NE/2/A

Town and Country Planning Act 1990 section 77,

Town and Country Planning (Inquiries Procedure) (England) Rules 2000

Public Inquiry into planning applications by London Ashford Airport Ltd for the construction of a runway extension and erection of a terminal building at London Ashford Airport Limited, Lydd, Romney Marsh, TN29 9QL

Proof of Evidence of David Heaver

21 December 2010

Natural England ref: LEG01-013 005/Planning – Lydd Airport Public Inquiry

Table of Contents

Introduction

1. I am David Heaver, Senior Invertebrate Specialist for Natural England and a professional entomologist. I am one of the organisation's two resident experts on invertebrates and, in this capacity, provide technical advice and support to members of Natural England's staff throughout the whole of England in relation to matters concerning the ecology and conservation of invertebrates. I have undertaken this role within Natural England for the past 3 years.

2. I hold a Master's Degree in Ecology, and am a former committee member of the Dipterist's Forum, the Society dedicated to the conservation and ecology of true flies.

3. Prior to become Natural England's Senior Invertebrate Specialist, I worked within Natural England on a range of entomology conservation projects in the West Midlands region. Previous to this, in my contract work for Natural England's statutory processor, English Nature, I undertook the extensive invertebrate survey project on Thorne Moors Site of Special Scientific Interest and National Nature Reserve, which ultimately assisted in the protection of this area from damaging peat extraction operations.

4. I am first author of the Natural England Common Standards Monitoring Guidance for the assessment of invertebrate condition across the SSSI series and currently lead in the development of ISIS, the database project which establishes invertebrate assemblages from data samples. My research interest is in the ecology of a Red Data Book 1 cranefly *Protogonomyia alboscutellata*, a species found in springline tufa flushes.

5. In this proof I will consider the special invertebrate interest features of the Dungeness, Romney Marsh and Rye Bay Site of Special Scientific Interest (the 'SSSI') and proposed Ramsar site ('pRamsar') with particular reference to those found in ditches and on the vegetated shingle. I will then go on to describe the impacts of the proposals of London Ashford Airport Ltd (the 'applicant') on this fauna focusing first on the conservation value of the ditches to be lost and the impacts of the proposals upon these ditches. I will also assess the value of the proposed new, replacement ditches. I will then go on to describe the invertebrate interest on the vegetated shingle and finally I will touch on the potential impacts of increased Nitrogen deposition on emissions on the invertebrate fauna via their supporting habitats. The conservation interest of the designated sites and the potential impacts of Nitrogen deposition on the flora of those sites are described in detail in proof of evidence of my Natural England colleague, Jo Dear, which should be read in conjunction with mine.

The Value of the Dungeness Landscape for invertebrates

6. The national and international importance of Dungeness for nature conservation has been set out in the proof of evidence of Jo Dear. In order to fully describe the invertebrate interest of Dungeness, it is necessary to use a series of technical terms that entomologists employ to explain the rarity, distribution patterns and conservation status of invertebrate species. The conservation status of invertebrates is recognised in volumes known as Red Data Books and the species referenced therein are referred to as Red Data Book species ('RDB'). Many of these invertebrate species are also subject to independent classification as "section 41 Biodiversity Action Plan species". This refers to an agreed list of species (including invertebrates) and habitats of priority importance for the conservation of biodiversity in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. More details of the terminology related to conservation of invertebrates are provided in Appendix 1 to this proof.

7. In general, the unique complex of habitats present at Dungeness, Romney Marsh and Rye Bay Site of Special Scientific Interest (the 'SSSI') support an extremely diverse invertebrate community. The information gathered to support the SSSI notification process (See Appendix 3 of NE/3/A) notes that at least 271 nationally scarce, 75 Red Data Book (RDB) and 17 provisional Red Data Book (pRDB) species have been recorded from the SSSI since 1980 across this site. A number of these are also section 41 Biodiversity Action Plan species in need of direct conservation action to aid their recovery.

8. The Dungeness area in general and the SSSI in particular represent, therefore, one of the finest known ranges of invertebrate species of conservation concern in England. Groups which have significant numbers of rare species include moths (Lepidoptera), beetles (Coleoptera), bees, wasps and ants (Hymenoptera), and flies (Diptera). These include the extensive British population of the medicinal leech *Hirudo medicinalis*, Britain's largest water beetle, the great silver beetle *Hydrophilus piceus*, a subspecies of the pygmy footman moth *Eilema pygmaeola pallifrons* that is known only from Dungeness, another endemic bug *Aphrodes duffieldii*, and several species of bumblebee listed on the UK Biodiversity Action Plan, to name just a tiny fraction of the species.

9. In my proof, I will focus on two particular habitats on Dungeness that are both of critical importance for the national conservation of invertebrates and which are likely to be affected by the current development proposals of the applicant. These habitats can be

referred to in non-technical language as: lowland ditch systems and vegetated shingle. These two habitats are specifically referred to in the SSSI notification package (see Appendix 3 of NE/3/A) and are explained by Jo Dear in her proof.

The nature and value of the Dungeness lowland ditch systems for invertebrates

Introduction

10. All ditches are man-made landscape features for either conveying water off sites and/or for acting as livestock barriers. They vary greatly in design, age, character, underlying geology, longevity, connectivity, water quality and in the management practices and regimes to which they are subject. Subsequently ditches vary quite considerably in their general ecological status in terms of the species they are able to support.

11. The supporting information underpinning the SSSI designation (see Appendix 3 of NE/3A) used previous survey work and metrics that were different to the more recent approach used in the analysis in this proof. That point aside, the earlier work also goes to support the value of wetlands on the site:

> "*The exceptional richness of the wetland invertebrate assemblages in the SSSI is indicated in the conclusions of Drake (2004), who ranked grazing marshes on the basis of representation of nationally rare and nationally scarce species, the quality of the water beetle fauna, and fidelity scores (indicating closeness of association with grazing marsh) for uncommon species. Drake (2004) included three areas of grazing marsh in his analyses that fall within Dungeness, Romney Marsh and Rye Bay SSSI. Walland Marsh and Rye Harbour were both given an overall ranking of national significance, placing them in the top 16 grazing marsh sites in Great Britain for grazing marsh invertebrates, whilst Pett Level was regionally significant and one of the top 45 sites*.

12. Ditches can sometimes be seen as historical landscape features, with Tooley (1995, citing Brookes) noting the fact that a number of the parish boundaries on the nearby Walland Marsh are straight and follow medieval drainage ditches or sea walls. This shows real antiquity of a number of the ditches on the Dungeness SSSI.

13. It is, of course, worth noting that the value for invertebrates on grazing marshes is, in my opinion, almost always confined to the bounding ditches, with the grazed pasture of the fields usually being of little conservation concern in its own right. So, to speak of the value of grazing marshes and levels for invertebrates is largely to speak of the value of ditch faunas.

The application ditches

14. The application site is crossed by a series of ditches some of which are known locally by the old term “sewer”. These will be referred to as the “application” ditches. The ditches form part of the wider Denge Marsh area, which runs between the coast and the sea cliffs and to the north and west of the application site. The land is low lying and at low elevation and crosses through an area of nationally important buried geomorphology. Jo Dear has explained the importance of the application site, including the area around the application ditches, for geomorphology in her proof.

15. Figure 1, which has been drawn using information from the applicant’s submissions (the information used is described on the figure), shows the location of the ditches in the wider context of the Denge marsh and Dungeness area. Currently the application ditches are a mixture of those managed by the Romney Marsh Area Internal Drainage Board (IDB) and private ditches managed by the occupier of the land (see CD1.42a). The main in-flows from the south are from the first half of the Mockmill Sewer (Ditch 5 on Figure 1) and from the area known as Romney Salts in the north via Paines Field Petty Sewer (Ditch 4 on Figure 1). The water then flows via an IDB control structure into the second half of Mockmill sewer (Ditch 3 on Figure 1) towards the large Dengemarsh sewer (circa 500m from the application site), a main river overseen by the Environment Agency. The small Ditch 2 (Figure 1) flows into Ditch 1 and then into Pains Field Petty Sewer. As can be seen in Figure 1, the application ditches show good connectivity to each other. In addition, the application ditches have good connectivity with the wider area of Romney Salts, to the north and Denge Marsh to the west. Mockmill sewer (Ditch 5) drains an area in the SAC and SSSI connecting the ditches to the shingle wetlands.

16. The ditches managed by the IDB are managed regularly to ensure water flow for drainage purposes is not impeded. The IDB manage their ditches in accordance with their Biodiversity Action Plan (RMAIDB, 2010) which aims to maintain and enhance the waterways it manages for ditch and waterway wildlife.

17. Figure 2a shows the ditches in the application site overlain on the First Series of Ordnance Survey maps (1843-1893). Most of the application ditches are present in 1843-1893 maps. This demonstrates clearly that most of the application ditches, like those of the wider marsh, are very well established with most of those in the proposed runway expansion area, at least 120 to 150 years old.

The invertebrate interest in the application ditches

Species of Conservation Concern Found in the Application Ditches

18. The applicant surveyed the application ditches in May and August 2007, using standard sampling techniques (see Core Document 1.23g (LAA)); note that in the applicant's survey the application ditches are referred to as 'drains'). The applicant's surveyor recorded all the captured species of invertebrates and noted the species of conservation concern and interest using the RDB criteria described above and in Appendix 1. Since that time however several species groups, most notably the water beetles (Foster, 2010), have been reviewed and their status accounts extensively revised. It is important when assessing the effects of these applications to use the up-to-date information on conservation concern and therefore I use this more recent categorisation. Using the most up to date status accounts on the seven application ditches now reveals one RDB2 species, five Near Threatened, six Nationally Scarce, one Least Concern (the definition of these conservation status terms is found in appendix 1).

19. The invertebrates of greatest conservation interest found in the applicant's survey and their current (revised) conservation status is shown in Table 1 below. Most species found were identified down to species level, though the aquatic *Bagous* weevils are only identified down to genus level, so it is not possible to tell which species are involved. However, many of the c. 21 British species of *Bagous* are either in the Rare categories, or Nationally Scarce, though we cannot tell if any of those were present in the Lydd samples. The surveyor later suggested that none of the Bagous were rare (see Core Document 1.33a(LAA)), though we still have no species list for them.

Table 1

Species of Conservation Concern Found in the Application Ditches

Taxa (Species)	**Conservation Status in 2010 (using most up to date criteria for all taxa).**
Odonata (Dragonflies and Damselflies)	
Hairy dragonfly (*Brachytron pratense)*	Least Concern
Scarce Emerald Damselfly (*Lestes dryas)*	Near Threatened
Diptera (True Flies)	
Black Colonel soldierfly (*Odontomyia tigrina)* Flecked G*eneral* Soldierfly (*Stratiomys singularior)*	Nationally Scarce
Ornate Brigadier soldierfly (*Odontomyia ornata)*	RDB2
Coleoptera (Beetles)	
Limnoxenus niger, *Great silver water beetle (Hydrophilus piceus)* *Enochrus nigritus* (=isotae) *Hydrochus elongates*	Near threatened
Enochrus quadripunctatus, *Graptodytes bilineatus* *Peltodytes caesus,* *Odacantha melanura*	Nationally Scarce

20. Using the most up to date status accounts on the seven application ditches reveals one RDB2 species, five Near Threatened, six Nationally Scarce, one species of Least Concern. The five Near Threatened species which lie just below Vulnerable status could in my opinion easily be tipped into the higher threat categories by continuing site loss and degradation across their range, and so merit attention. The ditches are clearly of high quality as they support an assemblage of rare and scarce species of invertebrates showing a good species diversity.

Application Ditch Interest and the SSSI Invertebrate Interest

21. The application ditches are part of the SSSI wetland assemblage interest feature. The SSSI citation mentions, by way of example, great silver diving beetle *Hydrophilus piceus*, the dragonflies and the soldierflies, all of which have good representation within the application ditches. Those species considered to be part of the SSSI notification as part of the wetland invertebrate features are noted in Table 2 (below). The application ditches thus hold a sizable part of the representation of the SSSI wetland invertebrate interest features as listed in the citation.

22. The legally protected, blood-feeding Medicinal leech, *Hirudo medicinalis*, has very good representation across Dungeness, with it occurring in over 100 of the water bodies across the Dungeness, Romney Marsh and Rye Bay area. Surveys for the legally protected medicinal leech were undertaken at the same time as those for other invertebrates, though the invertebrate surveys failed to find medicinal leech in the application ditches.

23. The importance of the area generally for medicinal leech would, in my opinion, have suggested that a greater survey effort than that undertaken was justified. However, the 2006 Great Crested Newt survey (see CD1.17) did discover medicinal leeches in what the newt survey methodology numbers as ditches 5 and 7 (the numbering system for ditches in the newt survey appears to correspond to the numbering system referred to in the invertebrate survey) . This is a significant find, both in confirming the presence of medicinal leech and in terms of the conservation importance of the ditches as part of the SSSI. The population of medicinal leech in the SSSI is considered to be the largest and most important in the UK. Impacts on medicinal leech are discussed in more detail in Jo Dear's proof.

Table 2

Application Ditch	SSSI feature?	Species name
Ditch 1	Y	*Lestes dryas,* Near Threatened
		Bagous sp.,
	Y	*Graptodytes bilineatus*, Nationally Scarce
	Y	*Hydrochus elongatus*, Near Threatened
	Y	*Hydrophilus piceus*, Near Threatened
	Y	*Peltodytes caesus* Nationally Scarce
Ditch 2	*Y*	*Lestes dryas,* Near Threatened
		Bagous sp.,
	Y	*Enochrus quadripunctatus* Nationally Scarce
	Y	*Limnoxenus niger* Near Threatened
Ditch 3		*Bagous* sp.,
(Mockmill Sewer)	Y	*Hydrochus elongatus*, Near Threatened
	Y	*Limnoxenus niger*, Near Threatened
	Y	*Peltodytes caesus*, Nationally Scarce
	Y	*Odontomyia tigrina* Nationally Scarce
Ditch 4		*Bagous* sp.,
		Odacantha melanura Nationally Scarce
Ditch 5	Y	*Enochrus nigritus*, Near Threatened
(Mockmill Sewer)	Y	*Hydrochus elongatus*,Near Threatened
	Y	*Hydrophilus piceus*, Near Threatened
	Y	*Limnoxenus niger*, Near Threatened
	Y	*Peltodytes caesus*, Nationally Scarce
	Y	*Odontomyia tigrina*, Nationally Scarce
	Y	*Odontomyia ornata*, Red Data Book 2
	Y	*Stratiomys singularior* Nationally Scarce
		Medicinal leech *Hirundo medicinalis* Sch 5
Ditch 6	*Y*	*Limnoxenus niger*, Near Threatened
	Y	*Odontomyia ornata* Red Data Book 2
Ditch 7		*Bagous* sp.,
	Y	*Limnoxenus niger* Near Threatened
		Medicinal leech *Hirundo medicinalis* Sch 5

Table 2. The Red Data Book, Near Threatened and Nationally Scarce species as recorded in 2007 but re-evaluated by 2010 status accounts for each of the Application ditches surveyed, with the SSSI wetland feature species noted. *Bagous* weevils have been retained as in the original submission. It is instructive to resolve this aggregate data down into SSSI feature group categories, with the species of conservation concern within those groups found in the application ditches being noted. English names of the species are given where they exist. Medicinal leech is added here for information, though was not found as part of the main invertebrate survey.

Comparison of Application Ditches with other UK ditch systems

24. A methodology for assessment of grazing marsh ditch invertebrate assemblage quality is provided in a report on behalf of Buglife, the main invertebrate conservation charity in the UK (Palmer *et al*, eds, *In Prep*). This was based on study of very high quality SSSI ditch ecosystems throughout the UK. It sets methods for assessing the conservation importance of the ditches in terms of their invertebrate assemblage. It is designed principally for assessment of ditches in coastal flood plain grazing marsh habitat, and though the fields around the application ditches are currently used for arable crops, the broader context makes them comparable. This point is supported by the eighty-three species which are found in the application ditches which are all coded (i.e. given an individual species value in the assessment process) for quality ditches in the tables of species provided in the methodology (Palmer *et al*, eds, *in prep*). A detailed description of the methodology used for calculating the values in table 3 and a rationale for why this approach was adopted is provided in appendix 2.

25. Table 3 below details the mean values for the metrics calculated in line with the Buglife methodology. The key value in the table is the Species Conservation Status Score. This is derived by assigning a value taken from the Buglife report to each species, summing all those values and dividing by the number of species to arrive at the score. The higher the score value, the greater the conservation significance of the sample. Fourteen species taken from the application ditches were not given any values in the Buglife report system and were removed from consideration in this exercise.

26. Those survey results which were only taken to the genus level, rather than down to species, were included as genera where this avoided double counting and where the individual species within that genus had individual species scores, and all were given the Species Conservation Status Score value of one as allowed for by the Buglife scoring methodology. This potentially underplays the importance of some of the records, especially for the *Bagous* weevils which have relatively high numbers of rare species amongst their ranks. A recent survey by Drake (2010) across the nearby East Guldeford and Pannel Valley discovered six *Bagous* species in a small area, with three of them being Nationally Scarce, one RDB1 species, and 2 others possible RDB1. Five of the application ditch samples contained *Bagous* weevils, and this does suggest that, had they been resolved down to species, their true conservation value would be recognised. However, none of the *Bagous* weevils are scored at species level in the Buglife scoring methodology and so have not been included in the ditch scoring assessment.

Table 3

Seven application ditches scored under the Buglife ditch manual technique

Application Ditch	Salinity	Marsh Fidelity score	Species conservation Status score	Number of coded species/ taxa
Ditch 1	0.05	1.05	1.44	25
Ditch 2	0	1.19	1.56	25
Ditch 3	0	1.26 ;1.23	1.33; 1.41	30; 32
Ditch 4	0	1.17	1.15	27
Ditch 5	0	1.32; 1.24; 1.33	1.32; 1.38; 1.55	28; 39; 31
Ditch 6	N/a	N/a	N/a	8
Ditch 7	0	1.15	1.32	22
Median Value for all application ditches			1.38	
National Mean for high quality grazing marsh *	<2000µS cm^{-1} (Fresh water)		1.4	

(Palmer *et al*, in prep) mean of 434 samples

27. The table above shows that the application ditches are only just below the mean for high quality ditches judged on a national scale. This demonstrates their high value. Moreover, the scores that have been attributed to the application ditches above by reference to the Buglife method must be viewed as being conservative, for a number of reasons. First, not all the application ditches were sampled with the same effort, the data

were only gathered from one year and Ditch 6 has so few species records that it is not possible, under the method, to score it with the other ditches. Secondly, the sample sites were chosen to reflect only those areas to be directly lost to the runway footprint so only parts of each ditch length were sampled, which will have lead to an under-recording of whole ditch features. Thirdly, the significant addition of medicinal leech in two of the samples outwith the main invertebrate dataset has not been factored into this exercise, though it clearly elevates the conservation value of both the individual samples in which it was found, and the Lydd ditch complex as a whole. If you add in scoring for the medicinal leech to the ditches where it was found, it would raise the scoring of the conservation value of those ditches significantly, since it is accorded the highest possible score of 5 points. Adding the medicinal leech record to Ditch 5's score raises the two samples scores to 1.48 or 1.45 (from 1.38 or 1.32, depending which of the samples clustered around the confluence of Drain 7 one uses), whilst that of Ditch 7 rises to 1.48 (from 1.32), elevating their comparative conservation significance further.

28. Moreover, and significantly, if only those ditches that are directly affected by loss to the development are included in the Buglife evaluation, and the medicinal leech is added in to Ditch 7, and the lowest medicinal leech influenced sample score for Drain 5 taken (the 1.45 value), the median value becomes 1.40, or equal to the national figure for high quality grazing marsh ditches.

29. Table 3 shows that the ditches vary in their current invertebrate quality compared with the national average of some 434 high quality ditches but are generally of high value. It is clear that Ditches 2 and 5 hold some of the highest quality scores, with the single sample from Ditch 2 nearing the quality of the highest quality sample of the three that were taken from Ditch 5. Ditch 4 has the lowest score. Four of the sample Species Conservation Status scores match or are equal to the average English and Welsh freshwater habitat score given above, with one score lying just below the average for high quality wetlands. However, I again stress that these scores must be viewed as being conservative, for the reasons I have set out above. Given these circumstances it is evident that the application ditches are of special quality and are of importance as both a feature of this particular SSSI and the national SSSI network generally.

30. Species Conservation Status score values do not highlight the contribution to quality from a wealth of interesting species upon which such scores are derived, such as the Water spider *Argyroneta aquatica* which builds a silken diving bell beneath the water's surface which it provisions with air from the surface, and where it consumed its prey. The

attractive and large Ornate Brigadier soldierfly *Odontomyia ornata* occurs in at least Ditches 3, 5 and 6, this species being of note as referenced in the Buglife report:

> "The soldierfly *Odontomyia ornata* (Vulnerable) and the Great silver water beetle (*Hydrophilus piceus*) (Near Threatened) deserve greater attention in the context of grazing marshes. They were among the most widespread and frequent of the scarce species, and both were associated with early to mid stage ditches with particularly high Species Richness." (p77).

31. The report regards this soldierfly as a "flagship species" for grazing marshes, and being a reliable indicator of "rich" conditions. The report notes that across all the 533 ditches sampled across England and Wales:

> "Species richness, SCS and marsh fidelity in ditches with *O. ornata* were significantly higher than in the remaining ditches, and, as noted for *Hydrophilus piceus*, the median species-richness (50 species) was high for a widespread species, suggesting that its presence may also indicate some of the best ditches in English grazing marshes." (p74).

32. The Near Threatened water beetle *Limnoxenus niger* is another species found in the application ditches which has suffered declines in the north of its range, but is widespread across the ditches of application site, where it lays its eggs in a cocoon secured to foliage below the water's surface, but receiving an air supply through a 60 mm-long, spongy-tissued ribbon.

33. In 1980 the Scarce Emerald Damselfly *Lestes dryas* was considered probably extinct in the UK, but in 1983 the species was rediscovered in Essex. Although probably under-recorded and now placed in the Near Threatened category, the British Dragonfly Society (citing Benton *et al*, 1996) consider that there are "no grounds for complacency" with this species. The damselfly was found in Ditches 1 and 2. The slight indication of salinity in Ditch 1 is of interest, in that this damselfly, unlike many of its kind, will tolerate slightly brackish water, conditions that appear currently not to exist in any of the other ditches sampled, though the highest number of larvae was in Ditch 2 which appears not to have saline influence.

34. In conclusion, it is clear that the application ditches are well established and form a link between the areas of vegetated shingle and the surrounding marshland. The ditches support a biodiverse invertebrate fauna with a range of rare and uncommon species

including the legally protected medicinal leech and number of species known to be indicators of high conservation quality ditches. The ditches hold an aquatic invertebrate assemblage that is both a representative part of and connected to the wider SSSI and is of conservation importance in the context of the national SSSI network.

Impacts of the proposals on the application ditches

35. Since the ditches have both individual species lists which can be linked to the SSSI criteria and the wider SSSI, and now Species Conservation Status scores under a national grading scheme, one can look at the likely and potential impacts on the ditch faunas from the development proposals. Figure 3 shows the areas of ditch to be lost to the runway and the ditches the applicant proposes as replacement drainage structures (these will subsequently be referred to as the 'new ditches'). Information from the applicant's Surface Water Drainage Strategy (see Core Document 1.42a(LAA)) has been used to estimate approximate lengths of the ditches which will be destroyed. These lengths, and notes related to the proposed location of inputs from the runway drainage via the new ditch system, are included in Table 4. This table also cross references the invertebrates of conservation concern found in the applicant's surveys.

36. Obviously since construction may involve extended drainage of the whole ditch lengths (at least to the nearest water control structure) these lengths may significantly underestimate the *actual* lengths of ditch impacted. The impact of draining ditches during construction would depend on what length of ditch was drained, for how long and when in the year, and what the pollution control measures were put in place during the construction and drainage period.

37. My conclusion is that the ditches will be adversely impacted by the applicant's proposals to a very substantial extent as a result of the direct loss of the SSSI features. In addition to this conclusion, increases in water management structures associated with the new ditches have the potential to have impacts on the remaining old ditch lengths. The applicant's Water Drainage Strategy (see CD1.42a) shows two existing control structures and two small culverts, with a proposal to relocate one of these structures and then insert a new one at the top end of the new ditches. Four new culverts are planned, doubling the number of culverted sections of ditches. In addition, four new outfalls will connect from the runway drainage into the ditch system. This substantial change in the water handling regime may well adversely affect those existing, old ditch lengths that, on the face of it, escape from being affected as they are not lost to the development.

38. The high quality of the existing ditches' fauna suggests that water quality is high, since some of the species listed are associated with good water quality including the scarce emerald damselfly *Lestes dryas* (BDS Factfile).

39. When the impacts on the ditch network are considered in relation to records from individual ditches, it can be seen that Ditch 2, though supporting only three of the rare species, has both one of the highest Species Conservation Status scores, is one of the two *Lestes dryas* sites, and has up to half of its length shown to be lost to the development, with the remainder potentially also being subject to water quality declines as a result of the existence and operation of the expanded airport. The Ditch 3 section of the Mockmill sewer has an estimated 3/5ths lost to direct impact, with water quality issues potentially arising from the development as well, and is ranked as one of the mid quality ditches, supporting two Near Threatened species (i.e. just below the critical status section of the conservation status scheme). The Ditch 5 impacts, estimated at up to 50% loss, affect the highest number of conservation concern species *and* impact on a mid ranking ditch assemblage overall and potentially on the highest scoring samples, with water quality issues potentially arising from the development for the southern sections in addition.

40. Approximately 1/3 of Ditch 4 and a 55m length of Ditch 7 could affect one rare and one Nationally scarce beetle, though as always the *Bagous* weevils remain a point of uncertainty. Both medicinal leech populations in Ditches 5 and 7 are affected, raising additional concerns which are both material considerations in planning terms and in relation to appropriate mitigation for a legally protected species under Schedule 5 to the Wildlife and Countryside Act 1981 (as amended).

41. In summary, the proposals directly impact SSSI ditches, which contain important SSSI features and additionally some rare species through the complete loss of very substantial ditch lengths. There is direct loss to development of a significant length of a ditch complex with a high Species Conservation Status Score equalling the national average score for high quality grazing marsh. In addition, populations of the legally protected medicinal leech are impacted, and there are impacts on other species such as the scarce emerald damselfly *Lestes dryas.* In addition, although my conclusion on the scale of the impacts does not rely on the point, there are also potential impacts arising from the new water control structures engaging with the remaining old ditch lengths, as well as water quality issues arising from the junction of the old and the new ditches. I consider that the impacts on the invertebrate interest of the existing, old ditch lengths which remain after the development may be masked, and may, in fact, result in greater harm than at first seems apparent.

Table 4

Impacted lengths of ditches lost to the runway development.

Application Ditch	Species Conservation Status score	Rare Species potentially impacted	Estimated impact on ditch integrity
Ditch 1	1.42	• *Lestes dryas,* Near Threatened • *Bagous* sp., • *Graptodytes bilineatus*, Nationally Scarce • *Hydrochus elongatus*, Near Threatened • *Hydrophilus piceus*, Near Threatened • *Peltodytes caesus* Nationally Scarce	Appears to have no direct loss to the runway footprint.
Ditch 2	1.54	• *Lestes dryas,* Near Threatened • *Bagous* sp., • *Enochrus quadripunctatus*, Nationally Scarce • *Limnoxenus niger* Near Threatened	*98m (Est 1/3- ½ ditch lost) to the runway and RESA footprint. Remainder potentially affected as downstream of runway inputs*
Ditch 3 (Mockmill Sewer)	1.36 (median value; 1.33-1.39 range)	• *Bagous* sp., • *Hydrochus elongatus*, Near Threatened • *Limnoxenus niger*, Near Threatened • *Peltodytes caesus*, Nationally Scarce • *Odontomyia tigrina* Nationally Scarce	Approx 300m lost (Est 3/5ths total length) directly lost to runway and RESA footprint the remainder potentially affected as downstream of runway inputs
Ditch 4	1.14	• *Bagous* sp., • *Odacantha melanura* Nationally Scarce	*Est 1/3rd lost* to runway and RESA upstream of runway inputs
Ditch 5 (Mockmill Sewer)	1.38 (median value; 1.32-1.55 range)	• *Enochrus nigritus*, Near Threatened • *Hydrochus elongatus*, Near Threatened • *Hydrophilus piceus*, Near Threatened • *Limnoxenus niger*, Near Threatened • *Peltodytes caesus*, Nationally Scarce • *Odontomyia tigrina*, Nationally Scarce • *Odontomyia ornata*, Red Data Book 2 • *Stratiomys singularior* Nationally Scarce • *Medicinal leech, Schedule 5*	239m (Est up to ½ of ditch length), lost directly lost to runway and RESA footprint the remainder potentially affected
Ditch 6	*n/a*	• *Limnoxenus niger*, Near Threatened • *Odontomyia ornata* Red Data Book 2	Appears to have no direct loss to the runway footprint.
Ditch 7	1.3	• *Bagous* sp., • *Limnoxenus niger* Near Threatened • *Medicinal leech, Schedule 5.*	55m loss to Runway and RESA – to be culverted.

Replacement Ditches

42. In paragraph 7.2.3(c)(ii) of its statement of case, the applicant asserts that "the impact on the ecological value of the ditches due to realignment would be mitigated by the creation of appropriate wetland features on the east of the airfield, including a ditch replacement (1300m), which would create a net benefit" (although the applicant identifies impacts to the 'ditch networks' with reference to the Special Area of Conservation and not, as it should have, also identify these impacts in reference to the SSSI). In order to help assess how likely the new ditches would be to succeed, it would be helpful if there were examples from within the existing SSSI of where such ditch loss, on this scale, had been done previously. However, I am not aware of any loss of ditches on anything like this scale from within the SSSI. There have been examples of small losses, such as the Little Cheyne court wind farm proposals, but this only involved a small length (< 10m) of ditch culvert for the access route to the wind farm.

43. The reason for the lack of examples, even of unsuccessful proposals, is that loss of SSSI interest features on the scale of those in the airport expansion proposals is extremely unusual, even as a proposal. In addition, the drainage ditches in the SSSI are part of the fabric and functioning of the landscape; they perform valuable functions additional to their conservation value (as wet fences and as drainage). It is therefore not in the interests of most land owners to seek to remove ditches.

44. In the absence of direct comparisons, the likelihood of the new ditches developing into replacements of sufficient quality must be assessed from the knowledge of similar ditch systems and from the habitat requirements of species that use them. The application ditches share some common features with the nearby Walland marshes, also part of the Dungeness SSSI. Both hold populations of the Ornate Brigadier soldierfly *Odontomyia ornata* and the nationally scarce water beetles *Graptodytes bilineatus* and *Noterus crassicornis* (Palmer *et al*, in prep). The ditches on the Dungeness SSSI have sustained their interest over time as is shown by an analysis the 1982 data for the nearby Walland Marsh. The Nature Conservancy Council commissioned a survey of a number of ditches and ditches in this area (Palmer, 1982). This old data has been subject to the same calculations as the new data collected for the more recent report, using the same method (*Palmer et al*, in prep).

45. It is clear from looking at the Walland Marsh data that the 1982 Species Conservation Status score of 1.55 is matched by the 1.51 survey score for the recent survey in the same general area (*Palmer et al*, in prep). This demonstrates that the ditches within the same SSSI as the application ditches can retain high levels of conservation significance over many years. Figures 2a and b shows that most of the application ditches are well established and have been in existence for over one hundred years. It is reasonable to assume that the application ditches have also retained their value over a similar time frame, a function of ditch age and management.

46. Some additional information can be taken from the habitat requirements of the species present. From an analysis of the whole ditch data set, the Palmer *et al* (in prep) report also suggests that *Graptodytes bilineatus* prefers later successional stage ditches, often being more choked with vegetation, whilst a more limited sample for sites holding the Scarce Emerald Damselfly "emphasised its preference for small (shallow, narrow), 'old' and moderately choked ditches" (p72, ibid, Palmer *et al*, In Prep). It can take many years for suitable vegetation to establish in ditches and the later successional stage ditches may not be arrived at for many years.

47. There have been few studies looking at ditch colonisation over time, though the work done by Drake (2009, 2008) for the Royal Society for the Protection of Birds at their Otmoor and Greylake Reserves (the 'RSPB study') is instructive. These two surveys looked at the fauna of recently created ditches, managed for conservation purposes, against older and well established drains, and a number of gulley systems which often dried out. The statistical analysis that were performed on this data showed three distinct assemblage types, with different species groups being present between the three "ditch" systems. Whilst the quality of the "new" (about five years old at Greylake and up to eight years at Otmoor) ditches was not insubstantial and did feature many rare species which greatly elevated the Species Conservation Status scores, it was heavily dominated by beetle species and lacked some of the faunal components found in the established ditches. Importantly, a good range of the species present in the Lydd ditches were also found in the older ditch assemblage in that survey, and the representation of leeches, snails and mollusc species would appear not to be supportable in a newer replacement ditch complex. Drake (2009) noted:

"Species showing a slight preference for the deep or old ditches in the RSPB study were the beetles Hyphydrus ovatus, Haliplus obliquus (which feeds on Chara so should have been present in shallower ones too), the mayfly Caenis robusta, the water-boatmen Cymatia coleoptrata and Sigara dorsalis, water spider Argyroneta aquatica and the two Holocentropus caddis that feed like water spiders with a web to catch small animals, the caddis Triaenodes bicolor (which swims about in a long thin case), and the leeches Erpobdella octoculata and Theromyzon tessellatum which feeds on water birds. Some molluscs (Physa fontinalis, Sphaerium corneum) were much more frequent in the deeper ditches and this may reflect age rather than water depth, and slow colonisation of new ditches because of their low mobility.

Seven of those species were recorded in the application ditches. This is not to ignore the conservation role of ditch restoration and conservation guided management in delivering new successional suites of species (Drake, 2009, p10), but such work is done whilst maintaining a core of the middle and late successional faunas, either by proximity and connectivity, and/ or by ways of working the ditches themselves."

48. The key point here is that ditch complexes can retain their interest over many years, and that the age of ditches and their successional state is important in supporting parts of the key fauna, albeit they remain subject to the impacts of ditch clearance and adjacent land management from time-to-time which partially re-sets the successional clock. It is likely that the invertebrate assemblages emerging in any new mitigation ditches will be different from those assemblages lost or damaged to construction. The existing ditch fauna in the application ditches resembles the old ditch faunas of the RSPB study, and less resemblance with the newer ditch faunas, and that after five to eight years of ditch maturity. Overlain onto those RSPB ditches is sensitive conservation grade management and the maintenance of good water quality, since that is the sole concern for that organsiation. Management would typically follow conservation best practice guidelines, such as only clearing ditches from one side, leaving lengths or refuges uncleared etc. In this case, the replacement ditches are not primarily conservation ditches but primarily drainage ditches.

49. Whilst our understanding of the detailed ecological requirements within ditch systems, and the species interactions with ditch parameters, is only in its infancy, it is necessary to note the issues arising in connection with the new ditch design, although this is not a

point which is necessary to show that the replacement ditches are insufficient as replacements. The new ditches will have additional and different water control structures as part of their design, with two additional culverts, and four new outlets. These structures will all take up area in hard structures but in addition they break up the ditches' continuity to a certain extent. Due to the extra structures, the new ditches and the existing ditches will form nine separate lengths of ditch as opposed to five previously (I have not included in either count ditches that will remain unmodified structurally). This will make the habitat less continuous and more engineered. The new ditches are designed to have a lower bed level compared to the existing ditch system and to have an increased hydraulic head (see CD1.42a) In other words they are designed to drain faster. This design is not similar to the bed levels or hydraulic head (ie the existing underlying form and function) of the existing ditches as recorded by the applicant and therefore cannot be considered suitable functional replacement habitat even if all previous concerns are left aside. Though the existing ditch network is also subject to works by the Internal Drainage Board amongst others, this work does operate to higher conservation standards than one might normally otherwise encounter. Deviations away from conservation standard management are likely to diminish the quality of the resulting invertebrate assemblage which emerges within any new ditch complex.

50. In summary, the proposed new ditches are designed for the primary function of draining the new runway and for surface water drainage. The applicant recognises (though not fully) the limited value of these new ditches and the unlikelihood of them forming a suitably high quality invertebrate assemblage, "for some time". The loss of 800m of high quality, SSSI ditch habitat with a rich invertebrate fauna represents adverse harm to the SSSI. In addition, it could potentially set a precedent leading to future further loss elsewhere. The Species Conservation Status scores of the impacted ditches equals the national average of high quality grazing marsh ditches, to which there must be added the presence of the legally protected Medicinal leech. The assemblage of species present in these ditches shows some relatedness to similar old ditch faunas, and it cannot simply be replaced through either moving ditch material into an ecologically unsuitable early successional ditch habitat or by natural colonisation over the short term. The large development footprint of the airport expansion proposal removes the opportunity for colonisation since much of the source will be similarly impacted and lost or damaged. If one considers the prospect of water quality declines on top of that, it puts beyond doubt that creation of new ditches cannot be expected to support all those key elements of the existing fauna. The fact that there currently exist many rare and scarce ditch

invertebrates does strongly point to the fact that ditches are not all equal and cannot be simply re-created with a predictable end point in sight. If the future management of the replacement ditch network is driven primarily by surface drainage considerations, and the ditches themselves are averaging 0.75 m wide by 2m deep and are not of the sort of profiles one would construct for new conservation ditches, then the colonisation of the remaining fauna and the establishment of anything other than a more earlier successional fauna seems destined to take many years.

Vegetated Shingle

The Value of the vegetated shingle complex for invertebrates

51. Dungeness, Romney Marsh and Rye Bay SSSI includes two of the largest shingle structures in the British Isles, with over 1,650 ha of the exposed shingle beach. Dungeness contains a classic sequence of shingle beaches and is the best example of a cuspate shingle foreland in Great Britain. The unique habitats and underlying geomorphology in and around Dungeness are covered in more detail in Jo Dear's proof of evidence. In entomological literature, habitats associated with the "bare" ground elements of heathland, semi-natural grasslands, and those naturally eroding habitats (such as eroding river banks and shingle) are classified as "early successional habitats". However, the very established shingle heathland found at Dungeness near the airport also shares these early successional habitat characteristics.

52. The value of early successional habitats, which are typically short –lived habitats, on Dungeness is that the system maintains a range of successional states, aspects, substrate type and particle size, and a vegetation cover that remains open and generally low. Assemblages of invertebrates on these type of habitats typically favour open, hot, and exposed habitat areas, and tend to follow habitat patches as their condition changes. On some sites, such as soft rock cliffs, this openness is maintained by cliff face slumping and collapse, whilst at Dungeness coastal processes and the nature of the substrate itself help in delivering quality habitat. The extent of the resource also means that localised invertebrate populations do not have to travel far to find new nesting or food resources. The long term continuity of early successional habitats and its geographical location, leading to a more continental type climate pattern, provide a fairly unique combination within the UK.

53. The value of early successional stages in habitats for invertebrates has been commented on a number of times, with Thomas & Morris (1994;1995) noting the majority of rare (Red Data Book) species occurred either at these early successional stages or in the later stages (typically in very old trees). Their findings were confirmed in Webb et al (2010) in relation to Section 41 NERC Act species.

Since Dungeness encompasses such large areas of shingle, sands and silts it is not surprising that this is reflected in the number of rare and scarce invertebrates that are found there. The information gathered to support the SSSI designation (see Appendix 3 of NE/3/A) notes at least 271 nationally scarce, 75 Red Data Book (RDB) and 17 provisional Red Data Book (pRDB) species have been recorded from the SSSI since 1980 across this large site, with a number of these being S41 Biodiversity Action Plan species in need to direct conservation action to aid their recovery. The most recent synthesis of the fauna is presented in Table 14 of the Natural England's document Dungeness, Romney Marsh And Rye Bay Spa And Proposed Ramsar Site, Public Copy Edited 15 September 2010, which lists some 154 species (see CD14.9) A number of these are tied to the early successional habitats, and the following are examples occupying marginal sandy sediments. The extremely rare and attractive carabid ground beetle *Bembidion argenteolum* has a 1987 record from the Denge beach area, with only one other recent record in mainland UK. The species has now been declared extinct in Northern Ireland, its previous stronghold. The Red Data Book 1 Dungeness flagship carabid beetle *Omophron limbatum*, an attractive metallically green spotted beetle, was found in good numbers on the silty and open margins of south end of the ARC pit in August 2010 (Telfer, 2010). The same Dungeness field meeting discovered the RDB1 spider-hunting wasp *Evagetes pectinipes*, a species largely confined to Kent, and known principally from the Deal to Sandwich dunes, with this record re-enforcing the species presence at Dungeness (Allen, 2009, Mark Telfer, pers com, 2010).

54. The shingle and open sediment areas of Dungeness support a large number of invertebrates of conservation importance, including a number of S41 Biodiversity Action Plan species, such as the Whelk-shell jumping spider *Pseudeuophrys obsoleta* (RDB3), found in only 12 hectads in the UK since 1992, and which seems to use empty whelk shells on the shingle ridges as its home. The BAP running crab spider *Philodromus fallax* is found amongst the more sandy parts of the shingle and sand complex, whilst the small Liocranid Sac spider *Apostenus fuscus* (RDB1) is only found at Dungeness in the UK, and in 2006 was discovered at Lydd. This species occurs on shingle covered with a thin layer of soil and the false-oat grass *Arrhenatherum elatius* plant community (Spider

Recording Scheme). This species would seem to be especially vulnerable to habitat changes given its reliance on a sparse vegetated surface, as would the RDB1 Pygmy Footman moth, *Eilema pygmaeola pallifrons*, a yellowish subspecies now found only at Dungeness, where its larvae feed on lichens.

55. The rare ant *Temnothorax interruptus* is mostly a Submediterranean species and likes hot open grassy areas and short lichen dominated grassland, a feature common to a number of the species on the edge of their range in this part of southern Britain. The seemingly endemic leafhopper *Aphrodes duffieldi* is also found on grasses on parts of Dungeness.

56. Taken together and recognising that this is only a very small part of the overall recorded fauna, it is clear that the early successional habitats across Dungeness and around the airport do support a nationally important invertebrate resource.

The potential impacts on the vegetated shingle communities from the proposals

57. The impacts on the invertebrates of the vegetated shingle are linked to those potential impacts upon their supporting habitat. The airport demonstrated an increase in its contribution to Nitrogen deposition as a result of the expansion proposals (see CD1.45). Jo Dear's proof has highlighted the impacts of potential nutrient enrichment from airport emissions on vegetated shingle habitats. An increase in the nutrient status of the substrate by enhanced aerial deposition can both alter plant community structure by allowing more widespread species to establish, and also by increasing vegetative lushness, potentially leading both to more cover (horizontal and vertical), and new plant species establishing. The increased vegetation growth described in Mrs Dear's proof has the potential to affect invertebrates. For example, increased growth of fast and tall growing species such as some graminoids has been shown on some habitats to be promoted by increased nutrients. In turn this then covers bare sand and ground in which some invertebrates live. In addition it can increase shading and substrate cooling, altering the microclimate that is such an important feature of the early successional stage habitats at Dungeness. Given that parts of the fauna are on the edge of their range, then structural changes to the vegetation exacerbating cooling may well have a detrimental effect. In addition any species which relies on a host plant that is competitively disadvantaged in a nutrient enriched environment will struggle and if the host plant is outcompeted from the site, the invertebrate will similarly be outcompeted. The potential

to adversely affect the lichen sward within the grassland could lead to declines in both the Pygmy footman moth and the Liocranid Sac spider which, given their tenuous position in the UK, could edge them closer to extinction.

Conclusion

58. Due to the direct loss of SSSI ditch habitat and potential other impacts on the special aquatic ditch fauna from the construction of the airport proposals, there is unavoidable and substantial adverse harm to the interest features of the SSSI. Due to increase in the airport's contribution to air emissions, and in particular nitrogen deposition as a result of the airport proposal, there is a mechanism for potential impacts on the invertebrates of vegetated shingle, which, unmitigated, has the potential to cause harm to the SSSI invertebrate assemblage.

Figure 1

Figure 2

Figure 2b

Figure 3

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Appendix 1

Invertebrate Status definitions

This appendix explains the old and current classification systems for invertebrates conservation status assessment. The National UK Red Data Book classifications overall purpose is to place species on a continuum away from their extinction either as a UK species or in totality. So, the Red Data Book 1 category (Endangered) sees a high and real risk of extinction taking place if the causative factors continue to operate, with the Vulnerable and Rare categories lying below this. Below the higher level extinction threat categories are the Nationally Scarce or Notable A & B species status categories, whose status is described in UK distributional terms (described more fully in Appendix 1).

The causative factors pushing a species towards extinction are, of course, intermeshed with the species' distribution, for a species with only 1 UK population is generally more at risk than one with 10 populations.

The more contemporary re-placement by the newer IUCN categories sees the UK Red Data Book 1 being replaced by a more internationally accredited Critically Endangered category, and the other categories of threat (Endangered and Vulnerable) are similarly mapped across, though not completely so. The new system does both introduce status categories that do not easily match the old ones, (such as Near Threatened which are close to qualifying for Vulnerable), and also allows national discretion in setting up Nationally Scarce as a category. A set of criteria exist to allow specialists reviewing species status accounts, to reasonably confidently place most species under the correct threat category.

JNCC Invertebrate Status Categories

These status categories take account of how the population of invertebrate species is thought or known to be changing. It takes account of factors acting on the population. These categories apply to the United Kingdom..

Red Data Book Category 1. RDB1 - Endangered

Species in danger of extinction and whose survival is unlikely if the causal factors continue operating and whose numbers have been reduced to a critical level or whose habitats have dramatically reduced.

Red Data Book Category 2. RDB2 - Vulnerable

Species likely to move into the Endangered category in the near future if the causal factors continue operating. Includes species of which most or all of the populations are declining throughout their range and those in vulnerable habitats.

Red Data Book Category 3. RDB3 - Rare

Species with small populations, that are not at present Endangered or Vulnerable, but are at risk. They are estimated to exist in only fifteen or fewer 10 km squares, and are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Red Data Book Category I. RDBI - Indeterminate

Species considered to be Endangered, Vulnerable or Rare, but where there is not enough information to say which of the three categories (RDB1 to 3) is appropriate.

Red Data Book Category K. RDBK - Insufficiently Known

Species that are suspected, but not definitely known, to belong to any of the above categories, because of lack of information. They include species recently discovered or recognised in Britain, in poorly recorded or taxonomically difficult or unstable groups, inhabiting inaccessible or infrequently sampled but widespread habitats or of questionable native status.

Provisional Red Data Book pRDB

The prefix "p" before any Red Data Book category indicates a provisional grading, this may indicate a change in status that has yet to be confirmed or that more information is needed to ascertain the full status of the species.

Nationally Scarce (Notable) Category A - Na

Species which do not fall within RDB categories but which are uncommon and thought to occur in 30 or fewer 10 km squares of the National Grid or, for less well recorded groups, within seven or fewer Vice Counties.

Nationally Scarce (Notable) Category B - Nb

Species which do not fall within RDB categories but which are uncommon and thought to occur in between 31 and 100 10 km squares of the National Grid or, for less well recorded groups, within between eight and twenty Vice Counties.

Nationally Scarce (Notable)

Definition. Species which are estimated to occur in 16 to 100 10km squares in Great Britain. The subdividing of this category into Nationally Scarce A and Nationally Scarce B has not been attempted for some species because of either the degree of recording that has been carried out in the group to which the species belongs, or because there is some other reason why it is not sensible to be so exact.

Definitions of IUCN threat categories (IUCN 1994)

This set of conservation definitions is internally recognised.

EXTINCT (EX). A taxon *is Extinct* when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW). A taxon is *Extinct* in the wild when it is known to survive only in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR). A taxon is *Critically Endangered* when it is facing an extremely high risk of extinction in the wild in the immediate future, as detailed by any of the criteria A to E.

ENDANGERED (EN). A taxon is *Endangered when* it is not *Critically Endangered* but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria A to E.

VULNERABLE (VU). A taxon is *Vulnerable* when it is not *Critically Endangered* or e*ndangered* but is facing a high risk of extinction in the wild in the medium term future, as defined by any of the criteria A to D.

LOWER RISK (LR). A taxon is Lower Risk when it has been evaluated but does not satisfy the criteria for any of the categories *Critically Endangered, Endangered or Vulnerable.* Taxa included in the Lower Risk category can be separated into three sub-categories:

• **Conservation Dependent (CD).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the

cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

• **Near Threatened (NT).** Taxa which do not qualify for *Lower Risk (Conservation Dependent),* but which are close to qualifying for *Vulnerable*; occurring in 15 or fewer hectads.

• **Nationally Scarce (NS).** Taxa occurring in 16-100 hectads, but which are not *Threatened*, *Lower Risk (near threatened)* or *Lower Risk (conservation dependent)*.

• **Least Concern (LC).** Taxa which do not qualify for *Lower Risk (Conservation Dependent) or Lower Risk (Near Threatened).*

DATA DEFICIENT (DD). A taxon is *Data Deficient* when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. *Data Deficient* is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that a threatened category is appropriate.

NOT EVALUATED (NE). A taxon is *Not Evaluated* when it has not been assessed against the criteria.

Summary of the thresholds for the IUCN Criteria

Criterion	Main thresholds		
	Critically Endangered	Endangered	Vulnerable
A. Rapid decline	>80% over 10 years or 3 generations in past or future	>50% over 10 years or 3 generations in past or future	>20% over 10 years or 3 generations in past or future
B. Small range – fragmented, declining or fluctuating	extent of occurrence <100km^2 or area of occupancy <10km^2 (<1 x 10km^2)	extent of occurrence <5000km^2 or area of occupancy <500km^2 (<5 x 10km^2)	extent of occurrence <20,000km^2 or area of occupancy <2000km^2 (<20 x 10km^2)
C small population	<250 mature individuals, population	<2500 mature individuals, population	<10,000 mature individuals, population

and declining	declining	declining	declining
D1 Very small population	<50 mature individuals	<250 mature individuals	<1000 mature individuals
D2 Very small range			<100km^2 or <5 locations
E. Probability of extinction	>50% within 10 years	>20% within 20 years	>10% within 100 years

The old and new IUCN Red Data Book threat categories are compared below:

http://www.snh.org.uk/publications/on-line/advisorynotes/49/49.htm

Old	New
Extinct	Extinct / Extinct in the wild
Endangered	Critically endangered / Endangered
Vulnerable	Vulnerable
Rare	No direct equivalent
No direct equivalent	Low risk:
No direct equivalent	Conservation dependent
No direct equivalent	Near threatened
nationally scarce	nationally scarce
Indeterminate	Data deficient
Insufficiently known	Data deficient

Recent revisions of species status accounts in the UK, under the JNCC Species Status Assessment project, have increasingly utilised the International Union for Conservation of Nature and Natural Resources (IUCN) Criteria, rather than the more UK based Red Data Book status categories, though the new Species Status accounts do have standing as Red Lists. The difference between the two systems is, simplistically, that the RDB is based on distribution whilst the IUCN is more threat based. Not all species groups have yet been reviewed in this way, so the two systems still run in parallel.

Appendix 2

Note on use of the Buglife methodology

The extensive and recent Buglife survey of grazing marsh flora and fauna in the UK has been used in this analysis. The following is a brief explanation of the rationale for the use of this approach and its metrics for ditch comparison. The Executive summary of the report (p6) describes the overall project:

"A major survey of the aquatic vegetation and invertebrate fauna of ditches in coastal grazing marshes in England and Wales was carried out in 2007, 2008 and 2009. The aims were to establish baseline data, assess the extent of and reasons for any observed change in the biota and produce management guidelines for ditches."

It was for these reasons of wide geographic coverage, immediacy, and extent of the sampling regime, that offered the best and most comprehensive data set to allow comparison of the Lydd ditches and, importantly, place them into a wider context. The focus, through the scoring metrics, on assemblages, rather than the traditional and somewhat old fashioned arguments based solely on the rare elements of those assemblages, was also relevant and resonated with Natural England's own ISIS database. The latter was not used, as the sampling pool across the SSSI suite is considerably less than in the Buglife project at this time and so a wider comparison is less easily made.

The development of the Species Conservation Status Score is a logical extension of previous scoring systems, most notably the water beetle based "Wetscore" metric, but is an improvement in that it covers a very wide range of taxonomic groups, and so gives greater emphasis to more of the species in the samples taken in surveys, as noted the Buglife manual (p24):

"The scoring system used here is similar to that for the plants and is an adaptation of 'Wetscore', a method of ranking water beetle assemblages (Foster et al., 1990; Foster & Eyre, 1992). It allocates a score to each species according to its relative rarity, then calculates the average (the Species Quality Index or SQI) for a sample or a wetland. A geometric range of scores (1 to 32) is used in Wetscore but here each of the native species in Table 2 is given a Conservation Status score of 1 to 5, as follows (for definitions of categories see Section 4.4.2):

Category Score

**Habitats Directive Annex II and/or IV; WCA Schedule 5; Red List*

CR, EN, VU (revised assessments); Red List E or V (unrevised lists) 5

**Red List Rare (R in unrevised lists), DD or K; Near Threatened 4*

Nationally Scarce (NS, Nationally Notable Na and Nb) 3

Local 2

None of the above (common) 1

Some of these are UK Biodiversity Action Plan priority species.

Where multiple categories apply to a species, the highest score is used, not the sum of the scores.

The Invertebrate Conservation Status Score (or SQI) for a sample or a wetland is obtained by adding together all the individual species scores, then dividing by the number of native taxa recorded. Non-native taxa (see Table 5) are not used when calculating this metric. Also, if a sample contains fewer than ten invertebrate taxa the SQI should not be calculated."

Though the salinity metrics and those of the marsh fidelity have been calculated for each of the Lydd ditch samples, in concert with the main method I have concentrated mostly in the Conservation Status Score, this often reinforcing the Marsh Fidelity one and often adding little new (ibid, p25).

This therefore provides a robust system developed by key workers which has operated in the recent past, ensuring the opinion on species coding is up to date, and covering a large number of high quality ditch systems and species likely to be found in them. It is in this light that the scoring of the Lydd ditches should be seen.

Appendix 3

The Red Data Book and Nationally Scarce species as recorded and status classified in 2007 for each of the Application ditches surveyed.

Ditch 2	*Lestes dryas*, (Red Data Book 2) *Bagous* sp., *Enochrus quadripunctatus*, Notable b *Limnoxenus niger* Notable a
Ditch 3 (Mockmill Sewer)	*Brachytron pratense*, Notable *Bagous* sp., *Enochrus coarctatus*, Notable b *Helochares lividus*, Notable b *Hydrochus elongatus*, Red Data Book 1 *Limnoxenus niger*, Notable a *Peltodytes caesus*, Notable b *Rhantus suturalis* Notable b *Odontomyia tigrina* Notable
Ditch 4	*Bagous* sp., *Helochares lividus*, Notable b *Odacantha melanura* Notable b
Ditch 5 (Mockmill Sewer)	*Brachytron pratense*, Notable *Enochrus nigritus*, Red Data Book 3 *Helochares lividus*, Notable b *Helophorus griseus*, Notable b

	Hydrochus elongatus, Red Data Book 1 *Hydrophilus piceus*, Red Data Book 3 *Limnoxenus niger*, Notable a *Peltodytes caesus*, Notable b *Odontomyia tigrina*, Notable *Odontomyia ornata*, Red Data Book 2 *Stratiomys singularior* Notable
Ditch 6	*Limnoxenus niger*, Notable a *Odontomyia ornata* Red Data Book 2
Ditch 7	*Brachytron pratense*, Notable *Bagous* sp., *Helochares lividus*, Notable b *Limnoxenus niger* Notable a