	456	2012	1.86
Song thrush	S41; BoCC (Red)	645	2012	0.50
Redwing	WCA1; BoCC (Red)	679	2013	1.85
Mistle thrush	BoCC (Red)	452	2012	0.50
Cetti's warbler	WCA1	223	2012	2.80
Grasshopper warbler	S41; BoCC (Red)	58	2012	1.80
Aquatic warbler	Annex 1; S41; BoCC (Red)	9	2005	1.75
Dartford warbler	Annex 1; WCA1	41	2012	1.85
Barred warbler	Annex 1	28	2010	1.85
Wood warbler	S41; BoCC (Red)	33	2012	1.75
Firecrest	WCA1	564	2012	1.85
Spotted flycatcher	S41; BoCC (Red)	164	2012	0.50
Red-breasted flycatcher	Annex 1	52	2013	1.85
Pied flycatcher	BoCC (Red)	182	2012	0.50
Bearded tit	WCA1	34	2012	1.85
Willow tit	S41; BoCC (Red)	10	2009	1.85
Golden oriole	WCA1; BoCC (Red)	100	2012	1.75
Red-backed shrike	Annex 1; WCA1; BoCC (Red)	67	2011	1.85
Starling	S41; BoCC (Red)	637	2013	0.50
House sparrow	S41; BoCC (Red)	386	2012	0.50
Tree sparrow	S41; BoCC (Red)	239	2012	0.50
Brambling	WCA1	386	2012	1.86
Serin	WCA1	49	2012	1.85
Linnet	S41; BoCC (Red)	718	2012	0.50
Twite	S41; BoCC (Red)	171	2012	1.85

Species	Legal status	No. of records since 2000	Year of most recent record	Distance from site (km)
Lesser redpoll	S41; BoCC (Red)	298	2012	1.86
Common crossbill	WCA1	189	2012	1.85
Parrot crossbill	WCA1	2	2004	2.16
Bullfinch	S41	157	2012	0.50
Hawfinch	S41; BoCC (Red)	26	2010	1.85
Lapland bunting	WCA1	130	2012	1.85
Snow bunting	WCA1	427	2012	1.85
Yellowhammer	S41; BoCC (Red)	200	2012	0.50
Ortolan bunting	Annex 1	9	2003	2.16
Reed bunting	S41	484	2012	1.86
Corn bunting	S41; BoCC (Red)	558	2012	0.50

Appendix D
Confidential Species Report

Badgers are protected under the Protection of Badgers Act 1992 and as such they receive heightened legal protection. Badger records herein are CONFIDENTIAL and should not be made available to the public.

KMBRC returned four records of badger since 2000. Two records in 2003 from St. Nicholas at Wade (5 km west-north-west of Site) – one record from January and one from September. A single September record from Richborough 2005 was 5 km south of the Site. A single May record in 2006 from Netherhale Farm, near Birchington was 3.5 km north-west of the Site.

There is no further information available on these records.

No signs of badger were recorded during the Extended Phase 1 habitat survey although suburban and rural habitats on Site were considered suitable to support foraging and/ or commuting badgers.

Impacts caused by the reinstatement of the outfall are likely to cause only a negligible impact of temporary nature to foraging badgers and no further survey work is required. Best practice should be followed should any works be required around the manhole locations within the Site, including the covering of any excavation at night.

Appendix E
Scientific Names

Common/ English name	Scientific name
Mammals	
Badger	*Meles meles*
Bat/*Chiroptera Sp.*	*Chiroptera Sp.*
Brown hare	*Lepus europaeus*
Brown long-eared bat	*Plecotus auritus*
Common pipistrelle	*Pipistrellus pipistrellus*
Dormouse	*Muscardinus avellanarius*
Harvest mouse	*Micromys minutus*
Hedgehog	*Erinaceus europaeus*
Nathusius' pipistrelle	*Pipistrellus nathusii*
Natterer's bat	*Myotis nattereri*
Pipistrelle/Pipistrellus species	*Pipistrellus species*
Serotine	*Eptesicus serotinus*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Birds	
Red-throated diver	*Gavia stellata*
Great crested grebe	*Podiceps cristatus*
Ringed plover	*Charadrius hiaticula*
Golden plover	*Pluvialis apricaria*
Grey plover	*Pluvialis squatarola*
Lapwing	*Vanellus vanellus*
Sanderling	*Calidris alba*
Greenshank	*Tringa nebularia*
Green sandpiper	*Tringa ochropus*
Turnstone	*Arenaria interpres*
Little tern	*Sterna albifrons*
Robin	*Erithacus rubicula*
Blackbird	*Turdus merula*
House sparrow	*Passer domesticus*
Herpetofauna	

Common/ English name	Scientific name
Grass snake	*Natrix natrix*
Slow-worm	*Anguis fragilis*
Viviparous lizard	*Zootoca vivipara*
Flora	
Alexanders	*Smyrnium olusatrum*
Asparagus	*Asparagus officinalis*
Barberry	*Berberis vulgaris*
Basil Thyme	*Clinopodium acinos*
Bedstraw Broomrape	*Orobanche caryophyllacea*
Black knapweed	*Centauria nigra*
Black medick	*Medicago lupulina*
Blackthorn	*Prunus spinosa*
Box	*Buxus sp.*
Bramble	*Rubus fruticosus agg.*
Bristly oxtongue	*Helminthotheca echioides*
Butterfly bush	*Buddleia davidii*
Charlock	*Sinapis arvensis*
Cleavers	*Galium aparine*
Cock's foot	*Dactylis glomerata*
Common bent	*Agrostis capillaris*
Common bird's-foot-trefoil	*Lotus corniculatus*
Common mallow	*Malvus sylvestris*
Common nettle	*Urtica dioica*
Common reed	*Phragmites australis*
Cornflower	*Centaurea cyanus*
Cotoneaster	*Cotoneaster sp.*
Creeping buttercup	*Ranunculus repens*
Creeping thistle	*Cirsium arvense*
Daisy	*Bellis perennis*
Daisy bush	*Brachyglottis greyii*
Dandelion	*Taraxicum officinale*

Common/ English name	Scientific name
Deptford Pink	*Dianthus armeria*
Divided Sedge	*Carex divisa*
Dogwood	*Cornus sanguinea*
Elder	*Sambucus nigra*
English stonecrop	*Sedum sp.*
False oat-grass	*Arrhenatherum elatius*
Fennel	*Foeniculum vulgare*
Field bindweed	*Convolvulus arvensis*
Field scabious	*Knautia arvensis*
Goat's beard	*Tragapogon porrifolius*
Groundsel	*Senecio vulgaris*
Hawthorn	*Crataegus monogyna*
Hemp agrimony	*Eupatorium cannabinum*
Hypericum	*Hypericum sp.*
Ivy	*Hedera helix*
Laurel	*Laurus sp.*
Lesser centaury	*Centaurium pulchellum*
Man Orchid	*Orchis anthropophora*
Martin's Ramping-fumitory	*Fumaria reuteri*
Mugwort	*Artemesia vulgaris*
Oxeye daisy	*Leucanthemum vulgare*
Perennial rye-grass	*Lolium perenne*
Prickly Saltwort	*Kali turgidum*
Red clover	*Trifolium pratense*
Red fescue	*Festuca rubra*
Red pimpernel	*Anagallis arvensis*
Ribwort plantain	*Plantago lanceolata*
Saint John's wort	*Hypericum perforatum*
Sea Barley	*Hordeum marinum*
Sea couch	*Agropyron pungens*
Sea plantain	*Plantago maritima*
Sharp-leaved pondweed	*Potamogeton acutifolius*

Common/ English name	Scientific name
Shepherds purse	*Capsella bursa-pastoris*
Smooth sow-thistle	*Sonchus oleraceus*
Teasel	*Dipsacus fullonum*
Traveller's joy	*Clematis vitalba*
Wall barley	*Hordeum murinum*
Yarrow	*Achillea milifolium*
Yorkshire fog	*Holcus lanatus*
Invasive species	
Japanese knotweed	*Fallopia japonica*
Wall cotoneaster	*Cotoneaster horizontalis*
Himalayan cotoneaster	*Cotoneaster simonsii*

Appendix F
Photographs of the outfall discharge structure

Appendix 7.9
Phase 1 Habitat Survey of Land Off Spitfire Way

Technical note: Manston Airport DCO EIA

Extended phase 1 Habitat Survey of Additional Land Within the Order Limits: Off Spitfire Way

1. Site Context

This Site[1] is approximately 0.25 ha (hectares) in extent and lies to the north of Spitfire Way (B2190) and the west of Manston Road (B2050) at the intersection of these two roads. The approximate central point is at National Grid Reference (NGR) TR 33107 66449.

The Site lies on the north-western boundary of the original Manston Airport site with residential areas to the north and arable farmland dominating the wider landscape. A woodland copse lies immediately north-west of the site, detaching it from the residential estates, and an area of semi-improved grassland lies along the south-western boundary. The site comprises brownfield land also with some evidence of ongoing storage of domestic waste.

2. Method

An extended phase 1 habitat survey of the Site and its surrounds was undertaken by a Wood (formerly Amec Foster Wheeler) ecologist on 12 October 2017; during the survey, distinct habitats were identified and any features of interest subjected to a more detailed description in a target note (TN)[2]. As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was extended[3] to allow for the provision of information on other ecological features, including identification of the presence or potential presence of legally protected and otherwise notable species.

It should be noted that while every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey, although it was sufficient to identify the phase I habitats present.

3. Results

3.1 Habitats

The Site was dominated by bare ground and hardstanding with ephemeral/ short perennial and tall ruderal growth throughout. Hardstanding was located in the western third of the Site. This was in relatively good condition with piles of household waste, a skip and a shed type structure made of corrugated metal sheets along the boundary. Bare ground with tall ruderal growth dominated the eastern two thirds of the Site; species recorded included abundant yarrow, oxeye daisy, mugwort, bristly ox-tongue and white melilot, with

[1] The 'Site' here refers to the 0.25 ha of land off Spitfire Way that was surveyed and not the larger Order Limits site of the RSP DCO application.
[2] Joint Nature Conservation Committee (2010). Handbook for phase 1 habitat survey - a technique for environmental audit. JNCC, Peterborough.
[3] Institute of Environmental Assessment (1995). *Guidelines for Baseline Ecological Assessment*. E&FN Spon, London.

occasional ribwort plantain, common mallow, creeping thistle, purple flax, and colt's-foot. Fennel, false oat grass and hedge bindweed were frequent along the Site boundary. Ash and sycamore saplings, and elder with dense ivy cover lined the north-eastern boundary.

3.2 Protected and Notable Species

The Site and surrounding habitats provided suitable basking/foraging/refuge habitat for the commonly occurring reptile species, slow worm and common lizard. They also provided suitable foraging habitat for widespread birds and hedgehog, a priority species[4].

Figure 1 shows the mapped habitats and target notes (TN).

4. Summary and Recommendations

4.1 Habitats

No notable habitats are present onsite. 'Open Mosaic Habitats on Previously Developed Land' is a NERC Act 2006 section 41 habitat, however the extent of this habitat onsite is <0.25ha and as such it does not meet the criteria as a notable habitat.

The area of woodland located immediately offsite to the north-west, comprises lowland mixed deciduous woodland, a habitat of Principal Importance for Biodiversity Conservation and a Kent Biodiversity Action Plan habitat. Direct impacts are not anticipated to this habitat; however, due to proximity it is recommended that working practices measures should be implemented to prevent any potential indirect impacts (i.e. pollution / dust).

4.2 Species

Reptiles

The mosaic habitat of bare ground, ephemeral /short perennial and tall ruderal vegetation onsite provides potential reptile basking/foraging habitat. The surrounding woodland also provides opportunities for refuge. Therefore it is recommended a full suite of reptile presence / absence surveys should be undertaken between April and October inclusive, following the survey methods outlined in Froglife (1999)[5], which requires seven visits. If present, a method statement and associated mitigation (such as reptile exclusion fencing) may be required to ensure that reptiles are not impacted by the proposed works.

Birds

Vegetation clearance should take place outside of the breeding bird season (which is February to September depending on seasonal variation). If this is not possible, the work area should be searched immediately prior to commencement of works (within 24 hours) by an ecologist to ensure that no nesting bird nests are present. If active nests are found to be present they must be left in situ and protected with a buffer/exclusion zone until any young birds have fledged the nest.

Other notable species

The Site has the potential for hedgehog. It is therefore recommended that during any vegetation clearance works an Ecologist (or suitably competent person) is present to carry out a detailed check for hedgehog.

[4] Listed under section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 as a species "of principal importance for the purpose of conserving biodiversity" in England.
[5] Froglife (1999) Reptile Survey: An introduction to planning, conducting and interpreting surveys for snake and lizard conservation Froglife Advice Sheet 10.

Author	Reviewer
....	....
Mike Raven	Mark Linsley

Copyright and non-disclosure notice

Third party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

633000

633100

166500

166400

N

SI

Key

Application boundary

Parkland and scattered trees-broad-leaved

Broadleaved woodland - semi-natural

Neutral grassland - semi-improved

Tall ruderal

Ephemeral/shortperennial

Buildings

Bare ground

Hardstanding

0 10 20 30 m

Scale at A3: 1:600

Client

RSP

Manston Airport DCO
EIA

amec foster wheeler

Figure 1
Extended phase 1 habitat map - Land off Spitfire Way

November 2017

38199-Lon 201.mxd squij

file: P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon 201.mxd

Appendix 7.10
Extended Phase 1 Habitat Survey of Land Parcel 1362

Technical note: Manston Airport DCO EIA: Extended phase 1 habitat survey of Land Parcel 1362

1. Site context

This site is approximately 35.7 hectares[1] (ha) in extent and lies to the south of the A299 Hengist Way and west of the A299 and the A256 Richborough Way. The Cottington Link Road runs adjacent to the southern boundary. The Site is located in Manston, Kent with the approximate central point at National Grid Reference (NGR) TR 33720 64773.

The site lies beyond the southern boundary of the proposed development site. Arable land and associated farm buildings surround the site and, other than the former airport site to the north, farmland dominates the wider landscape. A land parcel to the west of the site and south of the A299 supports a solar farm and a woodland copse lies immediately south of this. A main line railway is also present to the southeast corner of the site.

2. Method

An extended phase 1 habitat survey of the site and its surrounds was undertaken by a Wood (formerly Amec Foster Wheeler) ecologist on 12 October 2017. During the survey distinct habitats were identified and any features of interest subjected to a more detailed description in a target note (TN)[2]. As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was extended[3] to allow for the provision of information on other ecological features, including identification of the presence or potential presence of legally protected and otherwise notable species.

It should be noted that while every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey, although it was sufficient to identify the phase 1 habitats present.

3. Results

Habitats

The site was dominated by bare ground in the form of a recently sown arable field with a narrow margin around the perimeter, approximately 0.5 to 1 metre (m) wide with tall ruderal growth. Dominant plant species within the field margin were hoary mustard, bristly ox-tongue, with occasional bastard cabbage, cleavers, prickly sow-thistle and dove's-foot crane's-bill.

Beyond the field margin and adjacent to the highway there was a strip of semi-improved grassland along the northern half of the western and eastern Site boundaries, with a number of grass species recorded; including red fescue, perennial rye-grass, cock's-foot, false oat-grass, Yorkshire fog, smooth meadow grass and

[1] As measured using the tool in MAGIC: http://magic.defra.gov.uk/MagicMap.aspx
[2] Joint Nature Conservation Committee (2010). Handbook for phase 1 habitat survey - a technique for environmental audit. JNCC, Peterborough.
[3] Institute of Environmental Assessment (1995). *Guidelines for Baseline Ecological Assessment*. E&FN Spon, London.

crested dog's-tail, with the following herb species being common: bristly ox-tongue, red clover, mugwort, creeping thistle and hoary mustard. Other species recorded at lower frequencies were bastard cabbage, cleavers, prickly sow-thistle, spear thistle, common ragwort, common mallow, dove's-foot crane's-bill and Canadian fleabane.

In the semi-improved grassland strip adjacent the dual carriageways a recently planted species-rich hedgerow was present along the northern and eastern boundary of the site. This comprised young trees (approximately 1.5m in height) protected with tree guards. Species included typical native hedgerow species such as hawthorn, hazel, blackthorn, wayfaring-tree, oak, buckthorn and dogwood.

A waterbody (a pond) was located in the south-east corner of the site. The pond was possibly created to provide a catchment for water runoff from the adjacent dual carriageways. The pond appeared dry at the time of survey, although access to/visibility of the waterbody was restricted by the presence of dense common reed with occasional common reed mace. The outer edge of the waterbody was dominated by field horsetail and occasional teasel and willow saplings. A recently planted hedgerow surrounded the water body and had planted goat willow, dog rose and butterfly bush, in addition to the recently planted species mentioned above. Ground flora was more diverse here with, in addition to those species mentioned above, fennel, lucerne and curled dock.

Cottington Road ran along the southern boundary of the site, with an arable field located to the south of Cottington Road; part of this appeared to have been recently cultivated with the remainder containing an asparagus crop. A line of Leyland cypress ran along the boundary of these fields with the Cottington Road.

In the south of the site a species-poor, gappy hedgerow (3-4 m high) created a boundary between the site and the arable field to the west. Dominant species of this hedgerow included cherry spp, elm, elder with dense ivy growth and blackthorn. Holly, oak and poplar were recorded occasionally as standard trees within the hedgerow, and ground flora was species-poor, with cleavers, bastard cabbage, hogweed, common nettle and mugwort recorded. Large gaps (5-10m) were frequent and fallen trees resulted in large areas of dead wood on the ground.

Immediately offsite, further to the north of the western boundary the field ran alongside a small broadleaved woodland plantation with young sycamore, elm, ash and cherry with a sparse understory.

Figure 1 shows the mapped habitats.

Protected and notable species

The arable habitat has the potential to support ground nesting birds, including lapwing and skylark (both red-list BoCC[4] / SPI[5]), and also overwintering golden plover (a qualifying species for the adjacent Thanet Coast and Sandwich Bay Special Protection Area). This habitat may also provide refuge for brown hare (SPI).

Adjacent habitats, including the hedgerow and woodland copse to the west of the site provide good potential for protected and notable species.

A number of burrows identified during the survey were of a size which may indicate use by badgers, however these were located off-site and down a slope from the field hedgerow extending along the western boundary of the site (approximate grid reference: TR 33562 64977), and could not be accessed for a detailed inspection. A number of mammal runs and one badger latrine were also recorded in the vicinity.

Standard trees within the hedgerow along the western boundary, namely the poplars, provided features suitable to support roosting bats and the hedgerow provided a lateral feature for which bats are likely to utilise for foraging and commuting.

The large areas of fallen dead wood, provide suitable habitat for saproxylic invertebrates and hibernacula opportunities for reptiles and great crested newt and other amphibian species. The semi-improved

[4] Bird of Conservation Concern. Source: Eaton, M.A., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud D., and Gregory, R. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds, 108:708-746.

[5] Species of Principal Importance in England, listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

grassland, and recently planted hedgerows also provided suitable habitat to support common reptile species such as slow worm and common lizard.

All habitats provided suitable habitats for nesting and foraging birds.

4. Summary and Recommendations

4.1 Habitats

The arable field, comprising the majority of the site, is considered to be of negligible conservation value. The semi-improved grassland habitats are also largely considered to be of low value for nature conservation as they are comprised of locally common species, which are abundant in the local area.

The hedgerows present onsite do not qualify as 'important' as defined by the The Hedgerows Regulations 1997, being either species poor or young in age (i.e. less than 30 years old). However, hedgerows are also a NERC Act 2006 section 41 habitat of principal importance and are defined as being '*any boundary line of trees or shrubs over 20m long and less than 5m wide, and where any gaps between the trees or shrub species are less that 20m wide*' (UK BAP, 2008[6]). The hedgerows present onsite are likely to meet the criteria as a NERC Act 2006 section 41 habitat of principal importance being >20m long and <5m wide and comprising native woody species.

A single pond is present on site. Ponds, for the purpose of the NERC Act 2006 section 41 habitat of principal importance, are defined as permanent and seasonal standing water bodies up to 2 ha in extent, which meet one or more of a set of criteria as defined by the Biodiversity Reporting and Information Group (BRIG) 2008 (updated in 2011)[7]. Further survey work would be required to determine the status of the pond.

The area of woodland located immediately offsite to the west, comprises lowland mixed deciduous woodland, a habitat of Principal Importance and a Kent Biodiversity Action Plan habitat. Direct impacts are not anticipated to this habitat; however, due to proximity to the site it is recommended that working practices include measures to prevent any potential indirect impacts (i.e. pollution / dust).

4.2 Species

Badger

Evidence of badger was recorded during the phase 1 survey. It is therefore recommended that a pre-construction badger survey is undertaken in advance of works, in order to identify any setts and assess levels of badger activity. If a badger sett is found, depending upon the final design of the works, a method statement or licence from Natural England may be required prior to commencement of works.

Bats

Trees with potential to support bat roosting features have been identified within the site. It is therefore recommended a detailed ground level roost assessment of trees is undertaken, including an inspection of the exterior of trees to look for features that could be used for roosting bats. If evidence of bats is recorded or a feature is found to provide good bat roosting potential further bat presence / absence surveys should be undertaken, in accordance with current Bat Conservation Trust guidelines[8] (May – August/September inclusive). A method statement or mitigation licence from Natural England may be required for bats prior to commencement of works.

[6] BRIG (ed. Ant Maddock) 2008. UK Biodiversity Action Plan: Priority Habitats Descriptions. (Updated 2011).
[7] Ponds that met the criteria to qualify as UK BAP priority habitats are deemed to qualify as habitat of Principal Importance. These are defined as permanent and seasonal water bodies up to 2 ha in extent, which meet one of the following criteria: (1) Habitats of international importance; (2) Species of high conservation importance; (3) Exceptional assemblages of key biotic groups; (4) Ponds of high ecological quality; (5) Other important ponds: i.e. important because of age, rarity of type or landscape context.
[8] Collins, J. (ed) (2016). Bat Survey for Professional ecologists: Good Practice Guidelines, 3rd Edition, Bat Conservation Trust, London.

Birds

Vegetation clearance should take place outside of the breeding bird season (which is February to September depending on seasonal variation). If this is not possible, the work area should be searched immediately prior to commencement of works (within 24 hours) by an ecologist to ensure that no nesting bird nests are present. If active nests are found to be present they must be left in situ and protected with a buffer/exclusion zone until any young birds have fledged the nest.

Reptiles

The grassland and hedgerow habitats onsite, and adjacent woodland habitat have the potential for common reptile species. It is therefore recommended a full suite of reptile presence / absence surveys should be undertaken between April and October inclusive, following the survey methods outlined in Froglife (1999)[9], which requires seven visits. If present, a method statement and associated mitigation (such as reptile exclusion fencing) may be required to ensure that reptiles are not impacted by any proposed works.

Great crested newt

Great crested newts (GCN) require ponds for breeding and a single pond is present on site. It is recommended that a habitat suitability index (HSI) assessment is undertaken of waterbodies within 500 m of the site in accordance with Oldham (2000)[10]. Depending on results GCN presence / absence surveys should be completed in accordance with Natural England guidance[11]. A method statement or mitigation licence from Natural England may be required for great crested newt (should they be present) prior to commencement of works.

Invertebrates

The site offers limited habitat for invertebrates of conservation interest, within the semi-improved grasslands and areas of dead wood. However, due to the limited extent of suitable habitat it is considered unlikely that the invertebrates present on site would constitute an assemblage of interest or nature conservation significance and as such further survey work is not considered necessary.

Author		Reviewer	
.....	.....	.....	.....
Mike Raven		Mark Linsley	

Copyright and non-disclosure notice

[9] Froglife (1999) Reptile Survey: An introduction to planning, conducting and interpreting surveys for snake and lizard conservation Froglife Advice Sheet 10.
[10] Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000). *Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus).* Herpetological Journal 10(4), 143-155.
[11] https://www.gov.uk/guidance/great-crested-newts-surveys-and-mitigation-for-development-projects

Third party disclaimer

Any disclosure of this report to a third party is subject to this disclaimer. The report was prepared by Amec Foster Wheeler at the instruction of, and for use by, our client named on the front of the report. It does not in any way constitute advice to any third party who is able to access it by any means. Amec Foster Wheeler excludes to the fullest extent lawfully permitted all liability whatsoever for any loss or damage howsoever arising from reliance on the contents of this report. We do not however exclude our liability (if any) for personal injury or death resulting from our negligence, for fraud or any other matter in relation to which we cannot legally exclude liability.

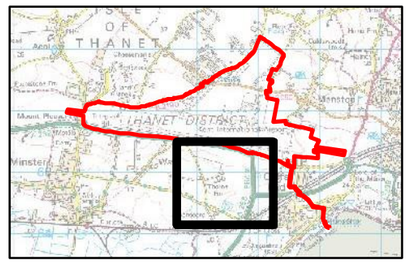
Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

633000
633500
634000
165500
165000
164500
N

Key

- Site boundary
- Park land and scattered trees- broad-leaved
- Intact hedge native species poor
- Deunct hedge native species-rich
- Broadleaved w oodland - sem i-natural
- Im proved grassland
- Reedsw am p
- Arable
- Hardstanding



0 100 200 300 m

Scale atA3: 1:5,000

Client

RSP

Manston AirportDCO
EIA

amec foster wheeler

Figure 1
Extended phase 1 habitat map - Land parcel 1362

November 2017 38199-Lon200.m xd squij

file: P:\Projects\38199 LON Manston AirportDCO EIA\Drawings\ArcGIS\Figures\38199-Lon200.m xd

Appendix 7.11
Ground Based Tree Assessment for Bats

Technical note: Manston Airport DCO EIA: Ground level assessment of trees with bat roosting potential at the former Manston Airport

1. Introduction

1.1 Background

RiverOak Strategic Partners (RSP) is planning to reopen Manston Airport (hereon within this report referred to as the Site) as a new air freight and cargo hub for the South East. This Site, covering approximately 325 hectares (ha), is located within the district of Thanet in Kent, close to the coastal town of Ramsgate. The approximate central point of the Site is at National Grid Reference (NGR) TR 330 657.

There was an operational airport at the Site between 1916 and 2014. Until 1998 it was operated by the Royal Air Force as RAF Manston, and, for a period in the 1950s, was also a base for the United States Air Force (USAF). From 1998 it was operated as a private commercial airport with a range of services including scheduled passenger flights, charter flights, air freight and cargo, a flight training school, flight crew training and aircraft testing. In the most recent years it was operating as a specialist air freight and cargo hub servicing a range of operators. Although the airport was closed in May 2014, much of the airport infrastructure, including the runway, taxiways, aprons, cargo facilities and passenger terminal remain intact.

The proposed Manston Airport development involves the development of an air freight and cargo facility with the capacity to handle more than 10,000 air transport movements (ATMs) of cargo aircraft per year as part of the provision of air cargo transport services.

1.2 Purpose of report

All UK bat species and their roost sites, whether currently occupied or not, are protected by law (see Appendix A).The proposed development has the potential to disturb any bats roosting within the trees at the Site. RSP therefore commissioned Wood to undertake a ground based assessment of the trees on Site to determine whether any possessed features that had potential to be used by bats for roosting. The results of the survey will be used, along with the results from other ecological studies, to inform an Environmental Statement chapter.

This technical note presents the methodology and results of a ground level visual assessment of trees at the Site for their potential to support roosting bats, which will be used to identify suitable trees for further survey work in order to assess any value to roosting bats.

2. Methods

2.1 Ground level visual assessment

All trees (including mature hedgerows) within the Order Limits, as well as, all visually unobstructed trees situated immediately outside of this footprint (on which indirect effects of the development may occur) were

assessed for their potential to support roosting bats. The assessment followed Bat Conservation Trust (BCT) guidelines[1] and took into account further guidance provided in the Bat Tree Habitat Key[2].The trees (refer to Appendix B for scientific names) were inspected from ground level using close focussing binoculars and a powerful light source to search for potential roost features (PRFs) such as the following (which are arboricultural terms for such features): rot holes; knot holes; tear outs; flush cuts; hazard beams; wounds; cankers; associations; thick latticed ivy; and other cavities, splits or lifting bark. In addition, any evidence of bat occupation (e.g. scratching, staining or droppings around potential entrances) was recorded.

This survey was undertaken on 28 November 2017, which provided suitable conditions for ground level visual assessments due to the seasonal reduction of foliage, allowing increased visibility of features higher up in the trees. The surveys were undertaken by a Wood ecologist appropriately experienced with such surveys. Where PRFs were identified the following details were recorded:

- grid reference;
- tree species;
- diameter at breast height (DBH)
- tree height;
- number and type of PRF(s);
- approximate height of PRF(s), and whether they were on the stem or limb;
- aspect that the PRF(s) were facing

In addition the tree was assigned a unique reference number and a photograph was taken to aid re-identification of individual PRFs.

Trees supporting PRFs were categorised in accordance with their level of potential suitability, in line categories adapted from the BCT guidelines, as follows:

- High - trees with one or more PRFs that are obviously suitable for use by larger numbers of bats on a more regular basis and for potential longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.
- Moderate - trees with one or more PRFs that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but are unlikely to support a roost of high conservation status.
- Low - trees with one or more PRFs that could be used by bats opportunistically. However, these PRFs do not provide adequate space, shelter, protection, appropriate conditions to be used on a regular basis or by larger numbers of bats.
- Negligible – trees with negligible habitat features that are not likely to be used by roosting bats.

Roost surveys of trees take a staged approach, with the first step being a preliminary ground level roost assessment, which may be followed up by second stage PRF inspections, presence/absence surveys and/or third stage roost characterisation surveys.

Trees that have been identified from ground level as supporting moderate or high potential PRFs that can be accessed by ground, ladder or by using rope and harness climbing techniques, will be subject to additional survey work, which will involve a closer inspection by an appropriately licensed bat worker using the most appropriate method, from May to September (to maximise the chance of capturing levels of peak bat activity). PRFs will be inspected using a high-powered torch or endoscope, as appropriate, to check for the presence of roosting bats or any evidence of bats use (e.g. droppings). Any additional PRFs of high to moderate suitability that were not identified from the ground level inspection and revealed by additional

[1] Collins, J (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.
[2] Andrews H. *et al.* 2013 Bat tree Habitat Key. AEcol, Bridgwater.

survey will be recorded and inspected, where they are accessible, and if they are inaccessible will be subject to a dusk and dawn emergence and re-entry survey from May to September.

Trees supporting high or moderate PRF categories, which cannot be adequately assessed (e.g. ivy clad trees) or safely accessed for closer inspection will be subject to a dawn and dusk detector-based survey from May to September. Ivy clad trees of a suitable size or age which were too obscured by foliage for an adequate inspection from the ground were recorded as having moderate suitability because they may support hidden PRFs. Conversely, smaller or younger ivy clad trees which were unlikely to support PRFs were recorded as having negligible or low suitability. Trees of low suitability will not be subject to additional surveys, but were identified for "bat friendly" arboricultural work if they are to be pruned or felled, and trees with no potential to support PRFs were not recorded.

Any PRFs of sufficient size to support nesting barn owls were also recorded.

3. Results

The ground level visual inspection identified 35 trees supporting PRFs. Table 3.1 highlights total number of trees of each suitability category (with full results presented in Table 3.2, Appendix C).

Approximately half (17) of the trees supporting PRFs were classified as of low or negligible potential and these require no further inspection/survey with regard to bats. Fourteen trees will require closer inspection or further survey and four trees (tree references 005*, 023*, 025* and 032A*) situated outside the Site boundary but were sufficiently close to be, potentially, impacted by the proposal.

Table 3.1 Total number PRF supporting trees of each potential suitability classification

	Suitability classification			
	High	Moderate	Low	Negligible
Number of trees	2	16	15	2

The majority of trees supporting high and moderate PRFs were located along the Site's north western (11 trees) and north eastern (5 trees) boundaries and two were situated near to the access road of the Airport's terminal building. Similarly, the majority of trees supporting low and negligible PRFs were located along the Site's north western (7) and north eastern boundaries (9), additionally one tree supporting a low PRF was situated in the approximate centre of the Site (tree reference 001).

Three hedgerow sections at the Site (tree references; x11, x35B and x38, also indicated in figure 3.1) could not be adequately assessed at all aspects due to restricted access caused by hedgerow width and dense scrubby undergrowth (tree reference, x38) and due to no land ownership permission (x11 and x35B). Despite this, all hedgerow stems and branches (tree references; x11 and x38) were sufficiently narrow as to only support PRFs, if present, of low to negligible suitability. In addition, the dense scrubby undergrowth at hedgerow x38 may also inhibit bats from accessing and egressing PRFs in the hedgerow stems, if present. Hedgerow section (x35B), located along the north eastern Site boundary contained a large conifer tree and 19 smaller trees and which were of a suitable size to support moderate and high PRFs.

In addition, three areas, without access outside the Site although contiguous with the Site boundary were recorded as containing trees of sufficient size and age as to support moderate and high PRFs, but could not be adequately assessed at all aspects due to no land ownership permission. The areas contained low numbers of trees, further details are provided below;

- Area 1. Private garden (0.004 ha, NGR: TR 34262 66670), containing one medium sized poplar with a PRF of high suitability and ≈11 medium sized ivy clad sycamores, (tree references; 005* and x06* respectively)
- Area 2. Landscaped garden (0.55 ha, central NGR TR 34457 65798), containing one medium-sized field maple with PRFs of high suitability and <20 medium sized mixed broadleaf and conifer tress (tree references 032A* and x32B*).

- Area 3. Dilapidated house in enclosed grounds (0.38 ha, central NGR TR 34159 66250), containing ≈10 ivy clad, small to medium sized trees, (tree reference x37*).

No PRFs of a sufficient size to support roosting/nesting barn owls were found during the survey.

4. Conclusions

The ground level tree inspection for PRFs identified 14 trees which in accordance with BCT survey guidelines will require PRF inspections or presence/absence surveys, appropriate inspection methods for each tree are presented in Table 4.1. One hedgerow section with trees (tree reference x35B) will require, pending access permission, a ground level visual inspection to search for PRFs not visible during the initial inspection as a permanent access road is proposed approximately five meters from the hedgerow section and the construction works may indirectly impact roosting bats, if present.

In addition, previously identified areas; 1 and 2, adjacent but outside the Site boundary contain PRF supporting trees and area 3 contains trees of a sufficient size to support moderate and high PRFs, which may be used by roosting bats, which if present, would likely to be negatively impacted by the proposal unless control measures were put in place. Such control measures will be detailed in a subsequent report but may include; screening off the areas, the restriction of certain types of lighting (flood lights), timing of works to daylight hours, and noise restrictions of plant machinery and power tools within a specified buffer distance of these areas.

Table 4.1 Recommended survey methods for second stage surveys (PRF inspection or presence absence surveys).

	Ground based endoscope inspection	**Climb: Ladder**	**Climb: rope and harness**	**One dusk and one dawn, emergence re-entry survey**
Tree reference	021	003, 013, 015, 016, 017, 018	004, 026, 027, 028, 030	024, x35A

5. Summary

Trees containing PRFs were found at Manston airport, further survey work has been recommended to closer inspect identified PRFs and to search for further signs of use by bats. A hedgerow section with trees, pending access permission, will require a ground level visual assessment to search for PRFs, and control measures on the proposal are recommended to reduce indirect impacts on roosting bats, if any, in three areas adjacent but outside the Site boundary.

Author	Reviewer
.Jonathan D'Arcy	Mark Linsley

Copyright and non-disclosure notice

Third party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 1800

Appendix A
Relevant Legislation and Policy

The Wildlife and Countryside Act 1981 (as amended) and the Conservation of Habitats and Species Regulations 2017

All British bat species are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* in respect of Section 9, which makes it an offence, *inter alia*, to:

- Intentionally or recklessly kill, injure, or take (handle) a bat;
- Intentionally or recklessly damage, destroy or obstruct access to any structure or place that a bat uses for shelter or protection; or
- Intentionally or recklessly disturb a bat while it is occupying a structure or place that it uses for shelter or protection.

British bat species receive further protection under Regulation 41 of the *Conservation of Habitats and Species Regulations 2017*, which make provision for the purpose of implementing European Union Directive on the *Conservation of Natural Habitats and of Wild Fauna and Flora 1992*. All British bat species are listed on Annex IV of the Directive, which means that member states are required to put in place a system of strict protection as outlined in Article 12, and this is done through inclusion on Schedule 2 of the Regulations, which makes it an offence, *inter alia*, to:

- Deliberately capture, injure or kill any bat;
- Deliberately disturb a bat, in particular any disturbance which is likely:
  - (a) To impair their ability:
    - (i) To survive, to breed or reproduce, or to rear or nurture their young, or
    - (ii) To hibernate or migrate.
  - (b) To affect significantly the local distribution or abundance of the bat species; or
- Damage or destroy a breeding site or resting place of a bat.

In addition, five British bat species are listed on Annex II of the Habitats Directive. These are:

- Greater horseshoe bat;
- Lesser horseshoe bat;
- Bechstein's bat;
- Barbastelle; and
- Greater mouse-eared bat.

As Annex II species under the Habitats Regulations, the Directive requires the designation of Special Areas of Conservation (SACs) by EC member states to ensure that their populations are maintained at a favourable conservation status. Where bats occur outside SACs the level of legal protection that these species receive is the same as for other bat species, however their inclusion on Annex II serves to underline their conservation significance and it is therefore less likely that adequate mitigation for loss of roosts of these species will be possible.

Natural Environment and Rural Communities (NERC) Act 2006

Under Section 41 of the *Natural Environment and Rural Communities Act 2006*, seven bats species are of principal importance for the purpose of conserving biodiversity in England. Under Section 41(3) of the Act, the Secretary of State must take steps (where they are reasonably practicable), and promote the taking of steps by others, to further the conservation of these species. The bat species listed as priority species are:

- Greater horseshoe bat;
- Lesser horseshoe bat;

- Barbastelle;
- Bechstein's bat;
- Brown long-eared bat;
- Soprano pipistrelle; and
- Noctule.

The Kent Local Biodiversity Action Plan (LBAP) includes:

- Common pipistrelle; and
- Soprano pipistrelle.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) refers to the steps that local authorities should take through the planning process in relation to species and habitats of principal importance. NPPF states that: "*Planning policies should promote the preservation, restoration and recreation of priority habitats, ecological networks and the recovery of priority species*".

Appendix B
Scientific names of species referred to in this document

Common/English Name	Latin/Scientific Name
Alder	*Alnus glutinosa*
Bird Cherry	*Prunus padus*
Elder	*Sambucus nigra*
Field Maple	*Acer campestre*
Hawthorn	*Crataegus monogyna*
Hornbeam	*Carpinus betulus*
Horse Chestnut	*Aesculus hippocastanum*
Poplar	*Populus sp.*

Appendix C
Tables and Figures

Table 3.2 Results of November 2017 ground level visual assessment

Tree reference	NGR	Species	Status of tree	Tree Height (m) Indicative values	DBH (cm) Indicative values	PRF type	PRF dimensions (WxDxUPxDOWN)	Roost Suitability	Recommended survey	Additional notes
001	TR 33963 65838	Field Maple	Alive	10	35	Eppicormic growth	n/a	negligible	no action	
2	TR 34166 66405	Alder	Alive	15	20	Ivy obscuring stem	n/a	low	no action	
3	TR 34155 66488	Bird Cherry	Alive	12	25	Lifted bark	Multiple points	moderate	ladder	
4	TR 34193 66507	Sycamore	Alive	17	40	Knot hole and split limb	4-?-0-?, 3-?-?-?	moderate	climb	
005*	TR 34252 66666	Poplar	Alive	20	unknown	Woodpecker holes	5-?-?-?	high	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal
x06*	TR 34262 66670	Sycamore (x11 trees)	Alive	20	unknown	Ivy obscuring stems	n/a	moderate	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal
007*	TR 34296 66660	Sycamore	Alive	10	unknown	Knot hole	10-4-?-?	low	no action	
8	TR 34166 66546	Alder	Alive	11	unknown	Ivy obscuring main stem	n/a	low	no action	Soft fell under an ecological watching brief
9	TR 34332 66991	Elder	Alive	10	18	Wound	1.5-4-7-5	low	no action	
010*	TR 34314 67008	Hawthorn (multi-stemmed)	Alive	12	unknown	Snapped stem	4-?-0-?	negligible	no action	

x11*	TR 34036 67208 - TR 34332 66991	Mixed species hedge line (Comprised of 91 bushes and small trees)	Alive	5-20	unknown	n/a	n/a	low	no action	
12	TR 33988 67093	Sycamore	Alive	19	25	Ivy obscuring stem	n/a	low	no action	Soft fell under an ecological watching brief
13	TR 33461 66598	Hornbeam	Alive	10	27	Tear out	9	moderate	ladder	
014	TR 33428 66616	Hornbeam	Alive	10	24	Lifted bark, 2 features	5-1-15-0	low	no action	Soft fell under an ecological watching brief
015	TR 33427 66634	Hornbeam	Alive	12	30	Knot hole	5-?-?-?	moderate	ladder	
016	TR 34051 66312	Bird Cherry	Alive	7	22	Wound x1, Tear out x2	Stem - 10-5-7-7, 2-?-?-?, 2-?-?-?	moderate	ladder	
017	TR 34063 66311	Silver Birch	Alive	9	27	Knot holes x 2	4-?-?-?, 4-?-?-?	moderate	ladder	
018	TR 32945 66323	Whitebeam	Dead	7	14	Wound and lifted bark	2-3-?-?	moderate	ladder	
019	TR 32912 66306	Whitebeam	Alive	9	32	Tear out	2-5-0-5	low	no action	Ecologist to inspect feature before any work is done on tree.
020	TR 33019 66358	Whitebeam	Alive	8	28	Wound	1-1-?-0	low	no action	Soft fell under an ecological watching brief
021	TR 33089 66392	Whitebeam	Alive	10	34	Tear out	3-3-0-?	moderate	ground assessment	
022*	TR 33157 66468	Sycamore	Alive	18	45	Impact shatter	?-?-?-?	low	no action	
023*	TR 33183 66487	Horse Chestnut	Alive	18	32	Knot hole	5-?-?-?	moderate	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal

024	TR 33228 66520	Sycamore	Alive	18	44	Tear out	3-3-0-?	moderate	ground assessment –dawn dusk, emergence re-entry surveys	
025*	TR 33257 66540	Sycamore	Alive	23	62	Ivy obscuring main stem	n/a	moderate	none	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal
026	TR 33259 66511	Sycamore	Alive	15	28	Knot hole, Impact shatter	4-?-0-?, 3-?-0-?	moderate	climb - knot hole	
027	TR 33254 66520	Sycamore	Alive	25	34	Tear out x2, wound x1	3-?-0-?, 3-?-0-?, 3-?-0-?	moderate	climb	
028	TR 33261 66530	Sycamore	Alive	20	32	Knot hole, Split branch creating two features	3-2-0-?, 3-4-15-?	moderate	ladder/climb	
29	TR 33282 66545	Sycamore	Alive	10	28	Knot hole	3-3-?-0	low	no action	
30	TR 33291 66551	Sycamore	Alive	10	34	Knot hole	3-?-0-?	moderate	climb	
031*	TR 34453 65832	Poplar	Alive	25	47	Ivy as feature	n/a	low	no action	Soft fell under an ecological watching brief
032A*	TR 34457 65798	Field Maple with 4 PRFs, in landscaped garden.	Alive	15	30	Woodpecker holes x4	All approx.. 6-?-?-?	high	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal
x32B*	TR 34502 65813	Landscaped garden containing <20 broadleaf and conifer trees of young to medium age.	Alive	Not recorded	unknown	n/a	n/a	undetermined	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal

033A	TR 34446 65780	Poplar	Alive	not recorded	24	Ivy obscuring stem	n/a	low	no action	Soft fell under an ecological watching brief
033B	TR 34446 65780	Poplar	Alive	not recorded	24	Ivy obscuring stem	n/a	low	no action	Soft fell under an ecological watching brief
034	TR 34447 65795	Field Maple	Alive	not recorded	17	Ivy obscuring stem	n/a	low	no action	
035A*	TR 34617 65748	Poplar sp.	Dead	not recorded	unknown	Ivy obscuring stem	n/a	moderate	ground assessment –dawn dusk, emergence re-entry surveys	
x35B*	TR 34671 65735 - TR 34511 65771	Mixed species hedge line with trees (1 mature conifer, 19 small trees)	Alive	Not recorded	unknown	unknown	n/a	undetermined	Ground level visual assessment	
036	TR 32263 66103	Willow	Alive	7	19	Eppicormic growth	n/a	low	no action	Dense growth of shoots around base of tree preventing full inspection. Possible PRFs present but unlikely. Soft fell under an ecological watching brief
x37*	TR 34159 66250	Mixed trees (8)	Alive	<20	unknown	n/a	n/a	undetermined	no action	Control measures recommended to reduce the risk of roost abandonment caused by indirect effects of the proposal
x38	TR 34404 65813 - TR 34443 65808	Hawthorn hedge line	Alive	not recorded	unknown	n/a	n/a	negligible	no action	

Nb. ***** in tree reference coulomb indicates trees situated outside of the Order Limits and "x" prefix indicates two or more trees. PRF dimensions (WxDxUPxDOWN: W = maximum width of access point to PRF; D = maximum depth of PRF from access point; UP = maximum height of PRF above access point; Down = maximum depth of PRF below access point. Measurements recorded in centimetres, undetermined measurements indicated by "?".

633000

634000

167000

166000

N

THANET DISTRICT

Kent International Airport

A299 HENGIST WAY

Area 1

Area 2

Area 3

012

x11

010

009

015

014

030

025

024

022

029

013

028

027

026

023

019

021

020

018

036

005

008

007

003

004

002

017

016

031

x36

034

001

032A

033A / 33B

x35B

035A

Key

Order Limits

Trees with potential for roosting bats

- High
- Moderate
- Low
- Negligible
- Undetermined

Hedge with potential for roosting bats

- Low
- Negligible
- Undetermined

Offsite areas containing trees with potential to support additional PRFs

- Private garden
- Landscaped garden
- Unmanaged grounds

0 100 200 300 400 m

Scale at A3: 1:8,000

Client

RSP

Manston Airport DCO
PEIR

amec foster wheeler

Figure 3.1
Indicative locations of trees supporting PRFs of High, Moderate, Low and Negligible suitability

file: H:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS \Figures\38199-Lon258a.mxd

Appendix 7.12:
Scientific Names

English Name	Scientific Name
Mammals	
American mink	*Neovision vision*
Badger	*Meles meles*
Brown hare	*Lepus europaeus*
Brown long-eared bat	*Plecotus auritus*
Common pipistrelle	*Pipistrellus pipistrellus*
Common seal	*Phoca vitulina*
Daubenton's bat	*Myotis daubentonii*
Dormouse	*Muscardinus avellanarius*
Grey seal	*Halichoerus grypus*
Harvest mouse	*Micromys minutus*
Hedgehog	*Erinaceus europaeus*
Leisler's bat	*Nyctalus leisleri*
Myotis spp.	*Myotis* spp.
Nathusius' pipistrelle	*Pipistrellus nathusii*
Natterer's bat	*Myotis nattereri*
Noctule	*Nyctalus noctula*
Otter	*Lutra lutra*
Pipistrelle spp.	*Pipistrellus* spp.
Rabbit	***Oryctolagus cuniculus***
Serotine	*Eptesicus serotinus*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Water vole	*Arvicola amphibious*
Whiskered bat	*Myotis mystacinus*
Birds	
Avocet	*Recurvirostra avosetta*
Barn owl	*Tyto alba*

English Name	Scientific Name
Bar-tailed godwit	*Limosa lapponica*
Bittern	*Botaurus stellaris*
Black-tailed godwit	*Limosa limosa*
Cetti's warbler	*Cettia cetti*
Charadrius plovers	*Charadrius* spp.
Corn bunting	*Miliaria calandra*
Curlew	*Numenius arquata*
Dunnock	
Gadwall	*Ana strepera*
Golden plover	*Pluvialis apricaria*
Grey partridge	*Perdix perdix*
Grey plover	*Pluvialis squatarola*
Hen harrier	*Circus cyaneus*
Hobby	*Falco subbuteo*
House sparrow	*Passer domesticus*
Kingfisher	*Alcedo atthis*
Knot	*Calidris canutus*
Lapwing	*Vanellus vanellus*
Little tern	*Sternula albifrons*
Mallard	*Anas platyrhynchos*
Marsh harrier	*Circus aeruginosus*
Mediterranean gull	*Ichthyaetus melanocephalus*
Meadow pipit	*Anthus pratensis*
Merlin	*Falco columbarius*
Mute swan	*Cygnus olor*
Nightingale	*Luscinia megarhynchos*
Northern shoveler	*Anas clypeata*
Nuthatch	*Sitta europaea*
Peregrine	*Falco peregrinus*
Pied avocet	*Recurvirostra avosetta*
Pintail	*Anas acuta*
Redshank	*Tringa totanus*
Red-throated diver	*Gavia stellata*

English Name	Scientific Name
Reed bunting	*Emberiza schoeniclus*
Reed warbler	*Acrocephalus scirpaceus*
Ringed plover	*Charadrius hiaticula*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Shelduck	*Tadorna tadorna*
Starling	*Sturnus vulgaris*
Snipe	*Gallinago gallinago*
Song thrush	*Turdus philomelos*
Teal	*Anas crecca*
Tree sparrow	*Passer montanus*
Turnstone	*Arenaria interpres*
Water rail	*Rallus aquaticus*
Reptiles	
Adder	*Vipera berus*
Common lizard	*Zootoca vivipara*
Grass snake	*Natrix natrix*
Slow worm	*Anguis fragilis*
Amphibians	
Common frog	*Rana temporaria*
Common/smooth newt	*Lissotriton vulgaris*
Common toad	*Bufo bufo*
Great crested newt (GCN)	*Triturus cristatus*
Marsh frog	*Pelophylax ridibundus*
Palmate newt	*Lissotriton helveticus*
Fish	
Atlantic salmon	*Salmo salar*
Barbell	*Barbus barbus*
Cod	*Gadus* sp.
European eel	*Anguilla anguilla*
Herring	*Clupea* sp.
Lemon sole	*Microstomus kitt*

English Name	Scientific Name
Mackerel	*Scomber scombrus*
Plaice	*Pleuronectes platessa*
Sandeel	*Hyperoplus lanceolatus*
Sea lamprey	*Petromyzon marinus*
Sea trout	*Salmo trutta*
Sole	*Cynoglossus* sp.
Sprat	*Sprattus sprattus*
Whiting	*Merlangius merlangus*
Invertebrates	
Banded demoiselle	*Calopteryx splendens*
Black-headed mason wasp	*Odynerus melanocephalus*
Boring millipede	*Polyzonium germanicum*
Cinnibar moth	*Tyria jacobaeae*
Common fan-foot	*Pechipogo strigilata*
Death-watch beetle	Xestobium rufovillosum
Desmoulin's whorl snail	*Vertigo moulinsiana*
Dog whelk	*Nucella lapillus*
Fisher's estuarine moth	*Gortyna borelii lunata*
Four-banded weevil-wasp	*Cerceris quadricincta*
Fritillary butterfly	*Argynnis sp.*
Garden tiger	*Arctia caja*
Great silver water beetle	*Hydrophilus piceus*
Hairy dragonfly	*Brachytron pratense*
Heath fritillary	*Melitaea athalia*
Heath grasper	*Haplodrassus dalmatensis*
Hornet robberfly	*Asilus crabroniformis*
Large red damselfly	*Pyrrhosoma nymphula*
Little yellow-faced bee	*Hylaeus pictipes*
Marbled white	*Melanargia galathea*
Moss carder bee	*Bombus muscorum*
Noble chafer	*Gnorimus nobilis*
Norfolk hawker	*Aeshna isosceles*
Oyster	*Ostrea edulis*

English Name	Scientific Name
Pale shining brown	*Polia bombycina*
Pearl-bordered Fritillary	*Boloria euphrosyne*
Phoenix fly	*Dorycera graminum*
Red-tailed bumblebee	*Bombus ruderarius*
Scarlet malachite beetle	*Malachius aeneus*
Shining ram's horn snail	*Segmentina nitida*
Shrill carder bee	*Bombus sylvarum*
Small heath	*Coenonympha pamphilus*
Stag beetle	*Lucanus cervus*
Tree bumblebee	*Bombus hypnorum*
Variable damselfly	*Coenagrion pulchellum*
Wall	*Lasiommata megera*
White admiral	*Ladoga camilla*
White-clawed crayfish	*Austropotamobius pallipes*
Desmoulin's whorl snail	*Vertigo moulinsiana*
Plants	
Alder	*Alnus glutinosa*
Apple	*Malus* sp.
Ash	*Fraxinus excelsior*
Beech	*Fagus sylvatica*
Betony	*Stachys officinalis*
Bindweed spp.	*Calystegia* spp.
Birch	*Betula sp.*
Bittersweet	*Solanum dulcamara*
Black knapweed	*Centaurea nigra*
Blackthorn	*Prunus spinosa*
Bluebell	*Hyacinthoides non-scripta*
Bog-bean	*Menyanthes trifoliata*
Borrer's saltmarsh grass	*Puccinellia fasciculata*
Bracken	*Pteridium aquilinum*
Bramble	*Rubus fruticosus*
Branched bur-reed	*Spaganium erectum*
Bristly oxtongue	*Helminthotheca echioides*

English Name	Scientific Name
Broadleaved dock	*Rumex obtusifolius*
Brome spp.	*Bromus spp.*
Cock's-foot	*Dactylis glomerata*
Common bent	*Agrostis capillaris*
Common elm	*Ulmus minor*
Common meadow rue	*Thalictrum flavum*
Common nettle	*Urtica dioica*
Common poppy	*Papaver rhoeas*
Common ragwort	*Jacobaea vulgaris*
Common reed	*Phragmites australis*
Common reedmace	*Typha latifolia*
Common speedwell	*Veronica persica*
Common spotted orchid	*Dactylorhiza fuchsii*
Cow parsley	*Anthriscus sylvestris*
Creeping thistle	*Cirsium arvense*
Dandelion	*Taraxacum officinale*
Deptford pink	*Dianthus armeria*
Divided sedge	*Carex divisa*
Dog rose	*Rosa canina*
Dog's mercury	*Mercurialis perennis*
Duckweed	*Lemna minor*
Elder	*Sambucus nigra*
False oat-grass	*Arrhenatherum elatius*
Fescue spp.	*Festuca spp.*
Field forget-me-not	*Myosotis arvensis*
Field maple	*Acer campestre*
Fool's watercress	Apium nodiflorum
Giant hogweed	*Heracleum mantegazzianum*
Goat willow	*Salix caprea*
Greater stitchwort	*Stellaria holostea*
Hairlike pondweed	*Potamogeton trichoides*
Hard rush	*Juncus inflexus*
Hawthorn	*Crataegus monogyna*

English Name	Scientific Name
Hazel	Corylus avellana
Heather	*Calluna vulgaris*
Hedge speedwell	*Veronica x franciscana*
Himalayan balsam	*Impatiens glandulifera*
Hogweed	*Heracleum sphondylium*
Holly	*Ilex aquifolium*
Honeysuckle	*Lonicera periclymenum*
Hop	*Humulus lupulus*
Hornbeam	*Carpinus betulus*
Horse chestnut	*Aesculus hippocastanum*
Ivy	*Hedera helix*
Ivy-leaved duckweed	*Lemna trisulca*
Japanese knotweed	*Fallopia japonica*
Knotgrass	*Polygonum* sp.
Lords and ladies	*Arum maculatum*
Maize	*Zea mays subsp. mays*
Man orchid	*Orchis anthropophora*
Marram grass	*Ammophila arenaria*
Meadow goat's beard	*Tragopogon pratensis*
Meadowsweet	*Filipendula ulmaria*
Meadow buttercup	*Ranunculus acris*
Meadow foxtail	*Alopecurus pratensis*
Meadow vetchling	*Lathyrus pratensis*
Moschatel	*Adoxa moschatellina*
Nipplewort	*Lapsana communis*
Oak spp.	*Quercus* spp.
Oil seed rape	*Brassica napus*
Pedunculate oak	*Quercus robur*
Pepper saxifrage	*Silaum silaus*
Perennial rye-grass	*Lolium perenne*
Pineapple weed	*Matricaria discoidea*
Poplar	*Populus sp.*

English Name	Scientific Name
Red clover	*Trifolium pratense*
River water dropwort	*Oenanthe fluviatilis*
Reedmace	*Typha latifolia*
Reed sweet-grass	*Glyceria maxima*
Ribwort plantain	*Plantago lanceolata*
River water-dropwort	*Oenanthe fluviatilis*
Rootless duckweed	*Wolffia arrhiza*
Rosebay willowherb	*Chamerion angustifolium*
Rough meadow-grass	*Poa trivialis*
Rue-leaved saxifrage	*Saxifraga tridactylites*
Scot's pine	*Pinus sylvestris*
Sedge	*Cyperus sp.*
Sessile oak	*Quercus petraea*
Sharp-leaved pondweed	*Potomogeton acutifolius*
Shining pondweed	*Potamogeton lucens*
Silver birch	*Betula pendula*
Soft rush	*Juncus effusus*
Spiny restharrow	*Ononis spinosa*
Spurge laurel	*Daphne laureola*
Starwort spp.	*Callitriche spp*
St. John's wort	*Hypericum perforatum*
Sweet chestnut	*Castanea sativa*
Tall fescue	*Festuca arundinacea*
Teasel	*Dipsacus fullonum*
True fox sedge	*Carex vulpine*
Tubular water-dropwort	*Oenanthe fistulosa*
Water mint	*Mentha aquatica*
Whitebeam	*Sorbus sp.*
White dead-nettle	*Lamium album*
Whorled water-milfoil	*Myriophyllum verticillatum*
Willow spp.	*Salix* spp.
Willowherb spp.	*Epilobium spp.*
Winter heliotrope	*Petasites fragrans*

English Name	Scientific Name
Wood anemone	*Anemone nemorosa*
Yellow flag iris	*Iris pseudacorus*
Yorkshire fog	*Holcus lanatus*

RiverOak Strategic Partners

Manston Airport DCO: Mitigation and Habitat Creation Plan

July 2018

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Report for

George Verrall
RiverOak Strategic Partners
Audley House
London
W1K6WF

Main contributors

Issued by

- Mark Linsley

Approved by

Nick Hilton

Amec Foster Wheeler

Floor 12
25 Canada Square
Canary Wharf
London E14 5LB
United Kingdom
Tel +44 (0) 203 2151610

Doc Ref. 38199

h:\projects\38199 mansion airport dco eia\0 client\environmental statement resubmission\chapters\chapter 7 - biodiversity\appendices\appendix 7.13 mitigation and habitat creation plan_final.docx

Copyright and non-disclosure notice

Third-party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Document revisions

No.	Details	Date
1	Draft	June 2018
2	Final	July 2018

Executive Summary

This report has been produced to describe the habitat creation and enhancement measures that mitigate the impacts upon the on-Site ecological receptors that are detailed in Chapter 7 of the Environmental Statement (ES). Much of this mitigation, as it involves, amongst others, birds and bats, which represent potential hazards on an operational airport, occurs off-Site in what has been called the Biodiversity Area (BA). The BA, currently an intensively farmed arable field, will comprise a number of lowland terrestrial habitats delivered through habitat creation, with the created habitats managed adopting practices appropriate to biodiversity conservation and the target receptors.

The report provides a summary description of the habitats within the Proposed Development, dominated by managed grassland and hardstanding, and those of the existing BA, currently dominated by arable land. It identifies the valued ecological receptors that occur within the Proposed Development, which are:

- Bats;
- Breeding birds, particularly grey partridge and skylark;
- Invertebrates;
- Reptiles, and
- Badger.

The mitigation (habitat) requirements of each are set out based upon the assumed impacts under the worst-case assessment of the ES with the design of the habitat creation of the BA based upon these requirements. For bats, these are roost provision for a number of species with purposefully designed buildings providing opportunities for both breeding and active period summer and winter hibernation roosts. The provision and appropriate placement of a range of bat boxes will also provide roost opportunities for several species of bats. The Proposed Development Site is of relatively poor quality for foraging bats as it is exposed and lacks woodland and other mature vegetation, which provide shelter, foraging areas and aid dispersal into the wider environment. The habitat creation in the BA is to include new broadleaved woodland planting, hedgerows, scrub, standing water and an extensive area of grassland, which will be managed (through timely cutting and no fertiliser/pesticide input) specifically for biodiversity. This range of habitats will provide an enhanced resource for foraging bats and facilitate their commuting and dispersal.

The extensive areas of grassland to be created in the BA will mimic that lost within the Proposed Development although, without the agricultural chemical inputs, will provide a richer foraging resource for birds and other wildlife. It will also be managed (mown) specifically to avoid any impacts on ground nesting birds, such as skylark. Hedgerows are to be planted with adjacent strips of land managed specifically to provide ideal nesting habitat for grey partridge. The chicks of this species will also benefit from the improved foraging resource in the grassland of the BA.

The small area of brownfield land which has recently developed within the Proposed Development provides opportunities for a range of invertebrates and reptiles. The BA includes an area of open mosaic habitat, with bare ground scrub and some varied topography, of enhanced value for invertebrates and reptiles.

The habitats created will also provide improved foraging for local badgers, with the extensive grassland far richer than the current cropped land.

The habitat creation measures show that in addition to adequately mitigating the impacts associated with the Proposed Development the in-perpetuity management for nature conservation of the BA will also provide net biodiversity gain, with the additional aim (e.g. through use of agri-environment schemes) of improving links and connectivity to features and other sites of biodiversity value in the wider locality. It is demonstrated that the habitat creation scheme is adequate for the worst case assessment and that the BA can absorb higher numbers than have been predicted due to both the extent of and beneficial management of habitats.

Good practice techniques for working with protected species and legal considerations are detailed, as well as a programme of habitat creation works within the BA.

Contents

1. Introduction

1.1 Purpose of report

The assessment of the potentially significant effects of the proposed development of Manston Airport on biodiversity[1], both within the site boundary and the surrounding area where appropriate has assumed a worst-case scenario, identifying the need for mitigation measures on this basis.

The assessment identified the following valued ecological receptors for which mitigation measures are required:

- Bats;
- Breeding birds, particularly grey partridge and skylark;
- Invertebrates;
- Reptiles, and
- Badger.

Broadly speaking, the mitigation proposed includes measures to be implemented within the Proposed Development area and also off-Site mitigation and compensation to be delivered via a programme of habitat enhancement and creation. This is to take place in a proposed Biodiversity Area (BA), currently an intensively farmed arable field[2] with low biodiversity value. Habitats to be created within the BA include those aimed specifically at benefitting the receptors identified above.

This report builds on the impact assessment contained in **Chapter 7** of the Environmental Statement and details the mitigation plan and associated habitat creation measures proposed to mitigate for the identified worst-case impacts on these valued ecological receptors. Given that all of the identified impacts are based on the loss of certain habitats that may be used by the receptors identified above, this report sets out the particular habitat features required by each of the receptors and describes how the loss of this habitat should be incorporated into the habitat creation plan. For example, it details the roost (both summer and winter) provision for bats, and habitats that will benefit foraging bats and the other target receptors, including woodland, scrub, hedgerows, (ephemeral) water features, extensive species-rich grassland and open mosaics (a mixture of areas of bare ground, scrub, grassland and ruderal growth).

The plan also sets out the good working practice measures for protected species and other wildlife as well as the management and monitoring of the receptors and habitats of the BA.

1.2 Structure of this report

Section 2 of the report details the baseline habitats of both the Proposed Development and the BA. It also describes what habitats are to be created in the BA and how these support the valued ecological receptors. Section 3 details the baseline for each of the valued ecological receptors, sets out the mitigation requirement for each and then adds detail on the specific habitat requirements for each. Section 4 details good practice techniques to be adopted during any ground works and site clearance to ensure appropriate compliance with legal considerations. Section 5 details the schedule for the habitat creation works in the BA.

[1] This is in accordance with Schedule 4, paras 1(c) &5(b) of the Infrastructure Planning (EIA) Regulations 2017), which states that “the characteristics of development must be considered with particular regard to the use of natural resources, in particular land, soil, water and biodiversity.

[2] This is referred to in ES Chapter 7 as land parcel or field 1362. An extended Phase 1 habitat survey of field 1362 is provided as **Appendix 7.10, ES Chapter 7**.

2. Habitats

2.1 Introduction

This section sets outs the existing habitats within the Proposed Development and the BA. It identifies the key ecological receptors from the Proposed Development and their habitat requirements with a description of the habitats to be created within the BA and how these suit the target receptors.

The Manston Airport Site is characterised by extensive areas of open grassland habitat interspersed with hard-standing associated with its former airport use. The large former runway dominates the Site in the south, with scattered buildings and access roads toward the eastern and western areas and further north on the site. North of the B2050 (Manston Road) is the area known as 'the Northern Grass', where the dominant habitat type is open grassland (with informal public access). Here the site comprises a large central field with smaller buildings, hard-standing and access roads around its periphery. Overall the habitats are of relatively low species diversity as would be expected of an airfield that only ceased operation relatively recently (2014) and when surveyed in 2015 was still being managed in accordance with agricultural practices.

The management of habitats at aerodromes is primarily governed by the need to reduce the potential risk of aircraft colliding with birds (bird-strike). Guidance produced by the CAA (CAP 772[3]) sets out how different types of habitat can be managed to reduce their attractiveness to those species of birds that pose the highest risk of bird-strike. The return of aeronautical use of the Site means that the habitats that remain on site will need to be managed in accordance with this guidance. Species chosen will be selected because they are considered not to attract flocks of birds or, particularly in locations close to the airfield, will be managed in such a way as to reduce their attractiveness (i.e. through reducing flowering or berry production). The species chosen will, however, be native and in-keeping with existing habitats within the local environment and, as far as possible, will create a biodiverse resource for wildlife. In addition, a mitigation site, the Biodiversity Area (BA), extending to 35.7ha, has been identified and its' current mapped habitats can be seen on **Figure 2.1**.

Within the BA it is proposed to create areas of lowland terrestrial habitats, including extensive grassland, broad-leaved woodland, hedgerows and scrub, such that these are of nature conservation value, but will also provide optimal habitat for the valued ecological receptors identified by the assessment:

- Bats;
- Ground-nesting birds;
- Invertebrates and grassland habitats;
- Reptiles, and
- Badgers.

Figure 2.2 shows the proposed habitat layout within the BA.

The new grassland habitat created will be managed specifically for nature conservation and provide a higher quality grassland habitat compared with that which currently exists on the airport site. This will result in enhanced value for wildlife in general as well as the valued ecological receptors that are targeted by the habitat creation programme.

Creating grassland from arable land is not a novel technique and has been carried out widely in recent decades. For example, the reversion of arable to species-rich grassland has long been a major area of work funded through agri-environment schemes, and has been based upon a significant extent of information and

[3] Civil Aviation Authority (CAA). (2017). Wildlife Hazard Management at Aerodromes. CAP 772. CAA, Gatwick.

advice on how to achieve successful outcomes e.g. Natural England Technical Information Notes (TINs) and the Technical Advice Notes (TANs) of the former Rural Development Service[4].

2.2 Description of baseline

Proposed development

The desk study (**Appendix 7.2, ES Chapter 7**) shows that the Site is characterised by extensive areas of open grassland habitat interspersed with hard-standing associated with former airport use.

Grassland areas cover 60% of the site (the remainder is predominantly hardstanding and buildings), with approximately 60% of the grassland classified as species-poor semi-improved grassland and the remainder semi-improved neutral grassland. The biodiversity value of the 'Northern Grass'[5] area is also reduced by its frequent informal use as an area for dog-walking and other recreational actives (e.g. walking, jogging).

Species-poor semi-improved grassland

This habitat type was observed to dominate the grassland areas to the north and south of the runway, around the buildings in the central and northern areas and the larger field north of Manston Road. These areas were reported as having recently being subject to management (regular cutting/mowing) with anecdotal evidence of agricultural improvement including twice-yearly fertilisation and (at least) an annual cut for silage, based on feedback from site security personnel. The majority of these areas had been recently cut for silage prior to the survey in June 2015. This management has resulted in a grass-dominated sward, with limited species diversity and low percentage cover of herb species.

Grassland around the former airport buildings was also recorded as this habitat type (including in the isolated part of the Site around the former fuel store). These areas included parcels not subject to silage cutting, but dominated by coarse grass species and generally lacking a diversity of herb species. It is possible that some of these areas may have previously been managed as short 'amenity' grassland close to the buildings, but have been left to become tall and 'rank' through lack of management.

Overall, the species poor semi-improved grassland is dominated by species favouring largely neutral (mesotrophic) conditions, likely as a result of regular fertilisation and management

Characteristic species present include coarse grasses such as false oatgrass, cock's-foot, red fescue, Yorkshire fog, common couch (*Elymus repens*) and perennial ryegrass. Other grasses occurring in some areas (but typically with less dominance) included yellow oat-grass and timothy (*Phleum pratense*). Herb species generally occurred as occasional or rare components of this community, with species such as hoary cress (*Lepidium draba*), ox-eye daisy, red clover (*Trifolium pratense*), black medick (*Medicago lupulina*), ribwort plantain and common mallow all recorded.

Semi-improved neutral grassland

More diverse grassland swards were also recorded (semi-improved neutral grassland) and comprised approximately 40% of the grassland, with the most extensive areas being to the western and eastern ends of the main runway as well as around buildings and hard-standing in the south-east part of the Site north of Manston Road. Smaller pockets of more diverse grassland were also recorded around buildings toward the western and eastern edges of the Site. These areas included grassland evidently subject to less intensive recent management, with the most extensive un-cut area around the eastern end of the main runway.

The dominant and characteristic species recorded included tall and coarse grasses such as false oatgrass, cock's-foot, Yorkshire fog (*Holcus lanatus*), creeping bent (*Agrostis stolonifera*), red fescue (*Festuca rubra*), perennial rye-grass (*Lolium perenne*) and meadow fescue (*Festuca pratensis*) along with a variety of herbs such as ox-eye daisy, ribwort plantain (*Plantago lanceolata*), yarrow (*Achillea millefolium*), bulbous buttercup

[4] The Rural Development Service (RDS) was formerly part of the UK Government's Department for Environment, Food and Rural Affairs (Defra). It ceased to exist on 1 October 2006 following the creation of Natural England although the TAN are available on archive.
[5] This refers to the grassland north of the Manston Road (B2050).

(*Ranunculus bulbosus*), rough hawkbit (*Leontodon hispidus*), goat's-beard (*Tragopogon pratensis*) and common vetch (*Vicia sativa*). These species favour neutral conditions resulting in these areas being classified as largely neutral grassland. However, species indicative of the underlying calcareous soil-type within the Site were also recorded. This included yellow oat-grass (*Trisetum flavescens*) which in some areas (particularly to the eastern end of the runway) was locally frequent or abundant. Other species favouring calcareous conditions (although only occurring as occasional or rare) included common restharrow (*Ononis repens*), grass vetchling (*Lathyrus nissolia*) and bee orchid; the latter being a very rare component of the open grassland but also found in localised locations in unmanaged areas around the Site.

At the time of the survey the grassland at the western end of the runway had been largely cut, although vegetative species present and a remaining un-cut central strip indicated this area had a higher species diversity than the species-poor areas dominating the central and northern parts of the Site. Overall the grassland is dominated by coarse grasses indicative of largely neutral (mesotrophic) conditions. However, species preferring calcareous conditions were also recorded across much of the Site, indicating the influence of underlying chalk soil conditions/geology in the area.

Other habitats

A range of other habitat types occurred in very small quantities. Of these, scattered broad-leaved trees/amenity grassland mosaic comprise 0.17ha, and 1.74km of species-poor hedgerow is present.

The hedgerows are distributed in a few locations; particularly to the north and south of the runway at its western end, close to the former car-park in the west of the Site, short sections of the northern boundary of the airfield south of Manston Road and along the northern-most boundary of the Site (north of Manston Road). They were formed of native woody species; particularly hawthorn, field maple, dog rose and blackthorn. Other woody species not regularly occurring included cherry, lime and wayfaring-tree. Ground flora associated with the hedgerows included Alexanders, ox-eye daisy, ribwort plantain, hedge bedstraw and fennel. Short hedgerows dominated by non-native species were also recorded toward the east of the Site south of the former car-park close to the terminal buildings. These included tall conifer (Leyland cypress) hedging and a short section across the road dominated by garden privet.

Biodiversity area

The mitigation site (the BA) is 35.7ha of land currently used for arable farming (**Appendix 7.10[6], ES Chapter 7**) and is dominated by the cropped area (currently conventional winter cereal). The field has a narrow margin approximately 0.5 to 1 metre (m) wide with tall ruderal growth. Dominant plant species within the field margin were hoary mustard, bristly ox-tongue, with occasional bastard cabbage, cleavers, prickly sow-thistle and dove's-foot crane's-bill.

Beyond the field margin and adjacent to the highway there was a strip of semi-improved grassland along the northern half of the western and eastern site boundaries, with a number of grass species.

In the semi-improved grassland strip adjacent the dual carriageways, a recently planted species-rich hedgerow was present along the northern and eastern boundary of the site. This comprised young trees (approximately 1.5m in height) protected with tree guards. Species included typical native hedgerow species such as hawthorn, hazel, blackthorn, wayfaring-tree, oak, buckthorn and dogwood.

In the south of the site a species-poor, gappy hedgerow (3-4 m high) created a boundary between the site and the arable field to the west. Dominant species of this hedgerow included cherry spp, elm, elder with dense ivy growth and blackthorn. Holly, oak and poplar were recorded occasionally as standard trees within the hedgerow, and ground flora was species-poor, with cleavers, bastard cabbage, hogweed, common nettle and mugwort recorded. Large gaps (5-10m) were frequent and fallen trees resulted in large areas of dead wood on the ground.

Immediately offsite, further to the north of the western boundary hedgerow the field ran alongside a small broadleaved woodland plantation with young sycamore, elm, ash and cherry with a sparse understory.

Figure 2.1 shows the phase 1 mapped habitats of the existing site.

[6] This reports the extended Phase 1 habitat survey of the BA (land parcel 1362).

2.3 Grassland habitats

Habitat creation

A species-rich grassland sward extending to approximately 30.5 ha will be created within the BA and form the principal habitat. This will be created through an initial depletion of soil nutrients and then sowing of an appropriate seed mix. A Habitat Management Plan (HMP) will include detail on sward establishment and early management e.g. to manage any arable plant ('weed') burden.

The species rich grassland will provide nesting habitat for skylark, and also grey partridge. In addition, other habitat with more favourable nesting characteristics (e.g. banks and areas with tussocky grass/perennials at the base of hedgerows) for this species will also be created.

The grassland, with no agricultural input (pesticides, fertilisers) will provide a high-quality foraging resource for grey partridge chicks and adults, with the loss of chick foraging habitat/insect prey known to be the main factor behind grey partridge decline. The species-rich grassland will also provide a foraging resource for pollinators (including many species of hymenoptera) and other invertebrates. In turn this will provide an increased foraging resource for many species of bats. The grassland will also provide an enhanced foraging resource for badgers, whose main prey are earthworms, which occur at much higher densities in uncultivated land than in arable.

Grassland creation methods

To obtain a high-quality grassland in the BA, the nutrient levels, particularly of phosphorous and nitrogen, of the existing arable site will need to be reduced. Excess soil available nitrogen is usually lost from soil over a relatively short time period following cessation of fertiliser application, however, phosphorus is more persistent (Bradley *et al.* 2006[7]). If required, phosphorous can be depleted by a number of techniques[8] with those likely used for the BA being:

- Harvesting biomass from the site e.g. a hay crop taken from a site will typically remove 10 kg of phosphorus per hectare, however, on clay soils it can take several years to sufficiently deplete phosphorous. Counter intuitively the addition of nitrogen-only fertiliser can speed the process.
- Application of lime[9] in high pH soils.

With the right soil nutrient conditions grassland habitats can be created where appropriate by one or a combination of the following approaches:

- Translocation: turf-stripping from the new aircraft pavement footprint and placement in the BA.
- Soil transfer: topsoil from the new aircraft pavement footprint/Northern grass area transferred to the BA (with or without additional seed collection from Site (or other suitable donor grassland) and addition to BA).
- Seed harvesting from the Site (or other suitable donor grassland) and addition to BA grassland area for sward enhancement.
- Use of green hay, harvested from appropriate grassland area on the Airport and then strewn over the BA.
- Purchase and sowing of an appropriate species-rich grassland seed mix.
- Natural regeneration: once a suitable substrate is established.

[7] Bradley, I., Michelle Clarke, M., Cooke, H., Harris, J., Harrison, P., Thomas, M., Towers, W. Rodwell, J. and Gowing, D. (2006). Guidance on understanding and managing soils for habitat restoration projects. English Nature Research Report 712. English Nature, Peterborough.
[8] Other methods, not likely required, include topsoil stripping: stripping the top 10-20 cm of nutrient enriched topsoil reveals the nutrient poor subsoil[8], and deep inversion ploughing, whereby the plough inverts a layer up to 1m deep bringing the subsoil to the surface, and thus reducing the nutrient load.
[9] Aluminium or iron salts can be added to low pH soils.

Turf Stripping, translocation and reuse

Areas of more botanically diverse, but specifically lacking large tussock-forming grasses likely to dominate the new sward in the NCA, semi-improved neutral grassland turf will be stripped from the footprint of the new aircraft pavement and placed in appropriate parts of the BA.

The approximate cutting depth of the turves would be between 30cm and 40cm, which would capture the rooting zone of grass and herb species. This would provide a robust platform for the translocation of the vegetation and the rooting zone. It is important that cut turves are transported and placed at the receptor site as quickly as is practical to avoid drying. If possible, the transfer and laying operation should on the same day or at least within a timeframe to prevent drying. If temporary storage is unavoidable monitoring and watering will be necessary. Turves should not be placed on top of each other but laid flat on a geotextile membrane.

Soil transfer

This involves the removal of the upper soil by an excavator and transportation to the receptor site where it is spread. The seed bank for many species is contained in the upper 6cm and the taproots, bulbs and rhizomes are generally within the layer below i.e. the 'bud' bank. The soil transfer would involve the removal of soil from areas of existing of higher quality grassland that will be replaced by new areas of aircraft pavement. The specific areas will be identified once the botanical surveys have been completed.

Seed Harvesting

Seed from the semi-improved neutral grassland on the former Airport will be harvested in late spring/early summer in the season prior to sward establishment. This will be done mechanically using either, for example, a suction harvester, brush harvester or forage harvester. This mix will be used to reseed appropriate parts of the BA grassland.

Green hay

Green hay can be taken from appropriate[10] species-rich donor areas within the Airport and spread on the BA. Green hay is harvested wildflowers and grasses just as they are shedding seed and still 'green'. The hay needs to be quickly transferred to the BA where it is spread allowing the seed to drop.

Seed mix

Any seed mix used will be of British native origin. If possible local origin (from the same Natural England Joint Character Area) seed will be used where there is an acceptable match for the geology and soils. Final seed mixes will be sourced from suppliers who adopt Flora Locale's[11] code of practice for collectors, growers and suppliers of native flora.

Natural regeneration

This can be used in areas of appropriate soil chemistry (i.e. after biomass harvesting, topsoil stripping etc) where the sward is allowed to regenerate naturally. Monitoring of any 'weed' burden would be closely monitored and controlled (e.g. through cutting/ herbicide application) if necessary.

The BA HMP will provide detail on the treatments necessary to prepare the BA for sward establishment.

2.4 Trees and hedgerows

An area of broad-leaved woodland of approximately 0.8ha in extent will be planted against that existing on the western boundary of the BA. This will comprise native species of local character. The eastern boundary of the woodland will be scalloped to increase the extent of interface with adjoining non-woodland habitat and

[10] Green hay should not be collected from any areas where inappropriate (tussocky) grasses (such as *Schedonorus arundinacea*) are present as these may dominate the sward in the BA.
[11] https://www.floralocale.org

provide a diversity of habitat and sheltered areas. The eastern face of the broad-leaved woodland will be softened by scrub planting. No woodland is to be lost from the airport and this habitat creation is to enhance the BA for bats.

Native, local character species hedgerows will be planted around the boundary of the BA, with some length of these new hedgerows planted upon low landscaped banks. Much of the hedgerow length will managed to be kept low e.g. 1.5m high so as not to deter ground nesting birds such as skylark. The existing BA has some 420m of gappy hedgerow. The gaps will be filled in this hedgerow with additional hedgerow planting of about 2,300m. The airport currently has about 600m of hedgerow, much of which will be removed.

The trees/woodland will provide foraging opportunities for those bat species which prefer to forage under tree cover. It will also provide shelter enhancing foraging conditions for many bat species. The mature woodland will provide natural roosting opportunities for bats. The hedgerows will provide commuting routes for bats between foraging areas and increasing opportunity for wider dispersal. The habitat enhancement for this group of valued ecological receptors in the BA will help achieve biodiversity gain.

2.5 Ditches and banks

To provide topographical and habitat diversity within the BA, ditches will be created to provide ephemeral water features. These will provide habitat for a range of plant species which will not occur elsewhere within the BA, and provide habitat for a range of invertebrates that rely on such ephemeral features, and the higher humidity that occurs within them even when they are dry. They are also likely to be used by amphibians, which prefer ephemeral water features as any (released) fish (which eat amphibian eggs/larvae) will not survive. The spoil from the ditch excavations will be used to make low earth banks for new hedgerow planting. The low banks as well as the banks from the ditches will provide ideal nesting locations for grey partridge. The ditches and banks are features, which lacking on the airport, are to be created to provide biodiversity enhancement and help achieve net gain.

Figure 2.2 shows the proposed habitat layout within the BA.

2.6 Agri-environment scheme

Consultation between RSP and Natural England (NE) will be held with the aim of entering the BA into an agri-environmental scheme.

RSP will also host a series of meetings, to include informal talks/ presentations by ecological stakeholders (for example representatives from Natural England on the Countryside Stewardships Scheme), with local agricultural landowners with the aim of encouraging them to enter components of their land into agri-environment schemes. The focus of this work is to enhance and strengthen connectivity, via the network of hedgerows, between the BA's and species diverse habitats off-site, such as Minster Marshes and the Ash Levels to the south and west of the Airport and Pegwell Bay National Nature Reserve to the east.

3. Species

3.1 Bats

Description of baseline

Overview of potential presence of bats at Manston Airport

In the UK there are 18 species of bat[12]. Initial survey work has indicated that at least six bat species use the site: common pipistrelle, soprano pipistrelle, Nathusius pipistrelle, brown long-eared, noctule and serotine. However, up to 11 species may use it taking into account other species within the locality within Kent (including Leisler's, Daubenton's, Natterer's, whiskered and Brandt's) and the habitats present (sections **7.4 and 7.11, ES Chapter 7**).

Roosting habitat

In summary a total of 71 buildings were identified on site, with 33 having negligible potential to support roosting bats. **Table 3.1** summarises the bat roosting potential of buildings on site. Building locations are presented on **Figure 3.1**. There are approximately 130 trees on site, many of which are less than 30 years old and have limited suitability for bats due to their simple growth form and lack of potential roosting features. A ground level assessment of trees with bat roosting potential was undertaken on 28th November 2017[13] and found a total of 14 trees with roost potential (two with high and 12 with moderate). The majority of these trees are located along the site's north-western and north-eastern boundaries. Full details of roosting habitat on site can be found within the Manston Airport DCO EIA.

Table 3.1 Summary of Bat Roosting Potential for all Buildings on Site (August-October 2017)

Overall Potential to Support Roosting Bats	Building Reference Number	Total number of building in Category
Confirmed Roost	B8, B16, B17, B33, B41 and B54	6
High	B1 and B43.	2
Moderate	B5, B18, B28, B29, B39 and B53.	6
Low	B2, B3, B6, B7, B11, B14, B15, B22, B25, B27, B34, B40 and B44.	24
Negligible	B4, B9, B10, B12, B13, B19, B20, B21, B23, B24, B26, B30, B31, B32, B35, B36, B37, B38, B42, B48, B49, B51, B55, B57, B58, B59, B60, B65, B67, B68, B69, B70 and B71.	33

**Highest potential stated for each building.*

Note B1 is an underground bunker and B18 is a ground-level bunker.

Many of the buildings support potential for a variety of roosts e.g. a potential hibernation roost may also have potential for day roosting. The current status of on-site roosts and potential roosting categories within buildings is summarised in **Table 3.2.**

[12] Bat Conservation Trust (2018) UK Bats. Available online at: http://www.bats.org.uk/pages/uk_bats.htm [Accessed 24/05/2018].
[13] Amec Foster Wheeler (January 2018) Technical Note: Manston Airport DCO EIA: Ground level assessment of trees with bat roosting potential at the former Manston Airport.

Table 3.2 Current status of on-site roosts and potential roost categories

Maternity Roosts	Hibernation Roosts	Day/Transitional Roosts	Night/Feeding Roosts
No confirmed roosts	Two confirmed roosts. B8 – brown long-eared droppings and a single possible *Myotis* sp. dropping. B33 – single brown long-eared.	Four confirmed roosts (B16, B33, B41 and B54). B16, B41 and B54 had likely common or soprano pipistrelle droppings. B16 and B33 had brown long-eared droppings.	One confirmed roost (B17) with brown long-eared droppings.
Three buildings with moderate potential	One building with high potential	One building with high potential	12 buildings with low potential
Eight with low potential	Two with moderate potential	Five with moderate potential	
	18 with low potential	25 with low potential	

Foraging and commuting habitat

Overall the site provides low quality foraging and commuting habitat for bats. The site consists of large areas of regularly mown semi-improved and poor semi-improved neutral grassland and extensive areas of hard-standing (including a runway, aircraft taxiing areas and buildings). The site is exposed and grassland is managed by regular cutting, resulting in low value foraging habitat for bats. Initial bat activity survey work has indicated low levels of bat activity, with activity being mainly being concentrated along the hedgerow boundary and the eastern end of the former runway. The initial bat activity surveys identified common pipistrelle, soprano pipistrelle and noctule bats. The preliminary static detector surveys again had a low level of activity, with the detector located to the west of the site, towards Spitfire Way having the majority of bat calls. The static detector surveys identified five species which include common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle (1 confirmed call, possibly 2 calls), noctule and serotine (1 call).

Status of bat species at Manston Airport

This section details the target species that require mitigation as part of the Proposed Development. In total there are 38 buildings which have potential to support roosting bats on site (including 6 confirmed roosts) and 14 trees which have bat potential on site.

The majority of buildings on site will be demolished or, if retained, extensively refurbished to accommodate the scheme. In the absence of roost characterisation surveys, a worst-case scenario has been adopted for the potential loss of roosts within buildings and trees and potential disturbance to foraging and commuting species on site. This considers likely species present based on: confirmed presence of a bat, initial indications of droppings and known bat assemblages foraging and commuting on site (from September 2015 for the SHP baseline)[14].

The likely roosting status of the six building roosts identified have been assessed in line with the criteria set out in the bat mitigation guidelines[14]. Where the status of a roost or species' population is uncertain, for example if the survey results were ambiguous, a precautionary approach has been taken in line with the worst-case assessment, and the higher level of value assumed.

An additional 38 buildings are considered to have bat potential but currently have no supporting bat roost characterisation survey data therefore the conservation status of bats potentially using these buildings cannot be confirmed at this stage. Based on our current knowledge of the site, habitat and building suitability for bats, distribution of bat species and professional judgement, the following reasonable worst-case scenario has been adopted for the purposes of mitigation (on-site) and compensation (off-site) design. Following the completion of roost characterisation surveys of all suitable buildings and trees on site, mitigation and compensation will be refined and hence subject to change. Taking into consideration confirmed roosts and 38 buildings with bat roost potential, the site may support;

[14] Mitchell-Jones, A.J. (2004). Bat Mitigation Guidelines. English Nature, Peterborough.

- Three small-moderate sized maternity roost for common species such as common pipistrelle, soprano pipistrelle and/or brown long eared bats;
- Five hibernation roosts (two confirmed and three potential) potentially supporting brown long-eared, Myotis sp., common pipistrelle or soprano pipistrelle species;
- Five transitional or night feeding roosts of within buildings; and
- Five individual or small roost sites within trees has been assumed.

The majority of the five transitional or night feeding roosts of buildings or individual or small tree roost sites are likely to consist of low or small numbers of common species such as common or soprano pipistrelle and brown long-eared bats. It has also been assumed that a small number of these roosts could consist of individual or small numbers of roosting *Myotis* sp. (such as Natterer's, Daubenton's, whiskered and or Brandt's), or of Nathusius', serotine, noctule or Leisler's bats. **Table 3.3** summarises the roosting status by species.

Table 3.3 Interpretation of likely roosting status by species.

Species	Availability of foraging/commuting habitat	Preliminary interpretation of likely roosting status on the site according to species+ (refer to Figures 3.1 for building references)	Activity recorded on the site*
Brown long-eared bat	Hedgerows and treelines are present on the western and eastern boundaries of Manston Road, and provide opportunities for foraging, connecting suitable habitat, despite built-up patches that are artificially lit. Foraging and commuting habitats are sub-optimal for this species which is a woodland specialist and shows preference for dark flight routes.	B33 is a confirmed hibernation site for brown long-eared bat. A single bat was found in B33 during inspections undertaken in January/February 2016 (SHP). B33 supports an individual brown long-eared or possibly on a precautionary basis a small hibernation roost of up to three bats. B8 is a confirmed hibernation site for brown long-eared bat. 25 brown long-eared droppings were recorded inside the building during winter surveys. B17 (40 droppings) has been confirmed as a day/transitional roost. B16 (3 droppings) has been rated as moderate potential for a maternity roost.	No brown long-eared calls were identified during static and transect detector survey (although this is likely to be due in part to the quiet calls of this species leading to under-detection). It is anticipated that there will be very low levels of foraging and/or commuting recorded across the Site, which would be primarily along boundary features.
Common pipistrelle	Suitable foraging habitat is available across the Site, along boundary features with some trees and hedgerows, as well as around artificial lights and landscaped areas. This species is a habitat generalist and will opportunistically forage around street lamps, scrub, hedgerows, trees and other features.	Buildings 16, 41, and 54 had droppings present and have been confirmed as day/transitional roosts (likely common or soprano pipistrelle). B41 and 54 have been rated as having low potential to support maternity or hibernation roosts, having potential to support only small numbers of bats. B16 has been rated as moderate potential for a maternity roost.	Low levels of Common pipistrelle activity were recorded on the Site. Of the species recorded during the static and transect surveys this was by far the most frequently occurring species, with 77.22% of calls (61 in total) during the September 2015 monitoring period (five nights at eight locations). A total of 34 common pipistrelle calls were recorded during the September 2015 dusk/dawn activity surveys across all four transects at the Site.
Soprano pipistrelle	Suitable foraging habitat is available across the Site, along boundary features with some trees and hedgerows, as well as around artificial lights and landscaped areas. Aside from a balancing pond and an emergency water supply tank, the Site lacks the water bodies with which soprano pipistrelles are typically associated.	Buildings 16, 41, and 54 droppings present and have been confirmed as day/transitional roosts (likely common or soprano pipistrelle. B41 and 54 have been rated as low maternity and hibernation potential having the potential to support low to small numbers of bats. B16 has been rated as moderate potential for a maternity roost.	Very low levels of soprano pipistrelle foraging and commuting were recorded across the Site. Static detectors found a total of eight calls (10.13%) at eight locations during the September 2015 5 days of monitoring. A total of two soprano pipistrelle calls were recorded during the September 2015 dusk/dawn activity survey across all four transects at the Site.

Species	Availability of foraging/commuting habitat	Preliminary interpretation of likely roosting status on the site according to species+ (refer to Figures 3.1 for building references)	Activity recorded on the site*
Nathusius' pipistrelle	Some suitable foraging habitat is available particularly along western and eastern boundaries of Manston Road. The Site does, however, lack woodland and large water bodies which Nathusius' pipistrelle is usually associated. Although considered one of the UK's rarer bats, this species is recorded more frequently in the south-east region.	No roosts identified. Static detectors have identified small numbers of Nathusius pipistrelle on site. Some trees and/or buildings on site may have potential to support small numbers of day/transitional roosting Nathusius pipistrelle.	Very low levels of foraging and commuting recorded across the site. With a single confirmed call and a single possible call during static detector monitoring. Static detectors recorded one call (1.27%), during the September 2015 (5 days of monitoring).
Noctule	Suitable foraging habitat is available across the Site. Areas include boundary features such tree lines, hedgerows, and across landscaped grassland areas within the centre of the Site.	No roosts currently identified. Static detectors and transect surveys have identified small numbers of noctule on site. Some trees on site may have potential to support small numbers of day roosting or hibernating noctule.	Very low levels of noctule activity were recorded at the Site Static detectors found three calls (3.8%), during the September 2015, five days of monitoring. One noctule call was recorded during the September 2015 dusk/dawn activity survey across all four transects at the Site.
Leisler's bat	Suitable foraging habitat is available across the Site. Areas include boundary features such tree lines, hedgerows, and across landscaped grassland areas within the centre of the Site.	No roosts currently identified. There remains low potential for small numbers of Leislers to be roosting on site.	No activity currently identified. Although, there is the potential for low levels of activity.
Serotine	Suitable foraging habitat is available across the Site. Areas include boundary features such tree lines, hedgerows, and across landscaped grassland areas within the centre of the Site.	No roosts currently identified. Static detectors have identified small numbers of serotine on site. Some buildings on site may have potential to support small numbers of day roosting or serotine.	Very low levels of serotine activity were recorded. Static detectors found four calls (5.06%), during the September 2015 (5 days of monitoring).
Daubenton's bat	The Site lacks woodland habitat for foraging opportunities. Boundary features Hedgerows and treelines are present on the western and eastern boundaries of Manston Road, and provide opportunities for foraging, connecting suitable habitat, despite built-up patches that are artificially lit. With the exception of a balancing pond and emergency water supply, the Site lacks the open water habitat with which Daubenton's bat are typically associated.	B8 had a possible *Myotis* sp. dropping present and has been confirmed as a hibernation site. As a worst-case scenario this building may support small numbers of day roosting and hibernating *Myotis* sp.	No *Myotis* passes were recorded. It is anticipated that very low levels of activity would occur along boundary features and in darker areas of the Site.
Natterer's bat	The Site lacks woodland habitat for foraging opportunities. Hedgerows and treelines are present on the western and eastern boundaries of Manston Road, and provide opportunities for foraging, connecting suitable	B8 had a possible *Myotis* sp. dropping present and has been confirmed as a hibernation site. As a worst-case scenario this building may support small numbers of day roosting and hibernating *Myotis sp*.	No *Myotis* passes were recorded. It is anticipated that very low levels of activity would occur along boundary features and in darker areas of the Site.

Species	Availability of foraging/commuting habitat	Preliminary interpretation of likely roosting status on the site according to species+ (refer to Figures 3.1 for building references)	Activity recorded on the site*
	habitat, despite built-up patches that are artificially lit.		
Whiskered bat	The Site lacks woodland habitat for foraging opportunities. Hedgerows and treelines are present on the western and eastern boundaries of Manston Road, and provide opportunities for foraging, connecting suitable habitat, despite built-up patches that are artificially lit.	B8 had a possible *Myotis* sp. dropping present and has been confirmed as a hibernation site. As a worst-case scenario this building may support small numbers of day roosting and hibernating *Myotis* sp.	No *Myotis* passes were recorded. It is anticipated that very low levels of activity would occur along boundary features and in darker areas of the Site.
Brandt's bat	The Site lacks woodland habitat for foraging opportunities. Hedgerows and treelines are present on the western and eastern boundaries of Manston Road, and provide opportunities for foraging, connecting suitable habitat, despite built-up patches that are artificially lit.	B8 had a possible *Myotis* sp. dropping present and has been confirmed as a hibernation site. As a worst-case scenario this building may support small numbers of day roosting and hibernating *Myotis* sp.	No *Myotis* passes were recorded. It is anticipated that very low levels of activity would occur along boundary features and in darker areas of the Site. .

+*Preliminary interpretation of likely roosting status: based on SHP hibernation survey work at B33 and the 2017 internal inspections of B8, 16, 17, 33, 41 and 54. No emergence or pre-dawn surveys have yet been undertaken, hence professional judgement has been used to make an assessment of the potential significance of roosts if present.*

Mitigation requirement

Licensing: derogation requirement

There is the potential for individual/small numbers of bats to be killed, injured or disturbed during site clearance prior to development with bats having the potential to occur in buildings or trees that will be demolished/refurbished or pruned/felled in the absence of mitigation.

All British bat species are protected by both UK[15] and European[16] legislation. This means that a licence is needed in order to carry out any otherwise illegal activities. A licence for the Proposed Development at Manston would only be granted if the three tests specified in the Habitats Directive are met. These are:

- There is 'no satisfactory alternative';
- The development is 'not detrimental to the maintenance of the species concerned at a favourable conservation status in their natural range'; and
- It is 'in the interests of public health and public safety, or other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment'.

In light of these legal considerations, mitigation and compensation measures will be provided. Bat roost compensation will be provided within this BA and additional on-site measures will also be provided, in order to maintain the favourable conservation status of the sites' bat populations.

As part of the DCO, a European Protected Species (EPS) Mitigation Licence would need to be obtained from NE prior to demolition or modification of all buildings or modification or felling of trees identified as bat roosts.

[15] British bats are listed in Schedule 5 of the *WCA 1981* (as amended).
[16] British bat species receive further protection under Regulation 41 of the *Conservation of Habitats and Species Regulations 2017*.

These will also include further buildings or trees identified as roosts during further roost characterisation surveys to be undertaken in 2018.

As part of the draft licence application, a Method Statement (MS) will be produced detailing measures, which will ensure as far as possible that no bats are harmed during modification, refurbishment or demolition of buildings, as well as setting out detailed requirements for the provision of replacement/compensation roost sites. Such mitigation and compensation will include the careful removal of potential roost features by hand under the supervision of a suitably licensed bat ecologist, phased building removal and timing of work to avoid sensitive periods in the bat life cycle such as breeding and hibernation (typically May – August and November – February respectively). Should a tree roost be identified, an EPS licence will be required and mitigation/compensation measures would be detailed as part of the draft application for the licence.

With the embedded measures incorporated into the Proposed Development, there will be no contravention of the legislation protecting bats and provision of roosting opportunities across the site will be an enhancement on what is currently available for bats. As such, mitigation (on-site) and compensation (off-site) measures will aim to ensure no significant effects as a result of roost destruction/disturbance. In addition to the roost provision, the habitats created within the BA will provide an enhanced foraging habitat for bats (section **7.11.20 through to 7.11.50, ES Chapter 7**).

Roost compensation and habitat creation

The bat mitigation and compensation strategy proposed for Manston Airport includes a suite of appropriate mitigation (on-site) and compensatory (off-site) bat habitat including roost creation and enhancement (see **Figure 2.1**).

Primary roost, foraging and commuting habitat compensation will be focused on off-site provision within the BA (**Figure 2.1**). Compensatory roosts will include:

- A bat barn (maternity, hibernation, transitional and feeding roost provision for a variety of key species);
- A bat bunker (hibernation roost provision);
- Six bat boxes with maternity and hibernation; and
- 20 bat boxes suitable for transitional/day roosts.

Off-site foraging and commuting habitat creation is also to be provided within the BA.

On-site roost provision is to include a total of 14 bat boxes for maternity, hibernation and transitional roost provision. Further details on mitigation and habitat provision is provided in the next section (also see **Figure 3.2).**

Habitat creation

At this stage, mitigation, compensation and habitat provision has been designed based on the worse-case assessment in the ES. Hence the measures are subject to possible refinement following the completion of roost characterisation and habitat surveys on site to reflect the confirmed conservation significance of the bat assemblage present on site.

On-site measures

Roost compensation

A total of 14 bat boxes are to be placed within the northern section of the site shown in **Figure 3.2**. These are to include four Schwegler Bat Colony Box 3FS, four Schwegler 1FS Large Bat Colony Boxes and six Schwegler 1FW Hibernation boxes suitable for hibernation, maternity and use as a transitional roost. These boxes will be selected to cater for all 11 species of bat which could potentially be present, with the exception of Serotine. This species is generally associated with roosting within building gables and cavity walls and so provision for serotine has been made off-site within the bat house. Schwegler Bat Colony Box 3FS and

Schwegler 1FS Large Bat Colony Boxes will be placed on a variety of aspects, with at least four boxes placed on southern facing aspects in order to create a suitable micro-climate for maternity purposes. The Schwegler 1FW Hibernation boxes will be placed on northern aspects to ensure a cool and stable micro-climate suitable for hibernating bats. **Table 3.4** details roost creation for target species within the Proposed Development.

Table 3.4 On-site Mitigation Target Species and Roost Creation

On-site Mitigation	Maternity	Hibernation	Transitional/Day Roost
Four Bat Colony Box 3FS boxes	Common pipistrelle and soprano pipistrelle but may also be suitable for other crevice roosting species	-	Natterer's Whiskered, Daubenton's, Brandt's, Common pipistrelle, Soprano Pipistrelle and Nathusius Pipistrelle.
Four Schwegler 1FS Large Colony Bat Box	Common pipistrelle and soprano pipistrelle but may also be suitable for other crevice roosting species	-	Brown long-eared, Daubenton's, Noctule, Leisler and Nathusius Pipistrelle.
Six Schwegler 1FW Hibernation Box	Common pipistrelle and soprano pipistrelle but may also be suitable for other crevice roosting species	Brown long-eared, Common pipistrelle, Soprano Pipistrelle, Nathusius Pipistrelle, Noctule, Leisler's, Daubenton's, Natterer's, Whiskered and Brandt's.	Brown long-eared, Common pipistrelle, Soprano Pipistrelle, Nathusius Pipistrelle, Noctule, Leisler's, Daubenton's, Natterer's, Whiskered and Brandt's.

Maternity roost provision for brown long-eared bats would be compensated for off-site within the bat barn. Compensation for individual or small numbers of serotine would also be provided off-site within the bat barn. Bat boxes are to be placed at a minimum of 3m on suitable trees or on mounted poles within the landscaped area (**Figure 3.2**).

Flight corridors and foraging habitat

The lighting strategy will be designed to ensure low light levels in the immediate vicinity of the bat box locations (see **Figure 3.2**). The northern section of the site will be designed to be a bat corridor and as such the following key principles to reduce the lighting will need to be considered:

- The minimum amount of light needed for safety should be used, following published standards for lighting tasked to minimise upward reflected light. Wherever possible, artificial lighting should be avoided completely.
- The use of bare bulbs and upward-pointing light should be avoided, to keep the spread of light near to or below the horizontal.
- Light sources with a narrow spectrum of wavelengths should be used, to reduce the range of species (both bats and other nocturnal fauna) affected by lighting.
- Light-spill should be minimised with the use of hoods, cowls, louvers and shields to direct the light where possible.
- For pedestrian lighting, low level lighting that is as directional as possible should be used, to achieve light levels below 3 lux at ground level.
- The times that lights are on should be restricted, for example through the use of motion-activated lighting, to provide some dark periods for bats and other wildlife.

Off-site measures

Roost compensation summary

A bat barn is to be located in the south-west of the BA, with a bat bunker located along the western boundary adjacent to the established broadleaved woodland. It is proposed that bat boxes are to be installed on trees (subject to landowner permission) or on poles immediately adjacent to the established broadleaved woodland to the west of the site. **Figure 2.1** shows the approximate locations of the off-site compensation roost provision and **Table 3.5** summarises the target species for off-site compensation roost provision (note the locations may vary slightly subject to ground conditions).

Table 3.5 Summary of target species for off-site compensation roost provision*

Species	Maternity	Hibernation	Transitional/Day Roost
Brown long-eared bat	Bat barn	Bat barn Bat bunker Schwegler Bat Hibernation Box 1	Bat barn Bat bunker Schwegler Bat Hibernation Box 1 FW Wooden bat boxes
Common pipistrelle	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes
Soprano pipistrelle	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes
Nathusius' pipistrelle	Bat barn Schwegler Bat Box 2FN	Bat barn Bat bunker Schwegler Bat Hibernation Box 1 FW	Bat barn Schwegler Bat Hibernation Box 1 FW Wooden bat boxes
Noctule	Schwegler Bat Box 2FN	Schwegler Bat Hibernation Box 1FW	Schwegler Bat Hibernation Box 1FW – suitable as a summer roost Wooden bat boxes
Leisler's bat	Schwegler Bat Box 2FN	Schwegler Bat Hibernation Box 1FW	Schwegler Bat Hibernation Box 1FW – suitable as a summer roost Wooden bat boxes
Serotine	Bat barn	Bat barn	Bat barn
Daubenton's bat	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes
Natterer's bat	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes
Whiskered bat	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes
Brandt's bat	Bat barn	Bat barn Bat bunker	Bat barn Bat bunker Wooden bat boxes

*Off-site roost provision has been provided to target the following species and to provide a range of roosting sites all year round. However, target species have the potential to use any of the mitigation roosts provided at any time of the year.

Bat barn

The bat barn is intended to mitigate for the loss of roosting habitat for common, soprano, Nathusius, brown long-eared and *Myotis* sp. and serotine, for use as a maternity and hibernation roost. The bat barn would have the potential to be used by bats all year round and would provide opportunities as a transitional roost and night feeding roost. The bat barn would also include 4 Schwegler 1WI on different external aspects (south-facing: maternity roosting and north-west facing: hibernation) set within the cavity walls (3m of higher) which provides all year-round safe roost potential for serotine in particular.

Minimum recommended dimensions:

- Volume 250m3;
- Roof void height a minimum of 2.5m (to allow for a variety of void roosting species).

Shape and orientation

An L-shaped floor plan is recommended as this offers a number of aspects, creating a range of microclimates inside the building. The short arm of the 'L' should be south-facing.

The short arm of the 'L' will have potential to be used for maternity roosting and so the roof void should not be over shaded by trees.

Wall construction

Walls should be constructed from stone or brick. A double skin should be used, with cavity wall insulation, leaving a 10-15cm gap at the top of the walls as bat roosting crevices. Small gaps in the pointing should be left open near to the eaves to allow crevice roosting species additional access to the wall cavity. Fibrous or sticky insulation materials which could entrap and entangle bats should not be used.

Gable ends

A permanently open aperture "letterbox sized" would be placed on one of the gable ends ideally away from the maternity roost end to prevent drafts. This would be provided for species such as brown long-eared and Natterer's.

Roof construction

The roof should be steep (optimum angle 42°) and double-pitched, with gables overhanging the walls by at least 10cm all round[14]. In addition, the roof should be covered with black slates or tiles (for maximum heat absorption) e.g. charcoal grey plain concrete roof tiles. The type of timber frame used should aim to minimise the number of support trusses which clutter the flying space within the roof void. A traditional cut and pitch construction with joists and rafters, including a deep central ridge board, is ideal, providing angles within which bats will roost.

Ridge tiles should contain sections unfilled with mortar to provide roosting crevices, with occasional ventilated ridges tiles to allow access into these and into the roof void. Occasional tiles in roof to allow bat access e.g. raised tiles at edges with mastics.

A wooden soffit box should be fitted around the whole edge of the roof (side walls and gables), with occasional gaps (e.g. 1.5cm deep x 10cm wide) between the wall and lower edge of soffit to permit bat access to the wall cavity and roof void.

The roof should be lined internally with loose-fitting traditional bitumastic felt which allows bats to hang from, in addition allowing space for bats to roost between tiles and felt, and tears created in the felt for bat access. Breathable membrane should not be used. Within the roof void, 1m lengths of rafter should be added alongside the roof timbers spaced 20-25mm away with a further piece used to bridge the two, creating a long-enclosed cavity. Additional rough sawn timbers fixed longitudinally within the roof void at various heights on the rafters will provide opportunities for grooming and social interaction.

Internal partitioning

A double wooden floor should be installed, with insulation between the two layers, dividing the house into a ground floor and an upper floor open to the roof ridge.

The ground floor should be further subdivided into smaller rooms, including a room within the north-facing area: the wall insulation material in this area should be continued to the tops of the walls, to create a very well insulated cool room. Within the cool room there will be a 2m minimum height of the artificial hibernaculum buried at least 1m deep underground with a 1m foundation.

Flooring

It is important that a high humidity is maintained in the lower floor, and especially the cool room, during winter, when bats are hibernating. Bare earth floors should be adequate for this, depending on local conditions; otherwise measures may be needed to introduce water into the ground floor, for example by having rainwater drainpipes routed into the building. Any areas of open water should be covered with mesh to prevent bats from drowning.

External access and security

A high-security access doorway to the ground floor should be built as the main human entrance to the bat barn. The upper part of the door should comprise an opening at least 500mm x 500mm (or an equivalent area, not less than 300mm high). The opening should be covered by a grille with horizontal bars spaced 130mm apart. Vertical supports should be spaced further apart than the horizontals bars, though not enough to allow the horizontal bars to be bent easily: a spacing of 750mm would be adequate. The door should be as close as possible to trees or hedges nearby without these actually obstructing the entrance. The ground floor access doorway will lead to a room in the centre of the ground floor. The doorway will not lead directly into the cool room.

A second, smaller (e.g. 500mm wide x 300mm deep) grilled entrance to the roost should be provided on a different aspect to the main entrance in order to provide bats with a choice of entry points and will include a mammal prevention panel below. This would need to be fitted with a similar baffle system, opening into one of the ground floor rooms (other than the cold room).

Wide, steeply sloping metal sills should be fitted to the bottom of both grilled bat entrances, to deter entry by predators such as cats.

Internal access points

Doorways with solid doors (for human access), fitted with locks and kept closed except during inspections, will lead from the initial entrance room into the other ground floor rooms, with a narrower open doorway from one of the ground floor rooms into the cool room.

Open hatches measuring 500mm x 500mm should be provided between the roof void and each of the ground floor rooms apart from the cool room.

A baffle should be installed above the grilled hatch leading from the room with the ground floor doorway to the roof void to reduce the amount of light entering the roof void from the main entrance door and deter access by pigeons and predators such as jackdaws. This can be achieved by constructing a wooden box in the roof void over the hatch with a short tunnel on one side opening into the roof void. A flight space of no less than 500mm x 500mm should be maintained throughout the tunnel.

Fixed ladder access into the roof void will need to be provided via one of the ceiling hatches, to enable roost monitoring.

Additional roost spaces

A number of crevices for bats will be provided within the rooms on the upper and ground floor including the cool room and hibernaculum. This can be achieved by installing a mixture of bat bricks on the ceilings and 0.5m^2 wooden panels attached to the walls by a 1cm baton at the top and a 2cm baton at the bottom, which provides a large flat crevice area. These panels should be placed low enough to permit inspection, i.e. with

the bases not above head height. Further roosting opportunities should be created by using 0.5-1m wide lengths of roofing felt, folded loosely and attached by the top edge to the wall, creating several loose layers with gaps in between, opening at the bottom. Additionally, 20 Kent wooden bat boxes (or similar) will be provided on the walls in the rooms, approximately 10 placed throughout the ground floor rooms and hibernaculum and a further 10 placed within the upper floor rooms, to create a variety of roosting features throughout.

Additional perches should be provided in the ground floor rooms in the form of rough-sawn timber batons attached to the ceilings throughout. These could be utilised as feeding perches and for grooming and socialisation.

Bat bunker

A purpose-built bat bunker will be constructed within the BA to compensate for the loss of five (potential) hibernation roosts on site comprising a low number of bat species; brown long-eared, *Myotis* sp., common pipistrelle or soprano pipistrelle species. The bunker will provide crevices for bats to hibernate.

The bunker will be constructed of materials similar to that of the bunkers to be lost on site. Wall construction will ensure a cavity is present and insulation should be continued to the tops of the walls throughout, to create a very well insulated bunker. In addition, the concrete block roof should be fully insulated. The bunker will be a 2m minimum height with the bunker dug into the ground to at least 1m or alternatively back filling around the wall to over 1m in height. There porch area will be over 1m x 2m which will have a divide leading into two subsequent chambers each being over 3m x 3m in size which will provide roosting opportunities throughout and will create a stable internal microclimate, primarily suitable for hibernation purposes although may be used by small numbers of bats on an occasional basis for transitional or day roosting purposes.

It is important that a high humidity is maintained during winter, when bats are hibernating. Bare earth floors would be provided for this and if required water introduced into the ground floor (with any areas of open water being covered with mesh to prevent bats from drowning).

Additional roosting spaces

Crevices will be provided for bats, this will include: bat bricks on the ceilings, and 0.5m^2 wooden panels attached to the walls by a 1cm baton at the top and a 2cm baton at the bottom, which provides a large flat crevice area. These panels should be placed low enough to permit inspection, i.e. with the bases not above head height. Further roosting opportunities should be created by using 0.5-1m wide lengths of roofing felt, folded loosely and attached by the top edge to the wall, creating several loose layers with gaps in between, opening at the bottom. In addition, 5 Kent wooden bat boxes and 3 Schwegler 1FW bat hibernation boxes will be distributed throughout the rooms.

Additional perches should be provided in the form of rough-sawn timber batons attached to the ceilings throughout. These could be used as feeding perches, or for grooming and socialisation.

External access and security

External access by humans for maintenance and inspection will be gained via a high-security access doorway to the bat bunker. The upper part of the door should comprise an opening at least 500mm x 500mm (or an equivalent area, not less than 300mm high). The opening should be covered by a grille with horizontal bars spaced 130mm apart. Vertical supports should be spaced further apart than the horizontals bars, though not enough to allow the horizontal bars to be bent easily: a spacing of 750mm would be adequate. Wide, steeply sloping metal sills should be fitted to the bottom of the grilled bat entrances, to deter entry by predators such as cats. The door should be as close as possible to trees or hedges nearby without these actually obstructing the entrance with the door opening into a porch area. An insulated separation wall extending part way across is to be provided so that no light enters from the doorway.

Active and hibernation period – bat boxes

Bat boxes are to be provided along the established broadleaved woodland to the west of the BA on established trees (subject to landowner permission) or on posts close to the tree lines. Hanging height of 3m

– 5m with a clear entrance to the box to encourage uptake. There will be three maternity bat boxes (Schwegler Bat Box 2FN) located at the southern end of the woodland area (on south facing aspects) and three boxes for hibernation (Schwegler Bat Hibernation Box 1FW) on the northern end of the woodland on northern aspect to provide a cooler more stable climate for hibernation. An additional 20 bat boxes suitable for transition/day roosts i.e. timber bat boxes (e.g. Kent bat box) will be provided. Boxes will be placed at a height of over 3m.

Flight corridors and foraging areas

Figure 2.1 shows the BA, which is approximately 35.7ha in extent. This will include both newly planted hedgerows and existing hedgerows to be enhanced by gap filling. This will form a species-rich hedgerow which will grow to provide commuting routes for bats along with foraging opportunities. Feathered whips (at least 150cm in height) should be planted to ensure commuting routes are in place immediately and reduce the need for newly planted hedgerows to grow in.

The broadleaved woodland to the west of the site will be enhanced and increased in area. Reptile and invertebrate habitat will extend ~5m from the hedgerow boundary surrounding the site which will provide additional invertebrates for foraging and commuting bats. Fruit bearing trees will be planted around the bat barn, these attract insects important for foraging bats but also will not shade out important southern faces aspects of the bat barn.

Two ditches will extend along the southern part of the western boundary to increase invertebrates adjacent to the bat barn, bat bunker and bat boxes.

Much of the BA will include species-rich grassland (**Figure 2.1**) which increases invertebrate abundance and will in turn provide an additional foraging resource for bats.

Monitoring

Licensed bat surveyors will monitor the effectiveness of roost mitigation and compensation and provide maintenance as required. A detailed monitoring programme will be provided within the Method Statement of the EPS licence and would be subject to approval from NE. This will enable an assessment of whether the bat populations have responded favourably to the proposed mitigation, and identify the need for any minor amendments or additional measures to increase the success of this strategy. The monitoring programme will likely include, as a minimum:

- Annual check of on-site and off-site bat boxes between May and September for a minimum of five years;
- Monitoring of temperature and humidity within newly created bat barn in June and July for at least two years post creation so that desired maternity conditions could be corrected where necessary;
- Twice annual internal inspection/emergence surveys of the compensation bat barn in June and July for a minimum of five years post building roost demolition;
- Monitoring of temperature and humidity within newly created bat bunker and artificial hibernaculum in the bat barn from December to February for at least two years post creation, to allow any variation from the desired hibernacula conditions to be corrected;
- Twice annual inspection of bat bunker and artificial hibernaculum in the bat barn in January and February for a minimum of five years post bunker demolition; and
- Static detector deployment on an annual basis within the bat barn and bat bunker for a minimum of 5 nights in spring, summer, autumn and winter for a minimum of five years.

Monitoring of off-site foraging activity will consist of the following:

- Monitoring of general bat activity within the BA will consist of three transect surveys visits during optimal survey season for bat activity (May and August) in years 1 – 5;

- Each survey visits to include two surveyors undertaking walked transects using real time, full spectrum recording devices such as bat loggers (to incorporate post survey call analysis) for approximately 2-3 hours after sunset;
- Surveyors will be suitably experience or qualified;
- Three surveys to be undertaken in different seasons (spring, summer and autumn); and
- All survey work to follow best practice guidance (Collins, 2016).

Subject to health and safety requirements and access, the monitoring approach of foraging activity on-site would follow the same principles as off-site.

A short annual monitoring report will be submitted to NE, Kent and Medway Biological Records Centre and the Kent Bat Group. After completion of all the monitoring, the results will be documented and supplied to the aforementioned organisations. This report will be made publicly available so that lessons can be learnt for future bat mitigation schemes.

Management and security

A check of the external features of the bat barn, bat bunker and bat boxes will be made every 6 months for evidence of damage and undesirable activities such fly tipping, fire damage and vandalism. Where such is found appropriate action with be taken which may include removal of tipped material, repairing damage or replacement / re-hanging of bat boxes (which may require guidance from a suitably licensed or qualifies ecologist), and/or the tightening of security.

The bat barn, bat bunker and bat boxes will be checked by a suitably licensed or qualified ecologist in conjunction with the monitoring activities for the site. Where required appropriate maintenance operations will be undertaken to repair, maintain and replace as required.

The bat barn and bat bunker will be fitted with high security access doors modified to allow for bat access. Theses doors are to prevent vandalism and fire and to allow for monitoring.

3.2 Reptiles

Description of baseline

No reptiles were recorded during the 2017 presence/absence surveys (**Appendix 7.6, ES Chapter 7**). However, a single adult common lizard was recorded on 23 August 2017 basking along the western site boundary (adjacent to Minster Road) during the placement of artificial refugia (tins and felts) for the presence/absence surveys.

Considering the negative survey results, this single record would indicate, if this was not a transient animal, that, and in accordance with Froglife guidance[i], a low population of common lizard might be present along the southern most section of the western Site boundary.

Small areas (c. 4ha) of the Site were not included in the 2017 reptile presence/absence survey (as there was no access) with much of this 4ha comprising ‘brownfield’ land (the former car park) at the eastern end of the site, which supported poor semi-improved grassland with scrub and also contained some low piles of rubble/soil (see ES Figure 7.3). These unsurveyed areas are shown in Figure 2 in **Appendix 7.6 (ES Chapter 7)**.

The assessment (see **ES Chapter 7**, **section 7.12**) assumed that there is a low population of common lizard within the perimeter fence in the south-west of the Proposed Development site. Due to the good habitat suitability of the, as yet, unsurveyed areas the assumption has been made that under a worst-case scenario, high populations of common lizard and slow worm occur in these areas. The Desk Study (see **Appendix 7.2, ES Chapter 7**) revealed no records of adders, and grass snake is considered likely absent due to the negative results from the presence/absence survey and the lack of water bodies within the unsurveyed areas.

The predicted effects would be limited to disturbance, removal and loss of potential terrestrial habitat, and land take / land cover change (habitat removal) resulting in death or injury.

Implementation of the appropriate measures will ensure legal compliance and the conservation status of any reptile populations would not be affected and thus effects are expected to be not significant.

Due to the limited extent of construction activity and current management, in the south-west of the site, effects on the low population of common lizard will be mitigated by an appropriate Method Statement including habitat manipulation to ensure working areas are safely made unsuitable for any reptiles prior to any construction activity. Where high populations of common lizard and slow worm are encountered, animals will be translocated to the receptor site, the BA (Field 1362) to the south of the Site. An area of similar extent although of higher quality for reptiles, will be created at this location in advance of translocation. A trapping and translocation exercise will occur prior to any site work and once the receptor site is sufficiently mature to receive any reptiles.

Mitigation requirement

Although considered unlikely based on the observations described above, a worst case scenario predicts a high population of both common lizard and slow worm in those parts of the Proposed Development that could not be surveyed. These un-surveyed areas total approximately 4 hectares. Presence / absence surveys over the remainder of the Proposed Development (303.2 ha[17]) did not reveal reptiles. The mitigation requirement results from impacts due to the land take / cover change of the unsurveyed areas during the construction phase of the development.

The mitigation measures will involve the exclusion (through installation of reptile-proof fencing) and trapping of animals at the unsurveyed areas – the donor site. Trapped animals will be moved to the receptor site, a 4ha area located within the BA - land parcel or Field 1362. Habitat suitable for both species of reptiles will be created sufficiently in advance of the translocation in order that it is suitably mature for translocated animals to thrive i.e. find adequate food and shelter.

In overview the mitigation for reptiles involves four main elements:

- Creation of a high-quality reptile habitat receptor site in the BA (Field 1362);
- Installation of reptile-proof fencing around on-Site donor site;
- Trapping of animals with fenced off exclusion areas and relocation to the bespoke mature receptor site in the BA; and
- Monitoring reptile populations of receptor site.

The next section describes each of the elements of the mitigation.

Mitigation

Trapping and Translocation

Installation of reptile fencing

Temporary reptile-proof fencing[18] will be used to enclose the donor areas. The largest of these (the former car park) will be compartmentalised in order that, any compartment once 'trapped out' and considered free of reptiles can be cleared (and so made available for construction preparation).

Prior to installation the fence line will be predetermined and marked by an ecologist in order to avoid sensitive features e.g. reptile refuge/hibernation sites. Vegetation along the fence line will be cut if required in

[17] This 303.2 ha (749 acres) being the area of outright permanent acquisition. The total Site area that is the subject of the DCO and falling within the Red Line Boundary of the application includes the existing below ground pipeline between the Site and Pegwell Bay. This means that the total area including the pipeline and its access points would be 311.7 hectares (770.2 acres). See **ES Chapter 3** (sections **3.2.2** and **3.2.5**).
[18] For example, *Greenalyte* polythene fencing.

order that it does not provide suitable reptile habitat. Any cutting will be undertaken in a progressive two stage process, firstly to 100mm, and then after at least four hours to ground level.

Trapping

Following standard good practice[19], artificial refugia (felts and tins) will be placed within the exclusion area and used as a basis for capturing animals. These will be placed at the density required according to the standard guidance of 100 / ha of suitable habitat with a minimum trapping effort of 90 suitable days between late March and late September/early October. Suitable conditions for trapping include temperatures between 10ºC and 18ºC with little or no wind and without persistent rain. Artificial refugia will be placed in the exclusion areas and left to settle for at least one week before trapping commences. Captured animals will be transferred to a temporary 'vivaria' for transportation to the receptor site. Animals will be released onto the receptor site within 2 hours of being captured.

Trapping in each compartment will only cease following five suitable survey days when no reptiles are seen.

The trapping and translocation operations will be undertaken by suitably experienced and trained ecologists operating as an Ecological Clerk of Works (ECoW) under a Method Statement.

Habitat creation

The proposed high quality reptile habitat in the BA will provide the following key requirements for reptile sites:

- Warmth for basking;
- Structural complexity for refuge, and
- Habitat connectivity to facilitate wider dispersal.

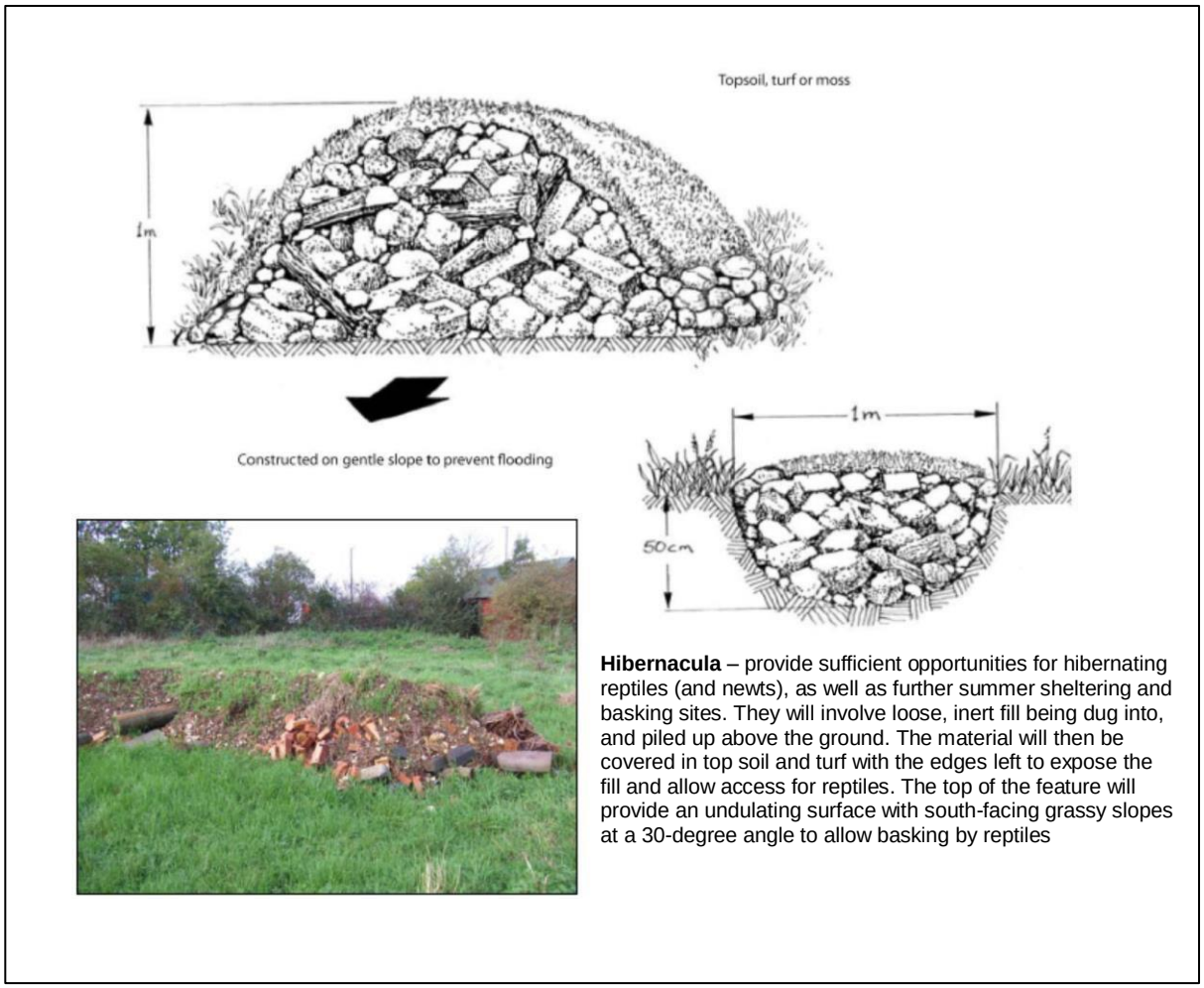
Warmth will be maximised by providing areas with high insolation (exposure to the sun), structural complexity will be provided by the planting regime and the provison of daytime refuges (log/brash piles) and purpose built hibernacula. Habitat conectivity will be ensured by having the bespoke reptile habitat in the receptor area directly adjacent and connected to suitable reptile habitat in the remainder of the BA.

Reptiles need to bask and open south facing areas which receive plenty of insolation provide this requirement, although variation in aspect (i.e. with some east and west facing areas) will maximise availbility of areas with high insolation throughout the day. Some low bunding/mounds (up to 1.5m above current ground levels) will be created throughout the receptor area. Similarly, some depressions will be created (but scraping the soil to form the bunding) that will create areas of higher humidity which are also beneficial to reptiles.

Planting will include establishment of native wildflowers and grasses as well as some shrub species. The planting will provide a foraging resource as well as cover/shelter, as will the daytime refuges and hibernacula. **Box 1** provides a hiberncaula design, although these can also be constructed from mounding building rubble taken from the Site.

The Habitat Management Plan (HMP) will set out how the habitats of the reptile receptor area will be managed to maintain suitable conditions for the target species.

[19] Herpetofauna Groups of Britain and Ireland (HGBI) (1998). *Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards.* HGBI advisory note for Amphibian and Reptile Groups (ARGs). - This is the most widely accepted guidance document on the requirements for reptile mitigation and translocation schemes.



Hibernacula – provide sufficient opportunities for hibernating reptiles (and newts), as well as further summer sheltering and basking sites. They will involve loose, inert fill being dug into, and piled up above the ground. The material will then be covered in top soil and turf with the edges left to expose the fill and allow access for reptiles. The top of the feature will provide an undulating surface with south-facing grassy slopes at a 30-degree angle to allow basking by reptiles

Box 1. Hibernaculum design[20]

Monitoring

Monitoring of the reptile population within the receptor site will occur every two years for six years beginning the year after translocation. The monitoring will comprise completion of population size class surveys[21].

The results of the monitoring will permit any adaptive management required to ensure continued effective delivery of suitable reptile habitat. Further monitoring will be implemented if significant intervention is required as a result of monitoring results. Monitoring objectives will be detailed in the HMP.

3.3 Breeding birds

Description of baseline

The Site provides suitable habitat for a variety of breeding birds. Hedgerows, scrub and trees are limited in extent although do provide opportunities, as do the buildings, for nesting passerines such as house sparrow, starling, song thrush and dunnock. All of these are Species of Principal Importance[22] (SPI) with all, except

[20] Source: English Nature. (2001) *Great crested newt mitigation guidelines*. Peterborough, English Nature.
[21] Froglife (1999). Reptile survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.
[22] SPI are listed under Section 41 of the Natural Environment and Communities Act (NERC) Act 2006 as species which are of principal importance for the conservation of biodiversity in England.

dunnock, also being red-listed Birds of Conservation Concern[23] (BoCC). The site grassland, the most extensive site habitat, provides nesting habitat for skylark, grey partridge and meadow pipit. All three species have been recorded on site (sections **7.13.1 -7.13.6, ES Chapter 7**).

Skylark

Skylark is an SPI, and is also BoCC red-listed due to a long-term decline in the UK breeding population, including a 29% decline in the South-East England Region from 1995-2015[24]. Skylark is described as a widespread and common but declining resident in Kent, and a common winter visitor and passage migrant[25]. The species principally breeds in arable farmland in the county, but is also found in a wide variety of other open habitats including grassland, saltmarshes and sand dunes. The decline is primarily due to the move from spring to autumn cereal sowing, which has led to a reduction in the food supply in winter and nesting opportunities in spring. The estimated breeding population in Kent has declined from 30,000-40,000 territories during 1988-94, to 20,000-28,000 during 2008-13[26].

Ungrazed grasslands and improved semi-natural grasslands hold some of the highest nesting densities of skylark of any habitat in lowland England[27]. In these habitats, the nesting densities of skylarks were found to range from 29 to 52 pairs per km^2 (100ha). With almost 200ha of ungrazed grassland, it is estimated, based upon these figures that the Site could support up to 104 pairs of breeding skylark. The long grass policy of the operational Site will maintain grass during the breeding season to a height of 200mm (CAP 772). This cutting height is sufficiently high to prevent skylark nest destruction. Although a risk of nest destruction will remain from machinery passage this is likely to affect very few nests due to the small amount of ground affected (i.e. just the line of the wheel tracks) and the mowing occurring infrequently over the main breeding period.

Grey Partridge

Grey partridge is an SPI and is BoCC red-listed due to severe, long-term decline in the UK breeding population, including a 79% decline from 1995-2015 in the South-East England Region, which includes Kent (Harris *et al*., 2017). The species principally breeds in arable farmland in Kent, but is also found in open grassland, marshes, sand dunes and vegetated shingle[28]. Grey partridge is described as a once widespread resident in Kent that has declined considerably in recent years, and now occurring primarily in coastal areas, particularly in Thanet/ eastern coastal areas of the county (Privett [ed], 2016). The estimated breeding population in Kent has declined from 2,000-4,000 pairs during 1988-94, to 600-1,200 during 2008-13. There has also been a marked contraction in the distribution of the species in Kent, having been recorded in 551 tetrads (2 x 2km squares) in 1967-73, and only 165 in 2008-13 (Clements *et al*., 2015).

It is estimated[29] that densities of grey partridge in sub-optimal landscapes are two or four pairs per km^2 (100ha). In habitats where conditions are more ideal (e.g. the non-agricultural grassland of the Site) densities, even without species-specific management, could be expected to be four or eight pairs per km^2. Higher densities can be found when species-specific management techniques are applied such as predator control or the provision of grassy margins, beetle banks and conservation headlands in arable crops. There are no species-specific measures operated on site for grey partridge although it is possible that some such habitat measures are adopted nearby off-site, with some land included within entry level agri-environment schemes especially to the north of the Proposed Development. Predators, such as foxes and badgers, may operate at much reduced levels in the main part of the site where the security fence reduces egress by such animals. It is possible therefore that the site might hold up to 20 pairs of grey partridge. However, it is also

[23] Eaton, M.A., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud D.& Gregory, R. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds, 108:708-746.
[24] Harris, S.J., Massimino, D., Gillings, S., Eaton, M.A., Noble, D.G., Balmer, D.E., Procter, D. & Pearce-Higgins, J.W. (2017). The Breeding Bird Survey 2016. BTO Research Report 700 British Trust for Ornithology, Thetford.
[25] Privett, K. [ed] (2016). Kent Bird Report 2014. Kent Ornithological Society.
[26] Clements, R., Orchard, M., McCanch, N. & Wood, S. (2015). Kent Breeding Bird Atlas 2008-13. Kent Ornithological Society.
[27] Browne, S., Vickery, J, & Chamberlain, D. (2000). Densities and population estimates of breeding Skylarks *Alauda arvensis* in Britain in 1997, Bird Study, 47:1, 52-65: http://dx.doi.org/10.1080/00063650009461160 [Accessed 21/03/18].
[28] Taylor, D.W., Davenport, D.L. & Flegg, J.J.M. (1984). The Birds of Kent. Kent Ornithological Society.
[29] Game Conservancy Trust. 2007. Grey Partridge News. Issue 7. Summer 2007. GCT, Fordingbridge.

possible that grey partridge is principally breeding off-Site as its favoured nest locations are bank sides, which are absent from the Site. Nonetheless, as grey partridge chicks are precocial[30], families from off-Site nests may move to the Site grassland habitats for foraging, which are likely to be richer in chick invertebrate food than the surrounding conventional farmland. The informal recreational use (particularly by dog-walkers) of the Northern Grass Area is also likely to prevent or reduce numbers of breeding grey partridge. Given these restrictions to breeding habitat it is likely that the maximum nesting population of grey partridge is in the region of 3-5 pairs.

Barn owl

Barn owl, a Schedule 1 species under the *Wildlife and Countryside Act 1981 (as amended)*, has been recorded on the site. Survey undertaken for Stone Hill Park[31] (SHP) found evidence of roosting in a single building in June 2015. SHP suspected barn owl(s) roosted although did not nest within the Site. During building inspections undertaken in autumn 2017 (**ES Appendix 7.6, ES Chapter 7**) for the Proposed Development, evidence of barn owls (in the form of pellets) were found in three buildings but nesting was not suspected as, although two of the buildings with pellets contained features that could be used for nesting, no evidence of nesting attempts was found.

The on-site buildings provide potential nest sites as well roosting opportunities for barn owl and the grassland provides sub-optimal foraging habitat as no or limited thatch has developed due to the previous airport grassland management. This management aims to prevent a thatch (e.g. a dead grass layer at ground level) from building up as this encourages birds of prey and increases the bird-strike risk (sections **7.14.1 -2**, **ES Chapter 7**).

Mitigation requirement

The mitigation requirement results from the disturbance and loss of nesting/foraging grassland habitat for grey partridge and skylark, both of which are SPI and red-listed BoCC (see **sections 7.13.8 to 7.13.14** and **7.14.4 -7, ES Chapter 7**).

As a result of construction there will be a c.20ha reduction in the extent of grassland. Most grassland in the vicinity of the runway will be maintained with loss of grassland predominantly from north of Manston Road. The regular and frequent informal public access/dog walking to the existing grassland area (extending to about 40ha) north of the B2050 (Manston Road), along with the continued mowing regime, reduce the quality of this area to breeding ground nesting species such as skylark and grey partridge. The grassland surrounding the existing runway with no public recreational activity provides better quality nesting habitat for ground nesting birds, and much of this area will remain on the operational site, albeit subject to disturbance from construction/runway upgrade activity and some new aircraft pavement.

Construction and operational phase activity at the site would make it unsuitable for nesting or roosting barn, which, due to safeguarding (birdstrike risk), also cannot be encouraged at the operational Site.

Habitat creation

To ensure that the conservation status of SPI/red-listed BoCC is maintained, appropriate habitat will be created within the BA prior to commencement of construction.

Skylark

The newly created grassland habitat within the BA will provide skylark with nesting and enhanced foraging habitat. The species-rich grassland will not have any inputs which will result in a natural sward and provide a greater abundance of invertebrates as a foraging resource. To avoid any damage to nests and their contents there will be no cutting (or grazing) between early April and early/mid-June[32].

[30] Hatched with eyes open, covered with down, and leave the nest within two days.
[31] The Stone Hill Park planning application ((OL/TH/0550) covered predominantly the same area as the current DCO application.
[32] https://ww2.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/helping-species/skylark/

Subsequent management will ensure that cutting prevents or minimises any loss of late nests, maintain nesting habitat and provide foraging and cover for young birds and adults.

Grey partridge

The grassland will provide nesting and foraging habitat for grey partridge. A number of proposed features will be of particular benefit to the species. The new (low) hedgerow planted on a wide low bank, as well as providing habitat for other farmland bird species, will provide a wind break and cover for grey partridge. A hedgerow on a bank with adjacent ground cover enables partridges to find well-drained and sheltered nest sites.

A 3m wide strip of land immediately adjacent to the hedgerow will be managed specifically to provide grey partridge nesting cover. The ground cover will be a mixture of perennial herbs and tall tussock-forming grasses, such as cock's-foot. Sections will be cut annually in rotation to prevent scrub invasion and maintain the grassy / perennial sward. The areas that are uncut provide old grass / plant stems and dead leaves from the previous year which partridges use for nest construction.

The species-rich grassland habitat to be created will form the main habitat within the BA. This will mimic the grassland to be lost at the Airport although with no inputs and management (e.g. height and timing of cutting (or grazing) targeted at conserving ground nesting birds and invertebrates will provide improved foraging habitat for grey partridge and skylark, both of which rely on invertebrate food for chick rearing during the breeding season.

Grey partridge will also benefit from the areas of bare substrate within the reptile and invertebrate habitat area. Unvegetated areas provide useful features for partridge chicks, particularly when they are small and downy, as they can get wet moving through vegetation and subsequent chilling can result in mortality. Bare areas allow chicks to dry out more quickly and prevent chilling.

The management required to maintain the character of the grassland will be provided in the BA Habitat Management Plan.

Barn owl

Any nest site confirmed on Site will be removed outside the breeding season prior to construction and a new alternative nest site would be installed at a sufficient distance away to prevent use of the Site. Such a locality will be near to a sufficient area of appropriate grassland for foraging (e.g. Minster Marshes/Ash Levels) and at least 1km distant from any dual carriageway or other similar roads.

Monitoring

The number of pairs of breeding birds in the BA will be monitored for at least five years from the first breeding season post-habitat creation. This will enable adaptive management of any of the measures in place to enhance the nesting suitability of the compensation site. Any changes to the type of measures implemented will generate further monitoring. Monitoring objectives will be detailed in the HMP.

3.4 Invertebrate assemblage

Description of baseline

On a walkover of the Proposed Development on 22 August 2017 a total of 169 invertebrate species were recorded, of which nineteen have a formal (red data book or nationally scarce) conservation status and two are new to Britain. Further detail is provided in the Manston Airport Invertebrate Scoping Survey report (see **Appendix 7.7 and sections 7.16.1 to 7.16.10, ES Chapter 7**).

The sample of invertebrates taken is sufficient to demonstrate that the invertebrate interest is not negligible. The fact that species with formal conservation status comprise more than 10% of the recorded fauna suggests high species quality, but in practice a large proportion of these species are in groups which have not been recently reviewed and the formal status of some is open to doubt. Kent is, anyway, rather rich in

species with formal conservation status simply because of its geographical location, and relatively ordinary places can support multiple nationally scarce species.

None of the species with formal status is particularly unexpected for the area or the habitats although collectively informative. They are all associated with open habitats, and some are characteristic of very open and sunny habitats, with many familiar components of rich assemblages on open calcareous habitats elsewhere in the south-east. Considering the limitations of the walkover survey the number of scarce aculeates[33] with restricted distribution is impressive and suggests that this group might prove of substantial interest. Furthermore, the populations of some of the scarcer species appeared to be large.

The two-species new to Britain are both leafhoppers of the genus Tettigometra. Both are assumed to be recent colonists, and to have limited conservation significance.

The scoping survey concluded that the site has high potential for invertebrates of open habitats. Factors favouring high interest are:

- Large area;
- Favourable geographical location;
- Long history of open conditions;
- High floristic diversity;
- Large populations of some important invertebrate foodplants; and
- Varied structure, including bare and sparsely vegetated ground, managed grassland, and some unmanaged or lightly managed tall herbs.

The managed grassland which comprises most of the habitat on the site is, however, compromised in its potential to support a particularly diverse assemblage by its uniform structure; limited topographical variation; limited area of bare ground; and its semi-improved character. A small proportion (some 4 ha) of this open grassland has not received modification through pesticide/fertiliser applications and provides a higher potential for invertebrate interest.

Though substantial invertebrate interest may be present, the expectation is that this will not prove exceptional, and some species, especially solitary bees and wasps, may be in part dependent on peripheral features and habitats, especially for nesting sites. Diversity and interest are considered likely to be higher in other open habitats than in the mown grassland. Higher interest overall in these areas is favoured by:

- Varied structure, including bare and sparsely vegetated ground, unmanaged tall herbs, and complex mosaics;
- Varied substrates;
- Locally varied topography; and
- Varied floristic composition, including good populations of a number of important foodplants not present, or rare, in the grassland.

Mitigation requirement

Much of the existing grassland within the Proposed Development is uniform and of unexceptional value to invertebrates and this is likely to remain as future management will be similar to current practise. Key interest is assumed to be in the open more diverse areas such as the former car park (brownfield) areas to the east of the Site. The loss of these onsite will be mitigated off-Site through the creation of open mosaic habitat in conjunction with the reptile habitat area in the BA. In addition, the other habitat creation in the BA, particularly the open grassland will be beneficial to a large range of invertebrate species (sections **7.16.12 – 14, ES Chapter 7**).

[33] A group of hymenoptera that possess a sting – the bees, wasps and ants.

Habitat creation

Onsite suitable habitat will be created in landscaped areas using recycled aggregates such as screened topsoil, crushed concrete (75mm is ideal) and broken bricks (with material coming from the Site). Sand and chalk areas will be created to encourage a more diverse flora and habitat mosaic. Suitable and appropriate planning can make these valuable invertebrate areas aesthetically attractive and compliant with CAP 772 measures for reducing bird-strike hazard.

Off-Site, the brownfield areas on-Site will be replaced with similar areas although of higher value for 'brownfield' invertebrates. The higher value will be provided by the creation of open mosaic habitat (within the BA reptile habitat area) as open mosaic features are also valuable for reptiles.

The creation of an open mosaic valuable to 'brownfield' invertebrates will include:

- Sparsely vegetated mounds with predominantly south-facing (dry/warm) aspects,
- Bare (sandy) ground,
- Small shallow scrapes to provide ephemeral pools (e.g. less than $5m^2$ and not large enough to attract water birds); and
- Unvegetated mounds of spoil/rubble/sand.

The management required to maintain the character of the open mosaic habitats will be provided in the BA Habitat Management Plan.

Monitoring

Monitoring of the invertebrate habitat every three years for the first nine years will occur to monitor effectiveness of incorporated measures and enable adaptive management. Monitoring objectives will be detailed in the HMP.

3.5 Badger

Description of baseline

The most recent desk study record for badger was from 2006. This was also the closest record albeit 3.5km from the Site. Walkover surveys of the site in 2017 did not reveal any evidence of badger (sections **7.15.1 to 7.15.4, ES Chapter 7**). However, an extended Phase 1 habitat survey of land parcel 1362 (the BA) in October 2017 did reveal a potential badger sett outside, but within 30m of, the boundary (see **Appendix 7.10, ES Chapter 7**). Badger signs within land parcel 1362 comprised a mammal run/path and a badger latrine. Currently the BA is an intensively farmed arable field i.e. it is cultivated with conventional inputs (fertilisers and pesticides).

Badgers are common and widespread in Kent and England, and it is considered that the low level of badger activity recorded on and adjacent the site (one potential sett recorded, confidential location) is likely slightly atypical of the area. This may be due to the perimeter security fence around much of the site and the surrounding busy roads, which would likely deter/prevent badgers from accessing the site. In addition, the generally flat, level terrain with little cover does not present optimal sett building habitat.

The worst-case scenario considered here is that the potential sett adjacent to land parcel 1362 is an active main sett and as such, due to the widespread nature of the species no adverse effects on the conservation status of badgers is predicted. Badgers are protected due to welfare issues only and therefore predicted effects and mitigation are to ensure no contravention of the appropriate legislation.

Mitigation requirement

The mitigation requirement is to prevent disturbance to the potential main sett (outside of although adjacent the BA). Mitigation is to be accomplished by ensuring that activities associated with the habitat creation will be of sufficient distance not to disturb the sett. No machinery will be used within 30m of the sett that

generates greater noise or vibration than that used currently to undertake existing agricultural operations. The habitats created in the BA will provide an enhanced foraging environment for badger.

Habitat creation

The grassland along with the field margins will all provide badgers with enhanced foraging opportunity. The management of the BA will be less intensive and frequent than the current agricultural practices and will reduce noise and vibration levels to the sett in the land adjoining the BA.

Monitoring

No specific monitoring for badger is to be undertaken and due to the on-going agricultural operations, it is unlikely that badgers will build a sett within the crop field. However, as badgers are highly mobile creatures which will frequently excavate new setts, walk-over surveys will be completed prior to the start of any habitat creation works in the BA. In the event that a new sett is discovered within 30m of a works footprint, ground clearance and construction activities will stop in this location until an appropriate mitigation strategy is in place. See also **Section 4**. Working with Protected Species.

3.6 Summary

Mitigation habitats

Table 3.6 summarises the habitat requirements of the valued ecological receptors, the area of retained habitats within the Proposed Development and the extent of habitats to be created within the BA in respect of those species/species groups.

Table 3.6 Summary of the habitat requirements of the valued ecological receptors, the area of retained habitats within the Proposed Development and the extent of habitats to be created within the BA for those receptors.

Species/ species group	Habitat requirements	Habitat on Site	Habitat created or retained on site	BA Habitat creation
Bats	Bats require roosts, which can be cavities within built structures or trees, for hibernation, shelter and rearing young, and foraging habitat. Bats prefer to feed over habitats which are good for flying insects, such as flower-rich grassland, water bodies, trees and shrubs.	71 buildings on site with 33 with negligible potential for roosts. Six confirmed roosts; two buildings with high roosting potential, six with moderate and 24 with low. 196 ha suitable foraging habitat of low potential.	No or little roost potential retained. 172 ha of grassed/ landscape areas retained. A total of 14 new bat boxes for maternity, hibernation and transitional roosts to be provided on Site.	Roost provision includes: a bat barn (maternity, hibernation, transitional and feeding roost provision for a variety of key species); a bat bunker (hibernation roost provision); six bat boxes with maternity and hibernation; and 20 bat boxes suitable for transitional/ day roosts. 36 ha of foraging habitat.
Reptiles (slow worm and common lizard)	Reptiles require basking sites for exposure to the sun (insolation), shelter whilst active from the elements (heat, dry weather and wind), during winter (hibernation sites), and from predators, food, and breeding habitat. A varied topography (south-facing slopes are particularly favoured) and a mosaic of open, sunny areas and dense cover provide the best range of basking opportunities. Structurally diverse habitats, or mosaics of vegetation of differing heights, ages or types provide shelter from the elements and from predators, especially when species such as bramble or gorse are present. Such habitat also provides opportunities for breeding and food items. Hibernation usually takes place underground in holes/burrows made by other species, and a varied topography can be better for these, or in crevices in above ground structures, such as piles of rubble.	A maximum of 4 ha of vegetated brownfield areas	No brownfield areas will be retained.	35 ha (i.e. excludes woodland) including 4 ha of brownfield/ open mosaic bespoke reptile habitat.

Species/ species group	Habitat requirements	Habitat on Site	Habitat created or retained on site	BA Habitat creation
Skylark (breeding)	A ground nesting species requiring vegetation (either grassland or a cereal crop) between 20-50cm tall and not too dense[34].	190 ha of managed grassland including 33 ha in the Northern Grass.	137 ha of grassland (excluding the Northern Grass Area). Note that grassland is currently regularly mown and this will continue one the airport is operational.	30.6 ha of high quality nesting habitat to be created; 35 ha of which will be foraging habitat.
Grey partridge (breeding)	A ground nesting species preferring nest sites in grassy areas raised above surrounding ground level e.g. on banks adjacent a hedgerow.	190 ha of grassland including 33 ha in the Northern Grass	137 ha of grassland to be retained and managed as noted above.	30.6 ha of high quality nesting habitat to be created; 35 ha of which will be foraging habitat.
Barn owl (nesting)	Barn owls nest in cavities in trees and in buildings. Cavities with unimpeded access are often chosen, and are often near foraging areas, including grassland where infrequent management has allowed a ground level layer of thatch to develop, which attracts small mammals (voles) upon which barn owls mainly feed.	Three buildings with signs of historic roosting, two with nesting potential but no signs of recent nesting.	No roosting / nesting habitat on Site will be retained. 137 ha of grassland retained.	35 ha foraging habitat in the BA. Nest / roost box provision (at a ratio of 1:1) elsewhere due to constraints of busy roads adjacent the BA.
Badger	Setts are often built on sloping ground. Foraging habitats include grassland particularly (as earthworms are a main food item), and also woodland and scrub.	No setts have been found on the site although signs of badger activity were noted in earlier surveys. 33 ha (Northern Grass Area) of potential badger habitat exist and for the purposes of assessment have been assumed to be used.	2.8 ha of landscaped areas in the Northern Grass Area.	The 36 ha BA will be suitable for foraging and potentially sett building.
Invertebrates	A mosaic of habitats with varied topography areas of bare substrate, and different vegetation types including scrub and flower-rich grassland.	190 ha of regularly mown / managed grassland and 4 ha of mostly vegetated brownfield areas.	137 ha of grassland.	30.6 ha of grassland; 4ha of open mosaic habitat; 0.8 ha of woodland; 0.6 ha of ditch and 2,300 m of new hedgerow[35].

Note: measurements are indicative.

[34] Grasslands (e.g. silage) and crops, such as winter cereal, with agro-chemical inputs do not provide good nesting conditions as they are managed too intensively and the vegetation is too dense.
[35] The habitat creation in the BA also involves the planting of about 2,300m of hedgerow. The airport currently has about 600m of hedgerow, much of which will be removed. The airport has no woodland with the BA including the planting of 0.8 ha of native broad-leaved woodland, and 0.6 ha of ephemeral wetlands (ditches).

3.7 Tolerance of worst case assessment

This section describes the tolerance of the mitigation and habitat creation in the BA in relation to the worst-case assessment (ie. how much additional capacity the BA has, over and above that required to mitigate the worst-case scenario). In all cases it is not considered likely that the worst-case scenario would be exceeded. This is on the basis that the worst case already assumes optimal habitat where surveys have not been possible. Nonetheless, there is significant tolerance in the BA to absorb greater numbers of all species than those that have been predicted and as such the habitat creation measures to be provided are deemed sufficiently robust to cater for any scenario that could realistically occur.

Bats

If additional roosts were identified additional roost provision could be made. Additional boxes could be provided on the Proposed Development Site as well as on the BA with changes made to the specification of the bat barn and bunker to incorporate additional roosting opportunities. Alternatively, additional structures (barn or bunker or both) could, if necessary, be installed in the BA. The habitats of the BA and the way they are to be managed also provide for a higher quality foraging for bats than on the airport site.

Reptiles (slow worm/common lizard)

Exceedance of the worst case could result in the unlikely event that additional species (i.e. adder and/or grass snake) were found in the small areas remaining to be surveyed. On the basis that the main prey of grass snake is amphibians and fish it is unlikely, with no water present, that grass snakes would be present. However, the habitat creation in the BA already provides ample suitable habitat for grass snake with the ditches providing ephemeral water features that will provide amphibian habitat. The reed swamp, immediately adjacent to the BA, is also suitable for this species. Additional ditches or even ponds could be created to further improve suitability for grass snake. Further measures would be the placement of piles of cut grass (resulting from the grassland management) in appropriate locations which will provide nesting sites for this species.

Adders rarely occur at high density and only low numbers would be likely. The main prey of adders is small mammals and these occur in higher densities when there is a thatch layer in grassland. Manston airport has been specifically managed to prevent such a layer from developing, which, along with the lack of structural diversity and homogeneity of vegetation further decreases the suitability of the Site for this species. However, in the unlikely event that adders are observed the habitat creation planned for the BA already provides ideal conditions for this species, and no further measures would be required.

Breeding birds

Grey partridge and skylark

The tolerance of the BA to cater for greater numbers of grey partridge and skylark comes from the habitats to be created and the way they are to be managed. The grassland habitat created in the BA will provide optimal habitat for grey partridge and skylark whereas the existing habitat on the airport is highly compromised. As a result the BA will permit both species to nest at higher densities than on the airport. In addition, the BA will be managed in such a way that these species are encouraged to nest which will permit a higher level of breeding success (i.e. the number of chicks that manage to fledge), which is key to improving population size. The beneficial management will be the avoidance of mowing and other significant activities during the breeding period. This will allow skylarks to raise two to three broods each season, which will help to maintain populations. It will also prevent nest destruction, and permit better foraging for adults and grey partridge chicks. Land with no management for grey partridge can expect to hold 4.5 pairs per 100 ha (GCT, 2006[36]) although with management this can be considerably increased e.g. up to 80 pairs per 100 ha. This indicates that the BA, with it habitats created and managed specifically for grey partridge, could hold many more pairs

[36] The Game Conservancy Trust. 2006. Conserving the Grey Partridge, GCT, Fordingbridge. Note: The GCT is now called The Game and Wildlife Conservation Trust.

than predicted to be lost in the likely worst-case scenario due to the Proposed Development. Again, management is key as the better quality habitat is likely to result in each pair enjoying better nesting success with more young being recruited into the adult population.

Barn owl

Nest site compensation for this species is to be provided elsewhere as the BA is an inappropriate location being situated too close to busy roads. Close proximity of barn owl habitat to roads can lead to mortality due to the height at which barn owls fly. In the unlikely event that more than one barn owl pair is nesting within the airport, additional nest boxes can be provided at appropriate locations. Such locations would be at least 1 km from a dual carriageway and in an area with sufficient foraging habitat (grassland) for a pair of breeding barn owls. Nest box provision will be properly coordinated in partnership with the local representative of the Barn Owl Trust and with the Kentish Stour Countryside Partnership Project[37] and the Kent Wildlife Trust.

Invertebrates

The habitat creation scheme of the BA includes an inbuilt tolerance with the range of habitats all managed beneficially for invertebrates. It would also be straightforward to adapt the management of the BA for any particular species or species group (if subsequent survey reveals such at the airport) should that be necessary.

Badger

Sufficient data is available to determine that the assessment is already robust with a worst-case scenario considered. The BA will provide less disturbed and higher quality habitat for foraging than the airport site.

3.8 Bird-strike risk

The habitat creation in the BA is not expected to significantly increase the risk of bird strike such that it reaches an unacceptable level. Indeed, similar habitats co-exist adjacent to may airports in the UK. The habitat creation planned for birds will provide ideal nesting opportunities particularly for two species of ground nesting bird. One of these, grey partridge, is largely terrestrial, and is reluctant to fly unless flushed and then generally only does so for short distances at a height of no more than 2-3 metres above the ground. The other, skylark, is a small bird (c. 40 grams) that is not expected to occur in high numbers during the breeding season[38] and as such is highly unlikely to present a significant bird strike risk. In addition, the BA is located outside the airport flight paths. During the breeding season the grass will be maintained at sufficient height (similarly to the long grass policy operated on the airport[39]) to prevent attracting waders, wildfowl and other flock-forming species. Outside the breeding season the BA can be subject, similarly to other land adjacent the airport, to appropriate measures consistent with other biodiversity conservation objectives outlined in the habitat management plan to reduce bird-strike.

[37] https://www.kentishstour.org.uk/the-partnership/
[38] The CAA give skylark a damage percentage of 0.7 compared with 2.6% for a starling and 8.3% for lapwing (CAP 772).
[39] A key difference will be the timing of mowing with the main nesting period left undisturbed in the BA to prevent any destruction of nests/chicks.

4. Working with Protected Species

The construction and environmental management plan (CEMP) will include details of how to proceed if there is a likelihood of encountering protected species during the construction works. This will include the following general measures:

- Good practice guidance on working with or in close proximity to wildlife/sensitive habitats;
- Tool box talks; and
- Need for ecological watching briefs.

Task specific Method Statements will also be provided to inform the CEMP.

The HMP will include detail on the legal agreement that will provide for the management of the BA for the life time of the development.

4.1 Pre-demolition surveys for bats

As there is potential for individual/small numbers of bats to be killed, injured or disturbed and roosts disturbed a European Protected Species Mitigation Licence for bats will be required as detailed in the Licensing: derogation requirement of the mitigation section of 3.1.

The CEMP will include the details of buildings which will require pre-demolition checks for bats. These checks will be carried out by a suitably qualified and Natural England licensed ecologist.

4.2 Pre-construction surveys for badger

As badgers are highly mobile creatures which will frequently excavate new setts, walk-over surveys will be completed prior to the start of ground clearance and construction activities. The survey will seek to cover up to at least 50m from any works footprint i.e. it may need to go beyond the Order Limits. The requirement for these surveys, and general measures to protect badger (i.e. the use of ramps as a means of escape and closing trenches at night), will be detailed in the CEMP. These surveys will be targeted on those areas of the site which already support setts, have a history of badger activity/sett presence or have a high potential to support new badger activity and are within 50m of works which may cause disturbance to badgers. Currently these areas are:

- The northern boundary of the Northern Grass Area: there was no sett here in 2017 although the desk study indicated a potential sett in 2015; and
- Off the western boundary of the BA: a potential sett within 30m of the boundary of the BA and badger activity within the BA recorded in 2017.

In the event that a new sett is discovered within 30m of a works footprint, no ground clearance or construction activities will occur at the relevant locations until an appropriate mitigation strategy is in place.

4.3 Precautionary measures for reptiles

The worst-case assessment has assumed high populations of two species of reptile - common lizard and slow worm – within the areas that remain unsurveyed. Mitigation for reptiles in those areas is described in Section 2 and in this section measures are detailed for the remainder of the Site.

Reptile presence/absence surveys in 2017 did not reveal any reptiles, however, a single common lizard was observed on the western boundary of the Proposed Development during placement of the artificial covers for the surveys. This indicates a transitory animal or that small numbers of lizards may be present on Site.

As the site is extensive, and much of the Site grassland will remain, a habitat manipulation approach will be adopted to prevent any incidental injury/mortality to reptiles to ensure legal compliance. Appropriate techniques for clearing an area of reptiles have been developed, taking into account the available guidance on prevention of potential harm to reptiles and their populations[40 & 41]. This approach involves habitat manipulation and destructive searches.

The method involves inspection and assessment of an area or reptile habitat by a suitably experienced ecologist followed by habitat manipulation and, if required, targeted destructive searches (under a watching brief) of any areas which might provide refuge for reptiles i.e. tree or hedgerow roots, small patches of scrub, walls, loose concrete slabs or rubble piles. The manipulation is undertaken only while reptiles are active and encourages them to move in adjoining undisturbed areas. The CEMP will provide detail on any areas of the Site which do not represent reptile habitat and therefore which will not be subject to these measures.

4.4 Techniques for site clearance

Habitat manipulation

Vegetation (grass, ruderal[42] species and scrub) taller than 10cm will be gradually trimmed down to a height that is undesirable for occupation by reptile species (<10cm) but also wildlife in general. This will be undertaken using hand tools and will be done in two stages/cuts, undertaken approximately 4 hours apart, with the first stage to a height of 10-13cm and the final stage taking vegetation to approximately 5cm. Following each cut all the vegetation will be removed from the area, to limit the natural refugia available to reptiles, and wildlife in general, thus encouraging them to move out of the habitats which will be affected by site clearance or construction activities and into suitable, and connected, reptile habitat which will be retained.

This activity will only be undertaken during the daylight hours in warm and dry conditions (temperatures above 10°C) i.e. when reptiles are likely to be active, which is characteristically late March to early October.

Following strimming, any individual young trees and or small patches of scrub that cannot be retained as part of the development will also be removed in two stages. First, they will be subject to cutting down to a height of approximately 10cm. This will need to be undertaken outside of the bird breeding season (March to July inclusive) and in accordance with any mitigation proposed for other protected species (e.g. bats and/or badger). In the event that small section of semi-natural vegetation which could support nesting birds need to be cleared during the bird nesting season, an ecologist will check these areas immediately prior (on the same day) to clearance activities being undertaken.

Destructive searches

Destructive searches are generally advocated as the final stage in ensuring the effective clearance of an area of reptiles but also wildlife in general. They can only be undertaken when reptiles are active (this is also when most wildlife is active) which is usually between late March and early October (temperature dependent e.g. temperatures above 10°C). This element requires attention to the programme and phasing of any ground/ vegetation clearance. Destructive searches ensure the careful removal of all habitat or features which have value to reptiles. This technique will be employed in all medium risk habitats, following completion of habitat manipulation.

Destructive searches will require the ecologist undertaking a hand-search through any vegetation or other suitable feature whilst it is being removed carefully by a contractor. For example, an ecologist will supervise the clearance of hedgerow root bases, individual tree roots, or the dismantling of rubble piles. The ecologist

[40] English Nature (2004). *Reptiles: guidelines for developers*. Peterborough, English Nature. Note: English Nature is now Natural England.
[41] Herpetofauna Groups of Britain and Ireland (1998). Evaluating local mitigation/translocation programmes: maintaining best practice and lawful standards. HGBI advisory notes for Amphibian and Reptile Groups (ARGs). HGBI, c/o Froglife, Halesworth.
[42] Habitat dominated by tall weed species such as nettle, thistles, ragwort or teasel.

will search through any vegetation removed carefully looking for animals and moving them to a safe site should they be encountered.

The absolute method of destructive search will be dependent on the nature of the vegetation and the exact circumstances encountered. This method will be prescribed before works commences by the ecologist, however, it may include strimming and/or cutting of grassland and scrub in a similar way to that described for the habitat manipulation; or using a large excavator with a toothed bucket to gradually strip earth and remove tree roots and stumps or to move rubble.

Receptor Area

The survey work undertaken to inform the Environmental Statement indicates that reptiles are absent from or only present in very low numbers on much of the Site. It is therefore unlikely that many or any reptiles will be captured during site clearance activities and that most should disperse naturally ahead of habitat manipulation activities. However, if a reptile is encountered during these activities it will be translocated by the supervising ecologist to an appropriately sheltered location with suitable habitat or the reptile habitat within the BA.

5. Programme

The programme of works associated with the mitigation and habitat creation is shown in **Table 5.1**. The programme has been set in accordance with that of the Proposed Development. Construction Phase 1 commences in Q3 2019 on grant of the order in time for the opening and operation of the airport in Q4 2020.

Table 5.1 Programme of BA works

Work Area	Start Date	End date (latest)
Installation of bat buildings[43]	2019	2019
Provision of barn owl nest box	2018	-
Preparation of BA:		
▶ **Substrate preparation**	2019	2019
▶ **Woodland/hedgerow planting**	2019	2010
▶ **Reptile/invertebrate habitat creation**	2019	2021
Reptile Mitigation		
▶ **Trapping/translocation**	2020	2021
BA grassland establishment		
▶ **Harvest material from application site**	2019	2019
▶ **Establish BA grassland sward**	2019	2020

[43] This will require a Change of Use planning application.

Figures

633000

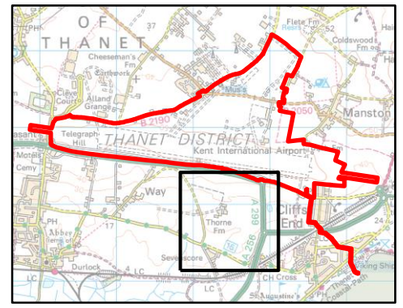
634000

165000

N

Key

- Application boundary
- Biodiversity area site boundary
- Broadleaved woodland - semi-natural
- Improved grassland
- Reedswamp
- Arable
- Hardstanding
- Intact hedge native species poor
- Defunct hedge native species-rich
- Parkland and scattered trees-broad-leaved



0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 2.1
Extended phase 1 habitat map - Land parcel 1362 / Biodiversity Area

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon200a.mxd Originator: vicki.smith

633000
633500
634000
165000
164500

N

Approximate location of bat boxes

Bats

Woodland providing shelter for foraging bats and increased prey abundance as well as roost opportunities. Hedgerows enhancing commuting routes around the BA and into wider environment. Ditches providing increased foraging opportunities. Bat boxes, bat barns and bunkers providing a variety of summer and winter roost locations for a wide number of species. Species-rich grassland grassland providing extensive foraging resource for a number of bat species.

Reptile Habitat

Mounds and banks to provide areas exposed to the sun for basking. Varied planting (herbs and shrubs) to provide structural complexity for shelter and foraging. Log/brash piles and pupose built hibernacula to provide daytime refuge and over wintering areas.

Invertebrate habitat

Sparsely vegetated mounds with predominantly south-facing (dry/warm) aspects. Bare (sandy) ground for invertebrate nest building. Small shallow scrapes to provide ephemeral pools.
Unvegetated mounds of spoil/rubble/sand.
Bare ground also providing drying out areas for grey partridge chicks to prevent chilling.

Breeding Bird Habitat

Species-rich grassland

Species-rich grassland created from a local provenance seed source.
Timing of management (mowing) specifically to encourage biodiversity.

Grassland cover to provide nesting sites.
No pesticide inputs to encourage invertebrates, important as chick food. Management timed to prevent nest destruction/chick mortality.

Breeding Bird Habitat

For grey partridge: hedgerow providing shelter/windbreak. A tussocky grass strip mixed with perennials along hedgerow base providing good nesting cover with some areas left uncut each year to provide material for nest construction and encourage invertebrate prey.
Ditch banks providing nest locations.

Key

- Broadleaved woodland
- New, low hedgerow planting
- Species-rich grassland
- Reptile and invertebrate habitat
- Low growing fruit trees
- Ditch
- Bat boxes
- Bat barn
- Bat bunker

Approximate locations subject to site conditions.

0 100 200 300 m
Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 2.2
Habitat Creation in the Biodiversity Area (BA)

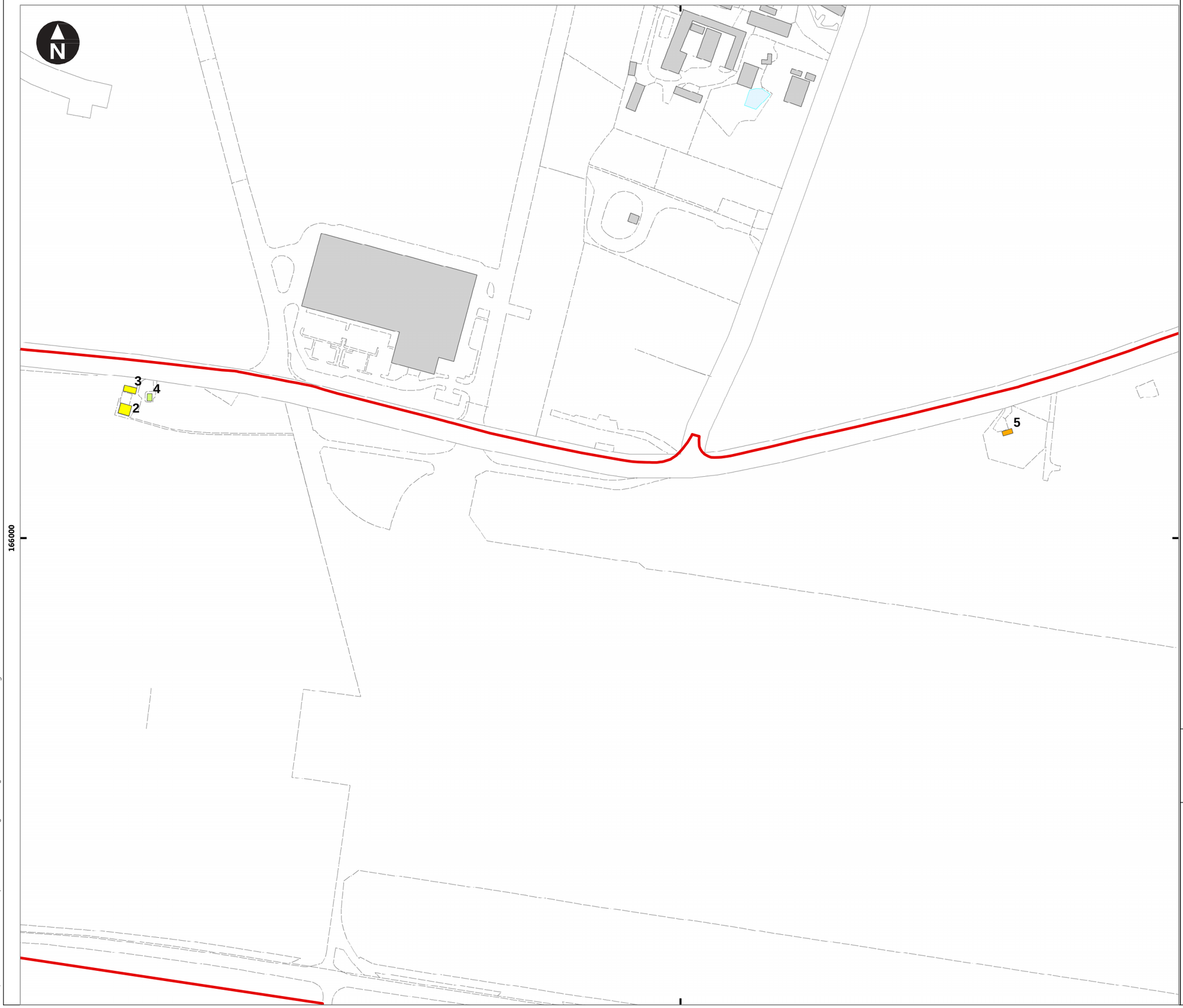
July 2018

wood.

H:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon592a.mxd Originator: jacqui.parkin

632000

166000



Key

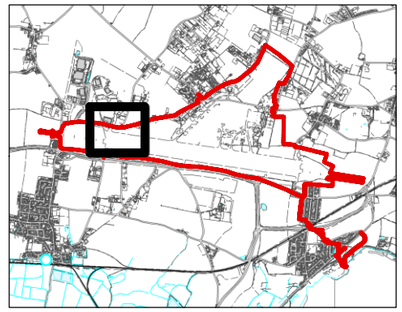
Order Limits

Confirmed Roosts and Potential Roosts 2017

Moderate

Low

Negligible



0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.1
Locations of buildings with roosts and bat potential

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon594a.mxd Originator: vicki.smith

633000

166000

N

27
28
25
26
22
23
24
21
18
20
19
17
16
14
15
13
12
9
11
8
6
7
10

Key

Order Limits

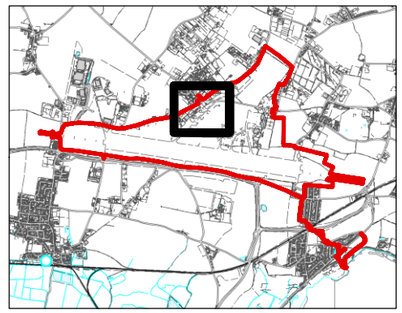
Confirmed Roosts and Potential Roosts 2017

Confirmed

Moderate

Low

Negligible



0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.1
Locations of buildings with roosts and bat potential

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon594a.mxd Originator: vicki.smith

634000

167000

N

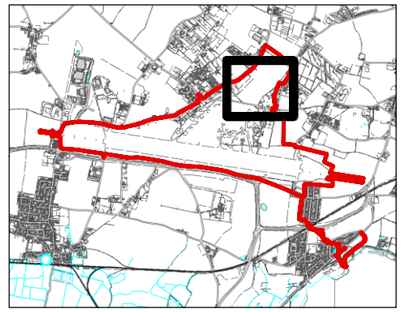
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

Key

Order Limits

Confirmed Roosts and Potential Roosts 2017

- Confirmed
- High
- Moderate
- Low
- Negligible



0 50 100 150 m

Scale at A3: 1:3,000

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.1
Locations of buildings with roosts and bat potential

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon594a.mxd Originator: vicki.smith

634000

166000

44

45

46

47

48

49

50

51

52

53

54

55

Key

Order Limits

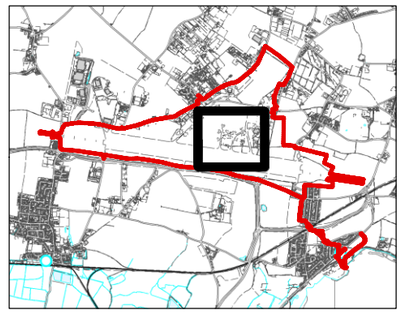
Confirmed Roosts and Potential Roosts 2017

Confirmed

Moderate

Low

Negligible



0 50 100 150 m

Scale at A3: 1:3,000

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.1
Locations of buildings with roosts and bat potential

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon594a.mxd Originator: vicki.smith

635000

56

57

58

66 68 69 67 71 65 64 62 70 63 61 61 59

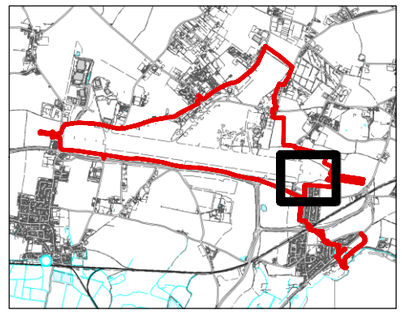
Key

Order Limits

Confirmed Roosts and Potential Roosts 2017

Low

Negligible



0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

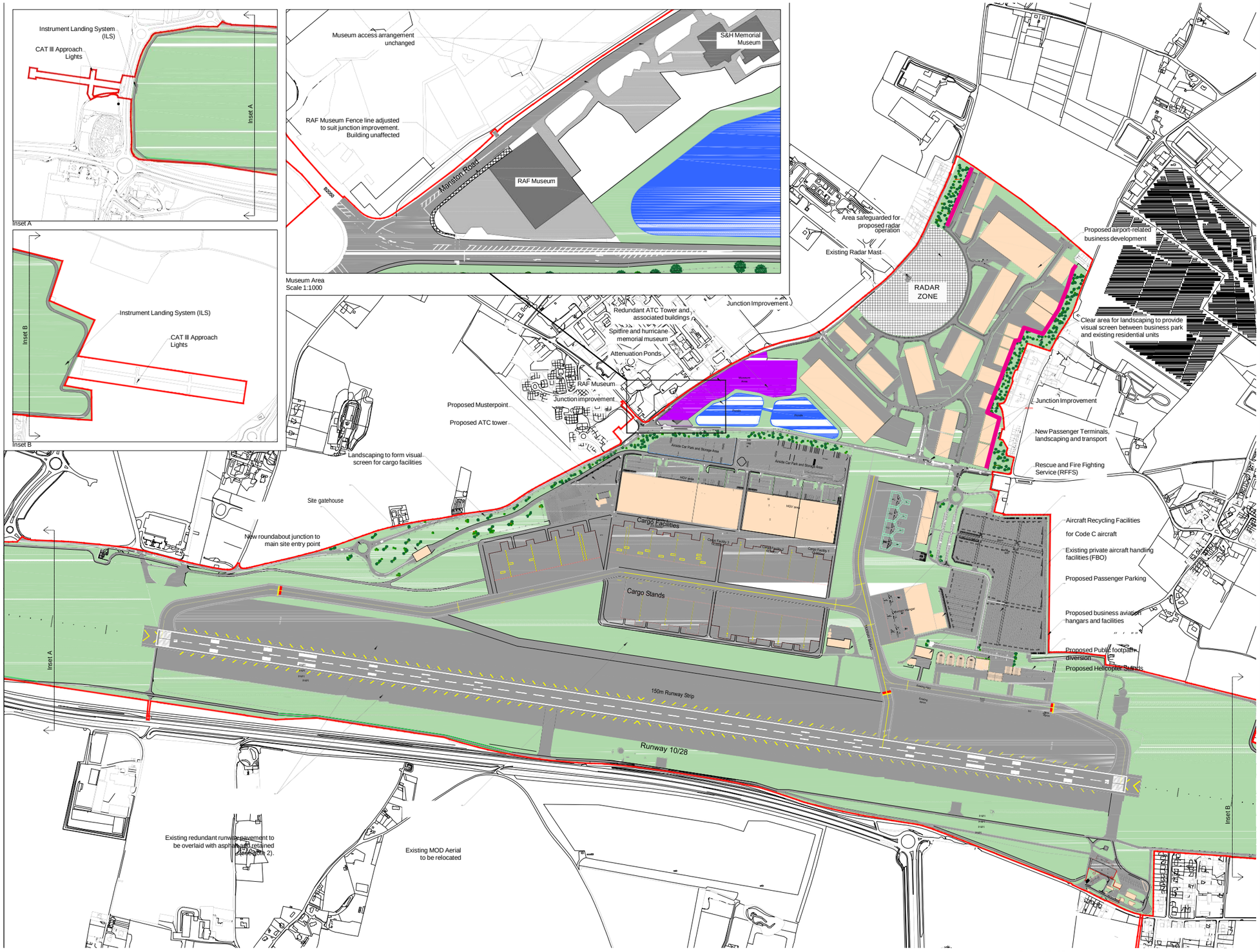
Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.1
Locations of buildings with roosts and bat potential

June 2018

wood.

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\ArcGIS\Figures\38199-Lon594a.mxd Originator: vicki.smith



Key

Approximate location of bat boxes

Order Limits

Buildings / Structures

Grassed Area

Landscaped Area

Drainage Pond

Museum Area

Pavement & Aircraft Pavement

Notes

1. OS Data obtained from emapsite™ May 2017: © Crown copyright and database rights 2017 Ordnance Survey 0100031673
2. Existing runway pavement to be retained at request of EA and Southern Water to protect adit. Strategic removal of pavement will be required to install runway and airport infrastructure, details to be agreed with EA and Southern Water.

Note:
Based on original drawing "RPS-MSE-XX-DR-C-2000_P13" supplied by RPS

0 m 1 km

Client

RSP

Manston Airport DCO
Environmental Statement:
Mitigation and Habitat Creation Plan

Figure 3.2
On-site roost provision

wood.

May 2018

Originator: Vicki Smith

P:\Projects\38199 LON Manston Airport DCO EIA\Drawings\InDesign\38199-Lon593.indd

English Name	Scientific Name
Wood anemone	*Anemone nemorosa*
Yellow flag iris	*Iris pseudacorus*
Yorkshire fog	*Holcus lanatus*

Appendix 8.1
Hydrogeological Impact Assessment


amec
foster
wheeler

Report for

Tony Freudmann
RiverOak Strategic Partners Limited Audley House
North Audley Street
Etc

Main contributors

Dr Tim Haines

Issued by

0"; -TiJ:H-

Approveq by

Dr Ben Fretwell

Amec Foster Wheeler

Floor 12
25 Canada Square
Canary Wharf
London E14 5LB
United Kingdom
Tel +44 (0) 203 2151610

Doc Ref. 38199CRR024i6

h:lprojects\38199 mansion airport dco eia\0 client\environmental statementlchapter 8 - freshwater environmentlappendiceslappendix 8.1hialappendix 8.1 hia_28.02.18.docx

Copyright and non-disclosure notice

Third-party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Document revisions

No.	Details	Date
	Draft Report	March 2017
2	Updated Draft	May 2017
3	Internal iteration	September 2017
4	Draft Final Report for Client comment	December 2017
5	Final Report for PIER II	January 2018
6	Final report for ES	February 2018

Contents

1. Introduction

1.1 Background to this Report

1.1.1 RiverOak Strategic Partners (hereafter referred to as 'RiverOak') is planning to re-open Manston Airport (the 'Proposed Development') as a new air freight and cargo hub for the South-East. This development site is located within the district of Thanet in the county of Kent and is shown on Figure 1.1.

1.1.2 Manston Airport has been an airport for approximately 100 years, with the level of activity increasing significantly from the end of World War II (WWII) in 1945, firstly as a military airfield and then more recently as the passenger airport. The airport has not been active since 2014. A full description of the Proposed Development is provided in **Chapter 3: Description of the Proposed Development** of the Environmental Statement (ES). The Proposed Development (over an area of approximately 3km^2) shall consist of the following principal components:

- A cargo handling freight facility, able to handle at least 10,000 movements per year; and
- Facilities for other aviation-related development.

1.1.3 The Proposed Development is a Nationally Significant Infrastructure Project (NSIP) under Part 3 of the *Planning Act 2008* (the '2008 Act') and therefore requires an application to be submitted for a Development Consent Order (DCO) under Section 14 of the 2008 Act. Under the 2008 Act this development constitutes a NSIP.

1.1.4 Environmental Impact Assessment (EIA) is required for certain developments under *The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017* (the '2017 EIA Regulations'). Some NSIPs always require EIA (the 2017 EIA Regulations define these under Schedule 1), others only require EIA if they are likely to have significant effects on the environment by virtue of their nature, size or location (the 2017 EIA Regulations define these in Schedule 2). In this instance, RiverOak is undertaking an EIA (in accordance with the 2017 EIA Regulations) under paragraph 10(e) of Schedule 2 because of the characteristics, location and potential impact of re-opening Manston Airport. This will ensure that any potentially significant effects of the Proposed Development on the environment are considered and, where appropriate, mitigated. This is being undertaken as part of the DCO application for Manston Airport.

1.1.5 A Preliminary Environmental Information Report (PEIR) was prepared by RiverOak (and consulted upon in Summer 2017) as part of the consultation process. The document addressed the various aspects of the environment, including the water environment. Following the introduction of the 2017 EIA Regulations, a revised PEIR was prepared (2018 PEIR) reflecting the latest available information and introducing a number of additional topics. A further consultation was held on the 2018 PEIR.

1.1.6 A Hydrogeological Impact Assessment and Flood Risk Assessment (FRA) have been prepared in support of **Chapter 8: Freshwater Environment** of the ES.

1.1.7 This Hydrogeological Impact Assessment provides information based on the Proposed Development and the data gathered up to the time of writing. Furthermore, it reflects comments received following the first PEIR consultation in the summer of 2017, the additional PEIR consultation in January 2018 and subsequent discussions with consultees including the Environment Agency (EA) and Southern Water (SW).

1.1.8 The report presented here constitutes the Hydrogeological Impact Assessment and has been prepared in support of **Chapter 8: Freshwater Environment** of the ES. It provides information based on the Proposed Development as described in **Chapter 3: Description of the Proposed Development** of the ES and data gathered up to this point.

1.1.9 In undertaking this work, particular attention has been paid to the Secretary of State's original comments on the Scoping Report which can be summarised as follows:

- A groundwater risk assessment should be undertaken in line with the Environment Agency's (EA's) "Groundwater Protection: Principles and Practice (GP3)";
- A quantitative risk assessment should be undertaken, unless robust justification can be provided otherwise;
- An assessment of the effects of the proposals on public and private water supplies should be undertaken. This should specifically consider effects and measures relating to trichloroethene (TCE);
- The scope of any intrusive works and associated mitigation measures are to be agreed with the EA, Thanet District Council (TDC) and Southern Water Services (SWS); and
- The Applicant should ensure that the effect of the proposals on the objectives of the Water Framework Directive (WFD), as set out in the South-East River Basin Management Plan (RBMP), are considered.

1.1.10 This Hydrogeological Impact Assessment is considered to address the first three bullet points above. It should be noted that the EA's GP3 has been updated to "The Environment Agency's Approach to Groundwater Protection", issued in March 2017[1]. This was revised in November 2017 (EA 2017) and launched as part of new groundwater collection on GOV.UK and with a new position statement for a national quality mark scheme for land contamination management (NQMS).

1.1.11 The remaining two bullet points above are addressed in the separate Phase 1 Land Quality Assessment (prepared as part of the ES and within Appendix 10.1) and **Chapter 8: Freshwater Environment** respectively. It should be noted that no intrusive works have been permitted as part of this EIA work.

1.2 Consultation

1.1.12 RiverOak has consulted on the Proposed Development and has invited responses in relation to all elements of it, including that undertaken as part of the earlier non-statutory pre-application periods of consultation and engagement on the project.

1.1.13 In relation to the water environment and in particular the hydrogeological environment, consultation including meetings has taken place with the EA, SWS, Kent County Council (KCC) and TDC. A key consideration in these meetings has been the location of the site on a Principal Aquifer that is a source of public water supply (PWS).

1.1.14 Minutes of the various meetings are included in **Appendix A**. Consultations have guided this assessment in that:

- Past hydrogeological assessments (by both the EA and SWS) mean that the further characterisation work is not required as the conceptual hydrogeological model is well understood;
- The primary concern is due to the proximity of the SWS public water supply source at The Lord of the Manor to the south-east of the site. This source also has an adit that runs approximately west-east along the line of the existing runway and has an attendant Source Protection Zone (SPZ). The potential risk to the Lord of the Manor PWS has been identified as the most important receptor to be considered in the risk assessment;
- The EA and SWS do not want to see any activity increasing the risk of contamination to the Lord of the Manor Source. The proposed new fuel farm has been identified as requiring particular assessment;
- SWS has indicated its preference that all drainage is positively removed off site rather than infiltrate the aquifer; and
- The EA and TDC wish to be consulted on any site investigation work, should that be required and/or agreed.

1.2 Report Structure

1.2.1 The structure of this report has adopted the following structure to facilitate an assessment of its adherence to "The Environment Agency's Approach to Groundwater Protection", namely:

- Chapter 1 provides some background to the project and the range of reports that have been developed to address the requirements of the 2008 Act;

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620438/LIT_7660.pdf

- Chapter 2 summarises the guiding groundwater protection principles and the legislative framework relevant to the Hydrogeological Impact Assessment;
- Chapter 3 describes the hydrogeological environment ('the baseline');
- Chapter 4 presents a quantitative risk assessment;
- Chapter 5 provides the conclusions and summary of the Hydrogeological Impact Assessment;
- Appendix A includes details from consultations; and
- Appendix B provides details of the groundwater modelling work undertaken in support of the Hydrogeological Impact Assessment.

1.2.2 This report refers to, and uses information collected as part of, the separate Phase 1 Land Quality Assessment (Appendix 10.1 of the ES).

2. Groundwater Protection and Legislation

2.1 Introduction

2.1.1 This Chapter summarises the guiding groundwater protection principles and the legislative framework relevant to the Hydrogeological Impact Assessment. Groundwater protection is set out in the EA's original GP3 and updated in its latest approach to groundwater protection (EA 2017). Details of relevant legislation are given in the light of the hydrogeological setting of the Proposed Development site.

2.1.2 The Proposed Development site is located in an area underlain by the Chalk aquifer (see **Figure 2.1** below), otherwise referred to as the Thanet Chalk Block. The Chalk aquifer is designated by the EA as a Principal Aquifer. This means the aquifer is also capable of supporting water supply and/or river baseflow on a strategic scale. Further details on the hydrogeological environment are given in **Chapter 3: Hydrogeological Environment**.

2.2 Protection of Groundwater

2.2.1 Groundwater supplies about one third of the mains drinking water in England. It also supports numerous private water supplies. In the Isle of Thanet public drinking water is supplied from groundwater.

2.2.2 Groundwater can have many benefits:

- It is water that generally needs little treatment prior to consumption, although on the Isle of Thanet groundwater has high nitrate levels and therefore does require some prior treatment;
- It provides water for rivers, wetlands and private water supplies. There are no rivers or wetlands within the Proposed Development site. Coastal conservation sites lie to the north and south of the Proposed Development (see Section 2.6). There are no private water supplies within a 2km radius of the centre of the site; and
- It provides essential water for industry and agriculture. There are four abstractions for agriculture with 1km of the site.

2.2.3 The presence of overlying layers of soil and rock often means that a groundwater aquifer, such as the Chalk that underlies this site, is relatively well protected from pollution compared with surface water. Water passing through these overlying layers is naturally filtered and many pollutants are degraded and attenuated during its passage to the water table. However, once polluted, an aquifer can be difficult and expensive to clean up.

2.2.4 The protection of groundwater is essential as any accidental spillage (e.g. liquid fuels) or the application of chemicals (e.g. fertilisers, pesticides etc.) to the ground has the potential to reach the water table. Whether it does or not will depend on the material involved and the ground conditions at the site. Care must also be taken to ensure that the overlying protective cover of soil and rock is not disturbed or removed.

2.2.5 The threats to groundwater are not just related to its quality, but also its quantity. For example, over-abstraction of groundwater can deplete groundwater resources, such that they cannot support other existing or future abstractions. Many rivers and conservation sites also depend on groundwater and may be harmed or lost if groundwater levels become too low. A decline in water levels can itself lead to a deterioration in groundwater quality, as saline or poor-quality water can be drawn in from the sea or up from depth.

2.2.6 The Proposed Development poses a potential risk to groundwater through pollution arising from the planned site activities or from the mobilisation of existing historical contamination during site works. Furthermore, these works could also increase the risks to groundwater by removing some aquifer material and/or the overlying protective cover of soil and rock.

2.2.7 The Proposed Development would not require a groundwater abstraction and therefore there is no direct threat to the quantity of water available to nearby abstractions and conservation sites. An indirect effect may arise through the reduction in rainfall recharge due to the increase in paved area across the airport. The current paved area (96ha) is approximately 6% of the catchment area (16km^2) to the Lord of The Manor source, and the re-developed site will have a paved area of approximately 132ha, approximately 8% of the catchment area.

2.2.8 The approach to protecting groundwater is set out in “The Environment Agency’s Approach to Groundwater Protection” (EA 2017). The EA’s priority is to protect water supplies intended for human consumption, as well as ensure protection of groundwater quality that supplies dependent ecosystems. This is achieved under the WFD (see Section 2.3); the approach seeks to apply progressively more stringent controls as the sensitivity of the location increases (e.g. applying greater controls the closer an activity is to an abstraction source).

2.2.9 Certain activities may present a particular hazard to groundwater due to a combination of the activity type, its duration and the potential for failure of measures taken to mitigate environmental impacts. Depending on the potential severity of the hazard, the EA may object (through planning or permitting controls) to such activities in certain areas. Close to sensitive receptors, the EA is likely to adopt the ‘precautionary principle’ as even where the likelihood of pollution occurring is not high, the consequences may be serious or irreversible.

2.3 Legislative and Regulatory Framework

2.3.1 Introduction

2.3.2 The control and protection of groundwater is covered by legislation and a series of guidance and policies issued by the EA. Relevant legislation includes, but is not necessarily limited to, the following (in approximate chronological order, most recent legislation first):

- T*he WFD (Standards and Classification) Directions (England and Wales) 2015*;
- *The Water Environment (WFD) (England and Wales) Regulations 2017*;

- *The Environmental Permitting (England and Wales) Regulations (EPR) 2010* together with subsequent amendments;
- *Floods and Water Management Act 2010*;
- *The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017*;
- The European Union (EU) *Floods Directive (2007/60/EC)*, as enacted into domestic law by the *Flood Risk Regulations 2009*;
- *Priority Substances Directive (2008/105/EC*), as enacted into domestic law in 2010;
- The *EU Water Framework Directive (2000/60/EC)* (WFD), as enacted into domestic law by the *Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*;
- *Water Act 2003;*
- *The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999;*
- *Environment Act 1995;*
- *Land Drainage Act 1991;*
- *Water Resources Act, 1991;*
- *Environmental Protection Act 1990;* and
- *Control of Pollution Act 1974.*

2.3.3 In addition, a range of policies and general good practice advice and technical guidance are of relevance to this assessment, including the following:

- Pollution Prevention Guidance Notes (PPG), which, whilst withdrawn by the EA, provide a good summary of environmental good practice measures which will demonstrate compliance with legislation for protection of the water environment;
- "The Environment Agency's Approach to Groundwater Protection" and its predecessor GP3;
- CIRIA Report C532: Control of water pollution from construction sites;
- CIRIA Report C648: Control of water pollution from linear construction projects – technical guidance;
- CIRIA Report C649: Control of water pollution from linear construction projects – site guide;
- CIRIA Report C692: Environmental good practice on site (third edition);
- CIRIA Report C698: Site handbook for the construction of Sustainable Urban Drainage Systems (SuDS);
- CIRIA Report C753: The SuDS manual; and
- Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73.

2.3.4 The key legislation and guidance/policies relevant to the Proposed Development are discussed in the following sections.

Key Legislation

Water Resources Act 1991

2.3.5 Section 93 of the *Water Resources Act 1991* allows for the designation of statutory water protection zones (WPZs) (for groundwater or surface waters). These may be designated to prohibit or restrict the carrying out of activities that are giving rise to the entry of poisonous, noxious or polluting matter into groundwater or surface waters and which present a risk of pollution. They may also be used to impose requirements on persons who carry out activities in the zone to take such steps as may be specified or described by the defined WPZ.

WFD (2000/60/EC)

2.3.6 Under the WFD, the EA has produced nine RBMPs for England to manage water quality targets and river basin planning. These were updated during 2015. One of the aims of the WFD is for all water bodies to achieve Good Ecological Status[2] by 2027 and to ensure no deterioration from current status.

2.3.7 Article 7.1 of the WFD requires member states to formally delineate water bodies that are used for the abstraction of drinking water, called drinking water protected areas (DrWPAs). All groundwater bodies in England and Wales are classified as DrWPAs due to the low abstraction thresholds set in the WFD. Article 7.2 stipulates that the requirements of the Drinking Water Directive must be met in England and Wales and this is the responsibility of the Drinking Water Inspectorate. Article 7.3 requires the protection of these water bodies "*with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water*". Safeguard zones can be established for this purpose if required.

2.3.8 Although the Article 7 objectives apply across a groundwater body, the point of compliance for Article 7.3 is at the point of abstraction. This means that applying protection measures equally over the entire land area of the DrWPA is not necessary to meet this objective.

Key EA Guidance/Policies

WFD Groundwater Body

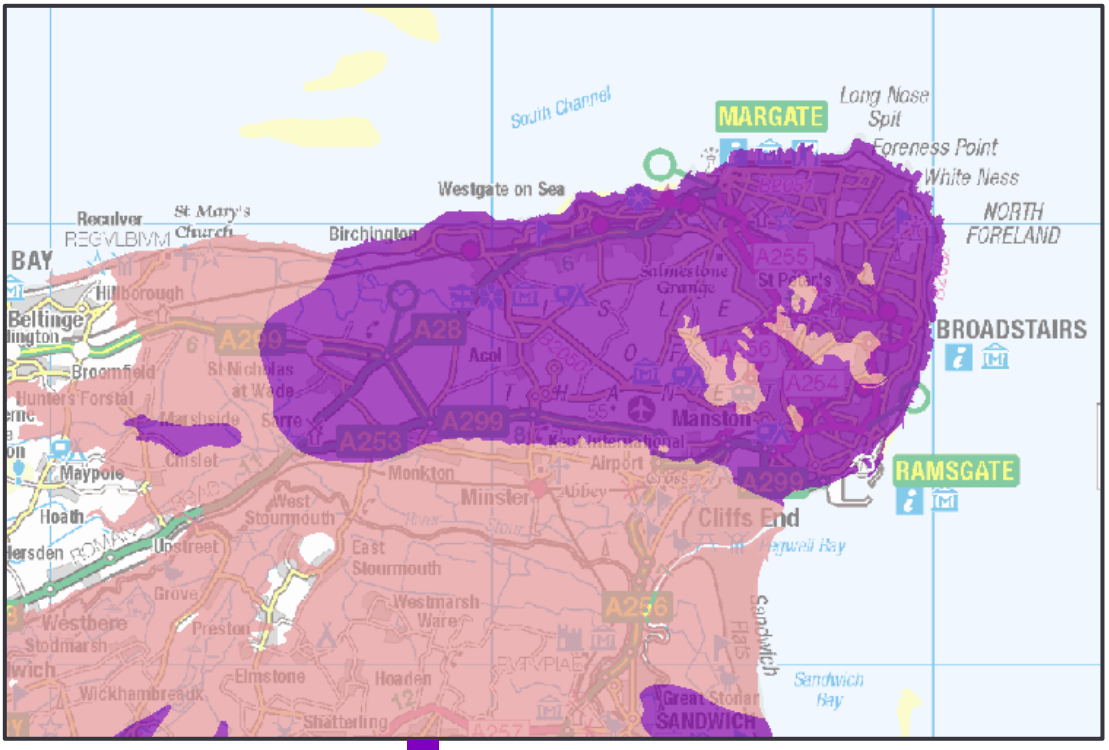
2.3.9 Under the WFD, the EA has produced nine RBMPs for England to manage water quality targets and river basin planning. These were updated during 2015. The Proposed Development is located within the South-East River Basin District.

2.3.10 The site is located within the Kent Isle of Thanet Chalk groundwater body (within the East Kent Chalk and Tertiaries Operational catchment). The overall 2015 water body is of poor status (as a result of poor status for both quantitative and chemical components), with an overall water body objective to achieve good by 2027. Attaining the default (good status) is not justified under WFD because the costs of the measures exceed the benefits for the quantitative component. However, the chemical component has an objective to reach Good status by 2027. To achieve this the WFD highlights improvements in relation to the area's Chemical DrWPA and General Chemical Test. These measures would be unaffordable to implement within a particular timetable (in advance of 2027) without creating disproportionate burdens for particular sectors or parts of society, or any identified solution would be at odds with the 'polluter pays' principle.

Aquifer Status

2.3.11 **Figure 2.1** shows the extent of the Chalk aquifer in the Isle of Thanet. The aquifer is designated by the EA as a Principal Aquifer. This means that the Chalk has a high intergranular and/or fracture permeability, implying that it potentially provides a high level of water storage. The aquifer is also capable of supporting water supply and/or river baseflow on a strategic scale. As mentioned earlier, the Chalk aquifer is the only supply of drinking water to this part of North Kent.

Figure 2.1 Outcrop of Chalk Principal Aquifer



Area of Principal Aquifer

Ref: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=groundwater&layerGroups=default&lang=_e&ep=map&scale=5&x=531500&y=181500#x=631420&y=166630&lg=3,&scale=6

Source Protection Zones

2.3.12 There are four PWSs that make up the abstraction group within the Thanet Chalk Block, namely Lord of the Manor, Minster B, Sparrow Castle and Rumfields.

2.3.13 The site is located entirely within a groundwater SPZ catchment (**Figure 2.2**). The inner zone (SPZ1), where contamination from site activities would present greatest risk to a PWS, is identified in an area at the eastern end of the site and in a strip beneath the runway and is coincident with the line of the Western Adit feeding the Lord of The Manor PWS. This is surrounded by a wider area of outer zone (SPZ2) that also dominates the area beneath the runway, in the south of the site. The remainder of the site falls within the wider SPZ catchment area (SPZ3).

2.3.14 **Table 2.2** lists those activities not permitted within a SPZ1.

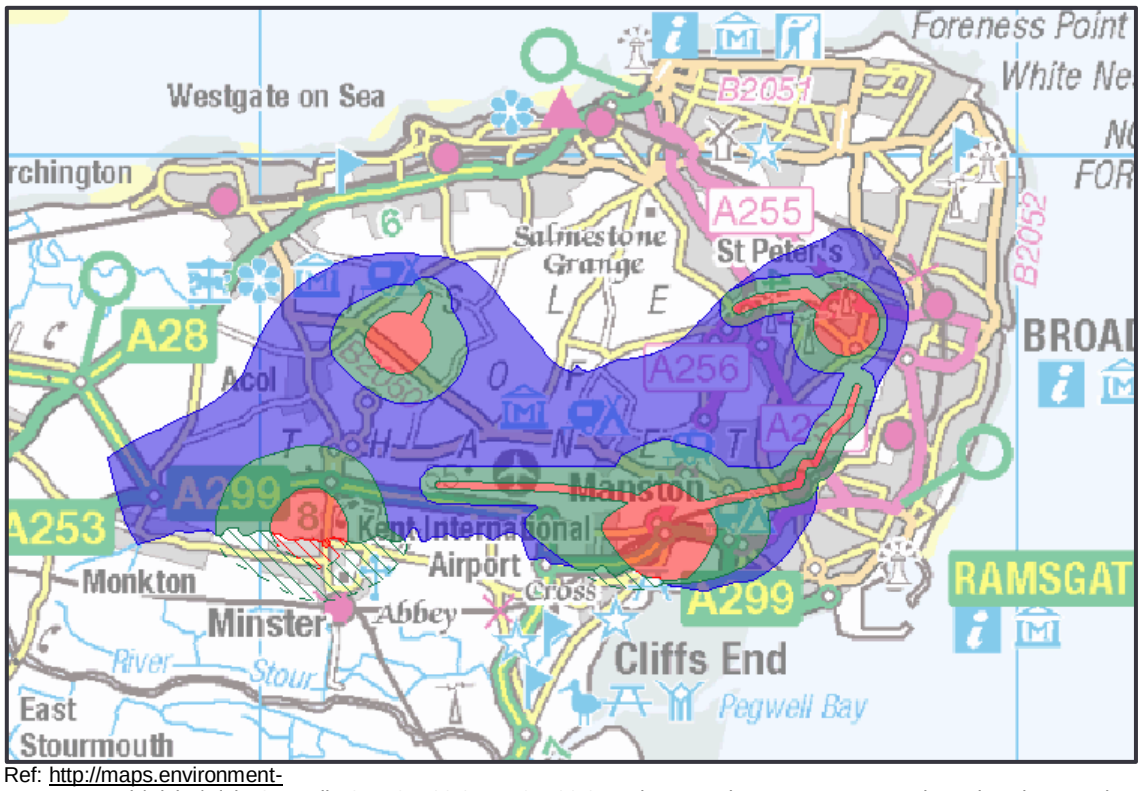
2.3.15 The EA also seeks to restrict activities in SPZ2, in particular:

- Non-nationally significant infrastructure schemes;
- Pipelines and high voltage fluid filled cables;
- Sub water table storage;

- Landfill locations; and
- Burials close to water supply used for human consumption or farm dairies where carcasses present a risk of disease transmission into groundwater.

2.3.16 SPZ3 (the source catchment protection zone) is defined as the area around an abstraction source within which all groundwater can potentially feed into the abstraction source. Although no specific activities are identified as being not permitted, the EA would look for appropriate precautions to be adopted for any activity in SPZ3 to ensure the prevention of pollution of groundwater and protection of it as a resource.

Figure 2.2 Designated SPZ



Ref: http://maps.environment-agency.gov.uk/wiyby/wibyController?x=531500.0&y=181500.0&topic=groundwater&ep=map&scale=5&location=London,%20City%20of%20London&lang=_e&layerGroups=default&distance=&textonly=off#x=634117&y=166969&lg=1,10,&scale=7

Inner zone (Zone 1) - Defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres;

Outer zone (Zone 2) - Defined by a 400-day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs, and instead this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction;

Total catchment (Zone 3) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Total Catchment Zone (TCZ) can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management.

Table 2.1 Activities not permitted within a SPZ1 (based on EA GP3)

The following have been amended in light of the 2017 update.	
Infrastructure	Non-nationally significant infrastructure schemes Transport developments Pipelines and high voltage fluid filled cables Underground coal gasification, coal bed methane and shale gas extraction Oil and conventional gas exploration and extraction
Storage of pollutants	Underground storage (and associated pipework) Sub water table storage
Landfill	Landfill location
Other waste activities	Non-landfill waste activities
Discharge of liquid effluents into the ground	Sewage effluent discharges inside SPZ1 Trade effluent and other discharges inside SPZ1 Cesspools and cesspits Sewerage pipework Discharge of clean roof water to ground Sustainable drainage systems
Diffuse sources	Land spreading Livestock housing Storage of organic manures on farms
Cemetery developments	Siting cemeteries close to a water supply used for human consumption Mass casualty emergencies Cemeteries: Protecting groundwater in highly sensitive locations
Burial of animal carcasses	Burials close to water supply used for human consumption or farm dairies On-farm carcass burials
Managing groundwater resources	Physical disturbance of aquifers in SPZ1*
Ground source heating and cooling	If a developer proposes to use hazardous substances for a GSHC system in a sensitive location such as a SPZ1, the Environment Agency may serve a notice to prevent pollution.

Notes *this is taken to mean the saturated part of the aquifer

2.3.17 The EA's GP3 guidance has recently been updated (Environment Agency 2017). There are a number of relevant position statements in the new guidance, including the following:

C1 Nationally or regionally significant schemes

The EA requires the promoters of schemes of national or regional significance to protect groundwater when choosing the location for their activity or development. In the cases where this is not possible due to national or regional interests, the EA expects to be fully involved in the scheme development to mitigate groundwater risks via EPR where applicable. Promoters are expected (via the environmental impact assessment process) to identify all the potential pollution linkages and apply best available techniques (BAT) to mitigate the risks.

C2 Non-nationally significant infrastructure schemes

In SPZ1 and SPZ2, the EA will only agree to proposals for infrastructure developments of non-national significance where they do not have the potential to cause pollution or harmful disturbance to groundwater flow or where these risks can be reduced to an acceptable level via EPR if applicable.

2.3.18 Where the EA judges there to be an unacceptable risk to groundwater from the storage of pollutants or their transmission through associated pipework, it will normally oppose such storage or transmission. If other material planning considerations determine that the development should proceed, the EA expects BAT to be applied.

D2 - Underground storage (and associated pipework)

The EA will normally object to new and increased underground* storage of hazardous substances in SPZ1. The EA will agree to such storage in Principal and Secondary aquifers outside SPZ1 only if there is evidence of overriding reasons why the:

- Activity cannot take place within unproductive strata; and
- Storage must be underground (for example public safety), in which case it is expected that the risks are appropriately mitigated.

Where such storage already exists, the EA will work with operators to assess and if necessary mitigate the risks, including an aim to change to above ground storage.

The EA will normally object to any redevelopment scheme involving retention of underground storage of hazardous substances in SPZ1 unless it can be demonstrated that risks to groundwater can be adequately mitigated.

For all storage of pollutants underground (hazardous substances and non-hazardous pollutants), the EA expects operators to adopt appropriate engineering standards and have effective management systems in place. These should take into account the nature and volume of the materials stored and the sensitivity of groundwater, including the location with respect to SPZs.

Safeguard Zones/ DrWPAs

2.3.19 The EA has indicated that for those 'at risk' DrWPAs it will establish a Safeguard Zone (SGZ). These non-statutory zones are areas where activities can impact adversely on the quality of water abstracted in the DrWPA. Action to address pollution is targeted in these zones so that extra treatment of raw water can be avoided. SGZs are a joint initiative between the EA and water companies. SGZs are one of the main tools for delivering the DrWPA objectives of the WFD. The EA also state

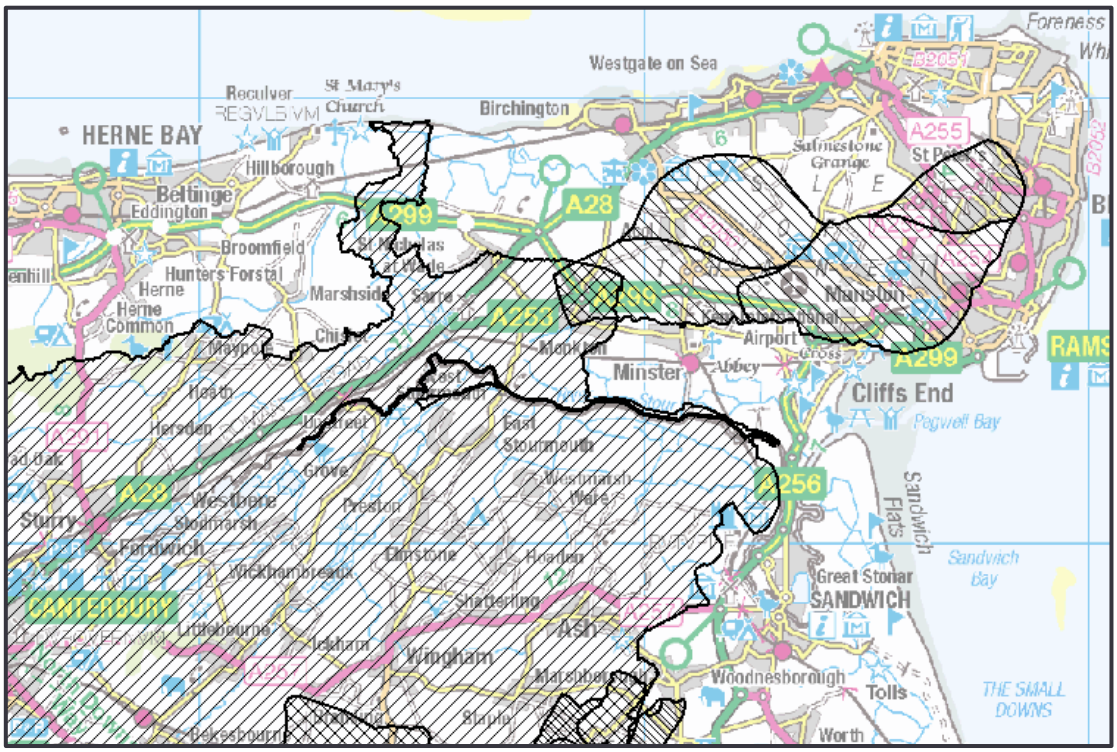
> *"Drinking water safeguard zones are designated areas in which the use of certain substances must be carefully managed to prevent the pollution of raw water sources that are used to provide drinking water*".

2.3.20 These zones are generally areas where the land use is causing pollution of the raw water.

2.3.21 In order to protect water resources, the EA wants to ensure that activities do not result in pollution leading to the need for more treatment. The identification of SGZs for any raw water sources that are 'at risk' of deterioration should result in the need for less additional treatment.

2.3.22 In 2015 a SGZ (Reference GWSGZ0115) around Manston was defined by the EA (**Figure 2.3**). The zone was primarily set up with respect to nitrate and solvents. Currently SWS, as part of its National Environment Programme (NEP) focused on the DrWPAs in the Thanet area, is investigating the possible sources and pathways of groundwater pollution, specifically from nitrate and solvents. This work may lead to an update and redefinition of the SGZ.

Figure 2.3 Safeguard Zones North Kent

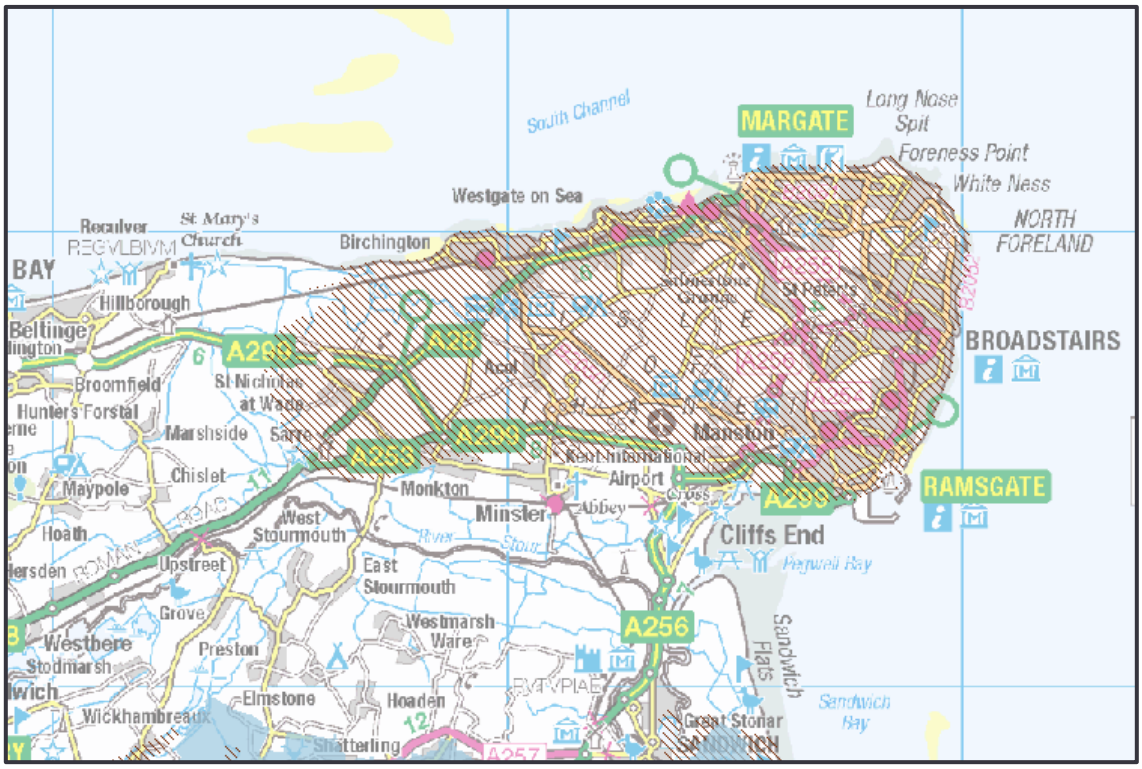


Ref: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=drinkingwater&layerGroups=default&lang=_e&ep=map&scale=5&x=531500&y=181500#x=628093&y=163713&lg=2,3,&scale=6

Nitrate Vulnerable Zones

2.3.23 **Figure 2.4** shows the extent of the nitrate vulnerable zone (NVZ) for the Thanet Chalk Block. This confirms that the major issue with groundwater quality in this area is the high level of nitrate.

Figure 2.4 Nitrate Vulnerable Zone



Ref http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=nvz&layerGroups=default&lang=_e&ep=map&scale=6&x=631420&y=166630

2.4 Habitats Regulations Assessment (HRA)

2.4.1 The north coast of the Isle of Thanet, located approximately 3.5km north of the site, is designated as a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protected Area (SPA) and RAMSAR site. In closer proximity to the Proposed Development site are Sandwich and Pegwell Bays, approximately 1.5km to the south-east. Together, these bays are part of designated National Nature Reserve (NNR), RAMSAR, SSSI, SPA and SAC sites, which are described more fully in **Chapter 7: Biodiversity** of the ES. The site has been identified as falling within the associated SSSI risk zones for Sandwich and Pegwell Bays.

2.4.2 Implementing the WFD contributes to outcomes for nature conservation and biodiversity by improving the water environment. The RMBPs include a summary of the measures needed for water-dependent Natura 2000 sites to meet their conservation objectives. Supporting Site Improvement Plans (SIPs) provide an overview of the issues (both current and predicted) affecting the current condition and outlines the priority measures required to improve the condition of the features. Sandwich Bay SAC, Thanet Coast and Sandwich Bay SPA and Thanet Coast SAC are water-dependent and fall under the North-East Kent (Thanet) SIP.

2.4.3 Measures for the Thanet Coast SAC and Sandwich and Pegwell Bay SPA were completed in 2015 to enable conservation objectives to be met according to the SIP. For Sandwich Bay SAC the measures will be complete by 2027 and require implementation of management actions to address and adapt to changes in water levels affecting sand dune vegetation.

2.4.4 The assessment of potential effects on these sites covered by the HRA are addressed in **Chapter 7: Biodiversity** and **Chapter 8: Freshwater Environment** of the ES. There is also a requirement under *The Conservation of Habitats and Species Regulations 2010* (SI 2010 No. 490) (the 'Habitats Regulations') to undertake a screening exercise to determine whether this (or any other) site is likely to be significantly affected by the Proposed Development, either alone or in combination with other plans and projects. If significant effects are likely, there will be a need for an Appropriate Assessment to be carried out. The screening, any Appropriate Assessment and subsequent assessment form part of what is known as the HRA, which forms an appendix to the ES.

2.4.5 Screening and any subsequent Appropriate Assessment will be undertaken by PINS (the 'Competent Authority'), drawing upon information regarding the likely effects of the Proposed Development on European sites that is provided by RiverOak. In undertaking its assessment, PINS are required to consult with Natural England (NE). To facilitate the process, Amec Foster Wheeler will also liaise with NE, and other interested parties as appropriate in the preparation of an Evidence Plan for the HRA.

2.5 Planning Policies

2.5.1 Relevant national and local planning policies are summarised in **Table 2.2**.

Table 2.2 Summary of key national and local planning policies

Policy	Summary
Draft Airports National Policy Statement (NPS): new runway capacity and infrastructure at airports in the South East of England, October 2017	Land use including open space, green infrastructure and Green Belt (Section 5.109): Construction and operation of airport facilities is a potential source of contaminative substances (for example, through de-icing or leaks and spills of fuel). Where pre-existing land contamination is being considered through development, the objective is to ensure that the site is suitable for its intended use. Risks require consideration in accordance with the contaminated land statutory guidance as a minimum. Water quality and resources (Sections 5.163 and 5.164):

	Section 5.163: Development may result in an increased potential for impacts on the water environment, especially the quality of the surface and groundwater through the discharge of waters contaminated with de-icer along with hydrocarbons and other pollutants. Section 5.164: The Applicant should make sufficiently early contact with the relevant regulators, including the EA, for abstraction licensing and environmental permitting, and with the water supply company likely to supply the water. Where the proposed development is subject to an EIA and the development is likely to have significant adverse effects on the water environment, the Applicant should ascertain the existing status of, and carry out an assessment of, the impacts of the proposed project on water quality, water resources and physical characteristics as part of the ES.
Thanet Local Plan 2006 Policy EC2 – Kent International Airport[i]	Identifies the requirement for proposals to demonstrate that new development cannot contaminate groundwater sources and/or that appropriate mitigation measures will be incorporated into the development to prevent contamination.
Thanet Local Plan 2006 Policy EP13 - groundwater protection zones[i]	Development located within groundwater SPZs, if identified to have the potential to result in a risk of contamination of groundwater sources, will not be permitted without adequate mitigation measures to prevent such contamination taking place.

3. Hydrogeological Environment

3.1 Introduction

3.1.1 This Chapter describes the hydrogeological 'baseline' environment, which provides the benchmark against which the Hydrogeological Impact Assessment is undertaken.

3.1.2 As stated in **Chapter 2: Groundwater Protection and Legislation** of this report, the site sits within an area of Chalk aquifer referred to as the Thanet Chalk Block. The hydrogeological environment of the Thanet Chalk Block has been the subject of a number of past studies by both the EA and SWS. These studies have primarily focussed on the assessment of the cause of high nitrate levels in the groundwater and the prediction of future trends.

5.1.1 The results of these studies have been made available to this Hydrogeological Impact Assessment and the baseline hydrogeological environment can therefore be described with a high level of confidence. Discussions with the EA and SWS have confirmed that no additional work is required to understand the groundwater environment in the vicinity of the Proposed Development and the nearby Lord of the Manor PWS. However, further site investigation will be required once access to land has been obtained, whether through voluntary agreement or by legal means either before or after the making of the application is determined.

3.1.3 The site setting and underlying geology is described below, followed by details regarding the hydrogeology, including the catchment characteristics. Details are also given with respect to the groundwater quality, in particular relating to the Lord of the Manor source.

3.2 Site Setting and Description

Introduction

3.2.1 Background hydrogeological information has been provided by SWS in the form of a number of reports (Aquaterra, 2007; Atkins, 2014 and 2015; Mouchel, 2007 and 2008, Amec Foster Wheeler 2017(b)). Relevant details from the reports have been included in the following sections.

Catchment Characterisation and Delineation

Catchment Characterisation

3.2.2 Topographically the catchment covers the highest part of the Isle of Thanet, with most land above the 40m Above Ordnance Datum (AOD) surface contour, sloping gently downwards towards the north and Westgate and more steeply descending in the south at Cliffs End. An east-west trending ridge of land higher than 50m AOD sits between Telegraph Hill and Manston Golf Course. From this ridge, two topographic lows, possibly dry valleys, extend to the north from Manston Golf Course towards Lydden and Fleete and to the south towards Pegwell Bay. The Proposed Development site itself has an elevation of around 49-50m AOD, with slightly higher ground in the southern and northern parts of the site, but steps down towards Manston Road to 41m AOD.

3.2.3 The catchment to the Lord of the Manor PWS is predominantly rural, with areas of urban and suburban land to the west on the outskirts of Ramsgate. Agricultural census data for 2010, combined with Ordnance Survey (OS) mapping, indicates that the Lord of the Manor catchment is made up of 43% urban and suburban land and 42% agricultural land (of which the predominant crops are wheat and other cereals such as barley, peas, beans and brassicas). The remaining 15% of land area comprises roads (8%), rough grazing and woodland. In the south-west of the catchment, the runway and apron of the Proposed Development site sit over the Western Adit, whilst the London – Ramsgate railway line, including a tunnel section, follows the line of the Eastern Adit into Ramsgate.

3.2.4 The main changes in the land-use in the catchment between the 1930s land utilisation survey and the current day are the expansion of Ramsgate towards the west and the marked increase in agricultural activity that occurred in the 1920s, with the conversion of meadowland/grass to arable. Changes have seen the ploughing up of orchards and conversion of land to market gardening and the establishment of high concentrations of brassica crops (cauliflowers in particular) and other intensive farming activities.

Catchment Delineation

3.2.5 Recent work on behalf of SWS (Amec Forster Wheeler, 2017) using the Flowsource software (© Groundwater Science) and the East Kent groundwater model has delineated the catchment area to the Lord of the Manor PWS based on a recent actual abstraction rate of 3.5Ml/d. The TCZ to the PWS covers an area of 16km^2 and extends from Chalkhole Farm in the north, to Alland Grange in the west, and Newlands Farm, on the outskirts of Ramsgate, in the east (**Figure 3.1**).

3.2.6 An inner zone (SPZ1) for the Lord of the Manor PWS, based on a 50-day travel time to the borehole, has been defined and is extended to include the adits (see **Figure 2.2**). An outer zone based on the area of the catchment contributing 70% of the abstracted volume covers a similar area to the TCZ.

Topography and Drainage

3.2.7 The Isle of Thanet comprises an area extending approximately 12km east-west by 4.5km north-south in the west and 9km north-south in the east. It is bordered by the sea to the north, east and south-east and by the River Stour to the south-west and the River Wantsum to the west (see **Figure 3.1**).

3.2.8 The Isle consists of a plateau that slopes gently westwards from the 30m high cliffs at the coast to an elevation of 10m AOD in the west, at the edge of the River Stour valley. The flat expanse of the River Stour valley is generally at only 2m AOD, but in some areas, is below sea level.

3.2.9 The site is on relatively high ground, mainly at an elevation of between 45-50m AOD. The southern portion is at an elevation of approximately 50m AOD, along the length of the existing runway, but rises to approximately 55m AOD in the westernmost corner of the site. North of the runway the site level declines to approximately 40m AOD in the west, at the Spitfire Way Junction (crossroads of the Manston Road (B2050) and Spitfire Way (B2190) carriageways), forming the start of the headwater valley for the Brooksend Stream, while remaining at 45-50m AOD in the northernmost part of the site. The site also encompasses the line of the buried pipeline to Pegwell Bay, which extends from the southern portion of the site at about 50m AOD to the outfall point in Pegwell Bay.

3.2.10 The average annual rainfall recorded at Manston between 1981 and 2010 was 592.5mm (Source: Meteorological Office). There are no rivers or watercourses on or adjacent to the site, partly due to the high permeability of the underlying Chalk. A series of water channels and streams that form part of the Minster Marshes are located more than 1km to the south of the site. The buried pipeline lies in closer proximity to the north-western extent of this system, but aerial photography indicates that it does not cross any surface water features. Minster Marshes drain south into the River Stour, 3km south of the site, which flows east and into Sandwich and Pegwell Bays.

3.2.11 OS mapping indicates a drainage channel on the opposite side of the road at the northernmost point of the site. This is possibly associated with an operational garden nursery (Rosemary Nurseries) adjacent to the site.

3.2.12 OS mapping indicates a number of water reservoirs within 3km of the site. A number of small uncovered reservoirs are located approximately 1.5km or more from the westernmost boundary of the site. A covered reservoir is located approximately 0.5km north of the site, and one further uncovered reservoir is located 0.3km from the southern boundary.

3.2.13 There are a number of other small water features (e.g. ponds) located within 3km of the site.

Soils and Land Use

3.2.14 The LANDIS soils database indicates that the site is underlain by slightly acid and lime rich, loamy soils that are freely draining. The leaching potential of the soils indicates that they have the potential to transmit a wide range of pollutants.

3.2.15 Although Manston Airport ceased operation in 2014, the remnant land use across the site remains. The southern part of the site is dominated by the tarmac runway, with a network of roads and taxiways linking this to the northern parts of the site. Carparks and buildings across the site remain and all the infrastructure is surrounded by cleared, maintained grass areas.

3.2.16 The site is bordered by roads that run along the length of the southern and western boundaries, with the B2050 cutting across the site in the north. Beyond these roads are farmland and industrial/retail areas (including Manston Fire Museum). To the north and east of the site are areas of farmland and residential dwellings.

Geology

3.2.17 The Isle of Thanet is underlain by the middle sequence of the Upper Chalk Formation (White Chalk sub-group), which is part of the North Downs outcrop that extends from the west near Guildford in Surrey to the Isle of Thanet on the east coast of England. The outcropping Chalk units are the upper Newhaven Chalk (previously the Margate Chalk), the Seaford Chalk and underlying Lewes Nodular Chalk. The total thickness of the Chalk in the North Downs of East Kent is between 237m (at Margate) and more than 275m at the southern limit of the Margate Chalk outcrop. The geology, superficial deposits and bed rock, is shown in **Figures 3.2a** and **3.2b** respectively.

3.2.18 The Seaford Chalk occurs at the coast and is a soft, blocky white chalk with seams of small to very large flint nodules. The overlying Newhaven Chalk underlies most of the Isle of Thanet and is composed mainly of smooth white chalk without marl seams and with few flint bands

3.2.19 The Chalk is underlain by Gault Clay and overlain by the Lower London Palaeogene Group, comprising the Thanet Formation, Lambeth Group and Thames Group. These formations are sands, silts and clays with pebbles and flint, but have not been confirmed as across the Proposed Development site itself.

3.2.20 The structure underlying the Isle of Thanet is an anticline/monocline striking east-west and facing south to south-west. The steepest exposed part of the anticline occurs in Pegwell Bay on the east of the Isle, and dips at 10° to the south-west.

3.2.21 Local to the Proposed Development site, the underlying bedrock is the Chalk dipping to the south, and trial pits recorded on the British Geological Survey (BGS) website[3] indicate that the Chalk is present at a very shallow (~1m) depth. Although mapped to the north-east of the site, the Thanet Formation was not encountered in the trial pits across the site, although could potentially be located beneath the north-east part of the site.

3.2.22 Head Deposits (mainly interglacial wind-blown sands with clay and silt) were found in trial pits in the centre and east of the site. The BGS mapping shows Head Deposits along the northern part of the site. The Head Deposits are overlain by Made Ground in the form of fill material with cinders, chalk and building rubble. This material was recorded in trial pits in the centre and north of the site, but is potentially located across the majority of the site due to the site's historical use. Dark grey sandy topsoil was found in the trial pits in the centre, north and east of the site.

3.3 Hydrogeology

Aquifer Status and Water Levels

3.3.1 The Principal aquifer under the Isle of Thanet is the Chalk that has an area of approximately 86km^2 (BGS, 2008). It is considered that the upper 70m or so of the Chalk is the productive zone of the aquifer, and this assumption is supported by the majority of the public abstraction sources in the area having adits with levels located at about 2 to -4m AOD (40-50m below ground level, mbgl).

3.3.2 The overlying Thanet Formation is classified by the EA as a Secondary Aquifer A (permeable layers capable of supporting water supplies at a local rather than strategic scale, in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers). It is not believed to be in hydraulic continuity with the Chalk; although in the vicinity of the site it is unsaturated, the Thanet Formation may act as a semi confining unit to the Chalk at the southern and western margins of the aquifer (Atkins, 2014). However, it is a relatively thin and non-continuous formation. The base of the Chalk is defined by the low permeability Gault Clay Formation (a rock layer with low permeability that has negligible significance for water supply or river base flow).

3.3.3 The water table within the Chalk is generally a subdued reflection of the surface topography. A groundwater mound has formed to the north west of Ramsgate, coincident with the Chalk anticline (Atkins, 2014). Generally, groundwater flow radiates outward from beneath the central topographically high towards the coast and to a lesser extent towards the Rivers Stour and Wantsum. Faults, joints and topographic features which may control drainage and infiltration are also likely to play a role in directing the flow of groundwater more locally.

3.3.4 **Figure 3.3** shows groundwater level contours based on the work undertaken for SWS by Atkins (2014). The figure shows that in the central part of the Thanet Chalk Block the water table is generally around 10m AOD, which corresponds to an unsaturated zone thickness of greater than 30m (Southern Water Authority (SWA), 1985). At the coast the unsaturated thickness reduces to a few metres, whilst seasonal fluctuations in groundwater levels in the block are small (1–5m) and dampened at low elevations. As Atkins note, however, the groundwater contours should be treated with caution (in particular the apparent groundwater mound in the east of Thanet) and are just one possible interpretation of the data.

[3] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

3.3.5 Water level records for observation boreholes (OBHs) on the Isle of Thanet suggest that the fluctuation in groundwater levels in response to rainfall recharge becomes more pronounced towards the centre of the Thanet Chalk Block and the topographic high on which the the Proposed Development site sits, with a seasonal change in water table level of up to 5m at Alland Grange and Fleete Reservoir compared to 0m to 2m at the edges of the Chalk to the south of the catchment. Comparison of the groundwater level data at the Lord of the Manor well with topography suggests that the unsaturated zone during the operation of this PWS is around 30m to 35m thick. The presence of the Western Adit may lead to a flattening in groundwater levels down gradient to the south, as it acts as a sump to the southerly flowing groundwater.

3.3.6 It is possible that perched water occurs within the Thanet Formation or above low permeability layers within the Thanet Formation. As stated earlier, the Thanet Formation is not thought to be present across the Proposed Development site. In addition, shallow perched water may occur in the Head Deposits or areas of Made Ground if low permeability horizons are present.

3.3.7 Work associated with the EA's East Kent groundwater model (Mott MacDonald 2006) shows that the winter peak in groundwater levels is typically in April, whereas the estimated percolation from the soil zone into the Chalk is highest in November to January i.e. there is a delay of three to four months associated with recharge through the unsaturated zone. It is clear that the low recharge values of 146 to 175mm/a (Entec 2010), together with the substantial unsaturated zone thickness over most of the area, mean that movement of recharge (and therefore pollutants) through the unsaturated zone is generally slow. The rate of movement of water through the unsaturated zone in the main body of the Chalk has been estimated at 0.5m/a based on pore water profiles (Southern Water, 1985).

3.3.8 In contrast, the EA[4] has evidence for occasional short-term responses (in the order of a few days) to individual summer storms, indicating a recharge contribution via fast fissure pathways. This range of responses reflects the complex matrix and fissure flow processes in the unsaturated zone of the Chalk, as well as variability in the nature of soils and shallow drift cover and soil zone processes.

3.3.9 In its work Atkins (2014) note that groundwater levels at Lord of the Manor are in the range -1 to +5m AOD (36 to 30 mbgl) and about 1m higher than during the 1980s, when the PWS was more actively used.

3.3.10 Across the Proposed Development site groundwater flow is from the north-east to south-west, with water levels falling from around 7m AOD to 3m AOD. Flowsource modelling undertaken for this Hydrogeological Impact Assessment (**Appendix B**) suggests that the Lord of the Manor Western Adit receives water from the area beneath the north-west of the Proposed Development and the large area of agricultural land to the north, whilst groundwater flowing to the Eastern Adit is derived from the eastern part of the catchment up the hydraulic gradient of Ramsgate.

3.3.11 Under natural conditions without abstraction, groundwater flow to the south would emerge as either baseflow into the River Stour or as springs emerging from the Chalk along the coastal margin.

Recharge and Aquifer Properties

3.3.12 Recharge is predominantly via the Chalk outcrop where fracturing is developed and soils are light and permeable. Aquifer recharge is thought to occur fairly uniformly across the exposed Chalk, irrespective of soil type, although there may be some time lag in recharge reaching the water table where there are soils of lower leaching potential. Recharge also occurs via the semi-permeable Thanet Formation. Over the Isle's urban areas rainfall recharge will be reduced, but there will be additional recharge inputs from leaking sewers and water mains.

[4] Meeting with EA Monday 7 November 2016

3.3.13 Where the Thanet Formation and or Head Deposits are present, recharge may move laterally to enter the Chalk due to the present of clay layers with these deposits. In urban areas a proportion of rainfall is diverted to the surface water drainage system thus reducing recharge, although leakage from the sewer network may increase recharge again.

3.3.14 The Chalk is a dual porosity media with a high matrix porosity and low primary permeability. Porosity is strongly dependent on the lithology and diagenetic history. The upper parts of the sequence have around 30-50% porosity. In the saturated zone significant flow takes place within solution-enhanced fissures that constitute only a small part of the overall porosity. Such fractures are typically best developed in shallow horizons and dominantly in the zones of modern and past water-table fluctuations. The bulk of porosity lies within the matrix, but groundwater in the matrix in the saturated zone is virtually immobile.

3.3.15 The BGS aquifer properties database (Allen et al., 1997) lists transmissivities for the North Downs as between 52–7,400 m^2/day, with a geometric mean of 720 m^2/day. There are no data specific to the Isle of Thanet in the BGS database.

3.3.16 Across the Proposed Development site, direct recharge will occur over greenfield areas and soft landscaping. Paved areas such as buildings, hardstand highways, runways and taxiways etc. are drained to the surface water drainage system. Some 'run-off recharge' may occur from areas covered by less permeable Head Deposits. Discussions with the EA and SWS have indicated that for the Proposed Development, the same arrangements should be preserved. The EA has indicated that discharge to ground would only be considered where the ground is shown to be free from contamination, the source of water is clean (e.g. roof runoff) and the location is distant from sensitive receptors.

3.3.17 The site drainage is discussed in more detail in the separate FRA (Amec Foster Wheeler 2017(c)).

Groundwater Abstractions

3.3.18 There are no licenced abstractions within the Proposed Development site boundary, but a number of individuals and organisations are licensed to abstract water from groundwater or ponds/lakes within 1km of the boundary (six located within 500m, with a further three within up to 1km). The abstractions are for private water undertaking, public water supplies (PWS) and agriculture (**Table 3.1**). It is assumed that where no licence end date is provided in the data source for this table (a 2016 Envirocheck Report), then the abstraction is currently operational.

Table 3.1 Licensed abstractions within 1km of the Proposed Development Site

Licence Holder	Purpose	Source	National Grid Reference (NGR)	Operational	Direction from Development Site	Approx. Distance from Development Site Centre (m)
Wilson & Wilson Ltd	Private water undertaking: general use (medium loss)	Groundwater	631690 165470	Yes	E	176
SWS	PWS: potable water supply - direct	Groundwater	635350 165100	Yes	E	384
SWS	PWS	Pond or lake	635350 165095	Yes	E	386
Mrs L R Saunders	Spray irrigation	Pond or lake	632855 166805	Yes	W	474

Licence Holder	Purpose	Source	National Grid Reference (NGR)	Operational	Direction from Development Site	Approx. Distance from Development Site Centre (m)
Mrs E Green	General farming and domestic/spray irrigation	Groundwater	632850 166810	Yes	W	481
Mrs L R Saunders	General farming and domestic/spray irrigation	Groundwater	632850 166810	Yes	W	481
SWS	PWS: potable water supply - direct	Groundwater	630650 165140	Yes	W	805
SWS	PWS: potable water supply - direct	Groundwater	630860 164860	Yes	SW	949
SWS	Agriculture (general)	Pond or lake	630860 164855	Yes	SW	954

3.3.19 TDC has confirmed that it does not have any records of private water supplies within a 2km radius of the centre of the site.

3.3.20 The Isle of Thanet Chalk aquifer has long been an important source of water for the area both for public supply and private abstraction. As mentioned in **Chapter 2: Groundwater Protection and Legislation** of this report, SWS abstracts groundwater for PWS from a number of sources around the Isle of Thanet. Most sources comprise a combination of boreholes and wells and horizontal adits tunnelled into the Chalk.

3.3.21 **Figure 3.4** shows the SW abstraction locations and adits (details provided by SWS). Over time many of these sources have been abandoned and in recent years, abstraction has been from three sources in the Thanet Chalk, namely Lord of the Manor, Sparrow Castle and Minster B. The Rumfields PWS is also part of the current water supply system, but it has been out of service for several years because of a nearby contamination threat.

3.3.22 The Lord of the Manor abstraction is closest to the Proposed Development site, approximately 385m from the eastern boundary. The source comprises two wells, namely Lord of the Manor and Whitehall (the latter is disused and sealed), with three adits. The source was constructed at the southern edge of Thanet to intercept any high permeability zones and abstract groundwater which would otherwise have discharged south towards the sea. The Whitehall abstraction was constructed first, in 1850, but suffered from saline intrusion, being close to the coast. Lord of the Manor was constructed in 1933 to intercept the same adit system but positioned to overcome the saline intrusion issue (Aquaterra, 2007).

3.3.23 The source has a daily abstraction licence rate of 14.77 megalitres per day (Ml/d) and an annual licence rate of 4,091 megalitres per annum (Ml/a). The Lord of the Manor source is part of a group licence with Minster B, Sparrow Castle and Rumsfield, with a combined abstraction limit of 7,250 Ml/a.

3.3.24 There are three adits at the Lord of the Manor PWS (**Figure 3.5** and **Table 3.2**), namely the Eastern, Western and South Western Adits, which were constructed in the late 19th and early 20th Century. Their details are summarised as follows:

- The Western Adit is 3,103m long and lies at an elevation of 2.8m AOD to -0.71m AOD (height of 3.51m). This adit is regularly dewatered;
- The Eastern Adit is 2,410m long to the now-disused Whitehall source and then extends on for a further 1,000m to the east, with a total elevation range of 0.96m AOD to -0.81m AOD. It has only been partially dewatered on a few occurrences (namely 1992 and 1998). There have been stability concerns raised relating to the dewatering of the Eastern Adit, which Aquaterra (2007) speculated constrained the source output; and
- The South Western Adit is 475.5m long. The elevation range of this adit is thought to be 0.96m AOD to -0.8m AOD (height of 1.76m).

Table 3.2 Lord of the Manor source construction details and pumping test information (after Aquaterra 2007)

Borehole	Depth (mbgl)	Casing Details	Diameter	Ground Level (mAOD)	Rest Water Level (mAOD)	Adits
BH1	40.9 m	Brick lined to 5.7m. Open hole to full depth	Variable in upper section up to 1.5m and approximately 1.15m in diameter below approximately 18m bgl.	35.46 (datum at 33.01 mAOD at the Chamber Floor)	0.6 mAOD (Oct 1957)	Western Adit (3103 m), ceiling 2.8 mAOD to floor 0.71 mAOD (height of 3.51m). Constructed in 1925. Eastern Adit (3410 m), ceiling 0.96 mAOD to -0.8 mAOD depth (height of 1.76m). South Western Adit 475.5 m long; ceiling 0.96 mAOD and floor -0.8 mAOD (height of 1.76m).

*Chamber floor level

3.3.25 The maximum deployable output (DO)[5] from the source has been considered to be 1.7 Ml/d, although Aquaterra (2007) concluded that the potential deployable output could be 4.5 Ml/d if the Eastern Adit could be dewatered. However, an adit risk assessment (on behalf of SWS) suggested that the Eastern Adit should not be dewatered due to its shallow elevation, unknown condition and potential for saline intrusion. Information from SWS indicates that although the source has not been used in recent years, actual abstraction rates before then were typically 3.5 Ml/d. Daily abstraction in the 1990's peaked at over 9 Ml/d and in the 2000's at over 8 Ml/d.

3.3.26 SWS, in its 2014 Water Resources Management Plan (WRMP14), stated that the maximum (peak) deployable output (PDO) of the Lord of the Manor PWS was 2.75 Ml/d and the minimum deployable output (MDO) was 1.50 Ml/d. In recent discussions with SWS[6], the water company has indicated that its current DO assessment for WRMP19 has resulted in a total write down of the DO for Lord of the Manor as a result of the nitrate water quality impacts pending a treatment solution. SWS has, however, still assessed the yield though using the full 2000 year run of the refined East Kent groundwater model. For a "Normal year" (1 in 2 year), it has estimated the PDO to be 5.2 Ml/d and the MDO to be 2.81 Ml/d. For a 1 in 200-year design drought event, the PDO is estimated to be 2.1 Ml/d and the MDO 1 Ml/d.

3.3.27 In its work, Atkins (2014) indicates that the abstraction rate at the Lord of the Manor PWS was higher in the 1980s than more recently, with the source little used since 2010.

3.3.28 The 2013 River Stour Abstraction Licensing Strategy (ALS) (EA 2013) indicates that there is "a presumption against" the licensing of new abstractions in the Chalk aquifer due to the high volume of abstraction already licensed.

Water Quality

Introduction

3.3.29 Water quality, in particular nitrate concentrations, have been a concern in Thanet for many years. The levels have been close to, or exceeded, the prescribed concentration or value (PCV) for nitrate of 50 mg/l as nitrate or 11.3 mg/l as nitrogen (UK Drinking Water Standard (DWS), Drinking Water Inspectorate (DWI) 2012). Other water quality issues include pesticides and organic compounds, including TCE.

3.3.30 Water quality data from the Lord of the Manor PWS supplied by SWS for the period 2001 to 2015, together with historical investigations, have been used to understand water quality issues in this part of the Isle of Thanet.

Nitrate

3.3.31 Groundwater in the Thanet Chalk Block has high levels of nitrate at levels at or exceeding current DWS limits.

3.3.32 Data from twenty OBHs drilled into the Chalk between 1975 and 1984 were used to profile unsaturated zone nitrate concentrations (SWA, 1985). These profiles implied a downward travel rate of nitrate through the unsaturated zone of 0.5m/a. The profiles also suggested that the majority of nitrate was coming from fertilised land and denitrification was not identified in the aquifer. The predictive modelling undertaken as part of the SWA study indicated that there would be a steep rise in nitrate concentrations in groundwater. For example, at the Lord of the Manor PWS the rise would commence in the early 2000s and not level off until 2100, with an increase from ~ 53mg/l NO_3 in 2000 to ~79.6mg/l NO_3 by 2050, flattening off at ~110mg/l NO_3 by 2100.

[5] The output of a commissioned source or group of sources or of bulk supply as constrained by any abstraction licence and if applicable well/aquifer properties, pumping plant and water mains, transfer and/or output mains, treatment and water quality.

3.3.33 High nitrate concentrations have been an issue at the Lord of the Manor PWS since the 1920s, when levels already exceeded the current DWS (SWA, 1985). Data supplied by SWS show that the trend for the period 2001 to 2005 was relatively flat, with concentrations varying between around 50 to 65mg/l NO_3. However, concentrations appear to have subsequently risen from around 57mg/l NO_3 in 2004 to 62mg/l NO_3 in 2010, observations that are consistent with the predictions made in the 1985 SWA study. After 2010 the PWS appears to not have been used and samples rarely taken, probably because the source can only be put into supply if nitrate treatment is undertaken.

3.3.34 Nitrate concentrations show no seasonal trend or correlation with groundwater levels or abstraction rate. There are, however, within the dataset samples with relatively lower or higher nitrate concentrations compared to neighbouring samples, for example:

- June 2001 (35.8mg/l NO_3) and May 2003 (37.5 mg/l NO_3), both of which coincide with start-up of the abstraction after a period of shut-down, and a drop in the water table;
- August 2003 (8.6mg/l NO_3) and November 2005 (42.6mg/l NO_3), both linked with relatively low water tables (<2m AOD), low rainfall and increased abstraction; and
- August 2005 (69.5mg/l NO_3) and October 2003 (60.6mg/l NO_3), both linked to the water table falling and then rising.

[6] Dr Simon Cook – Water Resource planner

3.3.35 These data suggest that when the water table is low (through a combination of low recharge and increased abstraction) the borehole and adits receive water with a lower nitrate concentration. When the source is started up after a period of no abstraction, low nitrate in groundwater is again reported. However, high nitrate can occur in response to a rising water table and this may be explained by a pulse of nitrate that has diffused out of the matrix to the fissures. The nitrate porewater profiles described in Mouchel (2008) show that nitrate concentrations decrease with depth through the unsaturated zone.

3.3.36 Whilst other sources of nitrate have been considered, such as the historical use of urea-based de-icer at Manston Airport, the high nitrate has most probably arisen as a consequence of the marked increase in agricultural activity that occurred in the 1920s with the conversion of grassland to arable. Since the 1940s the area of land in arable production has generally increased in Kent, at the expense of grassland (Atkins, 2015). Ploughing up of orchards and conversion of land to market gardening created a nitrate peak in the unsaturated zone that was identified in the 1970s. High concentrations of brassica crops (cauliflowers in particular) and other intensive farming on the southern edge of Thanet also contribute to the high nitrate loading. Past activities at the airport are not considered to be a source of nitrate.

Organic Contamination

3.3.37 Chlorinated solvents can include a wide range of organic chemicals containing at least one chloride ion. They have been used as degreasing and cleaning agents in military, industrial and dry-cleaning applications for many decades, although much contamination is believed to be historical, resulting from previous careless handling and disposal procedures at a range of locations in the Lord of the Manor catchment. Carbon tetrachloride, historically used as a refrigerant, propellant, in foams and dry cleaning has been banned from use in consumer goods since 2002 due its impact on the ozone layer (EU *Regulation 2037/2000*). Carbon tetrachloride use declined steeply since the 1980s due to concerns regarding its harmful effects.

3.3.38 Chlorinated solvents are volatile liquids. In liquid form they tend to sink through aquifers because they are denser than water and are classed as dense non-aqueous phase liquid (DNAPL). They will continue to sink until they encounter low permeability strata or are exhausted by smearing and entrapment. DNAPL accumulations can form long-term sources of groundwater contamination. Much like nitrate, they can be persistent under typical oxidizing (aerobic) aquifer conditions. Some degradation does occur under favourable (reducing) environmental conditions. For example, degradation of carbon tetrachloride to trihalomethanes, and tetrachloroethene (PCE) to TCE, and dichloroethenes, Vinyl chloride can occur in groundwater as a result of reductive dechlorination. The final stage of degradation is the conversion of vinyl chloride to ethenes which generally requires oxidizing conditions. Chlorinated solvents are sparingly soluble, but their solubility far exceeds DWSs (the combined DWS for PCE and TCE is 10µg/l, while vinyl chloride has a limit of 5 µg/l). They are also poorly retarded and so are relatively mobile. Due to their persistence, chlorinated solvent plumes can be very large (several km long).

3.3.39 Past airport activities such as aircraft repair and maintenance may have used solvents and onsite fuel storage and so could have been a source of organic contamination. It is reported that during WWII diesel fuel was burnt in trenches alongside the runway in order to disperse fog. Any residue from this activity is likely to have dispersed in the intervening 70 years.

3.3.40 There have been two reported (Atkins 2015) water quality incidents/issues at the Lord of the Manor PWS. These are as follows:

- June 1999 - domestic fuel spill near to the PWS adit, but remedial works ensured that the source was not impacted; and
- February 2007 – low polyaromatic hydrocarbon (PAH) concentrations were found in an OBH at Cliff End possibly transformer oil or electric cable oil, linked to historical rail use.

3.3.41 Water quality data from Lord of the Manor for chlorinated solvents provided by SWS for the period 2001 to 2015 includes analysis for PCE, TCE, carbon tetrachloride, 1,1,1 trichloroethane (111 TCA), vinyl chloride, 1,2 dichloroethane and total trihalomethanes (degradation products of carbon tetrachloride). This dataset has been examined for the period 2001 to 2015 (Amec Foster Wheeler, 2017) and is plotted in **Figure 3.6**.

3.3.42 The solvent detected most frequently at concentrations above the combined DWS is PCE. The pattern of detection is discussed below, although the lower frequency of sampling in some years means that some details are likely to have been missed:

- From June 2001 to December 2002 there was a rising trend in PCE, with concentrations generally ranging between 5 and 17µg/l, and a peak of 26µg/l in September 2002;
- Between May 2003 and December 2006 concentrations were between 0.5 and 15.2µg/l, although the sampling frequency was reduced;
- From 2006 to 2009 concentrations were generally between 10 to 17µg/l, and there was no detection in samples taken in 2009; and
- Samples taken after January 2010, when the PWS was out of service, contained PCE at between 4.7 and 7.5µg/l.

3.3.43 TCE was also detected, but always at concentrations below the combined DWS, with a peak concentration in June 2001 of 2.9µg/l. Concentrations follow a similar temporal pattern to that of PCE, with the majority of elevated concentrations between 2001 and 2004 and 2007 to 2010 (**Figure 3.6**), decreasing to lower levels in recent years, this suggesting a common source.

3.3.44 Other solvents detected at the Lord of the Manor PWS include:

- TCA between December 2007 and February 2008, at concentrations of 2.8 to 4.8µg/l;
- Vinyl chloride with a peak value of 2.4 µg/l in September 2009, but otherwise remaining at the 0.11µg/l (the likely laboratory detection limit);
- Carbon tetrachloride was consistently detected at a low concentration throughout the dataset, with a peak value of 1µg/l in August 2002; and
- Trihalomethanes was at a peak value of 6µg/l in September 2001.

3.3.45 The changing concentrations of PCE and potentially TCE, appear to be correlated with groundwater levels at the abstraction. In general, samples where PCE was absent coincide with periods of lower-than-usual water table (around 2m AOD), whilst peaks in concentration typically occur when the water table is higher. This pattern may suggest that a source or plume of PCE and other solvents is present, although the decrease in concentrations in recent years suggests that the plume may have degraded over the years. Low concentrations of carbon tetrachloride, which underwent decline in use in the 1980s and was banned in 2002, suggests that the source of contamination is likely to be historical rather than ongoing.

3.3.46 SWS records for the Lord of the Manor PWS show only sporadic occurrence of petroleum hydrocarbons in groundwater at low concentrations below DWSs. This dataset suggests that petroleum hydrocarbons are not an existing water quality issue at the abstraction.

Pesticides

3.3.47 SWS samples are screened for more than 30 individual pesticide compounds with varying frequencies. The total sum of identified pesticides is also reported. The majority of analytical results are below the detection limit.

3.3.48 The most notable event shown in the pesticide data is a high spike in diuron concentrations at the Lord of the Manor PWS in 2000/2001. The EA investigated possible sources in the urban area and it concluded that diuron was applied at incorrect dilution rates to amenity land, leading to the high concentrations at the PWS. Users switched from diuron to glyphosphate and concentrations of diuron at Lord of the Manor fell gradually over the following two years to reach very low levels by 2003.

3.3.49 Diuron has rarely been detected since, but a BGS (2004) study identified the widespread use of diuron in the Thanet area. Diuron and its metabolites may therefore be percolating through the soil and the unsaturated zone towards groundwater, which may give rise to a further impact in years to come.

3.3.50 Atrazine concentrations at the Lord of the Manor PWS also exceeded the PCV in 2000–2001. Since then levels have declined and have been around 20–30µg/l. Occasional low concentrations of simazine have been detected and there was a cluster of recordings of cyanazine at all three PWSs in 2003–2005. Atrazine and simazine were banned for non-agricultural use (e.g. local authority, road and rail) in 1993, with further restrictions introduced in the 2000s.

3.3.51 Detection of cynazine and simazine at concentrations below the DWS in September 2004, January 2005 and September 2006 could be linked to rainfall events, flushing applied product into the aquifer. The pesticide data suggest that although the PWS is vulnerable to pollution, there are currently no issues with these substances.

Other Water Quality

3.3.52 Reports of saline intrusion by SWA (1985) near Margate were possibly as a result of former groundwater abstractions at a nearby PWS sources in the area (EA, 2004). Following abandonment of the source the level of saline intrusion may have reduced (Atkins, 2014).

4. Groundwater Risk Assessment

4.1 Introduction

4.1.1 This Chapter first summaries the key aspects of the Proposed Development relevant to the groundwater environment and describes the conceptual understanding of the site. A description is then given of the approach and the results of the risk assessment undertaken using the so-called source-pathway-receptor method.

4.1.2 The approach adopted follows the Government guidelines for a Hydrogeological Risk Assessment report, as appropriate. The information used is entirely desk-based, drawing on records provided by the EA and SWS and the results of previous investigations.

4.1.3 RiverOak (and its predecessor RiverOak Investment Corporation) have made every effort to access the land for surveying, including the latter securing a section 53 consent in December 2016, and the former securing a voluntary licence to access the land. However, despite this the current owners have continued to restrict access. As a result, no project specific site investigations have been undertaken. Whilst the EA and SWS have confirmed that they would prefer any future intrusive site investigations to be limited to shallow depths with no deep boreholes in sensitive areas, this is not seen as problematic because the amount of information currently available is considered sufficient to develop a robust conceptual model and preliminary risk assessment.

4.1.4 Following consultation with the EA and SWS, the potential risk to the Lord of the Manor PWS in terms of water quality has been identified as the most important receptor to be considered. The potential indirect effect that may arise through the reduction in rainfall recharge due to the increase in paved area from 6% to 8% of the total catchment to the Lord of the Manor was not considered to be significant.

4.1.5 The key elements of the Proposed Development are listed and the potential sources of contamination are discussed. Particular attention is given to the proposed new fuel farm, given its proximity to the PWS. The pathway being considered is the Chalk aquifer and water entering the Western Adit of the PWS.

4.2 Proposed Development Site and Surroundings

4.2.1 Manston Airport has been an airport for approximately 100 years with the level of activity increasing significantly from the end of WWII in 1945. The airport has not been active since 2014. A full description of the Proposed Development is provided in **Chapter 3: Description of the Proposed Development** of the ES. The key aspects are presented below.

4.2.2 In light of the Proposed Development, those potential activities occurring in both the operational and construction phases that could have an effect on the water environment have been identified and include the following:

- Site drainage (surface water and soil drains) and waste water treatment;
- On-site storage of fuel and chemicals including cargo handling areas;
- Runway (de-icing) and aircraft maintenance/breaking/recycling, risk of spills etc;
- Land maintenance and the application of pesticides etc;
- Fire-fighting activities; and
- Construction activities associated with:

- Disturbance/removal of contaminated ground;
- Excavation/site investigation work creating vertical pathways for perched groundwater and contaminated land; and
- Re-activation of old drainage network/soakaways.

4.3 Conceptual Hydrogeological Site Model

Introduction

4.3.1 As previously stated, the conceptual model developed for the preliminary risk assessment has been based on previous work, historical reports and a desk-top study. At this stage, no intrusive investigations or site-specific data such as groundwater levels or land quality data are available. The conceptual model will be reviewed and refined during subsequent risk assessment tiers, which could be pre- or post-examination.

4.3.2 The conceptual model represents the characteristics of the site and indicates the possible relations between **contaminants**, **pathways** and **receptors**, where:

a) A **hazard** or **potential contaminant (source)** is an activity or substance which is present in, on, or under the land and has the potential to cause harm;

b) A **receptor** is that which could be adversely affected by the contaminant, including human beings; and

c) A **pathway** is a route or means by which a receptor could be exposed to, or affected by, a contaminant.

4.3.3 For a potential risk to exist at a site then all three of the above elements must be present and linked together so that a contaminant has been identified, a receptor is located on-site and there is an exposure pathway that links the contaminant to the receptor. The term **contaminant linkage** is thus used to describe a particular combination of contaminant-pathway-receptor relationship.

Conceptual Model

4.3.4 As discussed in **Chapter 3: Hydrological Environment** of this report, the geology beneath the site comprises Made Ground overlying in part Head Deposits which in turn overlies the Newhaven Chalk. The Thanet Formation may be present in the north-east part of the site but is not proven.

4.3.5 The Chalk is classified by the EA as a Principal Aquifer and the Thanet Formation as a Secondary Aquifer A. Shallow perched water may occur in the Made Ground or above low permeability layers within the Thanet Formation, whilst the Chalk aquifer supports a number of potable abstractions, including the Lord of the Manor PWS, with its associated SPZ1.

4.3.6 From discussion with the EA and SWS, for the purpose of this assessment, the key aspect of the conceptual model is how activities linked to the construction and operation of the Proposed Development may lead to contamination of the adit feeding the Lord of the Manor source. The main features of the groundwater and contaminant flow conceptual model are listed below:

- Direct recharge occurs mainly over the outcrop Chalk, with some ‘run-off recharge’ from areas covered by less permeable Head Deposits;

- The Chalk aquifer is unconfined and potential contaminants can migrate to the water table via fracture flow in fissures and relatively slow flow through the Chalk matrix, with exchange of contaminants between these two elements via diffusion;
- Groundwater contours suggest that the shape of the water table generally follows a subdued form of the surface topography, with flow radiating outward from the central topographically high area of the Thanet Chalk Block. As a result, a groundwater mound has formed to the north west of Ramsgate, coincident with the Chalk anticline. Generally, groundwater flow is radial towards the coast and to a lesser extent towards the Rivers Stour and Wantsum;
- Under natural conditions without abstraction groundwater flow to the south would emerge as either baseflow into the River Stour or springs emerging from the Chalk along the coastal margin;
- Groundwater under the Proposed Development site flows southward towards the natural discharge areas between Cliffsend and Pegwell, but is intersected by the Lord of the Manor PWS and its associated adits;
- Flowsource modelling (Amec Foster Wheeler 2017) suggests that the Western Adit receives water from an area beneath the north-west of the Proposed Development site and the large area of agricultural land to the north, whilst groundwater flowing to the Eastern Adit is derived from the eastern part of the catchment up hydraulic gradient of Ramsgate;
- Groundwater levels and the source configuration and construction suggests that the input from the Western Adit is reduced at low water table. The Eastern Adit appears to consistently collect water from the eastern part of the catchment, including the suburbs of Ramsgate. Water quality data for solvents and nitrate appears to confirm this understanding of flow;
- Both solvents and nitrate behave similarly. Both are relatively conservative in aerobic aquifers and low concentrations tend to coincide with low water tables of less than 2m AOD. During high to average water tables, higher concentrations of both are detected at the Lord of the Manor PWS;
- The sources of nitrate in groundwater include both urban (run-off, sewers and mains) and agricultural sources. Unsaturated zone porewater profiles suggest that the concentrations of nitrate beneath urban areas and parks is lower than beneath arable land. The main source of nitrate is likely to be agricultural activity; and
- The source of solvents is likely to be historical, linked to light industry, with the potential for multiple sources and plumes, but interaction with these sources appears to increase at a water table at or above 2-3m AOD.

4.3.7 A conceptual model cross-section showing the relationship between the SWS PWS, its adits and the Chalk aquifer and the possible effects of the Proposed Development is shown in **Figure 4.1**.

4.3.8 Given the geological setting there is little or no natural protection to the Chalk aquifer from spillages or pollution of recharge water. With the presence of the SPZ1, the most stringent groundwater protection measures are necessary. With these measures in place, future changes to the SPZ area or the addition of further abstractions in the vicinity of the Proposed Development site are not anticipated to require any further groundwater protection measures.

Potential Sources

4.3.9 It has been assumed that the operation of the Proposed Development would represent similar potential sources (hazards) as the previous airport i.e. it would not lead to the introduction of any new sources of potentially polluting substances over and above those that have existed previously. However, development associated with the Proposed Development, the building on new areas will result in ground disturbance and therefore the possible presence of contaminants and their release to the groundwater environment need to be considered.

4.3.10 The potential contaminant sources on the site are detailed in **Table 4.1**.

Table 4.1 Potential Contaminant Sources Associated with Manston Airport

Source Activity	Description	Potentially Polluting Substances
Water treatment facility	Plant for the treatment of on-site surface water.	Chloride, ammonium, dissolved metals, acids used for cleaning and pH balancing.
Fuel and chemical storage	Bunded fuel storage on hardstanding or within cargo handling areas.	Petroleum hydrocarbons (TPH) and chemicals benzene, toluene, ethylbenzene and xylene (BTEXs).
Re-fuelling	Spillage during re-fuelling.	TPH, BTEXs.
De-icing storage and use	Storage and application of de-icing chemicals.	Glycols.
Aircraft maintenance, breaking and recycling	Spillage of organic chemicals (solvents, fuels etc.).	TPH, BTEXs, solvents.
Emergency water use/fire fighting	Fire water and disposal.	Foaming agents, hydrocarbons. May become contaminated dependent on the emergency.
Pesticide application	Application of pesticides and herbicides to areas that drain into the Chalk.	Metaldehyde and herbicides (including MCPA, propyzamide, carbetamide, mecoprop and chlorotoluron) clopyralid, chlorotoluron, bentazone, metaldehyde, cypermethrin[7].
Foul drainage	Leakage from new foul sewers.	Nitrates, pesticides, organic solvents.
Surface drainage system including car parks	Leakage from drainage network.	Mineral salts, nitrates, pesticides, organic solvents, bacteria.
Existing soakaways	Some areas of the site drain to existing soakaways. Sediment in these soakaways may leach contamination to groundwater.	TPH, polycyclic aromatic hydrocarbons (PAHs) heavy metals.
Historical activities – soil contamination	The site has been used as a military airbase in the past and for light industrial activities linked to	TPH, BTEX, PAHs, heavy metals, chlorinated solvents, tetrachloromethane,

[7] http://www.adas.uk/Portals/0/Documents/Pesticides_Forum_annual_report_2015_web_final.pdf

Source Activity	Description	Potentially Polluting Substances
	the operation of the site (engineering works, munitions, burning of petrol along the runway, fuel pipes, waste oil tanks, use and storage of Pyrene runway foam, burning ground area and fire-fighting activities, fuelling and cleaning of aircrafts/helicopters, use of de-icing chemicals, waste storage areas, acid pits, substations and transformers etc.) that may have produced historic contamination at the site.	PFOS, PFOA, glycols, emulsifiers, asbestos, cyanides, radium, PCBs.
Made Ground/Head Deposits soils	Leaching of contaminants through disturbance and construction activities within Made Ground soils.	Ammonium, dissolved metals, phenols, asbestos and potential PAH, TPH, pH, carbon dioxide, and methane.
Made Ground/Head Deposits perched groundwater	Any perched groundwater found in the Made Ground may be potentially polluting substances and has a high vulnerability to pollution.	Ammonium, dissolved metals, phenols and potential PAH, TPH and volatile organic compounds (VOCs).
Construction activities	Ground disturbance and vibration increasing the number of fines with the potential for increased turbidity in groundwater.	Turbidity.

4.3.11 In discussions with the EA, the potential hazards associated with the re-development of the existing Jentex site as the new airport fuel farm have been identified as the major concern. This aspect is therefore examined in detail in Section 4.4 below.

4.3.12 The EA has also identified that use of pesticides for weed control should be limited to areas with active drainage and that no pesticides should be used over areas of land that freely drain into the underlying Chalk.

4.3.13 SWS has identified the possible risk of increase turbidity as a result of physical disruption (e.g. vibration, shaking) associated with any demolition, foundation piling or breaking up of the runway where it overlies the Western Adit, as a concern.

Potential Pathways

4.3.14 The main pollution pathway is from the surface to groundwater within the Chalk aquifer by vertical flow in the unsaturated zone and lateral flow in the saturated zone. The thin soils present on the Isle of Thanet do not retain pollutants and so any contaminants are readily available for leaching into the unsaturated zone and ultimately to the water table. Nitrate investigations (SWA 1985) have demonstrated that the rate of downward migration of groundwater is slow (0.5m/a), although there are occasionally episodes of more rapid movement following storms.

4.3.15 The Chalk is a dual porosity aquifer, in which any contamination that enters the Chalk migrates into the matrix under a concentration gradient. The reverse, diffusion-controlled movement out of the matrix into flowing groundwater within fissures limits the rate at which contamination can be flushed from the aquifer. In addition, the matrix remains saturated above the water table, where water is held by capillary forces and water within the matrix above the water table moves downwards slowly. In these ways the unsaturated zone and zone of water table fluctuation can act as stores of contaminant mass. The interaction between fissures and matrix acts in the short-term to reduce the peak of contaminants arriving at a receptor, but can also lead to contamination having a much longer duration or retention time, even if contaminant concentrations at the source diminish and fracture water concentrations start to reduce.

4.3.16 The additional potential pathways that may be introduced due to the Proposed Development include the following:

- **Deep foundation piling**: construction of piled foundations, other deep structures and excavations for any new buildings may create vertical pathways within the unsaturated zone;
- **Excavations**: if dewatering is required for deep excavations, pumping has the potential to draw in contaminated groundwater from elsewhere on-site or from off-site sources, creating new pathways or altering existing pathways;
- **Demolition**: demolition of old buildings may create vertical pathways within the unsaturated zone;
- **Boreholes**: incorrectly constructed and sealed deep site investigation or water level monitoring boreholes can create vertical pathways within the unsaturated zone; and
- **Construction**: may cause vibration leading to increased turbidity in groundwater.

4.3.17 Current pathways and pathways that may be developed due to the Proposed Development are identified in **Table 4.2**. As many of the pathways that may be created during the construction will remain during the operation phase, the pathways for both phases can be considered together.

Table 4.2 Receptors and Pathways

Receptors	Pathway
Groundwater in the Chalk aquifer (Principal Aquifer)	Discharge of contaminated groundwater through lateral flow in Made Ground into the Chalk. Discharge of contaminated groundwater through lateral flow in Head Deposits into the Chalk. Discharge of contaminated groundwater through lateral flow in Thanet Formation into the Chalk. Vertical migration of contaminants. Vertical migration via artificial pathways (e.g. deep piles, deep boreholes). Vertical migration in excavation areas from Made Ground. Lateral groundwater flow. Vibration leading to release of turbidity.
Groundwater in Thanet Formation aquifer (Secondary Aquifer A)	Discharge of contaminated groundwater through lateral flow in Made Ground into the Thanet Formation. Discharge of contaminated groundwater through lateral flow in Head Deposits into the Thanet Formation. Vertical migration of contaminants. Vertical migration via artificial pathways (e.g. foundations, deep piles). Vertical migration in excavation areas from Made Ground. Lateral groundwater flow.
Groundwater in Head Deposits	Discharge of contaminated groundwater through lateral flow in Made Ground into the Head Deposits. Vertical migration of contaminants. Vertical migration via artificial pathways (e.g. foundations, deep piles). Vertical migration in excavation areas from Made Ground. Lateral groundwater flow.
Lord of the Manor PWS Chalk aquifer	Vertical migration of contaminants. Vertical migration via artificial pathways (e.g. deep piles, deep boreholes). Lateral groundwater flow into adit.
Coastal waters	Vertical migration of contaminants. Vertical migration via artificial pathways (e.g. deep piles, deep boreholes). Lateral groundwater flow to coastal discharge locations.

Potential Receptors

4.3.18 The main receptors that are potentially at risk from the Proposed Development are summarised below:

- Groundwater in the Chalk aquifer (Principal Aquifer); and
- Groundwater PWS (the Lord of the Manor source).

4.3.19 Possible perched groundwater in the Head Deposits or Thanet Formation (Secondary Aquifer A), if present, is not considered to be significant due to its limited occurrence and because any groundwater from these formations is likely to drain into the underlying Chalk.

4.3.20 The likely significant effects from ground conditions on designated ecological receptors (i.e. Pegwell Bay SSSI) have been 'screened out' of requiring further assessment in this Hydrogeological Impact Assessment. This is on the basis that the identified ecological receptor is located downstream of the Lord of the Manor PWS and its associated adit, therefore any additional mitigation measures identified as outcomes of the assessment of impacts on groundwater underlying the Proposed Development will also be protective of the migration pathways through groundwater towards the Pegwell Bay SSSI.

4.4 Hydrogeological Impact Assessment

Introduction

4.4.1 A risk assessment following the EA GP3 has been undertaken using the Manston Airport conceptualisation presented in Section 4.3. The site activities are identified as an operational airport and associated construction work and the main receptor considered is the Chalk aquifer and in particular the Lord of the Manor PWS/Western Adit.

4.4.2 As the Proposed Development location cannot be changed and is a NSIP, then in accordance with EA requirements, the emphasis is placed on the protection of groundwater. The EIA process and this accompanying Hydrogeological Impact Assessment identifies all the potential pollution linkages and the BAT to mitigate the risks. The EA has been involved in discussions surrounding the Proposed Development and has helped to identify suitable mitigation measures.

4.4.3 As identified in **Chapter 2: Groundwater Protection and Legislation** of this report, the presence of the SPZ around the Lord of the Manor PWS influences the assessment as follows:

- SPZ1: Potentially polluting activities are not permitted in a SPZ1. The SPZ1 extends along the line of the Western Adit to the Lord of the Manor PWS and is more or less coincident with the runway (see **Figure 2.2**). There are no new potentially polluting activities in this area associated with construction and operation of the Proposed Development. For example, drainage from the runway would be collected and diverted off-site, so that the potential for pollution from activities on the runway is minimised; and
- SPZ2: the EA will only agree to proposals for infrastructure developments where they do not have the potential to cause pollution or harmful disturbance to groundwater flow or where these risks can be reduced to an acceptable level. In order to reduce risks then the EA expects BAT to be applied. Activities within SPZ2 have been assessed on this basis.

4.4.4 The Hydrogeological Impact Assessment presented here therefore considers those potential activities with SPZ2, on the assumption that there would be no new potentially polluting activities within the currently defined SPZ1. It comprises the following elements:

- Identification of main hazards (sources);
- Assessment of the likelihood of a release occurring;
- Assessment of the consequence of a release to receptors;
- Assignment of a relative measure to each of the above parameters to enable a qualitative assessment of the overall risk level (low, medium, high, critical);
- Identification of mitigation measures that would be put in place to stop or reduce the risk of contaminants escaping into the environment; and

- Recommendations for additional measures or monitoring where a residual risk has been identified.

4.4.5 For each source, the risk assessment therefore considers the hazard (e.g. event causing a release of a contaminated substance to the environment), the consequence of the release (e.g. pollution at a receptor), the likelihood of the event and the mitigation measures that can be implemented to prevent or reduce the consequence of the event. The assessment considers the risk before and after safeguards are put in place. Where the overall risk is identified as high or above, then the Proposed Development is considered to represent an unacceptable risk unless further mitigation measures can be implemented.

Hazards

4.4.6 For each of the identified sources, the impact assessment identifies the possible mechanisms that could result in the release of contaminants to the environment by considering such aspects as location, failures and maintenance and operational activities. Contamination due to surface water flooding and flood water management has been considered in the FRA and therefore are not be considered here.

4.4.7 The main mechanisms that could result in a release to the environment for the sources considered for this development (see **Table 4.1** above) are as follows:

- Leaks from fuel and chemical (e.g.de-icing compounds/fire-fighting foam additives) storage tanks (including within designated cargo storage areas) and delivery tankers during off-loading;
- Failure or overtopping of bunds or concrete floors/hardstanding during refuelling, aircraft maintenance/breaking/recycling etc;
- Failure of liners of attenuation ponds;
- Leakage from drainage network;
- Leakage of effluent from foul main network;
- Contamination following an emergency incident; and
- Application of pesticides to free draining areas.

4.4.8 Additional mechanisms that could result in an increased risk to the environment during the construction phase of the Proposed Development are as follows:

- Possible vertical and lateral pathways would be generated between aquifers during site investigation work;
- Creation of vertical groundwater pathways between aquifers through piled foundations, other deep structures and excavations;
- Mobilisation of poor quality groundwater within the Made Ground or Head Deposits;
- Earth and groundworks during demolition and construction mobilising contaminants into the Chalk aquifer; and
- Ground disturbance and vibration increasing the number of fines with the potential for increased turbidity in groundwater, particularly works in the vicinity of the adit under the runway.

4.4.9 In discussions with the EA, the potential hazards associated with the re-development of the existing Jentex site as the new airport fuel farm have been identified as the major concern. This aspect has therefore been examined in particular detail below, before construction and other operation hazards are considered.

Fuel Farm Hazards

4.4.10 As part of these proposals, there is a requirement for a new fuel storage facility to accommodate the needs of the airport. The existing Jentex fuel storage facility, located to the south-east of the airport (**Figure 4.2**), has been identified as the preferred option (Amec Foster Wheeler 2017(d)) for the new fuel farm as part of the Proposed Development. The Jentex site has been in operation for approximately 50 years. It is anticipated that the Jentex site would require re-development to meet current standards, along with a review of the new design for compliance against current regulations.

4.4.11 Following a review of the current layout and design, the fuel farm layout presented in **Figure 4.3** has been proposed for the Proposed Development, although any final layout will be subject to a further detailed design.

4.4.12 The main features and design changes compared to current layout include the following:

- New Jet A1 fuel storage tanks. To meet the daily fuel throughput requirements, it would be necessary to simultaneously load and offload from the Jet A1 Fuel tanks. For these activities to take place, the design requires separate loading and offloading storage tanks as well as an intermediary settling tank. Therefore, the current design includes 3 x 700m^3 (1 x loading, 1 x settling and 1 x offloading) double skinned Jet A1 fuel tanks located within a common bund;
- Fuel would be delivered to the site by road tanker. Fuel delivery to aircraft would be by a fleet of specialist fuel bowsers;
- It is anticipated that a small number of light aircraft may use Manston Airport. Therefore, an additional 20m^3 Avgas storage tank has been provided. This is located to the east of the main Jet A1 tanks, within the same common bund. The demand for Avgas is expected to be low, therefore the number of loading and offloading activities required for Avgas would be significantly less compared to the Jet A1;
- A dedicated bowser and trailer parking area has been provided to the east of the site. Normally empty bowsers would be parked within this area, but there is the potential for Jet A1 bowsers to be filled and stored in the parking area overnight ready for the morning shift, although this would be a maximum of two or three bowsers with connected trailers; and
- Fuel tanker offloading and bowser loading would occur to the south and north of the site respectively. Each of these locations would be provided with a curbed / bunded area and a sealed drainage system to contain unexpected leaks and prevent offsite releases and discharges into public waterways.

4.4.13 There are many potential hazards to be taken into consideration in the design of the new fuel farm and future operation. In this section, consideration is being given to the risks of a significant leak of aviation fuel reaching the saturated part of the underlying Chalk aquifer. The main pathway is from the surface to the Chalk groundwater, by vertical flow through fissures in the unsaturated zone and then lateral flow in the saturated zone.

4.4.14 It is expected that any kerosene spilt at the surface and bypassing any containment and drainage capture system, would enter the ground and travel downwards via fissures. A proportion of the release volume would be left along the pathway, smeared and entrapped. For small spills, the effect of smearing and entrapment would attenuate the kerosene before it reaches the water table, which lies at ~35mbgl.

4.4.15 For larger spills, kerosene would reach the water table, where it would spread out to form a light non-aqueous phase liquid (LNAPL) within the fissured Chalk. The kerosene would move out under the driving head created by the accumulation of LNAPL beneath the spill until either the driving head is no longer large enough to drive further movement, the LNAPL reaches the edge of the aquifer / receptor, or it reaches a barrier to flow.

4.4.16 The direction of spread is driven by the thickness of LNAPL, the hydraulic gradient of the water table and the orientation of fissures. Where there is limited hydraulic gradient, spreading would be close to radial. At Manston, the PWS adits are a potential preferential pathway for migration of LNAPL and contaminated groundwater and may influence the location and rate of spreading.

4.4.17 Larger spills have the potential to create their own driving head beneath the site of the spill due to the accumulation of LNAPL in fissures. This can force LNAPL below the water table as well as laterally. Furthermore, kerosene in contact with groundwater would leach hydrocarbons into groundwater to create a dissolved phase. This dissolved phase would be dominated by the more soluble compounds such as benzene, even though these form only a small proportion of the total mass. Due to the low mass of soluble compounds in kerosene, the concentrations of these compounds in groundwater would reduce over time as they are leached out and exhausted. As a result of leaching of the more soluble compounds, the remaining LNAPL would eventually comprise largely insoluble compounds. If left in the ground, this insoluble LNAPL would likely persist for many years.

4.4.18 As a result of leaching, a plume of contaminated water would develop extending from beneath the LNAPL downgradient in the direction of flow. Initially, the plume would expand in the downgradient direction as contaminants are leached from the LNAPL. However, following a period of acclimatisation, microbial-mediated degradation would start to degrade the dissolved compounds. The rate of degradation could be fast when compared to the rate of movement. Typically, the degradation process would result in the plume stabilising at some distance, before starting to contract once the supply of hydrocarbons available from leaching is reduced or exhausted.

4.4.19 Under natural conditions (i.e. the Lord of the Manor PWS not pumping), the hydraulic gradient is to the south with discharges around Pegwell Bay. With the Lord of the Manor PWS pumping then it is possible that the gradient is reversed with flow northwards towards the adit. If such a gradient exists and given the small distance to the adit, rapid contamination of the PWS could be possible.

4.4.20 Alternatively, as the adit is located to capture a large proportion of groundwater flow from the north of the Thanet Block, it is possible that the majority of the flow into the adit comes from the north and very little from the south. If this is the case, then even under pumping conditions the groundwater gradient northward towards the adit may be small or even absent.

4.4.21 To help resolve this uncertainty, a numerical analysis has been undertaken to determine the relative significance of flow to the Lord of the Manor adit from the aquifer to the south of the source, relative to flow from the aquifer to the north of the source. This was achieved using results from the EA's existing East Kent regional groundwater model (currently the BAT) and also the Flowsource software to predict the relative volumes of flow entering an adit to the source from the north and from the south. A technical note describing the methodology and results is presented in **Appendix B**.

4.4.22 The East Kent regional groundwater model was constructed by Mott MacDonald for the EA and other stakeholders in 2006. The model covers an area between the Chalk scarp east of Ashford to the coast around the Isle of Thanet. The model has three layers (two for the Chalk and one for overlying strata) and is built on the MODFLOW-VKD code, using the EA's in-house recharge code. The Lord of the Manor PWS is represented in the model as 30 abstraction wells, including the borehole and the Eastern, Western and South Western Adits. Each abstraction well pumps at the same rate.

4.4.23 The Hydrogeological Impact Assessment has been based on outputs from two East Kent model runs. In the Recent Actual (RA) model each well pumps at 116.7m^3/d, representing the average rate at which the PWS was pumped in recent years (3500m^3/d i.e. 3.5 Ml/d). In the PDO model each well pumps at 173.3m^3/d, equivalent to a total abstraction for the PWS of 5.2Ml/d. The Flowsource software has then analysed the modelled groundwater heads and flows to quantify the contributions of water from different parts of the Chalk aquifer to the Lord of the Manor PWS.

4.4.24 Flowsource takes the groundwater heads and flows from the MODFLOW model in each model cell, during each modelled stress period and calculates the following outputs:

- Capture Fraction (CF) - The fraction of water within each model cell captured by (or ending up at) a specified model cell (e.g. the cell hosting an abstraction);
- Volume From (VF) - The volume of water input to each model cell by model boundary conditions (i.e. recharge, riverbed leakage, and release from aquifer storage) that is captured by or ends up at a specified model cell;
- Volume Through (VT) - The volume of water that flows through the faces of each model cell that is captured by or ends up at a specified cell, based on the capture fraction and the total volume of water flowing through the faces of the model cell; and
- Age of waters - The time of travel from individual model cells to the abstraction cell. This calculation is based on the calculation of the time of travel of particles released at the water table, from the centre of each model cell, to the abstraction cell (using the MODPATH method of calculation of flow through permeable saturated media). This value does not include time of travel through the unsaturated zone.

4.4.25 The results of the combined model analysis are summarised as follows:

- A small proportion of the flow to the Western Adit of the PWS is predicted to originate from the aquifer to the south of the adit. In the long-term average, the proportion of flow originating from the south is about 1.2% (RA model) to 4.2% (PDO model);
- Under high water levels, this proportion is further reduced to about 0.1% to 0.2%. Under low water levels, the proportion is about 1.5% (RA model) to 5.3% (PDO model);
- This contribution, whilst very small, is not zero;
- In the RA model the flow that does reach the adit from the south is predicted to have very long times of travel in the saturated zone. This is due to a predicted zone of stagnation being to the south of the adit and close to it;
- In the PDO model there is a small area to the south of the adit with a predicted time of travel of about 200 days, i.e. the predicted zone of stagnation is slightly further to the south, as would be expected;

- In the RA model the proposed fuel farm location lies on the very edge of the modelled PWS catchment. The model cells immediately to the south of the proposed location are predicted to lie outside the catchment;
- In the PDO model the PWS catchment extends one additional model cell (i.e. 250m) to the south and thus includes the proposed fuel farm location; and
- In both models there is a very small predicted component of saturated groundwater flow east-west near the adit. However, the dominant direction of flow is north-south.

4.4.26 In conclusion, the location of the fuel farm site south of the adit means that when the Lord of the Manor PWS is pumping only a small proportion of groundwater form under the site flows north to the PWS adit. This indicates that a pollution event may not lead to an immediate and large-scale contamination of the PWS. However, although a small fraction of the flow to the adit is predicted to originate from the aquifer to the south, it is not zero. Therefore, the risk of contamination of the PWS cannot be eliminated without mitigation. In the case of a large fuel spill this can create its own driving head that could drive fuel in different directions or more rapidly towards the adit.

4.4.27 There are a number of uncertainties in the modelled results, including the following:

- The model is based on a 250m grid and as such all output represents average values over a 250m square;
- Where there are sharp gradients in Flowsource outputs, such as close to the catchment boundary to the south, there will be significant uncertainty in the values at a precise location;
- The Flowsource flow values are the result of interpolation from the rotated model grid. Whilst this is a robust procedure, it introduces further uncertainty into the results; and
- Small scale hydrogeological features, such as the precise location of the zone of stagnation and the detail of the ‘cone of depression’ around the PWS, are unlikely to be precisely represented by the model.

Construction Hazards

4.4.28 Hazards that could result in an increased risk to the environment during the construction phase of the Proposed Development include the following:

- Drilling causing vertical and lateral pathways to form between aquifers during site investigation work;
- Creation of vertical groundwater pathways due to piled foundations, other deep structures and excavations;
- Mobilisation of perched poor-quality groundwater within the Made Ground or Head Deposits;
- Earth and groundworks during demolition and construction mobilising contaminants into the Chalk aquifer; and
- Ground disturbance and vibration increasing the number of fines with the potential for increased turbidity in groundwater, particularly associated with works in the vicinity of the adit under the runway.

4.4.29 As with the other hazards discussed above, any contamination entering the Chalk aquifer will migrate to the Western Adit. The relatively large unsaturated zone thickness (>30m) and the relatively slow rate of water flow through this zone (0.5m/a) beneath these parts of the Proposed Development site means that any spill or accidental release of pollutants may not result in immediate or large-scale contamination of the PWS.

4.4.30 The creation of vertical pathways through site investigation drilling and/or deep foundations could result in more rapid contamination of the PWS and therefore such work should be avoided or if absolutely necessary undertaken with extreme care.

Other Operational Hazards

4.4.31 Operational hazards other than fuel farm leakage include the following:

- Leak from chemical (de-icing compounds/fire-fighting foam additives) storage tanks;
- Failure or overtopping of bunds or concrete floors/hardstanding during aircraft refuelling etc.;
- Failure of liners of attenuation bunds;
- Leakage from drainage network;
- Leakage of effluent from foul main network;
- Contamination following an emergency incident; and
- Application of pesticides to free draining areas.

4.4.32 In all these instances contamination entering the Chalk aquifer will migrate to the Western Adit. The relatively thick unsaturated zone beneath these parts of the Proposed Development site and the slow rate of flow through this zone again means that any associated spill or accidental release of pollutants may not result in immediate or large-scale contamination of the PWS.

Mitigation Measures

4.4.33 An important mitigation measure is that no potentially polluting activities would be located in SPZ1.

4.4.34 With respect to any potentially polluting activities located in SPZ2, standard mitigation measures in line with good practice and guidance would be implemented where appropriate, including measures to manage flood risk and drainage which are set out in the accompanying FRA. The EA in its response to the PEIR consultation (18 July 2017) indicated that it:

> "would therefore seek to work with applicants to ensure maximum environmental controls are in place for any agreed return to airport use".

4.4.35 The main mitigation measures that have been included in the Proposed Development are listed below, but these will be reviewed and revised once the final scheme is agreed and the results of any site investigation data are available.

Fuel Farm Construction and Operational Mitigation

4.4.36 For the fuel farm it would be important that specific and robust measures are incorporated into the design that address layout, primary containment integrity and design/operational controls for rapid detection, effective isolation and secondary/tertiary containment. The EA has stated that they "*would need to see a full options appraisal for any fuel depot location and agree full designs and containment processes for any agreed location*". The various options have been assessed (Amec Foster Wheeler 2017(d)). The appraisal identified that the adaptation of the Jentex site as the site for the Proposed Development fuel farm performs best against all of the following fuel farm requirements:

- Existing fuel farm infrastructure;
- Sufficient space and capacity;
- Separate and/or segregated access;
- Road access;
- Landside/airside access;
- Outside of groundwater SPZ1;
- Costs and constructability; and
- Proximity to aircraft aprons/stands and other operational considerations.

4.4.37 The following aspects can be considered within the fuel farm design following BAT principles, but these would be reviewed and revised once the final scheme is agreed:

- Primary containment is around the design of the fuel tanks and associated pipework (materials, thickness);
- Secondary containment takes a number of forms. In this case is includes a double skin on a tank;
- Bunding also provides a further level of secondary containment, affording containment to pipework and equipment associated with the tank, but outside of the double skin. The

appropriate sizing of bunding around the tanks. Guidelines require that the bunding must have the capacity to contain the largest predictable spill. This is achieved by providing the largest of either 110% capacity of the largest tank within the bund or 25% of the total capacity of tanks within the bund. For this tank farm a high level of integrity is embedded in the design, and each tank is located in an individual bund, so that only one tank is contained within one bund with 110% of the capacity of the tank plus an allowance for 1:100 rainfall event. Bunds to be constructed with adequate protection against collision and designed in accordance with standards;

- Comprehensive areas of hardstanding across the site with an associated active drainage capture system to collect all surface drainage and hence and any leaks;
- Containment with sealed drainage systems would be applied to bunds and fuel points, preventing the accidental entry of contaminants into sewer/stormwater drainage network;
- Oil interceptors and anti-pollution control valves would be installed to surface water runoff from internal roads;
- Systems of leak detection would be established beneath the tanks;
- The tank, pipework and loading/unloading would be equipped with shutdown to provide effective isolation. Where required this would include automatic detection and isolation systems (eg to protect against overfill of tank) and
- Appropriate areas of hardstanding, parking and operational buildings would be constructed for the airside bowser fleet.

4.4.38 In addition to leaks from the fuel tanks, contamination may also occur through spillage during loading and offloading operations. The inclusion of hard standing (with high kerbs) and an active drainage capture system would contain any spills and prevent them finding a route to ground (and ion the groundwater) or a pathway to the Pegwell Bay Outfall.

Other Construction Mitigation

4.4.39 Any potential sources introduced during construction will be controlled through good practice as set out in a Construction Environmental Management Plan (CEMP) and associated Code of Construction Practice (CoCP); as such they are unlikely to present a significant risk to groundwater. It would be a requirement that companies undertaking any construction work, inclusive of their workers and sub-contractors, are made fully aware of the hydrogeological setting and the sensitivity of the Lord of the Manor PWS and the appropriate measures required to minimise the risk of impact. During the development and construction phase mitigation measures may include, but are not limited to, the following:

- Contaminants would be prevented from entering the surface water system, including but not limited to sediment, fuel oil and building aggregates;
- Hazardous liquids would be stored further than 10m from any surface waters or surface water gullies during the construction phase;
- If there are concerns over potential impacts on the environment, works would be halted and the EA consulted immediately;
- The EA would be consulted on any changes made to the design of the surface water system;
- The EA would be consulted to ensure that the water quality discharge licence is varied in accordance with the current design proposals;
- Avoidance of the completion of deep boreholes, particularly in the more sensitive parts of the site, with all site investigation boreholes restricted to the minimum depth required to obtain geotechnical data for design purposes;
- No groundwater level OBHs would be constructed, unless approved by the EA;

- Dewatering or the placement of flow barriers to manage perched groundwater in the Made Ground during groundworks, so that flow into the underlying Chalk is prevented;
- The presence of potential groundwater flow in the Head Deposits would be taken into account in the design of deeper structures and in the selection of any infill materials;
- All contaminated ground would be investigated and remediation (as required) completed prior to the site being re-developed;
- Physical work within close proximity of the Western Adit may be potentially restricted (in type, timing and duration), subject to a further assessment;
- Piling would be avoided in sensitive areas, but if required would be designed to minimise hydrogeological risk[8] by using piling techniques that minimise disturbance and that also provide good seals;
- If/when existing buildings and infrastructure are demolished, then appropriate site assessment would be needed under footprints to ensure any historic contamination risk is fully understood and addressed. This is especially relevant for any chemical or fuel storage areas, including the Jentex site. Temporary surface water management or cover systems may be needed of exposed footprints until any remediation has been completed; and
- The location and configuration of any cement- or asphalt-batching plant during construction activities would be agreed with the EA and such plant should be as far from the SPZ1 area as possible, and designed to ensure all drainage is positively controlled.

4.4.40 In its response to the 2017 PEIR consultation, the EA also recommended the following:

- Personnel should be trained on the use of spill kits where applicable and other mitigation measures as outlined in the spill response plan;
- Penstock valves (existing or new) should be considered during the design phase of the surface water system and relevant personnel are trained in the use of the emergency system;
- A review of the use of any pesticides on the grassed areas should be undertaken to prevent pollution to groundwater or run-off in to surface water drains; and
- Outfalls in to surface waters should be monitored regularly during the construction phase and works halted if pollution is observed.

4.4.41 In their 2018 response the EA confirmed that he above recommendations stood but requested that risks associated with aircraft breaking/recycling and storage of materials in the cargo area be addressed as specific risks (see **Table 4.7**).

4.4.42 All these mitigation measures will be incorporated into the Proposed Development.

Other Operational Mitigation

4.4.43 The prevention of leakage and spillage of hazardous materials stored or used on-site would be addressed through environmental permitting during the operational phase. Mitigation measures will be documented in a future Environmental Management Plan (EMP) for Manston Airport. Specific measures would include the following:

- All drainage will be actively collected in appropriately sized attenuation pond(s) and treated prior to discharge off-site. Facilities would allow the interception and segregation of contaminated water and cleaner water (e.g. roof run-off). Ponds would be monitored for possible leakage;

[8] *Piling and Preventative Ground Improvement Methods on Land Affected by Contamination: guidance on Pollution Prevention* (National Groundwater and Contaminated Land Centre report NC/99/73) and *Piling into contaminated sites* (Environment Agency publication).

- EA Position Statement (Environment Agency 2017) G12 states:

  "*The discharge of clean roof water to ground is acceptable both within and outside SPZ1, provided that all roof water down-pipes are sealed against pollutants entering the system from surface run-off, effluent disposal or other forms of discharge. The method of discharge must not create new pathways for pollutants to groundwater or mobilise contaminants already in the ground. No permit is required, if the above criteria can be met*".

  However, discharge of treated water and clean water would be to Pegwell Bay rather than to ground, accompanied by the appropriate monitoring of water quality. Any discharge to ground would only be considered in those locations where the ground is shown to be free from contamination, the source of water is clean (e.g. roof runoff) and the location is distant from sensitive receptors;

- The location of all foul drainage would be agreed with the EA and any decommissioned existing drains would be removed, to ensure they do not form pathways for contaminant transport into the ground;
- All retained drainage pipework would be surveyed to allow the identification of leaks/failures and would be repaired to meet modern standards;
- All existing soakaways will be decommissioned and infilled with clean aggregate;
- All storage tanks will be appropriately designed to current standards (e.g. double skinned, bunded etc.). The design of required tank bunds would provide 110% storage capacity based on largest tank capacity and with the allowance for a 1:100 rainfall event;
- Deliveries of or storage within cargo units of any chemicals would be to designate controlled and bunded areas, with control levels and alarms used to identify leaks or overflows;
- Proposals for storage and use of any materials for firefighting will need the agreement of the EA and particular materials may not be approved, of some types of firefighting foams for instance, if there is a risk of loss to ground;
- Aircraft maintenance areas including those earmarked for aircraft breaking/recycling will be appropriately sized, using a lined (impermeable base) hardstanding and with a perimeter bund and contained drainage network. Areas designated for aircraft breakage/recycling would be subject to the appropriate environmental permitting to be agreed with the EA;
- Monitoring of the airport facilities, cargo units and potentially contaminating activities would be undertaken utilising inspections and regular walkover surveys;
- Maintenance and inspection procedures would be documented and implemented; and
- Environmental monitoring of surface waters would be put in place.

Risk Matrix

4.4.44 The risk matrix combines the likelihood of a hazard event occurring with the consequence of the event to derive an overall risk (negligible, low, medium, high and severe). The likelihood and consequence categories are summarised in **Tables 4.3** and **4.4** respectively, and are based on Amec Foster Wheeler's catchment risk assessment experience in the water industry.

4.4.45 The combined risk matrix is set out in **Table 4.5**, and individual hazards are then assessed with respect to the key Lord of the Manor PWS receptor using this risk matrix. The combination of likelihood and consequences leads to a qualitative assessment of the overall risk that is categorised from negligible to severe.

Table 4.3 Likelihood Assessment Criteria

	Likelihood					
	1	**2**	**3**	**4**	**5**	**6**
	Remote	**Highly Unlikely**	**Unlikely**	**Possible**	**Likely**	**Highly Likely**
Historical	Unheard of in the water industry	Has occurred one or twice in the water industry	Has occurred many times in the industry	Has been experienced once or twice by a water company	Has occurred frequently in a water company's experience	Has occurred frequently at a particular location
Frequency: (Continuous Operation)	Once every 10,000 - 100,000 years at location	Once every 1,000 - 10,000 years at location	Once every 100 - 1,000 years at location	Once every 10 - 100 years at location	Once every 1 - 10 years at location	More than once a year at location or continuously
Probability: (Single Activity)	1 in 100,000 - 1,000,000	1 in 10,000 - 100,000	1 in 1,000 - 10,000	1 in 100 - 1,000	1 in 10 - 100	> 1 in 10

Table 4.4 Consequence Assessment Criteria

Category	Description
Catastrophic	Large scale impact on Chalk aquifer. Results in exceedance of DWSs in PWS and other abstractions with the need to shut down supply or implement additional treatment. Long term/permanent impact.
Massive	Large scale impact on the Chalk aquifer. Results in exceedance of DWSs in PWS abstraction with the need to shut down supply or implement additional treatment. Long term (many years) impact.
Major	Large scale impact on the PWS source with major exceedance of water quality standards, and exceedance of DWSs and implement additional treatment. Long term (months/years) impact.
Moderate	Moderate scale impact on Chalk Aquifer with some deterioration in water quality standards and drinking water standards. Potable abstractions need monitoring and may need to be taken out of supply. Medium term impact (weeks/months).
Minor	Minor scale impact on Chalk aquifer with minor deterioration in water quality standards with low risk to groundwater abstractions. Medium term (weeks/months) impact.
Slight	Limited with little or no deterioration in water quality standards. Short term (days/weeks) impact.

Table 4.5 Risk Matrix

Consequence	Likelihood					
	Remote	Highly Unlikely	Unlikely	Possible	Likely	Highly Likely
Catastrophic	Low	Medium	High	High	Severe	Severe
Massive	Low	Medium	Medium	High	High	Severe
Major	Negligible	Low	Medium	Medium	High	High
Moderate	Negligible	Low	Low	Medium	Medium	High
Minor	Negligible	Negligible	Negligible	Low	Medium	Medium
Light	Negligible	Negligible	Negligible	Negligible	Low	Medium

Assessment Results

4.4.46 The combined risk table set out in **Table 4.5** has been used to assess the individual hazards (as identified in **Table 4.1**). Details are given in **Table 4.6** for those activities associated with the construction. **Table 4.7** assesses hazards associated with the long-term operation of the Proposed Development.

4.4.47 The assessment identifies that, without mitigation measures, a number of hazard events could result in a medium risk to the Lord of the Manor PWS during construction. Although residual (with mitigation) effects are considered for the temporary works during the construction phase to be negligible or low, a CoCP would be produced to manage activities during construction.

4.4.48 The assessment identifies that, without mitigation measures, a number of hazard events could result in a medium to high risk to the Lord of the Manor PWS during operations. However, the residual risk following the implementation of mitigation measures is generally negligible or low.

4.4.49 In the case of the fuel farm, the implementation of the proposed mitigation measures results in a low residual risk.' It is expected that an EMP would be produced for the operational phase and pollution prevention plans would also need to be agreed. These will consider best practice and also available innovative measures for spillage management.

4.4.50 The EA guidelines indicate that the EA will agree to fuel storage over Principal and Secondary aquifers outside an SPZ1, provided there is evidence of overriding reasons why the:

- Activity cannot take place within unproductive strata; and
- Storage must be underground (for example, for the purpose of public safety), in which case it is expected that the risks are appropriately mitigated. For the Proposed Development the EA has indicated a preference for any such storage to be above ground.

4.4.51 Where such storage already exists (as in the case of the potential use of the Jentex site), the EA:

> "will work with operators to assess and if necessary mitigate the risks, including an aim to change to above ground storage".

4.4.52 For all storage of pollutants underground (hazardous substances and non-hazardous pollutants), the EA expects operators to adopt appropriate engineering standards and have effective management systems in place. These should take into account the nature and volume of the materials stored and the sensitivity of groundwater, including the location with respect to SPZs.

4.4.53 These aspects would be taken in to consideration in the design of any new facilities, so the risk from leakage from fuel tanks could further be reduced by:

- Regular inspection of tanks and operating facilities and tank integrity monitoring programme would be required;
- Regular inspection of bunds and impermeable surfaces;
- Implementation of strict fuel delivery and control systems; and
- Detailed emergency response procedure/plan in the event of a failure.

4.4.54 The EMP and FRA would aim to ensure that the EA's objective of "*Good Status by 2027*" for the Kent Isle of Thanet Chalk WFD groundwater body is not compromised.

4.4.55 Consideration of the hydrogeological risks as part the project layout design allows designers to incorporate mitigation measures to minimise the groundwater risks from the Proposed Development.

Table 4.6 Determination of Hydrogeological Risks - Construction

Potential Source/Hazard	Mechanism	Likelihood	Consequence	Risk	Mitigation	Revised Likelihood	Residual Risk
Historical activities – soil contamination	The site has been used as a military airbase in the past century and light industrial activities linked to the operation of the site. Past activities may have produced historic ground contamination at the site. Possible vertical and lateral pathways may exist to the underlying aquifer that could be activated by construction work and/or site investigations.	Possible	Moderate	Medium	Water table deep (>30m below ground level), and earthworks are expected to be in dry material. No new deep boreholes would be constructed. Ground investigations and remediation (as required) would be completed prior to the site being redeveloped/constructed. If saturated material encountered then this would be contained and if contaminated remediated as appropriate.	Highly unlikely	Low
Made Ground and Head Deposits – deposit contamination	Past activities may have produced historic ground contamination at the site. Possible vertical and lateral pathways may exist to the underlying aquifer that could be activated by construction work and/or site investigations. Creation of vertical groundwater pathways between aquifers through piled foundations, other deep structures and excavations.	Possible	Minor	Low	Ground investigations and remediation (as required) would be completed prior to the site being redeveloped/constructed. Deep excavation and piling would be minimised.	Highly unlikely	Negligible
Made Ground and Head Deposits - perched groundwater contamination	Creation of vertical groundwater pathways between aquifers through piled foundations, other deep structures and excavations.	Possible	Moderate	Medium	Deep excavation and piling would be minimised. If saturated material encountered then this will be contained and if contaminated remediated as appropriate.	Unlikely	Low
General construction activities – increased fines	Ground disturbance and vibration increasing the number of fines, with the potential to increase turbidity in the groundwater.	Possible	Moderate	Medium	Limit works to areas away from the Western Adit. Water table deep (>30m below ground level), and so some attenuation of fine material. No new deep works near to adit.	Unlikely	Low

Table 4.7 Determination of Hydrogeological Risks - Operational

Potential Source/Hazard	Mechanism	Likelihood	Consequence	Risk	Mitigation	Revised Likelihood	Residual Risk
Water treatment facility	Leakage from on-site waste water lagoon and treatment plant.	Possible	Moderate	Medium	Lagoons constructed to high standards and monitored. Discharge of treated water and clean water to Pegwell Bay rather than to ground with appropriate monitoring of water quality.	Highly unlikely	Low
Fuel and chemical storage including within Cargo Units	Leakage from fuel storage tanks and/or loading and off-loading facilities:						
	- aviation fuel	Possible	Major	High	All storage tanks will be appropriately designed to current standards (e.g. double skinned, bunded etc.) design of required tank bunds to provide minimum 110 per cent storage capacity based on largest tank capacity with allowance for 1:100 rainfall event.	Highly unlikely	Low
	- other chemicals/hazardous substances	Possible	Moderate	Medium	Fuel farm to have comprehensive areas of hardstanding across the site with an associated active drainage capture system to collect all surface drainage and hence any leaks	Highly unlikely	Low
De-icing storage and use	De-icing chemical storage and application to planes, runway and taxiways.	Highly likely	Moderate	High	Application in designated areas with active drainage areas where run-off is led to water treatment lagoons. The lagoons will be appropriately sized to account for NPPF climate change allowances, to ensure that treatment facilities continue to function	Unlikely	Low
Re-fuelling	Spillage during re-fuelling.	Likely	Minor	Medium	Re-fuelling be to in designated areas with active drainage areas with fuel interceptors: use of control levels and alarms to identify leaks or overflows etc.	Highly unlikely	Negligible
Aircraft maintenance, breaking or recycling	Spillage of cleaning fluids, solvents and or fuels.	Possible	Moderate	Medium	Appropriately designed facilities with hardstanding and contained drainage system with interceptors as required. Aircraft breakage work subject to Environmental Permit to be agreed with EA.	Unlikely	Low
Emergency Water Use/fire-fighting	Fire water disposal.	Possible	Minor	Low	Application in designated areas with active drainage areas where run-off is lead to water treatment lagoons.	Unlikely	Negligible
Pesticide application	Application to free draining areas.	Unlikely	Moderate	Low	Pesticides only applied to hardstanding areas with active drainage to water treatment works.	Highly unlikely	Low
Foul drainage	Leakage from foul sewer connections.	Unlikely	Minor	Negligible	All foul drainage pipework to be surveyed to allow the identification of leaks/failures; these would be repaired to meet modern standards.	Highly unlikely	Negligible
Surface Drainage system including car parks	Pollution of and leakage from the drainage network.	Possible	Minor	Low	Drainage would be upgraded to modern standards and all flow collected in appropriately sized attenuation pond(s) and treated prior to discharge off site. Facilities would allow the interception and segregation of contaminated water and cleaner water (e.g. roof run-off). Ponds would be monitored for possible leakage.	Unlikely	Negligible
Existing soakaways	Some areas of the site drain to existing soakaways that are a potential route for contaminated water to enter the aquifer.	Possible	Moderate	Medium	All existing soakaways to be decommissioned and infilled	Unlikely	Low
Historical activities – soil contamination	The site has been used as a military airbase in the past century and light industrial activities linked to the operation of the site. Past activities may have produced historic ground contamination at the site. Possible vertical and lateral pathways may exist to the underlying aquifer.	Possible	Moderate	Medium	Water table deep (>30m below ground level) and earthworks are expected to be in dry material. No new deep boreholes to be constructed. Ground investigations and remediation (as required) would be completed (prior to the site being redeveloped/constructed.	Highly unlikely	Low

5. Conclusions

5.1 Site Setting and History

5.1.1 Manston Airport has been an airport for approximately 100 years with the level of activity increasing significantly from World War II. The airport has not been active since 2014. The adjacent Lord of the Manor PWS source dates from the 19th Century and the Western Adit was built in 1923.

5.1.2 The Proposed Development site is located over the Thanet Chalk Block, which has been the subject of a number of hydrogeological studies and therefore the conceptual groundwater environment is understood with some confidence. There are no surface watercourses in the vicinity of the site and under natural conditions, groundwater flow in the Thanet Chalk Block is approximately radial from the high ground south of Margate and with flow broadly from north to south under the Proposed Development site towards Pegwell Bay.

5.1.3 Across the Thanet Chalk Block, current groundwater quality does not meet drinking water standards due to the high level of nitrate and therefore water treatment is required. Water quality records suggest that there has also been infrequent contamination from solvents and pesticides. However, records do not identify either significant or persistent contamination that can be attributed entirely to past activities at the airport, although it is possible that some incidents may have gone unrecorded. Some residual contamination leading to low concentrations of TCE when water levels are high has been identified.

5.1.4 The SW Lord of the Manor source, together with three other sources, are the major supply of PWS in Thanet and therefore have high strategic importance, although the Lord of the Manor source has not been used since 2010. The SPZ associated with the Lord of the Manor PWS extends to include the Proposed Development site. The presence of the Western Adit that runs approximately along the line of the runway leads to an extension of the SPZ1 into this area.

5.1.5 Under pumping conditions at Lord of the Manor, the Western Adit captures the majority of the groundwater flowing from the north. Any contamination of the groundwater by activities to the north, including across the Proposed Development site and the wider catchment, may result in poor water quality at the Lord of The Manor. Groundwater modelling has shown that only a small proportion of water from the south flows to the adit.

5.1.6 Given the location of the site, its proximity to the Lord of the Manor source and Western Adit and the strategic important of the source, a Hydrogeological Impact Assessment has been undertaken.

5.2 Hydrogeological Risk Assessment

5.2.1 A qualitative risk assessment has been undertaken for the Proposed Development in relation to groundwater. The assessment first summarises the geology, hydrology and hydrogeology. This information is then used to develop a conceptual site model that identifies the potential sources of contamination, pathways and receptors.

5.2.2 Consultation with the EA and SW has confirmed the conceptual model and the likely hazards, with the proposed fuel farm being identified as the largest single hazard. The Chalk aquifer and, in particular, the Lord of the Manor source has been identified as the key receptor.

5.2.3 The risk assessment assumes that no new potentially polluting activities will occur in the SPZ1. The hazards are all assessed as potentially occurring in SPZ2.

5.2.4 The hydrogeological risk assessment has examined those hazard events that could result in a release of contaminants to the environment, the consequence of the release and the likelihood of the event occurring. A number of significant hazard events have been identified, and for each an appropriate set of mitigation measures (safeguards) have been proposed such that the residual risk is concluded in most cases to be low or negligible.

5.2.5 The possible exception is a hazard event associated with failure of aviation fuel tanks which coincides with a failure of a bund and/or impermeable surface or significant leak at the fuel farm contaminating the aquifer. With the proposed mitigation measures the likelihood of this event is considered to be highly unlikely. The groundwater modelling has shown that the majority of groundwater flow under the proposed fuel farm site is southward away from the adit and although, the consequence is considered to be major nevertheless the residual risk is assessed as low.

5.2.6 The risk from leakage from fuel tanks could further be reduced by:

- Regular inspection of tanks and operating facilities and tank integrity monitoring programme would be required;
- Regular inspection of bunds and impermeable surfaces;
- Implementation of strict fuel delivery and control systems; and
- Detailed emergency response procedure/plan in the event of a failure.

5.3 Summary

5.3.1 The past history of use of the site as an airport does not appear to have resulted in any significant water quality issues and therefore continued use of an airport employing modern environmental measures should ensure that future water quality issues are minimal.

5.3.2 The Proposed Development will not result in any new activities that will introduce additional hazards. The application of modern standards, improved drainage and regular monitoring and maintenance will ensure that the risk to groundwater is low or negligible.

5.3.3 All development associated with the airport that is within the catchment area to this source should be implemented to the highest standards to ensure that the risk of contamination is kept to a minimum. Appropriate training and awareness to be given to all staff involved in the Proposed Development and its construction.

5.3.4 The on-site storage of aviation fuel has been identified as the one area of medium risk and as such this aspect of the development should be subject to the most stringent mitigation measures and controls which adopted allows this residual risk to be assessed as low.

6. References

Allen, D J, Brewerton, L J, Cloeby, L M., Gibbs, B.R., Lewis, M A., Macdonald, A M., Wagstaff, S J and Williams, A T. 1997. The physical properties of major aquifers in England and Wales, British Geological Survey Technical Report WD/97/34, Environment Agency R&D Publication 8.

Amec Foster Wheeler 2017(a) – Manston Airport DCO Phase 1 Geoenvironmental Desk Study

Amec Foster Wheeler 2017(b) – Technical note: Lord of the Manor – Solvents and Nitrate prepared for Southern Water as part of the DrWPA NEP Programme: Groundwater Safeguard Zone Synthesis Report

Amec Foster Wheeler 2017(c) – Manston Airport DCO - Flood Risk Assessment

Amec Foster Wheeler 2017(d) - Technical note: 38199 – Manston Airport DCO EIA – Fuel Farm Requirements and Options Appraisal

Aquaterra, 2007. Lord of the Manor Constraints Investigation (Desk Study). Prepared for Southern Water pp. 42.

Atkins, 2014. Thanet sewers programme - Geotechnical and environmental investigation Phase A: desk study. Prepared for Southern Water. pp110.

Atkins, 2015. Thanet sewers programme: Geotechnical and environmental investigation Groundwater monitoring, February to June 2015. Prepared for Southern Water. pp208.

BGS 2004. Pesticides and their metabolites in groundwater - A field investigation from south east England. Groundwater Systems and Water Quality Programme Internal Report IR/04/014.

DWI 2012: UK drinking water standards: http://dwi.defra.gov.uk/stakeholders/guidance-and-codes-of-practice/WS(WQ)-regs-england2010.pdf

Entec, 2010. Thanet Nitrate Springs Groundwater Quality Project Phase 1 - Thanet Springs Sample Point Assessment. Prepared for Environment Agency South East. Pp44.

Environment Agency 2004 Groundwater Quality Review: River Thanet GWQR013.

Environment Agency 2013. Stour Abstraction licensing strategy: A licensing strategy to manage water resources sustainably.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289867/LIT_2048_61c7f0.pdf

Environment Agency's approach to groundwater protection (2017):
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/658135/LIT_7660.pdf

Mouchel 2007. Outline for the final report on Thanet Sewers Survey Phase II. Prepared for Southern Water. pp 98.

Mouchel, 2008. Groundwater Risk Assessment Interpretive Report – Isle of Thanet Groundwater Quality Assessment. Prepared for Southern Water. pp 39 British Geological Survey 2008. The Chalk aquifer of the North Downs. Research Report RR/08/02.

Mott Macdonald 2006. East Kent groundwater model. Final report. For the Environment Agency.

Southern Water Authority (SWA). 1985. Report on Thanet nitrate investigation: A study of the occurrence and cause of high concentrations of nitrate in groundwater's on the Isle of Thanet and their future trend. Southern Water Authority Technical Report, pp111

Thanet District Council (2006) Thanet Local Plan. Available online at: https://www.thanet.gov.uk/your-services/planning-policy/thanets-current-planning-policy/thanet-local-plan-2006/ [Accessed 12/12/2017]

.