



**Habitats Directive- Review of Consents
Proformas for Stages 1 and 2:**

Roydon Common
Swangey Fen
Thompson Common

hsi

**Hydrogeological Services
International Limited**
6 Millmead
Guildford
Surrey
GU2 4BE

June 2000

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ENVIRONMENT
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**Habitats Directive – Review of Consents
Proformas for Stages 1 and 2:**

Roydon Common
Swangey Fen
Thompson Common



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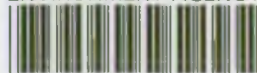
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**Hydrogeological Services
International Limited**

6 Millmead
Guildford
Surrey
GU2 4BE

June 2000

ENVIRONMENT AGENCY



124009

Ref: 8.185.008/ANC/jes

16 June 2000

For the attention of: Dr M Whiteman
Environment Agency – Anglian Region
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough
PE2 5ZR

Dear Dr Whiteman

Re: Habitats Directive-Review of Consents – Stage 1 and 2 Proformas

Please find enclosed one copy of the Stage 1 and 2 Proformas for Roydon Common, Swangey Fen and Thompson Common.

Yours sincerely,
For Hydrogeological Services International Ltd



A N Charalambous
Director

cc Lesley Saint
Area Habitats Directive Co-ordinator
1 bound copy, 1 unbound copy

Enc.

Roydon Common

APPENDIX 4

PROFORMA FOR STAGES 1 AND 2 OF THE REVIEW OF CONSENTS UNDER THE HABITATS DIRECTIVE

SECTION A: STAGE 1

A1. Name of the European site/composite SSSI:

Roydon Common and Dersingham Bog cSAC / Roydon Common SSSI

A2. Legal status of the site/composite SSSI:

Part of Roydon Common and Dersingham Bog Candidate SAC. Proposed RAMSAR.

A3. Designated features present:

1. SAC Habitat Group
- 1.2 Bogs & Wet Habitats
Depressions on peat substrates with *Rhynchospora alba*
3. SPA Species Birds
- 3.2 Birds of woodland and scrub;
- 3.3 Birds of lowland heaths and brecks. Represented by Nightjar (*Caprimulgus Europaeus*) and Woodlark (*Lullula arborea*).

ENGLISH NATURE Conservation Objectives¹

International Objectives:

1. Enhance the condition of the internationally important bog pools, flushes and pioneer vegetation typically supporting white beaked sedge ('depressions on peat substrates with *Rhynchospora alba*'). Maintain at favourable conservation status by safeguarding the water resource requirements of the mire, and ensure sustainable management using extensive grazing as a main management tool.

National Objectives:

1. Maintain groundwater levels that will support the wetland-dependent fen and bog communities in a favourable condition, in terms of their water resource requirements.
2. Reduce scrub and secondary woodland cover and then maintain at no more than 10% of the overall area of the valley mire.
3. Maintain and enhance the mixed valley mire and wet heath transition communities in a favourable condition, supporting a full range of vegetation types, ages, structures and successional phases, using extensive grazing as the main management tool.

NOTE: See HSI/ECUS (September 1999) "Habitats Directive – Initial Assessments at Priority Groundwater Fed Site", Final Report to Environment Agency – Roydon Common (Section 2).

¹ Note that English Nature plan to revise these objectives in due course in line with national guidelines.

A4. List the criteria which have been used to identify relevant permissions:
(criteria a and b should always be used)

- a. Any permission for an activity within the boundary of the European site.
- b. Any permission for an activity which is known to affect the European site.
- c. Any permission to abstract water within a 5 km radius of the site.
- d. Any permission to abstract groundwater up-gradient of the site.

A5. List all the relevant permissions identified:

NB In the case of consented discharges to water, permissions should be organised into groups (see 3.11)

Agency reference	NGR	Description of permission (<i>brief description only eg landfill site</i>)
6/33/58/032	TF 7480 1890	GW (Chalk); agricultural
6/33/58/124	TF 7910 2110	GW (Chalk); agricultural
6/33/59/025	TF 6741 1811	GW (Greensand); sand and gravel washing
6/33/59/031	TF 7064 1920	GW (Greensand); spray irrigation
6/33/61/006	TF 7330 2060	GW (Chalk); public supply
6/33/61/007	TF 7420 2290	GW (Greensand & Chalk); agricultural
6/33/61/012	TF 7630 2110 TF 7715 2335	GW (Chalk); agricultural
6/33/61/014	TF 7400 2180	GW (Greensand & Chalk); agricultural, domestic
6/33/61/035	TF 7350 2230	GW (Greensand); public supply
6/33/61/037	TF 7040 2460	GW (Greensand); spray irrigation
6/33/61/041	TF 7460 2200	GW (Chalk); spray irrigation
6/33/61/042	TF 7450 2190	GW (Greensand); public supply
6/33/61/043	TF 7010 2210	GW (Greensand); spray irrigation, fishery purposes
6/33/64/001	TF 7470 2420	GW (Chalk); agricultural
6/33/64/004	TF 7540 2480	GW (Chalk); agricultural
6/33/64/011	TF 7834 2372	GW (Chalk); agricultural
6/33/64/025	TF 7420 2620 TF 7690 2540 TF 7920 2550	GW (Chalk); public supply
6/33/64/026	TF 7320 2340	GW (Greensand & Chalk); public supply
6/33/64/035	TF 7720 2700	GW (Chalk); agricultural
6/33/64/048	TF 7430 2620 TF 7500 2560	GW (Greensand); public supply
6/33/64/051	TF 7350 2490	GW (Greensand); public supply
6/33/64/058	TF 6550 2380 TF 6544 2386	GW (Greensand); spray irrigation
6/33/64/060	TF 7355 2488	GW (Chalk); spray irrigation
6/33/64/061	TF 7553 2532	GW (Chalk); spray irrigation
6/33/64/062	TF 7467 2425	GW (Greensand); spray irrigation
6/33/64/063	TF 7600 2580	GW (Greensand); public supply

Agency reference	NGR	Description of permission (<i>brief description only eg landfill site</i>)
7/34/11/350	TF 8257 2360	GW (Chalk); combined gen. ag & domestic
7/34/11/480	TF 8040 2242	GW (Chalk); combined gen. ag & domestic
7/34/11/481	TF 8102 2172	GW (Chalk); combined gen. ag & domestic
6/33/59/004	TF 7080 1860	SW; spray irrigation
6/33/59/009	TF 7142 1780 TF 7155 1787 TF 7235 1876 TF 7248 1882	SW; spray irrigation
6/33/59/028	TF 6658 1811	SW; spray irrigation
6/33/59/033	TF 6770 1760	SW; spray irrigation
6/33/61/008	TF 7136 2075 TF 7250 2250 TF 7260 2255 TF 7430 2275 TF 7435 2270	SW; spray irrigation
6/33/61/015	TF 6425 2150 TF 6409 2125 TF 6585 2135 TF 6576 2115	SW; spray irrigation
6/33/61/020	TF 6348 2293 TF 6348 2293	SW; spray irrigation
6/33/61/031	TF 6648 2110	SW; spray irrigation
6/33/61/039	TF 6530 2130	SW; spray irrigation
6/33/64/041	TF 7080 2450	SW; spray irrigation
6/33/64/042	TF 7145 2615	SW; spray irrigation
6/33/64/056	TF 6880 2536 TF 7001 2571 TF 7110 2584 TF 6880 2530 TF 6920 2520 TF 7130 2580	SW; spray irrigation
6/33/64/059	TF 6943 2552	SW; spray irrigation

Note: GW = Groundwater
SW = Surface Water

SECTION C: STAGE 2 - ABSTRACTION LICENCES

C1. Are any of the features present identified as vulnerable to impacts from abstraction in Appendix 3? If so, list them: (See section 6, step I)

Bogs and wet habitats (SAC Habitat Group)

Birds of woodland and scrub; birds of lowland heaths and brecks.

C2. Are there any known abstraction problems on the site? If so briefly describe them: (See section 6, step II)

No

C3. What is the initial judgement of significance for the abstraction licences identified under SECTION A? (See section 6, steps I, II and IV)

Agency reference	NGR	Likely to have a significant effect? - yes or no	Initial judgement made under step I or II or IV? – specify
6/33/58/032	TF 7480 1890	no	IV
6/33/58/124	TF 7910 2110	no	IV
6/33/59/025	TF 6741 1811	no	IV
6/33/59/031	TF 7064 1920	no	IV
6/33/61/006	TF 7330 2060	no	IV
6/33/61/007	TF 7420 2290	no	IV
6/33/61/012	TF 7630 2110 TF 7715 2335	no	IV
6/33/61/014	TF 7400 2180	no	IV
6/33/61/035	TF 7350 2230	no	IV
6/33/61/037	TF 7040 2460	no	IV
6/33/61/041	TF 7460 2200	no	IV
6/33/61/042	TF 7450 2190	no	IV
6/33/61/043	TF 7010 2210	no	IV
6/33/64/001	TF 7470 2420	no	IV
6/33/64/004	TF 7540 2480	no	IV
6/33/64/011	TF 7834 2372	no	IV
6/33/64/025	TF 7420 2620 TF 7690 2540 TF 7920 2550	no	IV

Agency reference	NGR	Likely to have a significant effect? - yes or no	Initial judgement made under step I or II or IV? - specify
6/33/64/026	TF 7320 2340	no	IV
6/33/64/035	TF 7720 2700	no	IV
6/33/64/048	TF 7430 2620 TF 7500 2560	no	IV
6/33/64/051	TF 7350 2490	no	IV
6/33/64/058	TF 6550 2380 TF 6544 2386	no	IV
6/33/64/060	TF 7355 2488	no	IV
6/33/64/061	TF 7553 2532	no	IV
6/33/64/062	TF 7467 2425	no	IV
6/33/64/063	TF 7600 2580	no	IV
7/34/11/350	TF 8257 2360	no	IV
7/34/11/480	TF 8040 2242	no	IV
7/34/11/481	TF 8102 2172	no	IV
6/33/59/004	TF 7080 1860	no	IV
6/33/59/009	TF 7142 1780 TF 7155 1787 TF 7235 1876 TF 7248 1882	no	IV
6/33/59/028	TF 6658 1811	no	IV
6/33/59/033	TF 6770 1760	no	IV
6/33/61/008	TF 7136 2075 TF 7250 2250 TF 7260 2255 TF 7430 2275 TF 7435 2270	no	IV
6/33/61/015	TF 6425 2150 TF 6409 2125 TF 6585 2135 TF 6576 2115	no	IV
6/33/61/020	TF 6348 2293 TF 6348 2293	no	IV
6/33/61/031	TF 6648 2110	no	IV
6/33/61/039	TF 6530 2130	no	IV
6/33/64/041	TF 7080 2450	no	IV
6/33/64/042	TF 7145 2615	no	IV
6/33/64/056	TF 6880 2536 TF 7001 2571 TF 7110 2584 TF 6880 2530	no	IV

Agency reference	NGR	Likely to have a significant effect? - yes or no	Initial judgement made under step I or II or IV? – specify
	TF 6920 2520 TF 7130 2580		
6/33/64/059	TF 6943 2552	no	IV

C4. Describe the supporting case for the judgements given in C3:

(This should be set out in terms of the criteria for significance given in the procedure eg what is the mechanism of impact, which features are sensitive, what is their condition etc. Reference should be made to the conservation agencies view, the joint review and any problems identified under C2. Expand beyond a page if necessary)

- 1) See Supplementary Notes and listed references.
- 2) Joint Review: for the Environment Agency and Conservation Agencies to consider.

The Consultant cannot proceed beyond Step II; Step III requires the views of the Conservation Agencies (English Nature) for their judgement of feature condition.

C5. Does internal consultation support this initial assessment? (yes or no)

To be filled in by Environment Agency

C6. If not what is the new assessment? (See section 6, step V)

To be filled in by Environment Agency

STAGES 1 AND 2 OF THE DIRECTIVE OF CONSENTS UNDER THE HABITATS DIRECTIVE

SUPPLEMENTARY NOTES

ROYDON COMMON - ABSTRACTION LICENCES

Reference Document: "Guidance for the Review of Environment Agency Permissions: Determining Relevant Permissions and Significant Effect", 1999.

Other References:

HSI/ECUS (1999), Habitats Directive - Initial Assessments at Priority Groundwater Fed Sites – Roydon Common, for Environment Agency.

English Nature (August 1996), Impact of Water Abstraction on Wetland SSSI

HSI (June 2000), Environmental Appraisal: Sandringham Sands Sources – Hillington WTW & Patch, Hillington Church Farm, Grimston Manor Farm, Grimston Lanky Hill, Harpley and Congham Heath, for Anglian Water

Environment Agency (April 2000), Practical advice for Agency Water Resources Staff, Habitats Directive Stage 2 Review

SECTION A STAGE 1

A. Criteria for Identifying Relevant Permissions

A.1 The criteria used to identify relevant permissions are those listed in sections 3.8 and 3.12 of the Guidance Document.

A.2 Section 3.8 of the Guidance Document sets out three broad criteria regarding "relevance" as follows:

- "a. Any permission for an activity **within the boundary** of the European site is relevant and should be included in the review.
- b. Any permission for an activity which is **known to be affecting** the European site, either directly on a designated feature or indirectly by affecting the environmental quality of the site, is relevant and should be included in the Review.
- c. Any permission located outside the European site which has the potential to affect the features within the European site, should be considered relevant and included in the Review. Further guidance is given in the 'Guidance Document'."

A.3 Section 3.12 refers particularly to "abstraction licences". It states:

"Where there is a licensed abstraction of surface or groundwater from a hydrological system, part of which is designated as a European site, then that licence will probably be relevant to the Review unless it is downstream of the European site. Groundwater abstractions which are not in hydraulic continuity with the site can be disregarded. The licensing officer may be able to identify other criteria for establishing that licensed abstraction from both ground and surface waters could not affect the European site."

B. Determination of Relevant Permissions for Roydon Common

B.1 Figure 1 shows the locations of relevant licences.

B.2 Relevant abstraction licences shown on the map include those within the site boundary, within a 5 km radius of the centre of the site (TF 688 224) and up groundwater gradient of the site. The search envelope was defined by the Environment Agency.

SECTION C STAGE 2

A. Determination of "Significant Effect"

- C.1 The assessment of "Significant Effect" and the term "likely to have a significant effect" are discussed in section 4.0 of the Guidance Document.
- C.2 The procedure for the determination of whether relevant abstraction licences are "likely to have a significant effect" on the site is described in section 6 of the Guidance Document. A proforma is supplied in Appendix 4. More guidance in applying the criteria for assessing significant effect is provided in Appendix 3, Section 2 of the Guidance Document.

B. Determination of Significant Effect for Roydon Common

- D.1 There appears to be no known problem at the Site (Step II) as a result of historic and current licensed abstractions. However, licensed abstractions are occurring at a level less than that licensed.
- D.2 Roydon Common SSSI/NNR/Ramsar/cSAC is situated on the unconfined Lower Greensand. Approximately 2 km to the east of the site boundary, the Lower Greensand is overlain and semi-confined by the Gault Clay, which is overlain by the Chalk aquifer. Downward leakage from the Chalk is considered to enter the Greensand and appears to sustain westwards flow. However, the site is not in hydraulic continuity with the Chalk. The unconfined Lower Greensand, which is recharged by infiltration of rainfall, constitutes the source of groundwater supply to the site. Therefore, Chalk abstractions have not been considered likely to cause a significant effect on the site.
- D.3 Surface water abstractions within the defined search area are from the Rivers Gaywood and Babingley, and from drains connected to them. There are two surface water drains within the site area. These drain southwestwards, towards the Gaywood River, and are upstream of all licensed abstractions from the Gaywood. The Babingley River flows approximately 2.5 km to the north of Roydon Common, and is not in hydraulic continuity with the site. Therefore, the surface water abstraction licences identified within the search area are not considered to be significant.
- D.4 In the absence of "ecological criteria", hydrological criteria for significance have been applied as proposed in "Practical Advice for Agency Water Resources Staff", April 2000.
- (a) Riverine impacts; 10% at naturalised Q_{95} .
 - (b) Groundwater: 0.05 m of water level fall (drawdown), due to the presence of a mire community.
 - (c) With regard to cumulative impact of a number of abstractions acting together, a Licence Accretion Diagram (LAD) was suggested. Licences which breached the 0.05 m Hydrological Significance Threshold (HST) could be considered as likely to cause a significant effect.
- D.5 From a hydrogeological view point, the "0.05 m drawdown" criterion must be viewed in the context of:
- (a) The aquifer at the site is unconfined; peat may provide local confinement.
- D.6 The theoretical drawdown from each relevant licensed abstraction and cumulative drawdown are presented in Table 1. Assumptions as to hydrogeological condition and hydraulic parameters were the following:
- (a) Unconfined sand/sandstone aquifer
 - (b) Transmissivity (T) = $210 \text{ m}^2/\text{d}$
 - (c) Specific Yield (S) = 0.1 and 0.05

Pumping time (t) was taken as 200 days; abstraction rates were taken as average licensed annual, except for irrigation licences which were taken at peak daily rates over the period determined by the annual licensed quantity.

The Theis equation was used to estimate theoretical drawdowns:

$$s = \frac{Q}{4 \pi T} W(u)$$

Where: s = drawdown (m)

Q = abstraction (m^3/d)

$$u = \frac{r^2 S}{4 T t}$$

r = distance of observation point from pumped borehole abstraction (m)

S = storage co-efficient

T = transmissivity (m^2/day)

t = time (days)

It is assumed that for the relatively long periods of time for which the estimates are made, the response of the aquifer, although essentially unconfined, approximates to a confined (Theis) response. The value of $W(u)$ is obtained from tables, for different values of u . Some of the assumptions are:

- The aquifer has seemingly infinite areal extent.
- The aquifer is homogenous, isotropic and of uniform thickness within the area of influence.
- No recharge during the period of pumping.
- No delayed yield effects.

In practice, natural aquifers do not conform to all assumptions demanded by the equation, so that theoretical drawdowns should be treated with some caution. The condition of no recharge for 200 days is mainly applicable during periods of drought.

Transmissivity values are fairly well defined for the Lower Greensand. The value of $210 \text{ m}^2/\text{d}$ employed in these calculations is the geometric mean of results derived from long term pumping tests on AWS Greensand sources. Roydon Common is located on the unconfined Lower Greensand, with the centre of the site approximately 2 km west of the confining Gault Clay. Water level behaviour at Roydon Common could be affected by abstraction from the confined area, but will be dominated by unconfined storage characteristics. Unfortunately, no pumping test results are available for sources completed in the unconfined Lower Greensand. Representative values of specific yield for the Greensand are considered to be in the range of 0.1 – 0.3, the higher value possibly applying where it is overlain by Sand & Gravel. For sensitivity purposes, conservative values have been employed for specific yield, of 0.05 and 0.1.

- D.7 Table 1 and the Licence Accretion Diagrams (LADs) in Figures 2a & b show theoretical drawdowns at Roydon Common for specific yields of 0.1 and 0.05. In both cases the eighteen potentially significant licences, individually and cumulatively, cause theoretical drawdowns which are much less than the 0.05 m Hydrogeological Significance Threshold (HST).

TABLE 1: THEORETICAL DRAWDOWNS AT ROYDON COMMON SSSI/NNR/pRAMSAR/cSAC

Licence 6/33/...	NGR	Licence holder	Catch- ment No.	Use	Season	Total licensed quantity allowing for aggregates (1000 m ³ /y)	Quantity per site (1000 m ³ /y)	Daily rate m ³ /day	Easting	Northing	Aquifer (GS = Greensand, Ch = Chalk)	Radial (m)	Time for Abs (days)	Q (m ³ /d)	u = r ² S/4Tt		W(u)		Theis Drawdown (m)	
															S = 0.1	S = 0.05	S = 0.1	S = 0.05	S = 0.1	S = 0.05
59/025	TF 6741 1811	hepworth minerals	59	sand & gravel washing	annual		460.000	2000.00	567410	318110	GS	4510	200	1260.27	12.105	6.052	0.0000	0.0004	0.00000	0.00019
59/031	TF 7064 1920	mid norfolk canners	59	spray irrigation	apr-oct		48.000	843.00	570640	319200	GS	3691	57	843.00	28.488	14.244	0.0000	0.0000	0.00000	0.00000
61/007	TF 7420 2290	f k coe & son ltd	61	agricultural	annual		1.331	3.64	574200	322900	GS & Ch	5423	200	3.65	17.506	8.753	0.0000	0.0000	0.00000	0.00000
61/014	TF 7400 2180	i. mason	61	domestic & agricultural	annual	0.827	0.827	6.95	574000	321800	GS & Ch	5235	200	2.27	16.310	8.155	0.0000	0.0000	0.00000	0.00000
61/035	TF 7350 2230	anglian water services ltd	61	public water supply	annual		1000.000	3000.00	573500	322300	GS	4701	200	2739.73	13.155	6.577	0.0000	0.0002	0.00000	0.00021
61/037	TF 7040 2460	m rae	61	spray irrigation	apr-sep		75.000	1100.00	570400	324600	GS	2720	68	1100.00	12.921	6.460	0.0000	0.0002	0.00000	0.00008
61/042	TF 7450 2190	anglian water services ltd	61	public water supply	annual		1000.000	3000.00	574500	321900	GS	5722	200	2739.73	19.488	9.744	0.0000	0.0000	0.00000	0.00000
61/043	TF 7010 2210	pat o'brien	61	all	annual	2.000														
	TF 7010 2210	pat o'brien	61	spray irrigation	annual		0.300	20.00	570100	322100	GS	1334	15	20.00	14.127	7.063	0.0000	0.0001	0.00000	0.00000
	TF 7010 2210	pat o'brien	61	fishery purposes	annual		1.700	20.00	570100	322100	GS	1334	200	4.66	1.060	0.530	0.1860	0.5250	0.00033	0.00093
64/026*	TF 7320 2340	anglian water services ltd	64	public water supply	annual		831.918	3800.00	573200	323400	GS & Ch	4512	200	2279.23						
	TF 7320 2340	anglian water services ltd	64	public water supply	annual		207.979				GS	4512	200	569.81	12.119	6.060	0.0000	0.0003	0.00000	0.00006
64/048		anglian water services ltd	64	public water supply	annual	1600.000		4000.00						**						
	TF 7430 2620	anglian water services ltd	64	public water supply	annual		1600.000	4000.00	574300	326200	GS	6685	200	2191.78	26.601	13.301	0.0000	0.0000	0.00000	0.00000
	TF 7500 2560	anglian water services ltd	64	public water supply	annual		1600.000	2000.00	575000	325600	GS	6977	200	2191.78	28.976	14.488	0.0000	0.0000	0.00000	0.00000
64/051	TF 7350 2490	anglian water services ltd	64	public water supply	annual		1000.000	3000.00	573500	324900	GS	5324	200	2739.73	16.869	8.435	0.0000	0.0000	0.00000	0.00000
64/058		kings lynn golf club	64	spray irrigation	apr-oct	38.000		194.00												
	TF 6550 2380	kings lynn golf club	64	spray irrigation	apr-oct		26.000	114.00	565500	323800	GS	3585	228	114.00	6.707	3.354	0.0002	0.0079	0.00001	0.00034
	TF 6544 2386	kings lynn golf club	64	spray irrigation	apr-oct		12.000	80.00	565440	323860	GS	3663	150	80.00	10.652	5.326	0.0000	0.0008	0.00000	0.00002
64/062	TF 7467 2425	m mason ltd	64	spray irrigation	apr-oct		112.500	1200.00	574670	324250	GS	6155	94	1200.00	48.101	24.050	0.0000	0.0000	0.00000	0.00000
64/063	TF 7600 2580	anglian water services ltd	64	public water supply	annual		800.000	2330.00	576000	325800	GS	7962	200	2191.78	37.738	18.869	0.0000	0.0000	0.00000	0.00000
Total																			0.0003	0.0018

Notes:

Only groundwater abstractions from the Greensand are considered to be significant.

Licensed abstractions from the Chalk aquifer are not considered significant: drawdowns have not been calculated for these licences.

Hydraulic parameters used: Transmissivity (T) = 210m²/d, Storage Coefficient (S) = 0.1 and 0.05

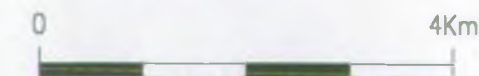
*Licence 6/33/64/026 is thought to derive 25% of its yield from the Greensand, and the remainder from the Chalk. The drawdown calculation for this licence is based on the Greensand proportion of yield only.

** Licence 6/33/64/048 mean daily quantity assumes 50% of aggregate from each of the two sources

LEGEND

- Habitat Directive Search Area
- 3Km radius line from centre site
- 5Km radius line from centre site
- Surface water feature
- Direction of flow
- ▨ Roydon Common SSSI/NNR/pRAMSAR/cSAC
- ⊞ Privately owned Chalk Licence
- AWS Chalk Licence
- ⊕ Privately owned Greensand Licence
- AWS Greensand Licence
- Surface Water Licence

Scale 1:75,000



TF71

Habitats Directive
Assessments at Priority Groundwater Fed Sites

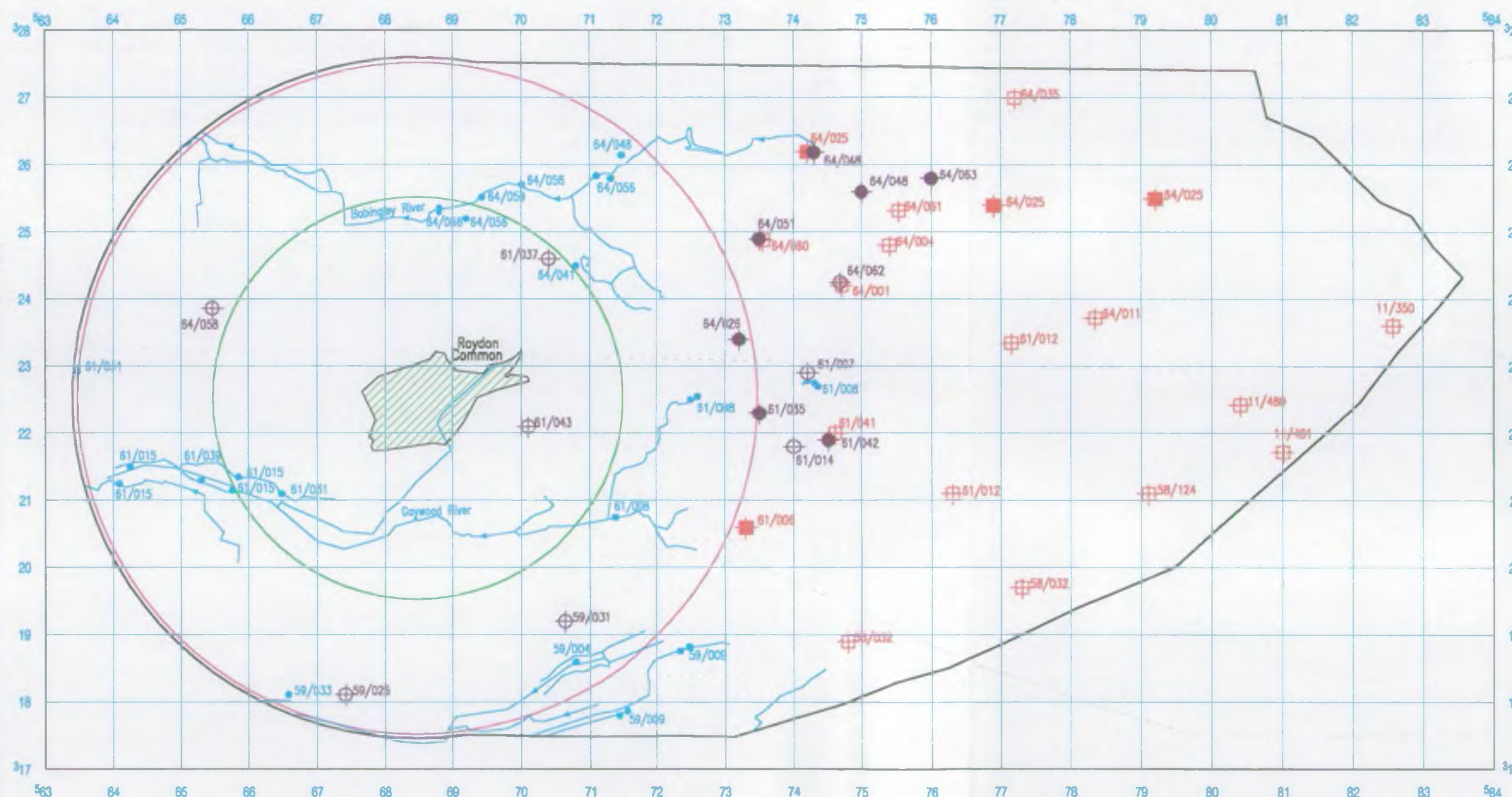
Location Map Showing Relevant Licences at Roydon Common SSSI/NNR/pRAMSAR/cSAC

Drawing File: 185 Habitat Directive\Drawings\roydon bh loca. dwg

Date: June 2000

Figure: 1

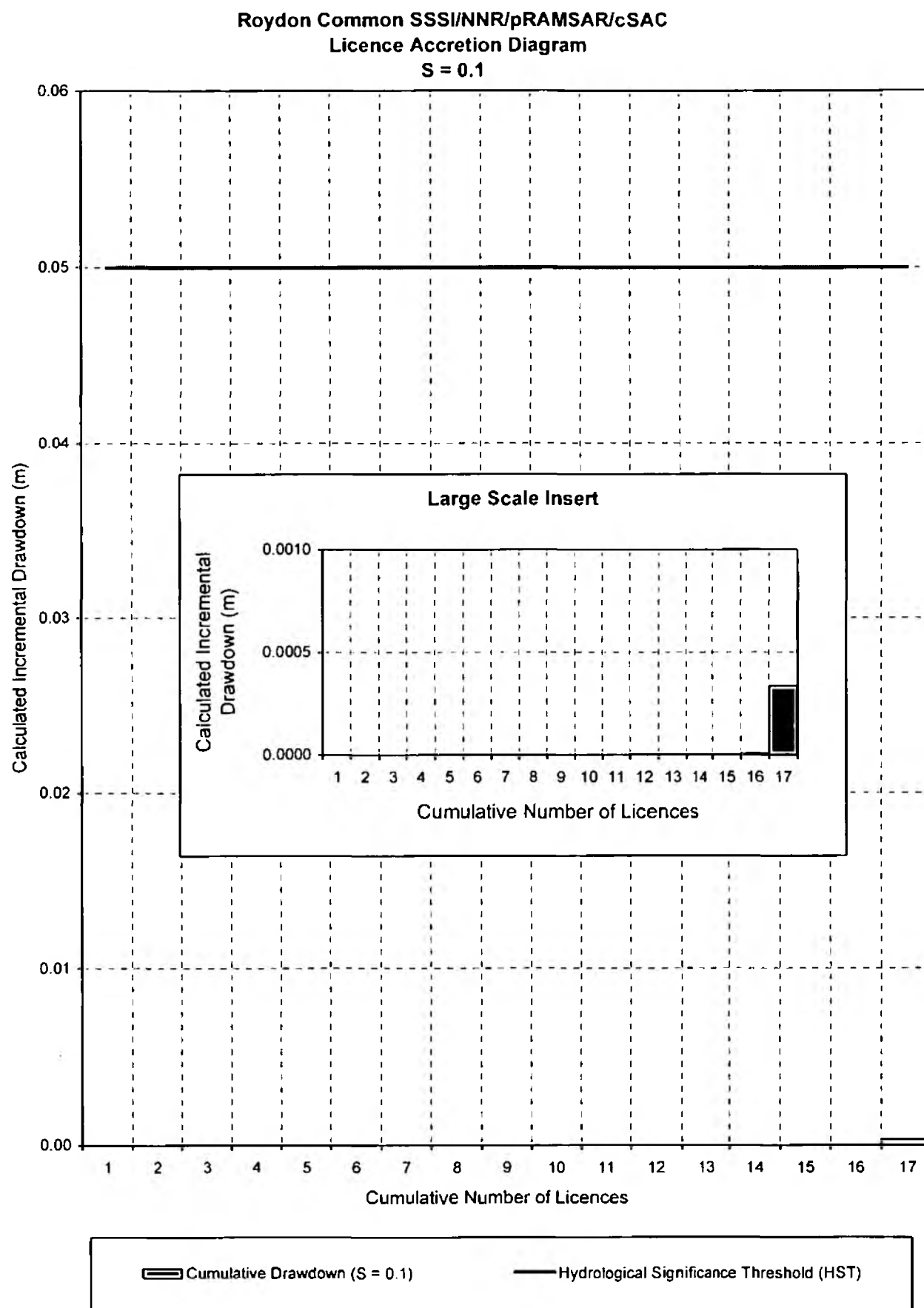
hsi Hydrogeological Services International Ltd
6 Millmead, Guildford, Surrey. GU2 4BE
01483 504221 mail@hsiltd.co.uk



DETAILS OF LICENCE ACCRETION DIAGRAM: ROYDON COMMON
SSSI/NNR/pRAMSAR/cSAC

Rank No.	Licence (6/33/...)	NGR	Drawdown, m (S = 0.1)	Drawdown, m (S = 0.05)	Cumulative Drawdown (S = 0.1)	Cumulative Drawdown (S = 0.05)	Hydrological Significance Threshold (HST)
1	59/031	TF 7064 1920	0.00000	0.00000	0.00000	0.00000	0.05
2	61/007	TF 7420 2290	0.00000	0.00000	0.00000	0.00000	0.05
3	61/014	TF 7400 2180	0.00000	0.00000	0.00000	0.00000	0.05
4	61/042	TF 7450 2190	0.00000	0.00000	0.00000	0.00000	0.05
5	64/048	TF 7430 2620	0.00000	0.00000	0.00000	0.00000	0.05
6	64/048	TF 7500 2560	0.00000	0.00000	0.00000	0.00000	0.05
7	64/051	TF 7350 2490	0.00000	0.00000	0.00000	0.00000	0.05
8	64/062	TF 7467 2425	0.00000	0.00000	0.00000	0.00000	0.05
9	64/063	TF 7600 2580	0.00000	0.00000	0.00000	0.00000	0.05
10	61/043	TF 7010 2210	0.00000	0.00000	0.00000	0.00000	0.05
11	64/058	TF 6544 2386	0.00000	0.00002	0.00000	0.00003	0.05
12	64/026*	TF 7320 2340	0.00000	0.00006	0.00000	0.00009	0.05
13	61/037	TF 7040 2460	0.00000	0.00008	0.00000	0.00017	0.05
14	59/025	TF 6741 1811	0.00000	0.00019	0.00000	0.00037	0.05
15	61/035	TF 7350 2230	0.00000	0.00021	0.00000	0.00057	0.05
16	64/058	TF 6550 2380	0.00001	0.00034	0.00001	0.00091	0.05
17	61/043	TF 7010 2210	0.00033	0.00093	0.00034	0.00184	0.05

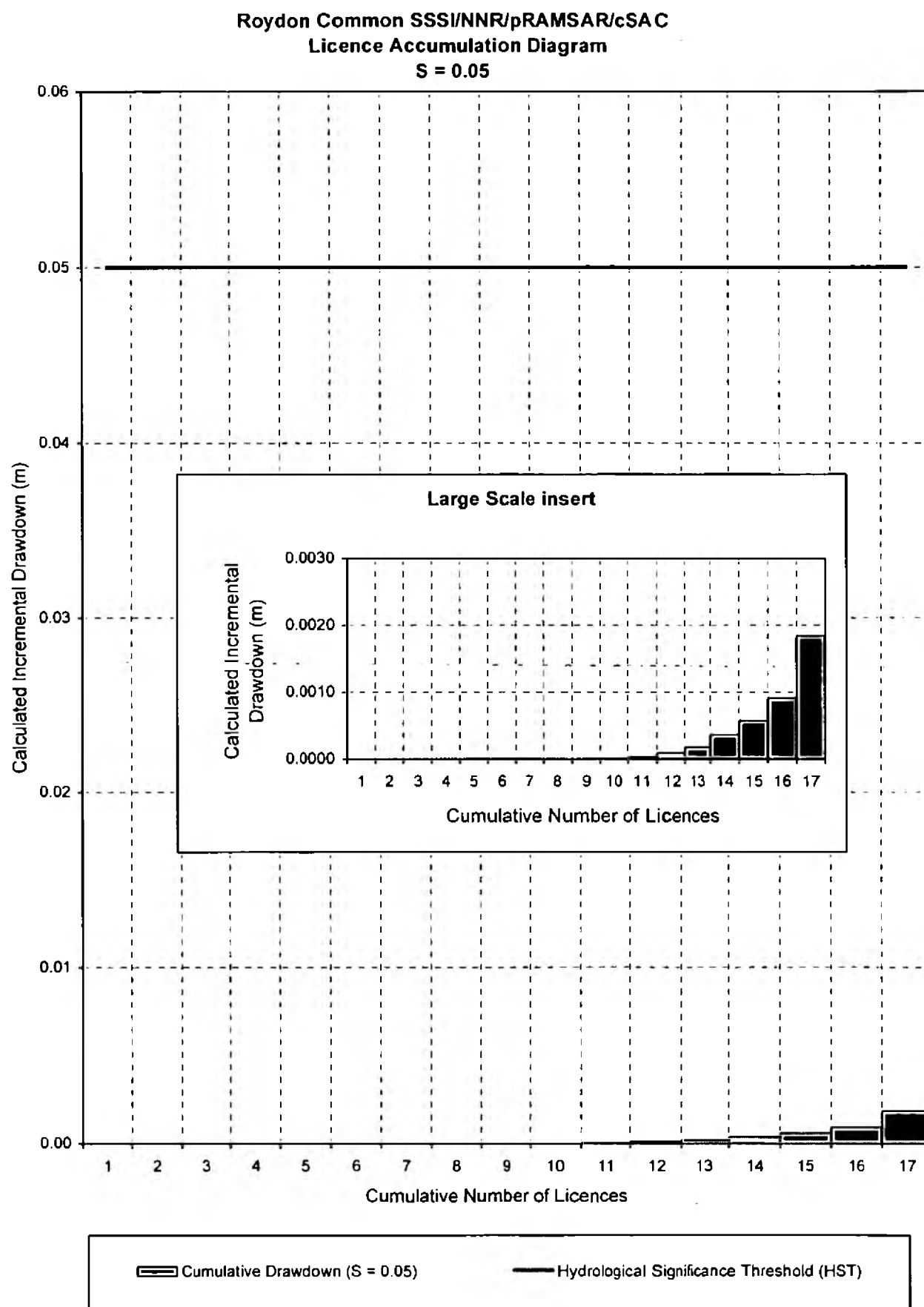
Figure 2a



**DETAILS OF LICENCE ACCRETION DIAGRAM: ROYDON COMMON
SSSI/NNR/pRAMSAR/cSAC**

Rank No.	Licence (6/33/...)	NGR	Drawdown, m (S = 0.1)	Drawdown, m (S = 0.05)	Cumulative Drawdown (S = 0.1)	Cumulative Drawdown (S = 0.05)	Hydrological Significance Threshold (HST)
1	59/031	TF 7064 1920	0.00000	0.00000	0.00000	0.00000	0.05
2	61/007	TF 7420 2290	0.00000	0.00000	0.00000	0.00000	0.05
3	61/014	TF 7400 2180	0.00000	0.00000	0.00000	0.00000	0.05
4	61/042	TF 7450 2190	0.00000	0.00000	0.00000	0.00000	0.05
5	64/048	TF 7430 2620	0.00000	0.00000	0.00000	0.00000	0.05
6	64/048	TF 7500 2560	0.00000	0.00000	0.00000	0.00000	0.05
7	64/051	TF 7350 2490	0.00000	0.00000	0.00000	0.00000	0.05
8	64/062	TF 7467 2425	0.00000	0.00000	0.00000	0.00000	0.05
9	64/063	TF 7600 2580	0.00000	0.00000	0.00000	0.00000	0.05
10	61/043	TF 7010 2210	0.00000	0.00000	0.00000	0.00000	0.05
11	64/058	TF 6544 2386	0.00000	0.00002	0.00000	0.00003	0.05
12	64/026*	TF 7320 2340	0.00000	0.00006	0.00000	0.00009	0.05
13	61/037	TF 7040 2460	0.00000	0.00008	0.00000	0.00017	0.05
14	59/025	TF 6741 1811	0.00000	0.00019	0.00000	0.00037	0.05
15	61/035	TF 7350 2230	0.00000	0.00021	0.00000	0.00057	0.05
16	64/058	TF 6550 2380	0.00001	0.00034	0.00001	0.00091	0.05
17	61/043	TF 7010 2210	0.00033	0.00093	0.00034	0.00184	0.05

Figure 2b



Swangey Fen

APPENDIX 4

PROFORMA FOR STAGES 1 AND 2 OF THE REVIEW OF CONSENTS UNDER THE HABITATS DIRECTIVE

SECTION A: STAGE 1

A1. Name of the European site/composite SSSI:

Norfolk Valley Fens cSAC / Swangey Fen SSSI

A2. Legal status of the site/composite SSSI:

Part of Norfolk Valley Fens Candidate SAC.

A3. Designated features present:

1.0 SAC Habitat Groups

1.1 Fens and Wet Habitats

Notified Interest Under SAC

Calcium-rich spring water fed fens.

- For which this is considered to be one of the best areas in the UK.
- For which the area contains no more than 10% of the UK's resource.

English Nature Conservation Objectives¹

International Objectives:

1. Maintain and enhance the condition of the internationally important calcium-rich spring water fed fens (M13).
2. Establish and maintain sufficient groundwater flow and ditch water levels to protect the wetland communities present.
3. Manage swamp and fen communities to maintain, in optimal condition, the NVC communities for which the site has been notified.
4. Reduce and control scrub at a level which is not detrimental to the open fen communities.

National Objectives:

1. Obtain further information about rare invertebrates and incorporate their needs into management prescriptions.

NOTE: See HSI/ECUS (September 1999) "Habitats Directive – Initial Assessments of Priority Groundwater Fed Sites", Final Report to the Environment Agency – Swangey Fen (Section 4.2, Figure 7 - Hydrological Map)

¹ Note that English Nature plan to revise these objectives in due course in line with national guidelines.

A4. List the criteria which have been used to identify relevant permissions:
(criteria a and b should always be used)

- a. Any permission for an activity within the boundary of the European site.
- b. Any permission for an activity which is known to affect the European site.
- c. Any permission to abstract water within a 5 km radius of the site.
- d. Any permission to abstract water up-groundwater gradient of the site.

A5. List all the relevant permissions identified:

NB In the case of consented discharges to water, permissions should be organised into groups (see 3.11)

Agency reference	NGR	Description of permission (<i>brief description only eg landfill site</i>)
6/33/44/009	TL 9730 9300	GW (Chalk); combined gen. ag & domestic
6/33/44/012	TL 9990 9190	GW (Chalk); agricultural
6/33/44/013	TL 9947 9186	GW (Chalk); spray irrigation
6/33/44/016	TM 0450 9300	GW (Chalk); combined gen. ag & domestic
6/33/44/019	TM 0020 9510	GW (Chalk); agricultural
6/33/44/033	TM 0850 9352	GW (Chalk); public supply
	TM 0851 9532	GW (Chalk); public supply
6/33/44/036	TM 0416 9378	GW (Chalk); agricultural, spray irrigation
6/33/44/038	TM 0560 9830	GW (Chalk); agricultural
6/33/44/043	TM 0750 9490	GW (Chalk); agricultural
6/33/44/049	TM 0030 9280	GW (Chalk); agricultural
6/33/44/075	TL 9990 9590	GW (Chalk); combined gen. ag & domestic
6/33/44/081	TM 0280 9350	GW (Chalk); combined gen. ag & domestic
6/33/44/087	TM 0470 9770	GW (Chalk); agricultural
	TM 0430 9720	GW (Chalk); agricultural
6/33/44/091	TL 9670 9440	GW (Chalk); agricultural
6/33/44/093	TM 0090 9910	GW (Chalk); agricultural
6/33/44/095	TM 0150 9450	GW (Chalk); combined gen. ag & domestic
6/33/44/098	TL 9840 9680	GW (Chalk); agricultural
6/33/44/131	TM 0028 9085	GW (Chalk); agricultural, spray irrigation
6/33/44/133	TM 0276 9500	GW (Chalk); agricultural
6/33/44/137	TM 0214 9168	GW (Chalk); augmentation (EA)
	TL 9810 9179	GW (Chalk); augmentation (EA)
	TL 9877 8944	GW (Chalk); augmentation (EA)
	TL 9941 9120	GW (Chalk); augmentation (EA)
6/33/44/218	TM 0510 9490	GW (Chalk); industrial
	TM 0510 9491	GW (Chalk); industrial
6/33/44/219	TM 0920 9360	GW (Chalk); industrial
6/33/44/226	TM 0510 9630	GW (Chalk); agricultural, domestic
6/33/44/227	TM 0190 9080	GW (Chalk); spray irrigation
6/33/44/243	TM 0225 9865	GW (Chalk); agricultural

6/33/44/249	TM 0161 9256	GW (Chalk); spray irrigation
6/33/44/259	TL 9850 8940	GW (Chalk); spray irrigation
6/33/44/260	TL 9744 9042	GW (Chalk); spray irrigation
6/33/44/263	TM 0269 8877	GW (Chalk); spray irrigation
6/33/44/267	TM 0550 9080	GW (Chalk); agricultural, spray irrigation
6/33/44/268	TM 0065 9485	GW (Chalk); agricultural, domestic
	TM 0067 9846	GW (Chalk); agricultural, domestic
6/33/44/269	TL 9951 9441	GW (Chalk); spray irrigation
6/33/44/275	TM 0332 9845	GW (Chalk); agricultural
6/33/44/280	TM 0617 9373	GW (Chalk); industrial
	TM 0608 9373	GW (Chalk); industrial
6/33/44/283	TM 0496 8985	GW (Chalk); agricultural
6/33/44/284	TM 0546 9476	GW (Chalk); industrial
7/34/13/037	TM 0942 9582	GW (Chalk); combined gen. ag & domestic
7/34/13/040	TM 0987 9652	GW (Chalk); combined gen. ag & domestic
7/34/13/041	TM 0498 9899	GW (Chalk); combined gen. ag & domestic
7/34/13/075	TM 0992 9904	GW (Chalk); combined gen. ag & domestic
7/34/13/119	TM 0544 9941	GW (Chalk); combined gen. ag & domestic
7/34/13/153	TM 0947 9497	GW (Chalk); combined gen. ag & domestic
7/34/13/188	TM 0895 9742	GW (Chalk); combined gen. ag & domestic
7/34/13/240	TM 0964 9959	GW (Chalk); combined gen. ag & domestic
6/33/44/020	TM 0060 9460	SW; spray irrigation
6/33/44/040	TL 9954 9437	SW; spray irrigation
6/33/44/051	TM 0170 9470	SW; spray irrigation
	TM 0220 9300	SW; spray irrigation
6/33/44/054	TM 0060 9760	SW; combined gen. ag & domestic & industrial
6/33/44/228	TL 9970 9310	SW; spray irrigation
6/33/44/233	TM 0700 9200	SW; spray irrigation
6/33/44/247	TM 0490 9200	SW; spray irrigation
6/33/44/248	TL 9900 9450	SW; spray irrigation
6/33/44/264	TL 9920 9190	SW; spray irrigation
6/33/44/272	TL 9925 9192	SW; spray irrigation

Note: GW = Groundwater
SW = Surface water

SECTION C: STAGE 2 - ABSTRACTION LICENCES

C1. Are any of the features present identified as vulnerable to impacts from abstraction in Appendix 3? If so, list them: (See section 6, step I)

Calcium-rich spring water fed fens (SAC Habitat Group)

See Section A3 for more details.

C2. Are there any known abstraction problems on the site? If so briefly describe them: (See section 6, step II)

No

C3. What is the initial judgement of significance for the abstraction licences identified under SECTION A? (See section 6, steps II and IV)

Agency reference	NGR	Likely to have a significant effect? - yes or no	Initial judgement made under step I or II or IV? – specify
6/33/44/020	TM 0060 9460	No	IV
6/33/44/040	TL 9954 9437	No	IV
6/33/44/051	TM 0170 9470	No	IV
	TM 0220 9300	No	IV
6/33/44/054	TM 0060 9760	No	IV
6/33/44/228	TL 9970 9310	No	IV
6/33/44/233	TM 0700 9200	No	IV
6/33/44/247	TM 0490 9200	No	IV
6/33/44/248	TL 9900 9450	No	IV
6/33/44/264	TL 9920 9190	No	IV
6/33/44/272	TL 9925 9192	No	IV
7/34/13/075	TM 0992 9904	No	IV
6/33/44/043	TM 0750 9490	No	IV
7/34/13/040	TM 0987 9652	No	IV
7/34/13/240	TM 0964 9959	No	IV
6/33/44/087	TM 0470 9770	No	IV
7/34/13/188	TM 0895 9742	No	IV
7/34/13/037	TM 0942 9582	No	IV

7/34/13/153	TM 0947 9497	No	IV
6/33/44/275	TM 0332 9845	No	IV
6/33/44/075	TL 9990 9590	No	IV
7/34/13/041	TM 0498 9899	No	IV
6/33/44/009	TL 9730 9300	No	IV
7/34/13/119	TM 0544 9941	No	IV
6/33/44/087	TM 0430 9720	No	IV
6/33/44/038	TM 0560 9830	No	IV
6/33/44/119	TG 0039 0138	No	IV
6/33/44/016	TM 0450 9300	No	IV
6/33/44/268	TM 0067 9846 TM 0065 9485	No	IV
6/33/44/095	TM 0150 9450	No	IV
6/33/44/091	TL 9670 9440	No	IV
6/33/44/283	TM 0496 8985	No	IV
6/33/44/098	TL 9840 9680	No	IV
6/33/44/226	TM 0510 9630	No	IV
6/33/44/093	TM 0090 9910	No	IV
6/33/44/012	TL 9990 9190	No	IV
6/33/44/267	TM 0550 9080	No	IV
6/33/44/081	TM 0280 9350	No	IV
6/33/44/219	TM 0920 9360	No	IV
6/33/44/131	TM 0028 9085	No	IV
6/33/44/049	TM 0030 9280	No	IV
6/33/44/019	TM 0020 9510	No	IV
6/33/44/133	TM 0276 9500	No	IV
6/33/44/243	TM 0225 9865	No	IV
6/33/44/036	TM 0416 9378	No	IV
6/33/44/013	TL 9947 9186	No	IV
6/33/44/260	TL 9744 9042	No	IV
6/33/44/033	TM 0850 9352 TM 0851 9352	No	IV
6/33/44/259	TL 9850 8940	Yes	IV
6/33/44/284	TM 0546 9476	Yes	IV

6/33/44/267	TM 0550 9080	Yes	IV
6/33/44/263	TM 0269 8877	Yes	IV
6/33/44/280	TM 0608 9373 TM 0617 9373	Yes	IV
6/33/44/218	TM 0510 9491 TM 0510 9490	Yes	IV
6/33/44/131	TM 0028 9085	Yes	IV
6/33/44/036	TM 0416 9378	Yes	IV
6/33/44/269	TL 9951 9441	Yes	IV
6/33/44/227	TM 0190 9080	Yes	IV
6/33/44/249	TM 0161 9256	Yes	IV
6/33/44/137	TL 9877 8944	Yes	IV
6/33/44/137	TL 9810 9179	Yes	IV
6/33/44/137	TL 9941 9120	Yes	IV
6/33/44/137	TM 0214 9168	Yes	IV

C4. Describe the supporting case for the judgements given in C3:

(This should be set out in terms of the criteria for significance given in the procedure eg what is the mechanism of impact, which features are sensitive, what is their condition etc. Reference should be made to the conservation agencies view, the joint review and any problems identified under C2. Expand beyond a page if necessary)

- 1) See Supplementary Notes and listed references.
- 2) Joint Review: For Agency and Conservation Agencies to consider.

The Consultant cannot proceed beyond Step II; Step III requires the views of the Conservation Agencies (English Nature) for their judgement of feature condition.

C5. Does internal consultation support this initial assessment? (yes or no)

To be filled in by Environment Agency.

☐

C6. If not what is the new assessment? (See section 6, step V)

To be filled in by Environment Agency.

STAGES 1 AND 2 OF THE DIRECTIVE OF CONSENTS UNDER THE HABITATS DIRECTIVE

SUPPLEMENTARY NOTES

SWANGHEY FEN - ABSTRACTION LICENCES

Reference Document: "Guidance for the Review of Environment Agency Permissions: Determining Relevant Permissions and Significant Effect", 1999.

Other References:

HSI/ECUS (1999), Habitats Directive - Initial Assessments at Priority Groundwater Fed Sites - Swanghey Fen, for Environment Agency.

Allen, D.J., The physical properties of major aquifers in England and Wales, BGS Technical Report WD.97.34, Environment Agency R&D, Publication 8.

Environment Agency (April 2000), Practical advice for Agency Water Resources Staff, Habitats Directive Stage 2 Review

English Nature, August 1996, Impact of Water Abstraction on Wetland SSSIs.

SECTION A STAGE 1

A. Criteria for Identifying Relevant Permissions

A.1 The criteria used to identify relevant permissions are those listed in sections 3.8 and 3.12 of the Guidance Document.

A.2 Section 3.8 of the Guidance Document sets out three broad criteria regarding "relevance" as follows:

- "a. Any permission for an activity **within the boundary** of the European site is relevant and should be included in the review.
- b. Any permission for an activity which is **known to be affecting** the European site, either directly on a designated feature or indirectly by affecting the environmental quality of the site, is relevant and should be included in the Review.
- c. Any permission located outside the European site which has the potential to affect the features within the European site, should be considered relevant and included in the Review. Further guidance is given in the 'Guidance Document'."

A.3 Section 3.12 refers particularly to "abstraction licences". It states:

"Where there is a licensed abstraction of surface or groundwater from a hydrological system, part of which is designated as a European site, then that licence will probably be relevant to the Review unless it is downstream of the European site. Groundwater abstractions which are not in hydraulic continuity with the site can be disregarded. The licensing officer may be able to identify other criteria for establishing that licensed abstraction from both ground and surface waters could not affect the European site."

B. Determination of Relevant Permissions for Swanghey Fen

B.1 Figure 1 shows the locations of relevant licences.

B.2 Relevant abstraction licences shown on the map include those within the site boundary, within a 5 km radius of the centre of the site (TM 015 933) and up groundwater gradient of the site. The search envelope was defined by the Environment Agency.

SECTION C STAGE 2

C. Determination of "Significant Effect"

- C.1 The assessment of "Significant Effect" and the term "likely to have a significant effect" are discussed in section 4.0 of the Guidance Document.
- C.2 The procedure for the determination of whether relevant abstraction licences are "likely to have a significant effect" on the site is described in section 6 of Guidance Document. A proforma is supplied in Appendix 4. More guidance in applying the criteria for assessing significant effect is provided in Appendix 3, Section 2 of the Guidance Document.

D. Determination of Significant Effect for Swangey Fen

- D.1 There appears to be no known problem at the Site (Step II) as a result of historic and current licensed abstractions. However, licensed abstractions are occurring at a level less than that licensed.
- D.2 The Chalk occurs at varying depths beneath Swangey Fen SSSI/SAC. Beneath the southern part of the site a buried channel has cut into the Chalk, to a depth of up to 70 m bgl, shallowing to 3 mbgl along the northern boundary of the site. The channel is largely filled with low permeability Boulder Clay, which is in turn overlain by Alluvium over most of the site, apart from where it is overlain by Sand & Gravel (close to the southwestern boundary, and along a small part of the northeastern boundary). Along the northeastern boundary of the site, the Boulder Clay locally thins to nothing, and the Chalk is directly overlain by Alluvium. Within this restricted area, the Chalk is in direct hydraulic contact with the Alluvium, and groundwater discharge from the Chalk to the Alluvium feeds a seepage face at the surface. This seepage is thought to sustain water levels in the wet fen area immediately to the southwest, in the centre of the site. The Sand & Gravel perched on the Boulder Clay along the southwestern boundary is a minor water-table aquifer, of limited extent. Although it may contribute some groundwater discharge to the southern part of the site, it is not in hydraulic continuity with the Chalk.
- D.3 The buried channel which occurs in the southern part of the site, as shown on Figure 1, is thought to be predominantly filled with Boulder Clay to a depth of up to 70 m bgl. Although this channel could inhibit hydraulic connection between the site and abstraction sources to the south, these sources were still considered to be significant.
- D.4 In the absence of "ecological criteria", hydrological criteria for significance have been applied by as proposed in "Practical Advice for Agency Water Resources Staff", October 1999:
- (a) Riverine impacts; 10% at naturalised Q_{95} .
 - (b) Groundwater: 0.1 m of water level fall (drawdown).
 - (c) With regard to cumulative impact of a number of abstractions acting together, a "Licence Accretion Diagram" (LAD) was suggested. Licences which breached the 0.1m Hydrological Significance Threshold (HST) could be considered as likely to cause a significant effect.
- D.5 Of the 9 surface water licences within the search area, 3 pertain to abstractions upstream of Swangey Fen SSSI/SAC from the River Thet, or drains associated with it. The River Thet flows through the site, and therefore the potential significance of these abstractions must be quantitatively considered. Their details are as follows:

Licence No.	NGR	Total Licensed Quantity (m^3/y)
6/33/44/233	TM 0700 9200	1,364
6/33/44/247	TM 0490 9200	34,100
6/33/44/051	TM 0220 9300	6,163
		<hr/> 41,627 <hr/>

River flow information is only available 2 km downstream of the site, at Redbridge gauging station (TL 996 923). Flows at the gauging station include input from a major tributary which joins the River Thet downstream of Swangey Fen, and are therefore not directly representative of flows through the

site. However, the combined licensed quantity of 41,627 m³/y for these potentially significant surface water licences is very small (0.16%) compared to measured flows at Redbridge (annual mean 1973 – 1997: 25,800,000 m³/y). For these licensed abstractions to exceed the significance criterion of 10% of naturalised Q₉₅, the flow of the River Thet through Swangey Fen would have to be around 1.5% of flow at Redbridge. This is obviously not the case, and therefore these licences are not considered to be significant.

D.4 From a hydrogeological view point, the “0.1 m drawdown” criterion must be viewed in the context of:

- (a) In the case of Swangey Fen, at the seepage slope, the Chalk and Drift are in hydraulic continuity, with water levels in the Chalk generally a little higher than those in the Drift. Below the break slope, where the seepages and wet ground occur the Drift groundwater levels are approximately 1.0 - 1.5 m lower than the Chalk levels. A fall of 0.10 m in the Chalk level is not thought likely to cause a significant impact on the seepage flow and therefore, in this case, the criterion may be considered somewhat conservative.

Pre-1988 Chalk water level seasonal fluctuations are 1 - 2 m; therefore, a 0.10 m fall, represents 5 - 10% of the fluctuations.

D.5 The theoretical drawdown from each relevant licensed abstraction and cumulative drawdown are presented in Table 1. Assumptions as to hydrogeological condition and hydraulic parameters were the following:

- (a) Semi-confined (leaky) Chalk aquifer
- (b) Transmissivity (T) = 200 m²/d
- (c) Storage Coefficient (S) = 0.001
- (d) Aquitard (Drift) average thickness (b¹) = 20 m
- (e) Aquitard (Drift) vertical permeability (K¹) = 10⁻³ m/d

(f) Leakance (L) = $\sqrt{T(b^1/k^1)}$ = 2000 m

Aquifer parameters were taken from Allen D.J. et al (1997), ‘The Physical Properties of Major Aquifers in England and Wales.’ A fairly wide range of Chalk transmissivities is quoted for the catchment of the River Thet. On the basis of baseflow and groundwater recessions over a 10 year period, Toynton, 1983 gave an average value of 203 m²/d. Pumping tests undertaken during the Great Ouse study indicated a range of 800 – 2000 m²/d within the Thet valley, and values of around 350 m²/d on higher ground. Another study of the general area reports that transmissivities of 300 – 500 m²/d are common in boreholes that penetrate buried channels, decreasing to 130 – 170 m²/d near the channel centres. A groundwater model of the Little Ouse catchment, which includes the River Thet, was produced by Mott MacDonald in 1993. Two layers of transmissivity values were necessary to calibrate the model – a thin, shallow, higher permeability Chalk layer, underlain by a thicker, low permeability layer representing the bulk of the Chalk. In the vicinity of Swangey Fen, the high permeability layer was assigned a transmissivity between 251 and 750 m²/d to the east of the site, and 750 to 2000 m²/d to the west of the site. Given the non-homogeneous nature of the Chalk, and the wide range of potential values for transmissivity, a conservative value of 200 m²/d was used for the purposes of this study, so that theoretical drawdowns represent the worst case scenario. Regionally, derived Chalk storage coefficients vary from 10⁻⁴ in confined areas to 3 x 10⁻³ in semi-confined areas. As the Chalk is semi-confined in the area of the site, a value of 10⁻³ is deemed appropriate. Leakance was estimated as 2,000 m, on the basis of an average Drift aquitard thickness of 20 m, and vertical permeability of 10⁻³ m/d.

As calculated values of u are small, they relate to the portions of Walton type curves with small, relatively flat gradients. Therefore, W(u, r/L) is much more sensitive to r/L, which defines the appropriate type curve, than to u, which defines the appropriate point on that type curve. The leakance factor is dependent on the Chalk transmissivity, the saturated aquitard thickness and the hydraulic conductivity of the aquitard. Therefore, calculated drawdowns will be more sensitive to these properties than to the assigned value of storage.

Pumping time (t) was taken as 200 days; abstraction rates were taken as average licensed annual, except for irrigation licences which were taken at peak daily rates over the period determined by the annual licensed quantity.

The equation that was used to estimate theoretical drawdown is that of Walton for semi-confined (leaky) aquifers.

$$s = \frac{Q}{4 \pi T} W(u, r/L)$$

Where: s = drawdown (m)

Q = abstraction (m^3/d)

$$u = \frac{r^2 S}{4 T t}$$

r = distance of observation point from pumped borehole abstraction (m)

Some of the assumptions made in the Walton method are:

- The aquifer and aquitard have seemingly infinite areal extent.
- The aquifer and the aquitard are homogenous, isotropic and of uniform thickness within the area of influence.
- Changes in aquitard storage are negligible and flow in the aquitard is vertical.
- No recharge during the period of pumping.

In practice, natural aquifers, and especially the Chalk, do not conform to all assumptions demanded by the equation, so that theoretical drawdowns should be treated with some caution. The condition of no recharge for 200 days is mainly applicable during periods of drought.

D.7 Table 1 and the Licence Accretion Diagram (LAD) in Figure 2 show theoretical drawdowns for the Chalk at Swangey Fen. Theoretically, Chalk drawdowns will exceed the HST of 0.1 m for 12 of the 45 groundwater abstraction licences. One of these licences (6/33/44/259 is adjacent to the river Thet. It is thought that its water is partly derived by induced river infiltration rather than from the Chalk aquifer. Of the licensed abstractions, three exceed the HST individually. These include 4 locations which are licensed under 6/33/44/137, associated with the Environment Agency Anglia inter-basin transfer scheme, and apparently seldom used. It is noted that the three abstractions are down gradient of the site and on the other side of the buried channel. However, the geometry, lithological character and hydraulic behaviour of the buried channel in the southern part of the site are not precisely known, and further investigation of these would enable a more accurate assessment of theoretical impact.

TABLE 1: THEORETICAL DRAWDOWNS AT SWANGY FEN SSSI/cSAC

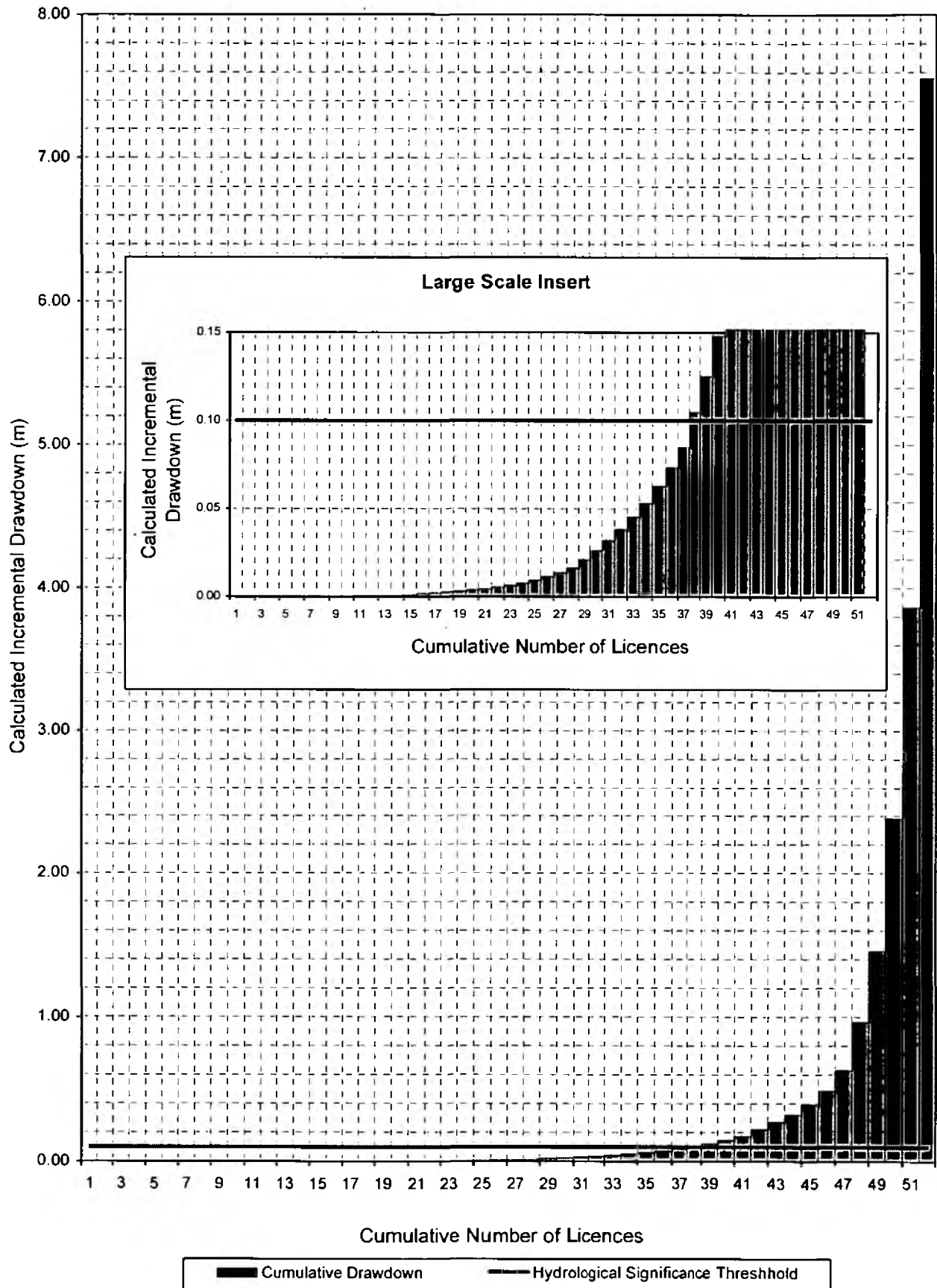
Licence	NGR	Licence holder	Catchment No.	Use	Season	Total licensed quantity allowing for aggregates (1000 m3/y)	Quantity per site (1000 m3/y)	Daily rate (m3/day)	Easting	Northing	Radial Distance (m)	Time for Abs (days)	Mean Daily Q (m3/d)	$u = r^2S/4T$	r/L	$W(u, r/L)$ from table	$W(u, r/L)$ estimated	Drawdown (m)
6/33/44/009	TL 9730 9300	reginald st vincent	44	combined gen. eq & domestic	annual		0.680	3.14	597300	293000	4211	200	1.863	0.1108	2.11		0.20811	0.00015
6/33/44/012	TL 9990 9190	pearn wyatt & son	44	agricultural - no charge	annual		1.660	4.55	599900	291900	2126	200	4.548	0.0283	1.06	0.84		0.00152
6/33/44/013	TL 9947 9186	pearn wyatt & son	44	spray irrigation	may-sep		7.360	490.91	599470	291860	2489	15	40.889	0.5165	1.24		0.60890	0.00091
6/33/44/016	TM 0450 9300	s e cracknell	44	combined gen. eq & domestic	annual		0.909	18.18	604500	293000	3015	200	2.490	0.0568	1.51		0.43862	0.00043
6/33/44/019	TM 0020 9510	tuffs estates ltd	44	agricultural - no charge	annual		7.300	20.00	600200	295100	2220	200	20.000	0.0308	1.11		0.71987	0.00573
6/33/44/033	TM 0850 9352	anglian water services limited	44	public water supply	annual	272.760	272.760	981.90	608500	293520	7010	200	747.288	0.3071	3.51		0.03823	0.01137
6/33/44/036	TM 0416 9378	i s cracknell	44	agricultural - no charge	annual		8.290	22.70	604160	293780	2703	200	22.712	0.0457	1.35	0.84		0.00761
	TM 0416 9378	i s cracknell	44	spray irrigation	apr-sep		95.500	2391.20	604160	293780	2703	40	261.644	0.2287	1.35	0.72		0.07443
6/33/44/038	TM 0560 9830	gardena enterprises sa	44	agricultural - no charge	annual		5.230	14.30	605600	298300	6466	200	14.329	0.2613	3.23		0.05100	0.00029
6/33/44/043	TM 0750 9490	j a alston	44	agricultural - no charge	annual		0.227	27.27	607500	294900	6210	200	0.622	0.2410	3.10		0.05984	0.00001
6/33/44/049	TM 0030 9280	trustees of mrs r s	44	agricultural - no charge	annual		4.930	15.91	600300	292800	1300	200	13.507	0.0106	0.65	1.00		0.00535
6/33/44/075	TL 9990 9590	p f southgate ltd	44	combined gen. eq & domestic	annual		0.240	0.91	599900	295900	3053	200	0.658	0.0583	1.53		0.42837	0.00011
6/33/44/081	TM 0280 9350	i w and m v clarke	44	combined gen. eq & domestic	annual		1.360	3.77	602800	293500	1315	200	3.726	0.0106	0.66	1.55		0.00230
6/33/44/087	TM 0470 9770	i j and g alston	44	agricultural - no charge	annual	1.860		13.64	604700	297700	5441	200	1.370	0.1850	2.72		0.09667	0.00005
	TM 0430 9720	i j and g alston	44	agricultural - no charge	annual		1.360	9.09	604300	297200	4801	200	3.726	0.1441	2.40		0.14403	0.00021
6/33/44/091	TL 9670 9440	the lady ypres	44	agricultural - no charge	annual		4.550	15.91	596700	294400	4924	200	12.466	0.1516	2.46		0.13336	0.00068
6/33/44/093	TM 0090 9910	a e button & sons	44	agricultural - no charge	annual		16.590	45.45	600900	299100	5831	200	45.452	0.2125	2.92		0.07578	0.00137
6/33/44/095	TM 0150 9450	victor george fulcher	44	combined gen. eq & domestic	annual		0.330	0.91	601500	294500	1200	200	0.904	0.0090	0.60	1.55		0.00056
6/33/44/098	TL 9840 9680	michael childerhouse	44	agricultural - no charge	annual		4.990	13.64	598400	296800	4675	200	13.671	0.1366	2.34		0.15576	0.00085
6/33/44/119	TG 0039 0138	e f shingfield and son	44	agricultural - no charge	annual		15.900	45.45	600390	301380	8156	200	43.562	0.4157	4.08		0.02043	0.00035
6/33/44/131	TM 0028 9085	pearn wyatt & son	44	all	annual	36.796		922.60										
	TM 0028 9085	pearn wyatt & son	44	agricultural - no charge	annual		4.979	13.60	600280	290850	2737	200	13.641	0.0468	1.37	0.84		0.00457
	TM 0028 9085	pearn wyatt & son	44	spray irrigation	mar-oct		31.818	909.00	600280	290850	2737	35	178.767	0.2675	1.37	0.72		0.05029
6/33/44/133	TM 0276 9500	derrick reynolds	44	agricultural - no charge	annual		6.640	18.18	602760	295000	2116	200	18.192	0.0280	1.06	0.84		0.00609
6/33/44/137	TM 0214 9168	environment agency	44	EA-anglia interbasin transfer	annual	13070.000		74880.00										
	TL 9810 9179	environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	602140	291680	1742	200	8219.178	0.0190	0.87	1.13		3.69545
	TL 9877 8944	environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	598100	291790	3720	200	8219.178	0.0865	1.86		0.28256	0.82406
	TL 9941 9120	environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	596770	289440	4728	200	8219.178	0.1397	2.36		0.15075	0.49301
		environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	599410	291200	2963	200	8219.178	0.0549	1.48		0.45312	1.48185
6/33/44/218	TM 0510 9490	banham poultry limited	44	industrial	annual	181.800	181.800	768.00	605100	294900	3940	200	498.082	0.0970	1.97		0.24845	0.04884
6/33/44/219	TM 0920 9360	penwood foods limited	44	industrial	annual		95.450	318.18	609200	293600	7706	200	261.507	0.3711	3.85		0.02613	0.00272
6/33/44/226	TM 0510 9630	j i salter	44	agricultural & domestic	annual	6.000	6.000	19.00	605100	296300	4686	200	16.438	0.1373	2.34		0.15472	0.00101
6/33/44/227	TM 0190 9080	a e sexton	44	spray irrigation	apr-sep		109.000	2400.00	601900	290800	2532	45	605.556	0.1764	1.27		0.59282	0.14283
6/33/44/243	TM 0225 9865	a e button & sons	44	agricultural - no charge	annual		33.179	90.90	602250	298850	5402	200	184.328	0.1824063	2.70		0.09900	0.00726
6/33/44/249	TM 0161 9256	a e sexton	44	spray irrigation	apr-sep		68.200	1200.00	601610	292560	748	57	378.889	0.0123101	0.37	2.22		0.33468
6/33/44/259	TL 9850 8940	a d stammers & son	44	spray irrigation	apr-sep		68.200	1500.20	598500	289400	4920	45	378.889	0.6656863	2.46		0.13370	0.02018
6/33/44/260	TL 9744 9042	s a lewin	44	spray irrigation	apr-sep		36.400	1200.00	597440	290420	4978	30	202.222	1.0210714	2.49		0.12900	0.01038
6/33/44/263	TM 0269 8877	messa m w pilgrim &	44	spray irrigation	mar-oct		82.200	1200.00	602690	288770	4884	69	456.667	0.4003102	2.34		0.15496	0.02816
6/33/44/267	TM 0550 9080	i a askew and partners	44	all	annual	80.640		1343.00										
	TM 0550 9080	i a askew and partners	44	spray irrigation	apr-oct		68.200	1309.20	605500	290800	4717	52	378.889	0.5339021	2.36		0.15178	0.02288
	TM 0550 9080	i a askew and partners	44	agricultural - no charge	annual		12.440	33.80	605500	290800	4717	200	34.082	0.1390625	2.36		0.15178	0.00206
6/33/44/268	TM 0065 9485	m c a r gathergood	44	agricultural & domestic	annual	0.547	0.547	1.50	600650	294850	1768	200	1.499	0.0195313	0.88	0.842		0.00050
6/33/44/269	TL 9951 9441	kirk hall farms	44	spray irrigation	mar-sep		122.000	1164.00	599510	294410	2279	105	334.247	0.0619234	1.14		0.69418	0.09232
6/33/44/275	TM 0332 9845	r m maynard	44	agricultural - no charge	annual		1.000	10.00	603320	298450	5462	200	2.740	0.1864681	2.73		0.09538	0.00010
6/33/44/280	TM 0608 9373	banham poultry limited	44	industrial	annual	271.800	271.800	1045.40	606170	293730	4645	200	744.658	0.1348502	2.32		0.15875	0.04703
6/33/44/283	TM 0496 8985	m r n de la cour	44	agricultural - no charge	annual		5.000	19.50	604960	289850	4886	200	13.699	0.1492131	2.44		0.13659	0.00074
6/33/44/284	TM 0548 9476	sovereign food group ltd	44	industrial	annual		90.900	400.00	605480	294760	4221	200	249.041	0.1113325	2.11		0.20684	0.02050
7/34/13/037	TM 0942 9582	executors of a w	13	combined gen. eq & domestic	annual		4.546	13.6	609420	295820	8311	200	12.455	0.4317300	4.16		0.01876	0.00009
7/34/13/040	TM 0987 9652	f bolwes	13	combined gen. eq & domestic	annual		1.1365	3.64	609870	296520	8968	200	3.114	0.5026581	4.48		0.01310	0.00002
7/34/13/041	TM 0498 9899	m j flowerday	13	combined gen. eq & domestic	annual		2.4867	6.82	604980	298990	6670	200	6.813	0.2780406	3.33		0.04605	0.00012
7/34/13/075	TM 0982 9904	d hegan	13	combined gen. eq & domestic	annual		0.409	1.1	609920	299040	10190	200	1.121	0.6490250	5.10		0.00671	0.00000
7/34/13/119	TM 0544 9941	norfolk agricultural	13	combined gen. eq & domestic	annual		4.545	18	605440	299410	7270	200	12.452	0.3303481	3.64		0.03316	0.00016
7/34/13/153	TM 0947 9497	c r wharton	13	combined gen. eq & domestic	annual		4.545	21	609470	294970	8143	200	12.452	0.4144363	4.07		0.02057	0.00010
7/34/13/188	TM 0895 9742	t h lord & sons	13	combined gen. eq & domestic	annual		3.318	9.1	608950	297420	8513	200	9.090	0.4529806	4.26		0.01680	0.00006
7/34/13/240	TM 0954 9959	banham poultry limited	13	combined gen. eq & domestic	annual		3.65	10	609540	299590	10287	200	10.000	0.6613881	5.14		0.00637	0.00003

Note: Licences with the prefix 7/34/ denote those in Anglian Region's Eastern Area (Ipswich Office)

DETAILS OF LICENCE ACCRETION DIAGRAM: SWANGHEY FEN SSSI/cSAC

Rank Number	Licence	NGR	Drawdown (m)	Cumulative Drawdown	Hydrological Significance Threshold
1	7/34/13/075	TM 0992 9904	0.00000	0.00000	0.1
2	6/33/44/043	TM 0750 9490	0.00001	0.00002	0.1
3	7/34/13/040	TM 0987 9652	0.00002	0.00003	0.1
4	7/34/13/240	TM 0964 9959	0.00003	0.00006	0.1
5	6/33/44/087	TM 0470 9770	0.00005	0.00011	0.1
6	7/34/13/188	TM 0895 9742	0.00006	0.00017	0.1
7	7/34/13/037	TM 0942 9582	0.00009	0.00027	0.1
8	7/34/13/153	TM 0947 9497	0.00010	0.00037	0.1
9	6/33/44/275	TM 0332 9845	0.00010	0.00047	0.1
10	6/33/44/075	TL 9990 9590	0.00011	0.00058	0.1
11	7/34/13/041	TM 0498 9899	0.00012	0.00071	0.1
12	6/33/44/009	TL 9730 9300	0.00015	0.00086	0.1
13	7/34/13/119	TM 0544 9941	0.00016	0.00103	0.1
14	6/33/44/087	TM 0430 9720	0.00021	0.00124	0.1
15	6/33/44/038	TM 0560 9830	0.00029	0.00153	0.1
16	6/33/44/119	TG 0039 0138	0.00035	0.00189	0.1
17	6/33/44/016	TM 0450 9300	0.00043	0.00232	0.1
18	6/33/44/268	TM 0065 9485	0.00050	0.00282	0.1
19	6/33/44/095	TM 0150 9450	0.00056	0.00338	0.1
20	6/33/44/091	TL 9670 9440	0.00066	0.00404	0.1
21	6/33/44/283	TM 0496 8985	0.00074	0.00479	0.1
22	6/33/44/098	TL 9840 9680	0.00085	0.00563	0.1
23	6/33/44/226	TM 0510 9630	0.00101	0.00665	0.1
24	6/33/44/093	TM 0090 9910	0.00137	0.00802	0.1
25	6/33/44/012	TL 9990 9190	0.00152	0.00954	0.1
26	6/33/44/267	TM 0550 9080	0.00206	0.01160	0.1
27	6/33/44/081	TM 0280 9350	0.00230	0.01390	0.1
28	6/33/44/219	TM 0920 9360	0.00272	0.01661	0.1
29	6/33/44/131	TM 0028 9085	0.00457	0.02118	0.1
30	6/33/44/049	TM 0030 9280	0.00535	0.02654	0.1
31	6/33/44/019	TM 0020 9510	0.00573	0.03227	0.1
32	6/33/44/133	TM 0276 9500	0.00609	0.03836	0.1
33	6/33/44/243	TM 0225 9865	0.00726	0.04562	0.1
34	6/33/44/036	TM 0416 9378	0.00761	0.05323	0.1
35	6/33/44/013	TL 9947 9186	0.00991	0.06314	0.1
36	6/33/44/260	TL 9744 9042	0.01038	0.07352	0.1
37	6/33/44/033	TM 0850 9352	0.01137	0.08488	0.1
38	6/33/44/259	TL 9850 8940	0.02016	0.10504	0.1
39	6/33/44/284	TM 0546 9476	0.02050	0.12554	0.1
40	6/33/44/267	TM 0550 9080	0.02288	0.14842	0.1
41	6/33/44/263	TM 0269 8877	0.02816	0.17657	0.1
42	6/33/44/280	TM 0617 9373	0.04703	0.22361	0.1
43	6/33/44/218	TM 0510 9490	0.04884	0.27245	0.1
44	6/33/44/131	TM 0028 9085	0.05029	0.32274	0.1
45	6/33/44/036	TM 0416 9378	0.07443	0.39717	0.1
46	6/33/44/269	TL 9951 9441	0.09232	0.48949	0.1
47	6/33/44/227	TM 0190 9080	0.14283	0.63233	0.1
48	6/33/44/249	TM 0161 9256	0.33468	0.96700	0.1
49	6/33/44/137	TL 9877 8944	0.49301	1.46002	0.1
50	6/33/44/137	TL 9810 9179	0.92406	2.38408	0.1
51	6/33/44/137	TL 9941 9120	1.48185	3.86593	0.1
52	6/33/44/137	TM 0214 9168	3.69545	7.56138	0.1

Swangey Fen SSSI/cSAC Licence Accretion Diagram



Thompson Common

APPENDIX 4

PROFORMA FOR STAGES 1 AND 2 OF THE REVIEW OF CONSENTS UNDER THE HABITATS DIRECTIVE

SECTION A: STAGE 1

A1. Name of the European site/composite SSSI:

Norfolk Fens cSAC / Thompson Common SSSI

A2. Legal status of the site/composite SSSI:

Part of the Norfolk Valley Fens Candidate SAC

A3. Designated features present:

1. SAC Habitat Group

- 1.1 Fens & Wet Habitats
Alkaline Fens

2. SAC Species Groups

- 2.1 Amphibia: Great Crested Newt
2.2 Vascular plants, lower plants and invertebrates of wet habitats

NOTE: See EN/EA Guidance Document, Appendix 2

Notified Interest under SAC

"Calcium rich spring water fens"; here represented by *Carex rostrata-Calliergon cuspidatum mire* (M9) and Desmoulins snail (*Vertigo Moulinsiana*)

Other Features

- a) Wet Pings; the more wet support some uncommon plant species, such as narrow small reed (*Calamagrostis stricta*), small bur-reed (*Sparganium minimum*) and saw sedge (*Cladium mariscus*).
b) Thompson water and surrounding reed swamp & carr provide important habitats for breeding birds, Great Crested Grebe (*Podiceps cristatus*), Gadwall (*Anas strepera*), etc.
c) Site is one of the most important in the UK for the Great Crested Newt (*Triturus cristatus*).

English Nature Conservation Objectives¹

International Objectives:

1. Maintain the populations of the internationally important Desmoulin's snail (*Vertigo moulinsiana*)
2. Maintain and enhance the condition of the internationally important "calcium-rich spring-fed fen communities" (M9: *Carex rostrata-Calliergon cuspidatum mire*).

National Objectives:

1. Ensure that water levels, flows and water quality are maintained.
2. Maintain and enhance the notifiable swamp and mire communities.
3. Enhance the diversity of community types and habitat structure.
4. Maintain and enhance the notifiable grassland communities.
5. Maintain and enhance the invertebrate populations, with particular regard for RDB species.
6. Maintain and enhance populations of the rare and nationally scarce vascular plants.
7. Maintain and enhance the alder woodland.
8. Maintain and enhance pings for their geological and biological importance.

¹ Note that English Nature plan to revise these objectives in due course in line with national guidelines.

NOTE: See HSI/ECUS September 1999 Report "Habitats Directive – Initial Assessments at Priority Groundwater Fed Sites", Final Report to Environment Agency – Thompson Common (Section 2)

A4. List the criteria which have been used to identify relevant permissions:
(criteria a and b should always be used)

- a. Any permission for an activity within the boundary of the European site.
- b. Any permission for an activity which is known to affect the European site.
- c. Any permission to abstract water within a 5 km radius of the site.
- d. Any permission to abstract groundwater upgradient of the site.

A5. List all the relevant permissions identified:

NB In the case of consented discharges to water, permissions should be organised into groups (see 3.11)

Agency reference	NGR	Description of permission (<i>brief description only eg landfill site</i>)
6/33/44/009	TL 9730 9300	GW (Chalk); combined gen. ag & domestic
6/33/44/025	TL 9470 9260	GW (Chalk); combined gen. ag & domestic
6/33/44/035	TL 9550 9540	GW (Chalk); combined gen. ag & domestic
6/33/44/044	TL 9720 9670	GW (Chalk); agricultural
6/33/44/050	TL 9250 9210	GW (Chalk); spray irrigation
6/33/44/079	TL 9890 9920	GW (Chalk); combined gen. ag & domestic
6/33/44/082	TL 9450 9870	GW (Chalk); agricultural
6/33/44/086	TL 9450 9870	GW (Chalk); agricultural
6/33/44/089	TL 9450 9870	GW (Chalk); combined gen. ag & domestic
6/33/44/091	TL 9450 9870	GW (Chalk); agricultural
6/33/44/098	TL 9450 9870	GW (Chalk); agricultural
6/33/44/109	TL 9450 9870	GW (Chalk); combined gen. ag & domestic
6/33/44/137	TL 9393 9060 TL 9515 9150 TL 9629 9215	GW (Chalk); augmentation (EA)
6/33/44/143	TL 92809130	GW (Chalk); combined gen. ag & domestic
6/33/44/185	TL 9470 9380	GW (Chalk); agricultural
6/33/44/241	TL 9610 9580	GW (Chalk); agricultural
6/33/44/244	TL 9183 9233 TL 9183 9239 TL 9187 9242	GW (Chalk); agricultural, domestic
6/33/44/255	TL 9001 9060	GW (Chalk); spray irrigation
6/33/44/256	TL 9465 9410	GW (Chalk); spray irrigation
6/33/44/274	TL 9271 9180	GW (Chalk); spray irrigation
6/33/48/018	TL 9530 0210	GW (Chalk); agricultural
6/33/48/032	TL 9294 0046 TF 9299 0048	GW (Chalk); public supply
6/33/48/033	TL 9406 0249	GW (Chalk); public supply
6/33/48/083	TL 9060 9920	GW (Chalk); combined gen. ag & domestic
6/33/48/138	TL 9170 9820	GW (Chalk); vegetable washing
6/33/48/172	TL 9205 9891 TL 9207 9890	GW (Chalk); combined gen. ag & domestic, spray irrigation

6/33/48/218	TL 9414 0181	GW (Chalk); ornamental or recreational lake
6/33/48/219	TL 9410 9650	GW (Chalk); agricultural, domestic & spray irrigation
6/33/48/238	TL 9027 0046 TL 9028 0046	GW (Chalk); industrial, cooling-al
6/33/48/246	TF 9458 0078 TF 9460 0078	GW (Chalk); public supply
6/33/44/097	TF 8998 9173 TF 9014 9177 TF 8965 9098	SW; spray irrigation
6/33/44/152	TF 9070 9130 TL 9120 9180 TL 9080 9180	SW; spray irrigation, impoundment
6/33/44/261	TL 9211 9068	SW; spray irrigation

Note: GW = Groundwater
SW = Surface Water

SECTION C: STAGE 2 - ABSTRACTION LICENCES

C1. Are any of the features present identified as vulnerable to impacts from abstraction in Appendix 3? If so, list them: (See section 6, step I)

Fens & Wet Habitats (SAC Habitat Group)

Vascular plants, lower plants & invertebrates of wet habitats, amphibia (SAC species Groups)

See section A3 for more details.

C2. Are there any known abstraction problems on the site? If so briefly describe them: (See section 6, step II)

No

C3. What is the initial judgement of significance for the abstraction licences identified under SECTION A? (See section 6, step I, II and IV)

Agency reference	NGR	Likely to have a significant effect? – yes or no	Initial judgement made under step I or II or IV? – specify
6/33/44/097	TF 8998 9173 TF 9014 9177 TF 8965 9098	No	IV
6/33/44/152	TF 9070 9130 TL 9120 9180 TL 9080 9180	No	IV
6/33/44/261	TL 9211 9068	No	IV
6/33/48/018	TF 9530 0210	No	IV
6/33/44/009	TL 9730 9300	No	IV
6/33/44/079	TL 9890 9920	No	IV
6/33/44/143	TL 9280 9130	No	IV
6/33/44/025	TL 9470 9260	No	IV
6/33/44/109	TL 9492 9092	No	IV
6/33/44/050	TL 9250 9210	No	IV
6/33/44/089	TL 9550 9400	No	IV
6/33/48/083	TL 9060 9920	No	IV
6/33/44/244	TL 9183 9233 TL 9183 9239 TL 9187 9242	No	IV

6/33/48/218	TF 9414 0181	No	IV
6/33/44/098	TL 9840 9680	No	IV
6/33/44/086	TL 9590 9750	No	IV
6/33/44/091	TL 9670 9440	No	IV
6/33/44/044	TL 9720 9670	No	IV
6/33/44/082	TL 9450 9870	No	IV
6/33/44/241	TL 9610 9580	No	IV
6/33/44/035	TL 9550 9540	No	IV
6/33/48/219	TL 9410 9650	No	IV
6/33/44/255	TL 9001 9060	No	IV
6/33/48/238	TF 9027 0046 TF 9028 0046	No	IV
6/33/48/219	TL 9410 9650	No	IV
6/33/44/274	TL 9271 9180	No	IV
6/33/48/033	TF 9406 0249 TF 9400 0249	No	IV
6/33/44/185	TL 9470 9380	No	IV
6/33/48/246	TF 9460 0078 TF 9458 0078	No	IV
6/33/48/138	TL 9170 9820	No	IV
6/33/48/032	TF 9299 0048 TF 9294 0046	Yes	IV
6/33/48/172	TL 9207 9890 TL 9205 9891	No Yes	IV IV
6/33/44/137	TL 9393 9060 TL 9515 9150 TL 9629 9215	No Yes Yes	IV IV IV
6/33/48/219	TL 9410 9650	Yes	IV
6/33/44/256	TL 9465 9410	Yes	IV

C4. Describe the supporting case for the judgements given in C3:

(This should be set out in terms of the criteria for significance given in the procedure eg what is the mechanism of impact, which features are sensitive, what is their condition etc. Reference should be made to the conservation agencies view, the joint review and any problems identified under C2. Expand beyond a page if necessary)

- 1) See Supplementary Notes and listed references.
- 2) Conservation Agencies view (English Nature) see HSI (September 1999), Environmental Appraisal: East Watton, section 6.1.
- 3) Joint review for the Environment Agency and Conservation Agencies to consider.

The Consultant cannot proceed beyond Step II; Step III requires the views of the Conservation Agencies (English Nature) for their judgement of feature condition.

To be filled in by the Environment Agency

C6. If not what is the new assessment? (See section 6, step V)

To be filled by Environment Agency

STAGES 1 AND 2 OF THE DIRECTIVE OF CONSENTS UNDER THE HABITATS DIRECTIVE

SUPPLEMENTARY NOTES

THOMPSON COMMON - ABSTRACTION LICENCES

Reference Document: "Guidance for the Review of Environment Agency Permissions: Determining Relevant Permissions and Significant Effect", 1999.

Other References:

HSI/ECUS (1999), Habitats Directive - Initial Assessments at Priority Groundwater Fed Sites – Thompson Common, for Environment Agency.

HSI/ECUS (1999), Environmental Appraisal: East Watton (Licence No 6/33/48/185)
English Nature (1996), Impact of Water Abstraction on Wetland SSSI

Environment Agency (October 1999), Practical advice for Agency Water Resources Staff, Habitats Directive Stage 2 Review

Allen, D.J., The physical properties of major aquifers in England and Wales, BGS Technical Report WD.97.34, Environment Agency R&D, Publication 8.

SECTION A STAGE 1

A. Criteria for Identifying Relevant Permissions

A.1 The criteria used to identify relevant permissions are those listed in sections 3.8 and 3.12 of the Guidance Document.

A.2 Section 3.8 of the Guidance Document sets out three broad criteria regarding "relevance" as follows:

- "a. Any permission for an activity within the boundary of the European site is relevant and should be included in the review.
- b. Any permission for an activity which is known to be affecting the European site, either directly on a designated feature or indirectly by affecting the environmental quality of the site, is relevant and should be included in the Review.
- c. Any permission located outside the European site which has the potential to affect the features within the European site, should be considered relevant and included in the Review. Further guidance is given in the 'Guidance Document'."

A.3 Section 3.12 refers particularly to "abstraction licences". It states:

"Where there is a licensed abstraction of surface or groundwater from a hydrological system, part of which is designated as a European site, then that licence will probably be relevant to the Review unless it is downstream of the European site. Groundwater abstractions which are not in hydraulic continuity with the site can be disregarded. The licensing officer may be able to identify other criteria for establishing that licensed abstraction from both ground and surface waters could not affect the European site."

B. Determination of Relevant Permissions for Thompson Common

B.1 Figure 1 shows the locations of relevant licences.

- B.2 Relevant abstraction licences shown on the map include those within the site boundary, within a 5 km radius of TL 936 963, centre of the northern part of the site, and up groundwater gradient of the site. The search envelope was defined by the Environment Agency.

SECTION C STAGE 2

C. Determination of "Significant Effect"

- C.1 The assessment of "Significant Effect" and the term "likely to have a significant effect" are discussed in section 4.0 of the Guidance Document.
- C.2 The procedure for the determination of whether relevant abstraction licences are "likely to have a significant effect" on the site is described in section 6 of Guidance Document. A proforma is supplied in Appendix 4. More guidance in applying the criteria for assessing significant effect is provided in Appendix 3, Section 2 of the Guidance Document.

D. Determination of Significant Effect for Thompson Common

- D.1 There appears to be no known problem at the Site (Step II) as a result of historic and current licensed abstractions. However, licensed abstractions have been occurring at a level of less than that licensed.
- D.2 Thompson Common SSSI/cSAC is underlain by Drift over Chalk. The Drift is variable in nature, comprising thin silty and sandy clays in the northern part of the site, directly overlying the Chalk. Beneath the rest of the site, a shallow permeable Drift layer is underlain by silty clay, which is over 3 m thick in the central part of the site, increasing to around 20 m in the southwest part of the site. Within the site area, water filled pingos, Thompson Water and the Thompson Stream are thought to be in hydraulic continuity with the shallow, permeable Drift. Examination of hydrographs in conjunction with lithological information indicates that in the northern part of the site the Chalk is semi-confined to near unconfined, with some hydraulic connection between the Drift and the Chalk. However, beneath the central and southwestern parts of the site, the Chalk is semi-confined, and the silty clay confining layer appears to prevent hydraulic continuity between the Chalk and the shallow Drift. Therefore, of the surface water features at the site, only those pingos in the northern part of the site, and the Thompson Stream where it passes through the northern part, are thought to be in hydraulic continuity with the Chalk aquifer.
- D.3 A buried channel is known to occur immediately south of Thompson Common SSSI/cSAC, as shown on Figure 1. This is predominantly clay filled, and appears to be between 40 and 67 m thick. Although this channel could inhibit hydraulic connection between the site and abstractions sources to the south, these sources were still considered to be potentially significant.
- D.4 Surface water abstractions within the defined search area are from ponds and streams in the vicinity of Mickle Mere, which drain eastwards to the River Thet. Thompson Stream, on the other hand, drains to the River Wissey. As these surface water abstractions are in a different catchment to Thompson Common, and therefore not in hydraulic continuity with the site, they are not considered to be significant.
- D.5 In the absence of "ecological criteria", hydrological criteria for significance have been applied as proposed in "Practical Advice for Agency Water Resources Staff", April 2000:
- (a) Riverine impacts; 10% at naturalised Q_{95} .
 - (b) Groundwater: 0.05 m of water level fall (drawdown), due to the presence of a mire community.
 - (c) With regard to cumulative impact of a number of abstractions acting together, a "Licence Accretion Diagram" (LAD) has been used (Figure 1). Licences which breached the 0.05 m Hydrological Significance Threshold (HST) could be considered as likely to cause a significant effect.

D.6 From a hydrogeological view point, the "0.05 m drawdown" criterion has been viewed in the context of:

- (a) The Chalk aquifer appears to be semi-confined in the northern part of the site, and therefore the hydraulic connection with the surface is leaky, rather than being a direct connection. Therefore, theoretically calculated Chalk drawdowns do not reflect water level falls in the overlying Drift and in most (if not all) the pingos. Close examination of Chalk and Drift hydrographs at a location approximately 1.7 km north of the site boundary, during a pumping test and during the 1989 – 1992 drought indicates that Drift drawdowns are likely to be 35% of Chalk drawdowns (HSI/ECUS reports, 1999).

D.7 The theoretical drawdown from each relevant licensed abstraction and cumulative drawdown are presented in Table 1. Assumptions as to hydrogeological condition and hydraulic parameters were the following:

- (a) Semi-confined (leaky) Chalk aquifer
- (b) Transmissivity (T) = 400 m²/d
- (c) Storage Coefficient (S) = 0.001
- (d) Aquitard (Drift) average thickness (b¹) = 5 m
- (e) Aquitard (Drift) vertical permeability (K¹) = 10⁻³ m/d
- (f) Leakage (L) = $\sqrt{T (b^1/k^1)}$ ≈ 1400 m

Aquifer parameters were taken from Allen D.J. et al (1997), 'The Physical Properties of Major Aquifers in England and Wales,' also from HSI/ECUS, 1999 reports.

Pumping time (t) was taken as 200 days; abstraction rates were taken as average licensed annual, except for irrigation licences which were taken at peak daily rates over the period determined by the annual licensed quantity.

The equation that was used to estimate theoretical drawdown is that of Walton for semi-confined (leaky) aquifers.

$$s = \frac{Q}{4 \pi T} W(u, r/L)$$

Where: s = drawdown (m)
 Q = abstraction (m³/d)
 $u = \frac{r^2 S}{4 T t}$
 r = distance of observation point from pumped borehole abstraction (m)

Some of the assumptions made in the Walton method are:

- The aquifer and aquitard have seemingly infinite areal extent.
- The aquifer and the aquitard are homogenous, isotropic and of uniform thickness within the area of influence.
- Changes in aquitard storage are negligible and flow in the aquitard is vertical.
- No recharge during the period of pumping.

In practice, natural aquifers, and especially the Chalk, do not conform to all assumptions demanded by the equation, so that theoretical drawdowns should be treated with some caution. The condition of no recharge for 200 days is mainly applicable during periods of drought. Induced Drift drawdowns due to pumping of the Chalk aquifer are likely to be less than the theoretically estimated Chalk drawdowns. Drift drawdowns have been assumed to be 35% of Chalk drawdowns (see D.6 above).

Estimated Chalk transmissivity values in the area vary from less than 200 m²/d to more than 1,000 m²/d. Nevertheless, there is reasonable confidence in assigning a representative value of 400 m²/d, in keeping with earlier assessments by the Environment Agency, Anglian Water Services and HSI/ECUS (see HSI/ECUS 1999 for summary). With regard to Chalk storage coefficients for the

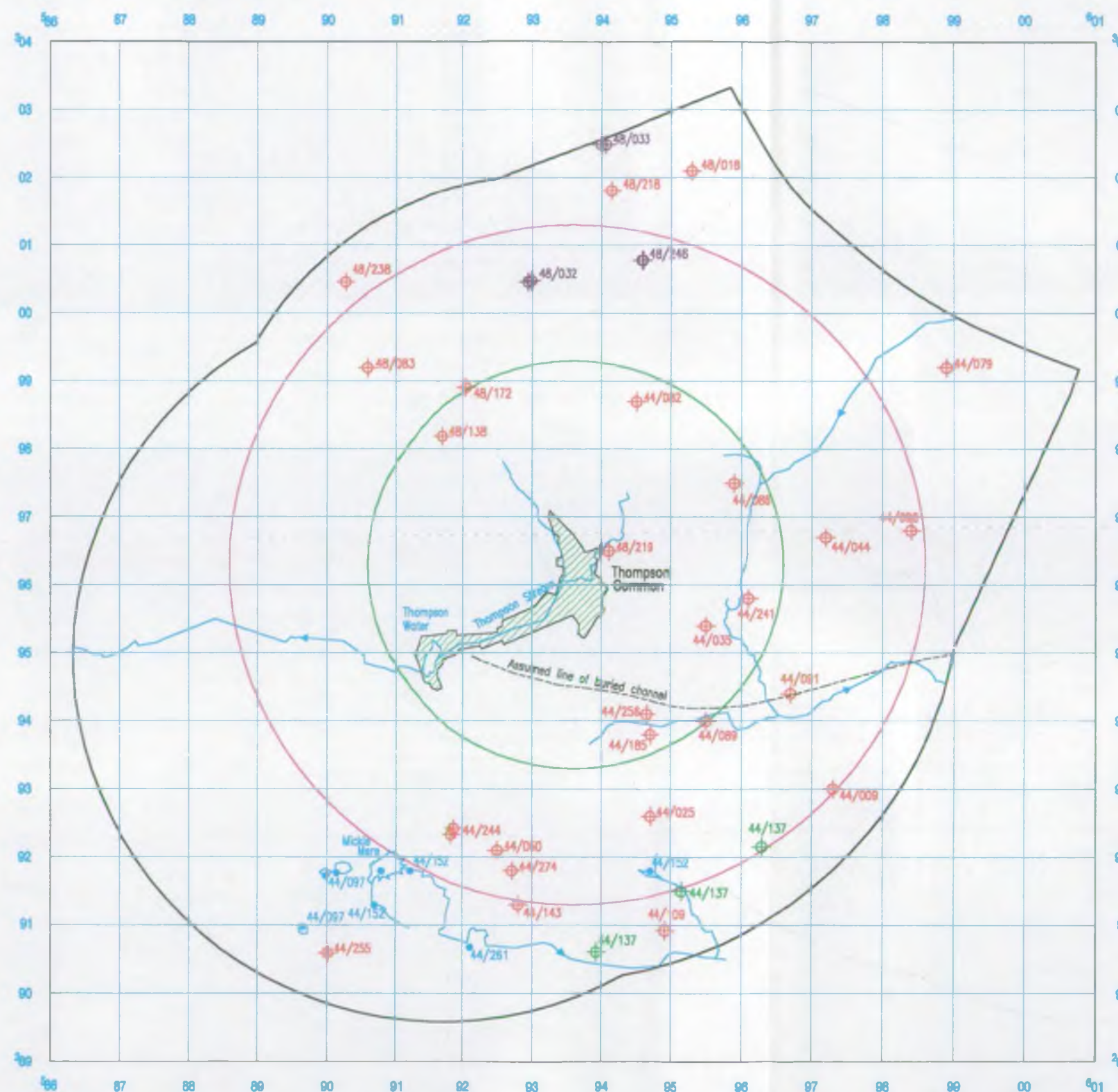
area, the range of derived values is in the order of 10^{-3} and 10^{-4} . Derived values of the leakance factor (L) are between 200 and 4,000 m. A value of 1,400 m was thought appropriate by HSI/ECUS, 1999 for the northern part of the site, on the basis of an aquitard thickness of 5 m having a permeability of 10^{-3} m/d and the Chalk having a transmissivity of 400 m²/d.

As calculated values of u are small, they relate to the portions of Walton type curves with small, relatively flat gradients. Therefore, W(u, r/L) is much more sensitive to r/L, which defines the appropriate type curve, than to u, which defines the appropriate point on that type curve. The leakance factor is dependent on the Chalk transmissivity, the saturated aquitard thickness and the hydraulic conductivity of the aquitard. Therefore, calculated drawdowns will be more sensitive to these properties than to the assigned value of storage.

- D.8 Table 1 and the Licence Accretion Diagrams (LADs) in Figures 2a and 2b show theoretical drawdowns at Thompson Common for the Chalk and the shallow Drift. Theoretically, Drift drawdowns will exceed the HST of 0.05 m for 5 of the 30 groundwater abstraction licences, namely 6/33/48/032, 6/33/48/172, 6/33/44/137, 6/33/48/219 and 6/66/44/256, at 6 different locations. Two locations are licensed under 6/33/44/137, associated with the Environment Agency Anglia inter-basin transfer scheme, and are seldom used. If Chalk drawdowns are employed as a worst case option, a further 3 groundwater abstraction licences, covering 3 locations, may be considered to exceed the HST.

TABLE 1: THEORETICAL DRAWDOWNS AT THOMPSON COMMON SSSI/cSAC

Licence 6/33/...	NGR	Licence holder	Catchment	Use	Season	Total licensed quantity allowing for aggregates (1000 m3/y)	Quantity per site (1000 m3/y)	Daily rate m3/day	Easting	Northing	Radial (m)	Time for Abs (days)	Q (m3/d)	u = r2S/4Tt	r/L	W(u, r/L) from Table	W(u, r/L) estimated > 1	Walton Chalk Drawdown (m)	Walton Drift Drawdown (m)
44/009	TL 9730 9300	reginald st vincent bagnell	44	combined gen. ag & domestic	annual		0.680	3.14	597300	293000	4958	200	1.863	0.0768	3.54		0.03674	0.00001	0.00000
44/025	TL 9470 9260	c w garrod	44	combined gen. ag & domestic	annual		1.660	4.55	594700	292600	3860	200	4.548	0.0466	2.76		0.09232	0.00008	0.00003
44/035	TL 9550 9540	bowes of norfolk ltd	44	combined gen. ag & domestic	annual		3.319	9.10	595500	295400	2102	200	9.093	0.0138	1.50		0.44179	0.00080	0.00028
44/044	TL 9720 9670	r j childerhouse and son	44	agricultural	annual		4.510	27.27	597200	296700	3622	200	12.356	0.0410	2.59		0.11411	0.00028	0.00010
44/050	TL 9250 9210	o v and e m and i r thurle	44	spray irrigation	apr-sep		0.172	7.27	592500	292100	4342	24	7.270	0.4980	3.10	0.07		0.00010	0.00003
44/079	TL 9890 9920	john buehan raynolds	44	combined gen. ag & domestic	annual		4.140	11.36	598900	299200	6042	200	11.342	0.1141	4.32		0.01575	0.00004	0.00001
44/082	TL 9450 9870	dennis george newby	44	agricultural	annual		3.320	9.09	594500	298700	2563	200	9.096	0.0205	1.83		0.29306	0.00053	0.00019
44/086	TL 9590 9750	messrs hall and son	44	agricultural	annual		1.660	4.55	595900	297500	2594	200	4.548	0.0210	1.85		0.28507	0.00026	0.00009
44/089	TL 9550 9400	peter eric churchyard	44	combined gen. ag & domestic	annual		1.140	3.18	595500	294000	2983	200	3.123	0.0278	2.13		0.20158	0.00013	0.00004
44/091	TL 9670 9440	the lady ypres	44	agricultural	annual		4.550	15.91	596700	294400	3636	200	12.466	0.0413	2.60		0.11272	0.00028	0.00010
44/098	TL 9840 9680	michael childerhouse	44	agricultural	annual		4.990	13.64	598400	296800	4826	200	27.722	0.0728	3.45		0.03905	0.00022	0.00008
44/109	TL 9492 9092	john robey leech	44	combined gen. ag & domestic	annual		7.450	20.45	594920	290920	5540	200	20.411	0.0959	3.96		0.02332	0.00009	0.00003
44/137	TL 9393 9060	environment agency	44	EA-anglia interbasin transfer	annual	13070.000	3000.000	74880.00	593930	290600	5710	200	8219.178	0.1019	4.08		0.02042	0.03339	0.01169
	TL 9515 9150	environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	595150	291500	5044	200	8219.178	0.0795	3.60		0.03435	0.05617	0.01966
	TL 9629 9215	environment agency	44	EA-anglia interbasin transfer	annual		3000.000	11000.00	596290	292150	4946	200	8219.178	0.0764	3.53		0.03710	0.06066	0.02123
44/143	TL 9280 9130	g w warren	44	combined gen. ag & domestic	annual		3.320	9.09	592800	291300	5064	200	9.096	0.0801	3.62		0.03383	0.00006	0.00002
44/185	TL 9470 9380	bernard matthews plc	44	agricultural	annual		53.000	143.63	594700	293800	2731	200	145.205	0.0233	1.95		0.25231	0.00729	0.00255
44/241	TL 9610 9580	m c h & j m gulliver	44	agricultural	annual		4.380	12.00	596100	295800	2550	200	12.000	0.0203	1.82		0.29666	0.00071	0.00025
44/244	TL 9183 9233 TL 9183 9239 TL 9187 9242	r.h. palmer,	44	domestic & agricultural	annual	5.000	5.000	20.00			4295	200	13.699	0.0576	3.07		0.06267	0.00017	0.00006
44/255	TL 9001 9060	r.g. abrey farms,	44	spray irrigation	apr-sep		54.500	1200.00	590010	290600	6736	45	1200.000	0.6245	4.81		0.00915	0.00219	0.00076
44/256	TL 9465 9410	g.m. pilkington,	44	spray irrigation	may-sep		100.000	1820.00	594650	294100	2438	55	1820.000	0.0676	1.74		0.32771	0.11866	0.04153
44/274	TL 9271 9180	gw warren	44	spray irrigation	apr-oct		13.600	400.00	592710	291800	4587	34	400.000	0.3868	3.28	0.07		0.00550	0.00192
48/018	TF 9530 0210	dawe estates ltd	48	agricultural	annual		0.227	0.68	595300	302100	6044	200	0.622	0.1142	4.32		0.01572	0.00000	0.00000
48/032	TF 9294 0046 TF 9299 0048	AWS ltd.	48	public water supply	annual	1278.000	1278.000	3500.00			4218	200	3501.370	0.0556	3.01		0.06712	0.04675	0.01636
48/033	TF 9406 0249 TF 9400 0249	AWS ltd.	48	public water supply	annual	829.645	829.645	2273.00			6205	200	2273.000	0.1203	4.43		0.01387	0.00627	0.00219
48/083	TL 9060 9920	r j childerhouse and sons	48	combined gen. ag & domestic	annual		3.318	9.09	590600	299200	4173	200	9.090	0.0544	2.98		0.06989	0.00013	0.00004
48/138	TL 9170 9820	a p (east anglia) limited	48	vegetable washing	21 jun-mar	162.000	162.000	727.00	591700	298200	2687	200	443.836	0.0226	1.92		0.26246	0.02317	0.00811
48/172	TL 9205 9891 TL 9207 9890	mr p l brown mr p l brown	48 48	spray irrigation combined gen. ag & domestic	apr-sep annual	116.126	113.636 2.409	1272.72 6.53	592050 592070	298910 298900	3036 3017	89 200	1272.720 6.600	0.0645 0.0284	2.17 2.15		0.19241 0.19566	0.04872 0.00026	0.01705 0.00009
48/218	TF 9414 0181	g.r. nobes,	48	ornamental or recreational lake	annual		14.760	120.00	594140	301810	5536	200	40.438	0.0958	3.95		0.02338	0.00019	0.00007
48/219	TL 9410 9650 TL 9410 9650 TL 9410 9650 TL 9410 9650	m.f. warren, m.f. warren, m.f. warren, m.f. warren,	48 48 48 48	all spray irrigation agricultural domestic	 may-sep annual annual	13.450	9.000 3.300 1.150	230.45 218.20 9.10 3.15	594100 594100 594100 594100	296500 296500 296500 296500	539 539 539 539	41 200 200 200	218.200 9.041 3.151	0.0044 0.0009 0.0009 0.0009	0.38 0.38 0.38 0.38	2.22 2.22 2.22 2.22		0.09637 0.00399 0.00139 0.00049	0.03373 0.00140 0.00049 0.00049
48/238	TF 9027 0046 TF 9028 0046	bowes of norfolk ltd	48	industrial and cooling	annual	228.700	228.700	799	590270	300460	5329	200	626.575	0.0887	3.81		0.02750	0.00343	0.00120
48/246	TF 9458 0078 TF 9460 0078	AWS ltd.	48	public water supply	annual	800.000	800.00				4588	200	2191.781	0.0658	3.28		0.04827	0.02105	0.00737



LEGEND

- Habitat Directive Search Area
- 3Km radius line from
NGR 593600,296300
- 5Km radius line from
NGR 593600,296300
- Assumed line of buried channel
- Surface water feature
- Direction of flow
- ▨ Thompson Common SSSI/cSAC
- ⊗ Privately owned Licence
- ⊗ AWS Licence
- ⊗ Environment Agency Licence
- Surface Water Licence

Note: 3 Km and 5Km radius lines are centred on NGR 593600,296300, in the northern part of the site, because only this area is thought to possess hydraulic continuity between the Chalk and water levels in pingos.



Habitats Directive
Assessments at Priority Groundwater Fed Sites

Location Map Showing Relevant Licences at Thompson Common SSSI/cSAC

Drawing File: 185 Habitat Directive\Drawings\Thompson final bh locs.dwg

Date: June 2000

Figure Number: 1

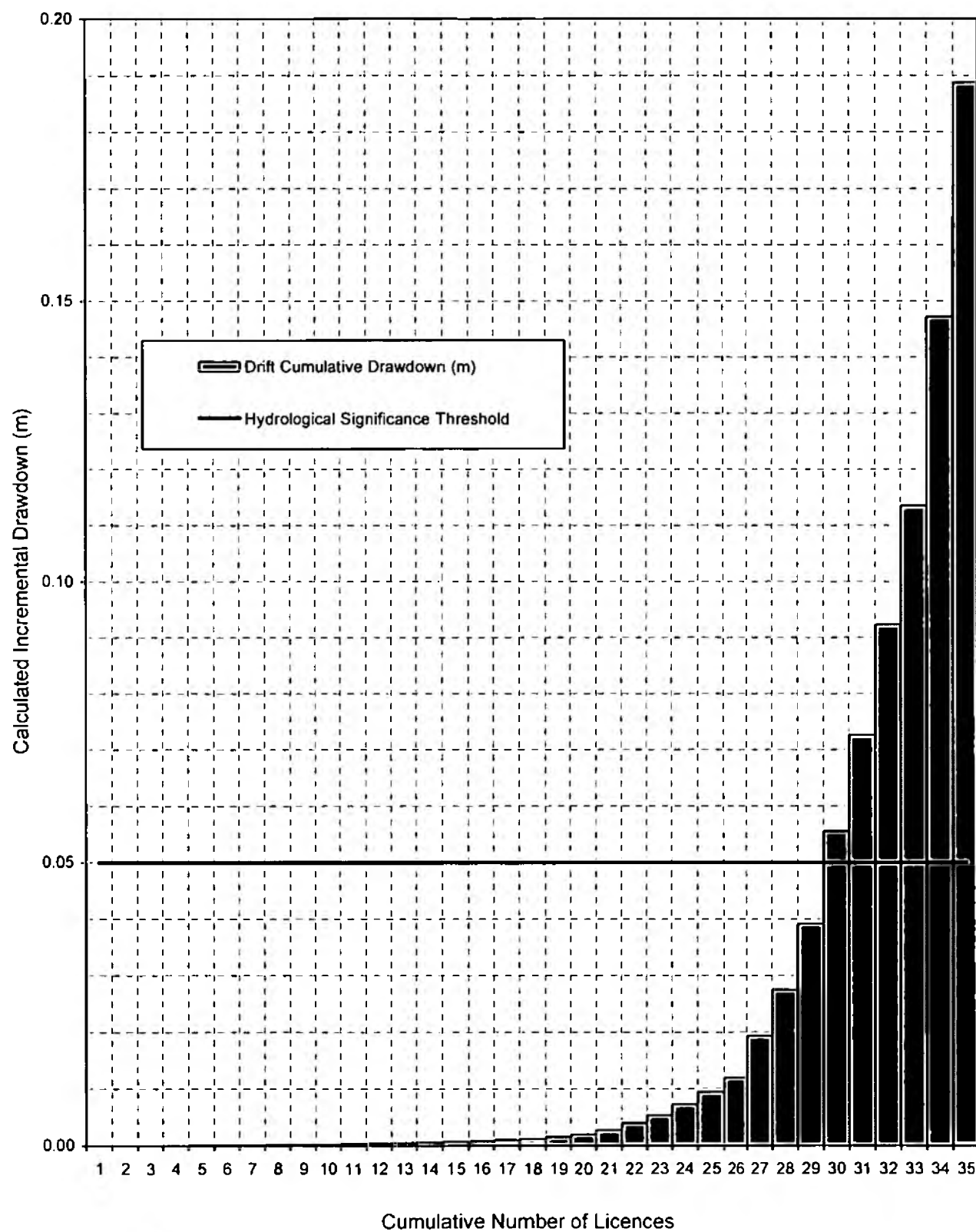
hsi Hydrogeological Services International Ltd
6 Millmead, Guildford, Surrey. GU2 4BE
01483 504221 mail@hsiltd.co.uk

DETAILS OF LICENCE ACCRETION DIAGRAM: THOMPSON COMMON SSSI/cSAC

Rank Number	Licence 6/33/...	NGR	Walton Chalk Drawdown (m)	Walton Drift Drawdown (m)	Chalk Cumulative Drawdown (m)	Drift Cumulative Drawdown (m)	Hydrological Significance Threshold
1	48/018	TF 9530 0210	0.00000	0.00000	0.00000	0.00000	0.05
2	44/009	TL 9730 9300	0.00001	0.00000	0.00002	0.00001	0.05
3	44/079	TL 9890 9920	0.00004	0.00001	0.00005	0.00002	0.05
4	44/143	TL 9280 9130	0.00006	0.00002	0.00011	0.00004	0.05
5	44/025	TL 9470 9260	0.00008	0.00003	0.00020	0.00007	0.05
6	44/109	TL 9492 9092	0.00009	0.00003	0.00029	0.00010	0.05
7	44/050	TL 9250 9210	0.00010	0.00003	0.00039	0.00014	0.05
8	44/089	TL 9550 9400	0.00013	0.00004	0.00051	0.00018	0.05
9	48/083	TL 9060 9920	0.00013	0.00004	0.00064	0.00022	0.05
10	44/244	TL 9183 9233	0.00017	0.00006	0.00081	0.00028	0.05
		TL 9183 9239					
		TL 9187 9242					
11	48/218	TF 9414 0181	0.00019	0.00007	0.00100	0.00035	0.05
12	44/098	TL 9840 9680	0.00022	0.00008	0.00121	0.00043	0.05
13	48/172	TL 9207 9890	0.00026	0.00009	0.00147	0.00052	0.05
14	44/086	TL 9590 9750	0.00026	0.00009	0.00173	0.00061	0.05
15	44/091	TL 9670 9440	0.00028	0.00010	0.00201	0.00070	0.05
16	44/044	TL 9720 9670	0.00028	0.00010	0.00229	0.00080	0.05
17	44/082	TL 9450 9870	0.00053	0.00019	0.00282	0.00099	0.05
18	44/241	TL 9610 9580	0.00071	0.00025	0.00353	0.00123	0.05
19	44/035	TL 9550 9540	0.00080	0.00028	0.00433	0.00151	0.05
20	48/219	TL 9410 9650	0.00139	0.00049	0.00572	0.00200	0.05
21	44/255	TL 9001 9060	0.00219	0.00076	0.00790	0.00277	0.05
22	48/238	TF 9027 0046	0.00343	0.00120	0.01133	0.00397	0.05
		TF 9028 0046					
23	48/219	TL 9410 9650	0.00399	0.00140	0.01533	0.00536	0.05
24	44/274	TL 9271 9180	0.00550	0.00192	0.02082	0.00729	0.05
25	48/033	TF 9406 0249	0.00627	0.00219	0.02709	0.00948	0.05
		TF 9400 0249					
26	44/185	TL 9470 9380	0.00729	0.00255	0.03438	0.01203	0.05
27	48/246	TF 9458 0078	0.02105	0.00737	0.05543	0.01940	0.05
		TF 9460 0078					
28	48/138	TL 9170 9820	0.02317	0.00811	0.07861	0.02751	0.05
29	44/137	TL 9393 9060	0.03339	0.01169	0.11200	0.03920	0.05
30	48/032	TF 9294 0046	0.04675	0.01636	0.15875	0.05556	0.05
		TF 9299 0048					
31	48/172	TL 9205 9891	0.04872	0.01705	0.20747	0.07261	0.05
32	44/137	TL 9515 9150	0.05617	0.01966	0.26364	0.09227	0.05
33	44/137	TL 9629 9215	0.06066	0.02123	0.32430	0.11350	0.05
34	48/219	TL 9410 9650	0.09637	0.03373	0.42067	0.14723	0.05
35	44/256	TL 9465 9410	0.11866	0.04153	0.53932	0.18876	0.05

Figure 2a

Thompson Common SSSI/cSAC
Licence Accretion Diagram
Drift

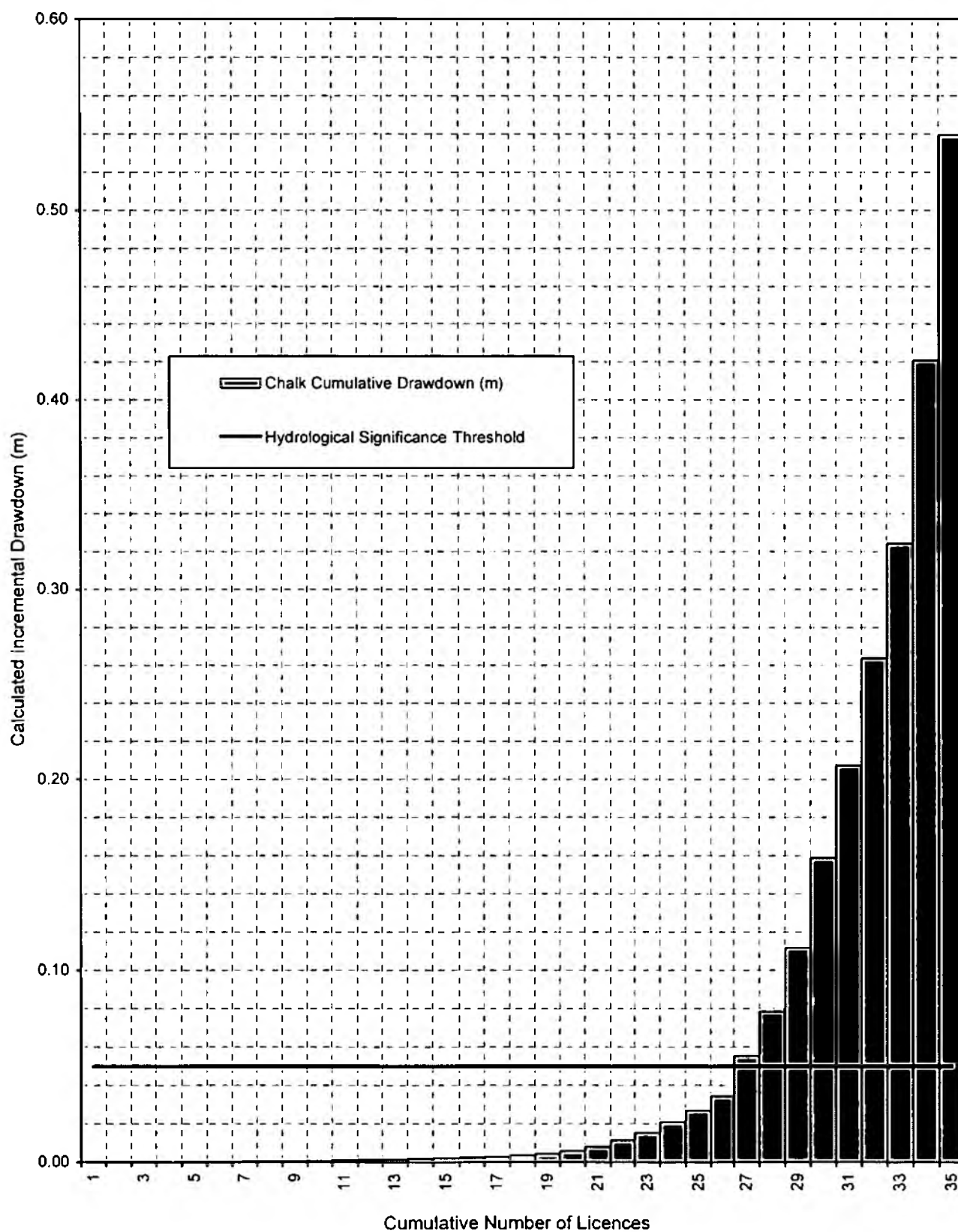


DETAILS OF LICENCE ACCRETION DIAGRAM: THOMPSON COMMON SSSI/cSAC

Rank Number	Licence 6/33/...	NGR	Walton Chalk Drawdown (m)	Walton Drift Drawdown (m)	Chalk Cumulative Drawdown (m)	Drift Cumulative Drawdown (m)	Hydrological Significance Threshold
1	48/018	TF 9530 0210	0.00000	0.00000	0.00000	0.00000	0.05
2	44/009	TL 9730 9300	0.00001	0.00000	0.00002	0.00001	0.05
3	44/079	TL 9890 9920	0.00004	0.00001	0.00005	0.00002	0.05
4	44/143	TL 9280 9130	0.00006	0.00002	0.00011	0.00004	0.05
5	44/025	TL 9470 9260	0.00008	0.00003	0.00020	0.00007	0.05
6	44/109	TL 9492 9092	0.00009	0.00003	0.00029	0.00010	0.05
7	44/050	TL 9250 9210	0.00010	0.00003	0.00039	0.00014	0.05
8	44/089	TL 9550 9400	0.00013	0.00004	0.00051	0.00018	0.05
9	48/083	TL 9060 9920	0.00013	0.00004	0.00064	0.00022	0.05
10	44/244	TL 9183 9233	0.00017	0.00006	0.00081	0.00028	0.05
		TL 9183 9239					
		TL 9187 9242					
11	48/218	TF 9414 0181	0.00019	0.00007	0.00100	0.00035	0.05
12	44/098	TL 9840 9680	0.00022	0.00008	0.00121	0.00043	0.05
13	48/172	TL 9207 9890	0.00026	0.00009	0.00147	0.00052	0.05
14	44/086	TL 9590 9750	0.00026	0.00009	0.00173	0.00061	0.05
15	44/091	TL 9670 9440	0.00028	0.00010	0.00201	0.00070	0.05
16	44/044	TL 9720 9670	0.00028	0.00010	0.00229	0.00080	0.05
17	44/082	TL 9450 9870	0.00053	0.00019	0.00282	0.00099	0.05
18	44/241	TL 9610 9580	0.00071	0.00025	0.00353	0.00123	0.05
19	44/035	TL 9550 9540	0.00080	0.00028	0.00433	0.00151	0.05
20	48/219	TL 9410 9650	0.00139	0.00049	0.00572	0.00200	0.05
21	44/255	TL 9001 9060	0.00219	0.00076	0.00790	0.00277	0.05
22	48/238	TF 9027 0046	0.00343	0.00120	0.01133	0.00397	0.05
		TF 9028 0046					
23	48/219	TL 9410 9650	0.00399	0.00140	0.01533	0.00536	0.05
24	44/274	TL 9271 9180	0.00550	0.00192	0.02082	0.00729	0.05
25	48/033	TF 9406 0249	0.00627	0.00219	0.02709	0.00948	0.05
		TF 9400 0249					
26	44/185	TL 9470 9380	0.00729	0.00255	0.03438	0.01203	0.05
27	48/246	TF 9458 0078	0.02105	0.00737	0.05543	0.01940	0.05
		TF 9460 0078					
28	48/138	TL 9170 9820	0.02317	0.00811	0.07861	0.02751	0.05
29	44/137	TL 9393 9060	0.03339	0.01169	0.11200	0.03920	0.05
30	48/032	TF 9294 0046	0.04675	0.01636	0.15875	0.05556	0.05
		TF 9299 0048					
31	48/172	TL 9205 9891	0.04872	0.01705	0.20747	0.07261	0.05
32	44/137	TL 9515 9150	0.05617	0.01966	0.26364	0.09227	0.05
33	44/137	TL 9629 9215	0.06066	0.02123	0.32430	0.11350	0.05
34	48/219	TL 9410 9650	0.09637	0.03373	0.42067	0.14723	0.05
35	44/256	TL 9465 9410	0.11866	0.04153	0.53932	0.18876	0.05

Figure 2b

Thompson Common SSSI/cSAC
Licence Accretion Diagram
Chalk





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