Thurrock Flexible Generation Plant

Environmental Statement Volume 6
Appendix 8.1: Published ALC Information and ALC Site Survey Results

Date: December 2019

Environmental Impact Assessment

Environmental Statement

Volume 6

Appendix 8.1

Report Number: OXF10872

Version: Final

Date: December 2019

Prepared by: Julia Tindale

Checked by: Tom Dearing

This report is also downloadable from the Thurrock Flexible Generation Plant website at: http://www.thurrockpower.co.uk

Thurrock Power Ltd

1st Floor

145 Kensington Church Street

London W8 7LP

Table of Contents

List of Tables

Summary

This appendix provides supporting information on soils for the assessment presented in Volume 3, Chapter 8: Land Use, Agriculture and Socio-Economics.

Qualifications

Julia Tindale, BSc (Hons), Mi Soil Sci of RPS has carried out agricultural and land use assessment work for over 25 years including detailed agricultural land classification, farm holding, recreation (including published rights of way; common land) and community assessments.

1. Thurrock Auger Boring Results

1.1 Notes

1.1.1 All depths are measured in cm. from the surface.

1.1.2 Colours and mottling are abbreviated:

- B - Brown
- DB - Dark brown
- DG - Dark grey
- DGB - Dark greyish brown
- G - Grey
- o - ochreous mottles

1.1.3 Textures are abbreviated:

- c - clay
- lms - loamy medium sand
- msl - medium sandy loam
- mszl - medium sandy silt loam
- sc - sandy clay
- scl - sandy clay loam
- SPL - Slowly Permeable Layer

1.1.4 Wetness Class is given on a scale ranging from I (well drained) to VI (effectively a swamp).

Table 1.1: Thurrock Auger Boring Results.

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
Soils on terrace gravels or head						
31	0 - 31	DB	msl	10	I	3b
	31 - 45	B	msl	10-15		
	45 - 55	B	lms	30		
	55 +	Impenetrably stony (assumed same as 45-55)				
32	0 - 28	DB	msl	5-10	I	3b
	28 - 45	B	msl	10-15		
	45 - 50	B	lms	15-20		
	55 +	Impenetrably stony (assumed same as 45-50)				
33	0 - 32	DB	msl	10	I	3b
	32 - 45	B	msl	10-15		
	45 - 50	B	lms	30		
	50 +	Impenetrably stony (assumed same as 45-50)				
Soils on terrace gravels or head						
34	0 - 31	DB	msl	10	I	3b
	31 - 45	B	msl	10-15		
	45 - 55	B	lms	30		
	55 +	Impenetrably stony (assumed same as 45-50)				
35	0 - 29	DB	msl	10	I	3b
	29 - 40	B	msl	10-15		
	40 - 50	B	lms	20		
	50 +	Impenetrably stony (assumed same as 40-50)				
36	0 - 30	DB	msl	10	I	3b
	30 - 45	B	msl	10-15		
	45 - 50	B	lms	20-30		
	50 +	Impenetrably stony (assumed same as 45-50)				

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
37	0 - 30	DB	msl	10	I	3b
	30 - 40	B	msl	15		
	40 - 45	B	lms	30		
	45 +	Impenetrably stony (assumed same as 40-45)				
38	0 - 30	DB	msl	10	I	3b
	30 - 40	B	msl	10-15		
	40 - 50	B	lms	20		
	50 +	Impenetrably stony (assumed same as 40-50)				
39	0 - 29	DB	mszl	5	I	3a
	29 - 90	B	msl	<5		
	90+	B	lms	<5		
40	0 - 30	DB	msl	10	I	3b
	30 - 45	B	msl	10-15		
	45 - 50	B	lms	20-30		
	50 +	Impenetrably stony (assumed same as 45-50)				
42	0 - 28	DB	msl	10	I	3b
	28 - 40	B	msl	15		
	40 - 45	B	lms	20-30		
	45 +	Impenetrably stony (assumed same as 40-45)				
43	0 - 30	DB	msl	5	I/II	3a
	30 - 45	B	msl	5		
	45 - 65	B	scl	20-30		
	65 +	B, o	scl	30+		
44	0 - 30	DB	msl	15-20	I	3b
	30+	Impenetrably stony (assumed lms with 20% stones)				
	Notes: topsoil stones larger and pebbly					

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
45	0 - 28	DB	msl	5	I	3a
	28 - 55	B	msl	5		
	55 - 65	B	lms	10		
	65 - 70	B	lms	20		
	70 +	Impenetrably stony (assumed same as 65-70)				
46	0 - 29	DB	msl	5	I	3a
	29 - 55	B	msl	5		
	55 - 65	B	lms	15		
	65 +	Impenetrably stony (assumed same as 55-65)				
47	0 - 30	DB	msl	5	I	3a
	30 - 80	B	scl	<5		
	80 +	B, o	sc	0		
	Notes: at Approx Grid Ref 67600 77600					
48	0 - 29	DB	msl	5	I	3a
	29 - 55	B	msl	5		
	55 - 65	B	msl/lms	10		
	65 +	Impenetrably stony (assumed same as 55-65)				
49	0 - 28	DB	msl	15-20	I	3b
	28 +	Impenetrably stony (assumed lms with 20% stones)				
	Notes: topsoil stones larger and pebbly					
50	0 - 29	DB	msl	5	I	3a
	29 - 55	B	msl	5		
	55 - 65	B	msl/lms	10		
	65 +	Impenetrably stony (assumed same as 55-65)				

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
Soils on estuarine alluvium						
1	0 - 21	DGB	c (limed)	few	III	3b
	21 - 32	DG, o	c	0		
	32 +	G, o	c (SPL)	-		
2	0 - 20	DGB	c (limed)	few	III	3b
	20 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
3	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
4	0 - 22	DGB	c (limed)	few	III	3b
	22 - 34	DG, o	c	0		
	34 +	G, o	c (SPL)	-		
5	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
6	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
7	0 - 21	DGB	c (limed)	few	III	3b
	21 - 32	DG, o	c	0		
	32 +	G, o	c (SPL)	-		
8	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
9	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
10	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
11	0 – 18	DGB, o	c	0	III	3b
	18 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
12	0 – 17	DGB, o	c	0	III	3b
	17 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
13	0 – 18	DGB, o	c	0	III	3b
	18 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
14	0 – 16	DGB, o	c	0	III	3b
	16 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
15	0 – 17	DGB, o	c	0	III	3b
	17 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
16	0 – 18	DGB, o	c	0	III	3b
	18 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
17	0 – 19	DGB, o	c	0	III	3b
	19 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
18	0 – 18	DGB, o	c	0	III	3b
	18 – 30	DG, 0	C (SPL)	0		
	30 +	G,o	C	0		
19	0 - 22	DGB	c (limed)	<5	III	3b
	22 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
20	0 - 20	DGB	c (limed)	few	III	3b
	20 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
21	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
22	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
23	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
24	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
25	0 - 21	DGB	c (limed)	few	III	3b
	21 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
26	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		

No.	Depth	Colour	Texture	% Total Stones	Wetness Class	ALC Grade
27	0 - 21	DGB	c (limed)	few	III	3b
	21 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
28	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
29	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		
30	0 - 19	DGB	c (limed)	few	III	3b
	19 - 35	DG, o	c	0		
	35 +	G, o	c (SPL)	-		
51	0 - 20	DGB	c (limed)	few	III	3b
	20 - 30	DG, o	c	0		
	30 +	G, o	c (SPL)	-		

2. Agricultural Land Classification Published Data

2.1 Collingwood Farm

AGRICULTURAL LAND CLASSIFICATION
& GAS MONITORING SURVEY

COLLINGWOOD FARM
SEVENTYHOLDS
ESSEX

A D A S

CONTENTS

A D A S

MINISTRY OF AGRICULTURE FISHIERES AND FOOD

REPORT ON AGRICULTURAL LAND CLASSIFICATION AND GAS MONITORING UNDERTAKEN AT COLLINGWOOD FARM, SEVEYHOLDS ESSEX.

SUMMARY

Areas within this 19.7 ha site were believed to be affected by seepage of landfill gas from an adjacent landfill site. A detailed survey of the site was consequently undertaken in August 1991 and details of soils and gas concentrations collected from 45 pre determined sampling points. Significant levels of methane gas were recorded flanking the eastern site boundary, with a consequent detrimental effect on agricultural land quality, recorded in the gas affected area.

1.0 INTRODUCTION

1.1 Land on this 19.7 ha site was inspected on the 27th, 28th and 30th August 1991 at the request of Strutt & Parker, Chelmsford. The site, which comprises part of field number NG 7777 is located between a golf course in the south, and a small housing development in the north. It is flanked to the west by a working sand and gravel pit and to the east by a landfill site which at the time of survey was undergoing the final stages of restoration. At the time of inspection the site was under oilseed rape stubble, and due to seed shedding, had a fairly dense cover of volunteer oil seed rape plants in the early stages of establishment.

1.2 During the early part of the 1990-1991 cropping year areas of failed crop, and stunted or less vigorous crop growth had been reported appearing in the oilseed rape crop alongside the eastern site boundary flanking the landfill site. These areas were believed to be the result of landfill gas seepage from the adjacent landfill site. A detailed survey of the area shown in Annexes 2 to 5 was consequently undertaken to investigate gas levels within the soil and to assess the actual extent of any gas affected areas. Simultaneously full details of the soils physical characteristics were also collected to enable the site to be graded under the MAFF Agricultural Land Classification (ALC) system.

2.0 METHODOLOGY

2.1 During May 1991 the site was overflown by the MAFF Aerial Photography Unit and panchromatic (black and white) prints produced at a scale of 1:1800 (see Annex 5). These photographs, taken during a period of vigorous crop growth, provide an overview of relative crop performance across the site and assist in delineating any areas of irregular or stunted growth.

2.3 For purposes of soil inspection and gas monitoring (undertaken following harvest) the site was divided into two key areas (see Annex 2).

Within one hundred metres of the eastern site boundary, land was inspected on a 50m grid basis, giving an average auger boring density within the area of 4 per hectare. The remaining part of the survey area which extended to 11.7 ha, served as a Control. This land was inspected on a 100 metres grid, giving an average boring density of one per hectare. In total 47 soil inspections were made.

2.4 At each soil inspection soil cores were taken at 10cm intervals to a maximum depth of one metre, using a hand held Dutch soil auger. Gas monitoring was undertaken using a GMI Oxygas Gascoseeker calibrated for Methane (see Annex 1 for description and definitions). Gas readings were taken at 30cm depth and at 10cm intervals below this unless stopped by impenetrable gravel. Full details of soil horizon depth, texture, Munsell colour, stone content and gley morphology were also recorded for each profile sampled. In addition four soil profile pits were excavated to a minimum depth of one metre and details collected on soil structure, rooting depth, wetness class and any visible effects of landfill gas induced anaerobism (oxygen depletion).

3.0 PHYSICAL FACTORS AFFECTING LAND QUALITY

Climate

3.1 Site specific climate data was obtained by interpolating information contained in the 5km grid agro-climatic dataset produced by the Meteorological Office (Met Office, 1988).

3.2 This shows average annual rainfall to be 560mm (22.4 inches) which is low by national standards. Field capacity days at 102 per annum are also low. The accumulated temperature for the area is measured at 1463°C. This parameter measures the cumulative build up of warmth throughout the year and in conjunction with rainfall influences the development of soil moisture deficits (SMD)*. Soil moisture deficits of 125mm and 122mm are recorded for wheat and potatoes respectively.

3.3 Barometric pressure readings were obtained from the nearest Meteorological Recording station at Shoeburyness. On the three days of the survey relatively high values of 1028, 1030 and 1026 milliban were recorded respectively.

3.4 Temperatures ranged from 21.0°C to 22.1°C, and wind speeds from 10 to 16 knots, over the three days of survey period.

---

* SMD: represents the balance between rainfall and potential evapo-transpiration. For ALC purposes the soil moisture deficits developing under a winter wheat and maincrop potato crop are considered. These reference crops have been selected because they are widely grown and in terms of their susceptibility to drought are representative of a wide range of crops.

3.5 Overall, climatic conditions do not constitute a limitation to land quality. However local weather conditions can significantly affect the daily rates of landfill gas emissions. In particular the relatively high barometric pressure readings prevailing at the time of survey could impede the flow of landfill gases to the surface. Lower ground water levels can also affect the rate of gas emission by reducing microbial activity resulting in lower levels of gas production.

3.6 Together these factors may help to explain the generally lower level of readings taken in August, when compared with the earlier reconnaissance survey undertaken in late January, when barometric pressure and windspeeds were lower and water levels likely to be higher (see paragraph 4.7).

Relief

3.7 A maximum altitude of 30 metres AOD occurs on the level or gently undulating land towards the north of the site. The southern half of the site comprises an open dry valley feature which falls to a minimum altitude of a little over 20 metres AOD close to the electricity pylon by the track. Slopes from the east and west facing valley sides are very gentle, having a maximum gradient of 4°. Neither altitude nor relief constitute limiting factors to agricultural land quality.

Geology

3.8 The geology of this area is shown on the 1:50,000 scale solid and drift edition geological sheet number 257 (Geological Survey, 1976). This shows most of the higher northern ground to comprise Blackheath Beds with Woolwich and Reading Beds occurring over the majority of the gentle valley slopes to the south.

3.9 The Soil Survey and Land Research Centre have mapped this area at a very generalised scale of 1:250,000 (SSEW, 1984). This map shows the site to comprise coarse loamy and sandy soils of the Hucklesbrook Soil Association. Field survey confirms the existence of these soils over the slightly irregular valley slopes flanking the eastern site boundary to the south of the footpath. Elsewhere fine loamy soils over clay were identified. Both soil types are described more fully in paragraphs 4.1 and 4.2.

Landfill Gas

3.10 During decomposition of landfill materials, leachate and gases may be produced. The major gases produced are usually methane (CH_4) and carbon dioxide (CO_2). Other gases including hydrogen (H_2), hydrogen sulphide (H_2S) and ethylene (C_2H_4) may also be present.

3.11 Although methane itself is odourless, some of the trace gas constituents have an obnoxious smell at very low concentrations and are responsible for the characteristic odour of landfill gases.

3.12 The effects of landfill gases are not fully understood. One of the most obvious effects is soil anaerobism (oxygen depletion) by volumes of gases moving upward through the soil. At its most severe this anaerobism produces a foul smelling bluish grey or greenish subsoil.

3.13 Although methane itself is not thought to be toxic to plants, many of the trace gases (eg ethylene and, hydrogen sulphide) are known to be toxic and these may be an important factor in the adverse effects of landfill gases on vegetation, Parry (1982). In addition, gases may be modified by microbial action as they pass upwards through the soil. For instance, hydrogen may be oxidised to methane and carbon dioxide; and methane itself to carbon dioxide and water. Thus, in simple terms, elevated carbon dioxide levels may be a significant factor in causing adverse crop effects by, for example, lowering soil pH due to formation of carbonic acid. Furthermore, landfill gases may be hotter than ambient air temperatures resulting in vegetation dieback due to heat effects. Consequently, measurements of methane alone, although giving a good indication of the presence of and likely seriousness of a landfill gas problem, cannot be relied upon to accurately predict the precise adverse effects on crops (DOE, MAFF, SAGA, 1988).

RESULTS

Distribution of Soils

4.1 Two main soil types were identified on site. Firstly and most extensively are soils developed from clay. These occur over the majority of the central and western part of the site. Typical profiles are stoneless or very slightly stony, moderately well drained (wetness class II) and comprise sandy silt loam, clay loam or silty clay loam upper horizons overlying clay below 40-60cm depth. Occasionally the lighter loamy textures extend to depth on lower slopes or overlie clay at shallow depth in some upper slope locations.

4.2 Secondly, occurring over small areas are soils derived from sand and gravels. These principally occur on the irregular valley slopes flanking the eastern site boundary to the south of the footpath. Soils in these areas are slightly or moderately stony and comprise sandy loam or coarse sandy loam topsoils overlying similar or lighter textured subsoils which typically overlie sand, coarse sand or gravel below 70/80cm depth.

Distribution of Landfill Gas

4.3 Out of the 47 sampling points 5 recorded significant* levels of methane (ie in excess of .5 on the 10% LEL scale). These higher readings were concentrated in a fairly narrow (20-30 metre wide) ribbon flanking the eastern site boundary to the south of the footpath.

* For the purposes of this report "significant" levels of methane are considered to be those which exceed 0.5 on the 10% LEL scale. 0.5 is the smallest unit of measurement on this highly sensitive scale and represents concentrations of .025% methane in air.

4.4 At the majority of these sampling points, readings of .5 or more occurred within 40cm of the surface. Vegetation within these areas was significantly retarded, with the volunteer oilseed rape plants appearing thin, yellow, and stunted, and the previous oilseed rape stubble having a bleached or dead appearance. Significant weed infestation (mostly dead) was also evident in parts of the area, as were wheelings caused by implement tyres.

4.5 These irregularities are also evident on the May aerial photography where retarded growth is identifiable by slight tonal and textural differences in the crop (see Annex 3).

4.6 The highest reading, (16 on the 100% LEL scale) was recorded at 40cm depth immediately adjacent to the chain link fence. On the May aerial photography a patch of bare ground was evident in this area, although this had subsequently become colonised by a few (mostly dead) 'invader' weed species which were evident at the time of survey. One topsoil - also located in very close proximity to the chain lime fence - was distinctly warm to the touch, when sampled.

4.7 It should be noted that gas readings taken during the reconnaissance survey in January within this area indicate significantly higher gas concentrations. At this earlier date the majority of readings were being made on the 100% LEL scale with values of 40 and 46 being recorded. Occasionally very high gas concentrations of up to 20% on the 100% gas scale, occurred. These higher gas readings may result from local climatic conditions being more favourable for gas production and release in January, than in the more recent August survey (see paragraphs 3.6 and 3.7 above).

4.8 Very low or trace readings (0.1 to 0.3 on the 10% LEL scale) were recorded at variable depths within the soil profile at a further 18 soil inspections in the August survey. It should be noted that these very low readings should be treated with extreme caution since they are beyond the accuracy limits of the equipment and are not necessarily indicative of absolute concentrations of methane present. It is interesting to note however, that the majority of these very low readings (72%) occurred in areas immediately adjacent to areas higher gas concentrations. The remaining (28%) low or trace readings occurred within the Control area, usually towards the base of the soil profile (90cm +). Little or no evidence of retarded crop growth was noted in these areas, either during ground survey or from aerial photography.

4.9 Soil Pit Observations

Four soil pits were excavated on site. Pits 1 and 2 were located in areas of higher gas readings close to the landfill site, while soil pits 3 and 4 were located at points with zero readings within the control area. Soil pit investigations revealed that root growth from the previous oilseed rape crop was significantly impeded in areas of higher gas concentrations compared with non affected Control areas.

4.10 At soil pit 1 which was excavated in the clayey soil variant, root growth ceased below 65/70cm depth. At 75/80cm significant gas induced anaerobism was evident with grey (Munsell colour 10YR5/2 and 10YR5/3) colours present on ped faces and a distinct foul odour. Gas readings in the auger hole at this location recorded very low concentrations of .2 from 30cm, increasing to .4 at 100cm and .5 at 110cm (all readings on the 10% LEL scale). The soil was noticeably moist throughout and wheelings from implements were obvious in the immediate vicinity.

4.11 At pit 2 which was excavated in the sandy soil variant higher concentrations of methane had been recorded in the auger hole, with readings of .4 from 40cm, increasing to .5 at 60cm and .6 at 90cm. Surprisingly visible signs of gas induced anaerobism were absent in the soil pit as was the foul odour noted at soil pit 1, although a "musty" smell was evident in the soil below 80cm depth. Root growth was slightly stunted in the upper subsoil, and became rare below 85/90cm. The oilseed rape stubble in the immediate vicinity of the pit was thin, as were the establishing volunteer oilseed rape plants. Some weed infestation had occurred in areas of bare ground.

4.12 Soil pits 3 and 4 were excavated in the Control area in clayey soil variants with zero concentrations of gas. Both pits showed strong brown colours (Munsell colours 7.5YR4/6 and 7.5YR5/6) predominating to depth with no signs of anaerobism and no trace of "mustiness" or foul

odour. Rooting was rigorous with common roots observed travelling along ped faces to well in excess of one metre.

4.13 The lack of visible evidence of gas induced anaerobism at pit 2 may be due to its location within lighter, sandy soil material. Because these soil textures are highly porous the gas is able to diffuse evenly through the soil matrix. In clay profiles, in contrast, it is confined to relatively small numbers of cracks and fissures when increased concentrations consequently occur, causing anaerobic conditions to develop.

5.0 DISCUSSION

5.1 In most areas of very low gas values (in the range 0.1-0.3) few or no visible crop effects were evident, suggesting that higher values at depth (ie in excess of .5) may have a more significant effect on crop performance than very low values near the surface. Soil pit investigations, however, indicated that significant readings of .5 on the 10% LEL scale at 110cm can give rise to zones of gas induced anaerobism above this depth. These visible signs of anareobism do not necessarily coincide with particularly high reading on the gascoseeker. This could be due to the fact that at this depth the gas is concentrated in relatively few cracks and fissures where it is not easily detected by the gas probe. Alternatively, since landfill gas is capable of migration, these anaerobic zones could be relict features indicative of high gas concentrations at a previous date.

5.2 In some areas of high gas concentrations the soil was moist to depth with wheelings from trafficking with implements clearly evident at the surface. These high moisture levels could be due to a localised drainage problem. It is also possible however, that they are a result of reduced transpiration rates associated with absent or retarded crop cover due to restricted rooting. No obvious signs of contamination by landfill leachate were observed during the survey.

5.3 The very low gas readings recorded towards the base of some control profiles may reflect the proximity of the underlying sand and gravel deposit which, being porous, will readily act as a conductor for migrating gases.

6.0 CONCLUSION AND AGRICULTURAL LAND CLASSIFICATION

6.1 The presence of gas in small areas close to the eastern site boundary is having a detrimental effect on agricultural land quality. The adverse effects of gas are currently very localised and concentrated in a narrow ribbon, close to the eastern site boundary, in the central section of the site (see Annex 4). This area extends to a little over one hectare and has resulted in downgrading land of higher quality to grades 3b and 4.

A breakdown of the agricultural land classification grades in hectares and percentage terms is provided below. The Accompanying Agricultural Land Classification Map is located in Annex 3.

ALC	Ha	%
2	12.1	61.5
3a	6.0	30.3
3b	1.3	6.5
4	0.3	1.7
TOTAL	19.7	100.0

6.2 Grade 2

This occurs over the majority of the site where soils typically comprise medium loamy textures overlying clay at 50-60cm (see paragraph 4.2). In many of the profiles within this area very low levels of gas (0.1-0.3 on the 10% LEL scale) were recorded below depths of 70cm . Soil pit investigations indicated that these very low gas levels do not impede root development, furthermore no visible signs of retarded or stunted growth were evident at the surface in these areas. For these reasons the very low gas readings recorded are not considered to be an overriding constraint to ALC grade. The chief limitations to agricultural land quality within this area are consequently minor winter wetness and summer droughtiness constraints.

6.3 Grade 3a

This is mapped to the north and north east of the site where fine loamy textures overlie poorly structured clay at shallower depth. Small areas of slightly stony light textured, sandy soils are also included within this mapping unit. These soils hold smaller reserves of plant available water than land graded 2, and are consequently limited by droughtiness constraints. In common with land graded 2, very low gas readings were recorded at isolated locations within this mapping unit but are not believed to constitute a significant limitation to agricultural land quality.

6.4 Grade 3b

This occurs in a small area flanking grade 4 to the east of the site. Soils occurring in this area are variable comprising of both clayey and sandy soils variants. The chief limitation to land quality within the area is droughtiness. In the south this derives wholly from the inherently light textures within the subsoil which hold inadequate reserves of plant available water. In the north droughtiness constraints arise from restricted rooting which is caused by gas induced anaerobism within the profile.

6.5 Trace gases which are harmful to plants (phytotoxic) may also be present within this area, and could constitute an additional limitation to land quality. This has not been investigated as part of the current survey.

6.6 Grade 4

This occurs in a narrow ribbon of variable soils immediately flanking the eastern site boundary. High gas levels were recorded in this area imposing a very significant constraint on crop growth. Heat effects and possible phytotoxic effects associated with unmeasured trace gases are likely to constitute further limitation to crop performance within this area.

SEPTEMBER 1991

KATHERINE A JEWSON
ADAS
CAMBRIDGE REGIONAL OFFICE

ADAS

ANNEX 1

GMI OXYGAS GASCOSEEKER

This instrument has three ranges of operation:

(1) 0-100% Volume Methane in air

(2) 0-100% Lower Explosive Limit (LEL)
(0-5% Volume Methane in air)

(3) 0-10% Lower Explosive Limit (LEL)
(0-0.5% Volume Methane in air)

The % volume gas range indicates the total volume of methane with respect to air.

The % LEL ranges indicate the explosibility of the flammable gas (methane/air) in the atmosphere. A reading of 1.0 on these scales represents concentrations of 0.05% Methane in air.

All gas monitoring undertaken in August was with the % LEL ranges, with the majority of readings being made on the highly sensitive 10% LEL range. It should be noted that these gas readings may not represent absolute concentrations of methane gas, (due to the modifying effect of other trace gases present) but can be used as a guide to the relative magnitude of the landfill gas problem. Furthermore, large daily fluctuations in rates of landfill gas emissions may occur in response to changes in prevailing weather conditions.

ADAS

SOURCES OF REFERENCE

DOE, MAFF, SAGA (1988). Joint Agricultural Land Restoration Experiments. Technical Sections accompanying Final Report (Main Report) 1982-1987 for Bush Farm, Upminster, Essex.

GEOLOGICAL SURVEY (1976). 1:50,000 scale Solid and Drift edition geological map, sheet number 257 (Romtora).

MAFF (1988). Revised guidelines and criteria for grading the quality of agricultural land.

METEOROLOGICAL OFFICE (1989). Climatological Data for Agricultural Land Classification.

PARRY, G D R (1982). The impact on agriculture. (Paper presented at one day seminar "New Land for Old - The Restoration and After use of Landfill sites" organised by the Inst. of Municipal Engineers, 3 March 1982).

SSEW (1984). 1:250,000 scale soils map, sheet 4. (Eastern England) and accompanying Bulletin 13.

2.2 Walton's Hall Farm

Cambs 51/89

AGRICULTURAL LAND CLASSIFICATION INCORPORATING SOIL PHYSICAL CHARACTERISTICS
WALTON'S HALL FARM, STANFORD-LE-HOPE, ESSEX

1. BACKGROUND

1.1 The site, an area of 46.7 hectares, is the subject of an application, by Cory Sand and Ballast Company, for the extraction of sand and gravel near Stanford-Le-Hope, Essex.

1.2 The site was previously surveyed by MAFF on a semi-detailed basis, in 1987, in connection with the preparation of the Essex Minerals Subject Plan. The current detailed Agricultural Land Classification survey broadly confirms the gradings assigned to the area during the previous survey. It must be noted that subgrade 3c does not exist in the 1988 Revised ALC System, thus the area mapped as 3c in 1987 is shown as subgrade 3b on the current ALC map.

1.3 In April 1989 the site was surveyed by Reading Agricultural Consultants to determine the ALC grading of the site using the Revised ALC System (1988). MAFF's current survey (November 1989) confirms their grading for the majority of the site. The soils and ALC detail recorded by MAFF is set out in the report below.

2. SITE PHYSICAL FACTORS

2.1 Climate

Climate data for the site was obtained from the published agricultural climatic dataset. (Met Office, 1989). This indicates that for the site's median altitude of 10m AOD the annual average rainfall is 554mm (21.8"). This data also indicates that the field capacity days are 101 and moisture deficits are 128mm for wheat and 126mm for potatoes. The climatic characteristics do not impose any climatic limitation on the ALC grading of the survey site.

2.2 Altitude and Relief

The survey area comprises a valley side lying to the west of Mucking Marshes. The land slopes gently from 10m AOD to 5m AOD adjacent to the railway line at the eastern edge of the site. Gradient and altitude do not constitute limitations to the ALC grade.

3. AGRICULTURAL LAND CLASSIFICATION

3.1 The definitions of the Agricultural Land Classification (ALC) grades are included in Appendix 2.

3.2 The table below shows the breakdown of the ALC grades for the survey area.

AGRICULTURAL LAND CLASSIFICATION

Grade	ha	%
2	28.3	61
3a	7.7	16
3b	8.0	17
Urban	1.4	3
Non Agricultural	1.3	3
TOTAL	46.7	100

3.3 Grade 2

The majority of the survey area has been graded 2. This land is associated with the freely draining* (wetness class I) deep loamy soils of soil type A described in paragraph 4.2.1. The loamy textures and the presence of gravelly material at depth, where it occurs, impose a slight limitation on the potential for these soils to retain water in this low rainfall area. As a result profiles are slightly droughty and restricted to grade 2 (very good quality agricultural land). Where soils have a wetness class of II minor wetness and workability imperfections combine with droughtiness to exclude this land from a higher grade.

* occasionally profiles are slowly permeable at depth and have a wetness class of II.

3.4 Subgrade 3a

Adjacent to Walton's Hall Road shallower and stonier loamy profiles over gravel have been graded 3a. These soils are described in full in paragraph 4.2.2. The stones within this soil have a moderate limiting effect on the profiles water holding capacity. Consequently moderate droughtiness is the major limitation to the ALC grade.

3.5 Subgrade 3b

Two main situations arise:

3.5.1 The majority of the land graded 3b is associated with the droughty stony soils of soil type C (described in paragraph 4.2.3). The presence of many stones throughout the subsoil imposes a significant limitation on the potential of this land to retain available water for crop growth. As a result this land is restricted to subgrade 3b (moderate quality agricultural land).

3.5.2 To the southeast corner of the site the remaining land graded 3b is associated with the soils of soil type D (described in paragraph 4.2.4). The soils are typically fine loamy and non calcareous with slowly permeable horizons at variable depths in the subsoil. These slowly permeable horizons maintain the ground water level to a higher level during the year on this alluvial plain. Consequently profiles are typically wetness class III and IV. This wetness and related workability limitation restricts the land to subgrade 3b.

3.6 Non Agricultural

A remnant water filled gravel pit has been mapped as Non Agricultural.

4.1 Geology

The published 1:50,000 scale geology Sheet 257 (Romford) shows the survey area to comprise mainly floodplain gravels with a small deposit of alluvium outcropping in the southeast corner of the site.

4.2 Soils

During this survey four main soil types were identified.

4.2.1 Soil Type A (refer to Appendix 1 and Soil Types Map)

The majority of the site comprises Soil Type A. These soils typically comprise medium clay loam or sandy silt loams which overlie medium or occasionally heavy clay loams at depth. Below this, particularly adjacent to Walton's Hall Farm, profiles may overlie gravelly material (approximately $75cm^{+}$).

4.2.2 Soil Type B (refer to Appendix 1 and Soil Types Map)

Adjacent to Walton's Hall Road shallower stonier soil variants have been mapped as Soil Type B. These soils typically comprise medium clay loam topsoils over medium clay loam or sandy silt loam upper subsoils which overlie gravelly material from approximately 70cms depth. Topsoils are very slightly or slightly stony and upper subsoils are slightly or moderately stony. The gravelly material comprises 40-55% flints in a sandy silt loam or sandy loam matrix.

4.2.3 Soil Type C (refer to Appendix 1 and Soil Types Map)

In the vicinity of Turner Farm thin soils over gravel predominate, these have been mapped as Soil Type C. These soils typically comprise topsoils of sandy silt loams over gravelly subsoils which consist of 40-55% flints in a sandy silt loam or sandy loam matrix.

4.2.4 Soil Type D (refer to Appendix 1 and Soil Types Map)

The remaining soils on site are deep and occur in association with the alluvial deposits mapped in the southeast corner of the site.

These soils typically comprise medium or heavy clay loams to depth which often overlie heavy clay loam lower subsoils. Gleying is evident throughout all subsoils and organic loam and sandy silt loam horizons occur sporadically in the subsoils of some profiles.

February 1991 RESOURCE PLANNING GROUP
Cambridge RO

APPENDIX 1

DESCRIPTION OF SOIL PHSYICAL CHARACTERISTICS

SOIL TYPE A

Topsoil	texture	:	medium clay loam or sandy silt loam
	depth	:	30/35cm
Upper Subsoil	texture	:	medium clay loam or sandy silt loam
	structure	:	weakly developed medium prisms
	depth	:	60/65cm
Lower Subsoil	texture	:	medium clay loam or occasionally heavy clay loam
	structure	:	moderately developed medium prisms
	gleying	:	occasionally
	depth	:	75/120cm
Gravelly Material		:	Occasionally occurs 75cm+. This material comprises 40-55% flints in a sandy silt loam matrix.

SOIL TYPE B

Topsoil	texture	:	medium clay loam
	stone	:	5 - 10% flints
	depth	:	30cm
Upper Subsoil	texture	:	medium clay loam or sandy silt loam
	stone	:	6 - 20% flints
	structure	:	weakly developed coarse and medium prisms
	depth	:	70cm
Gravelly Material		:	Comprises 40-55% flints in a sandy silt loam or sandy loam matrix.

SOIL TYPE C

Topsoil	texture	:	sandy silt loam
	stone	:	6 - 10% flints
	depth	:	25cm
Gravelly Material		:	Comprises 40 - 55% flints in a sandy loam or sandy silt loam matrix.

SOIL TYPE D

Topsoil	texture	:	medium or heavy clay loam
	depth	:	25cm
Upper Subsoil	texture	:	medium clay loam, heavy clay loam or sandy silt loam
	structure	:	weakly developed coarse and very coarse subangular blocky
	gleying	:	yes
	depth	:	60cm
Lower Subsoil	texture	:	heavy clay loam
	structure	:	as above
	gleying	:	yes
	depth	:	120cm

Additional Information

Rooting : Evident throughout all profiles.

pH : Profile pH ranges from 6.5 to 7.

Drainage Status : Profiles of Soil Type B and C are freely draining (ie wetness class I). Soil Type A is typically freely draining although occasionally may have a Wetness Class of II due to the presence of a slowly permeable subsoil at depth. The wetness class of Soil Type D ranges from III to IV.

STANFORD-LE-HOPE, ESSEX

Differences in grading between MAFF 1987 and 1989 surveys

1. 1987 semi-detailed and old ALC system.

2. 1989 detailed and Revised ALC system.

3. 1989 broadly confirms distribution and extent of grades mapped in 1987.

4. Key differences are:

(a) Slightly less grade 2 and more 3a in 1989. This is because parts of the land graded 2 in 1987 fails to meet the doughtiness requirements for grade 2 in the Revised System. South Essex has low rainfall and high MD's; 128 mm for Wheat and 126 mm for Potatoes. The Revised System puts more weight on the drought risk afforded by soils occurring in this area than the previous ALC system.

1987		1989	
Grade 2	33.5	2	28.3
3a	4.0	3a	7.7
Total	37.5	Total	36

The 1.5 hectares of land difference in these totals is due to area measurement error.

(b) The remaining approximate 8 hectares has been graded 3b in 1989 and a mix of 3c and 4 in 1987.

(1) 3c no longer exists in the Revised System, thus this droughty land is 3b in the 1989 survey.

(2) The land graded 4 in 1987 is due to poor drainage; because of the low rainfall in this area soils can be no worse than subgrade 3b on drainage with the Revised System.

(c) Textures vary slightly between the two surveys. During the 1989 survey many lab PSD measurements were taken to confirm the texturing. This facility was not available for the semi-detailed survey carried out in 1987.

Sarah
February 1991