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TECHNICAL REPORT WA/91/52

Geological notes and local details for 1:10 000 sheet TM 49 NW: Thurlton

Part of 1:50 000 Sheet 162 (Great Yarmouth)

P M HOPSON

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Geological notes and local details for
1:10,000 sheet TM 49 NW (Thurlton)
(Keyworth : British Geological Survey)

Author

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 Keyworth, Nottingham British Geological Survey 1991

NOTES

1. All the grid references cited in the text lie in 100 km grid square TM unless otherwise stated. Where reference is made to a borehole or locality only the first occurrence of such a reference in the text will have the grid reference quoted.

2. The Selected details include boreholes from the British Geological Survey National Geosciences Information Centre and natural sections.

3. Abbreviated logs of boreholes drilled for the British Geological Survey (BGS) during the recent surveying of the area are given in Appendix A.

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Geological Notes and local details for 1:10,000 sheet TM 49 NW (Thurlton)

Part of 1:50,000 sheet 162 (Great Yarmouth)

P M HOPSON

1. INTRODUCTION

This report describes the geology of the 1:10,000 sheet TM 49 NW (Figure 1) which is included in the 1:50,000 Great Yarmouth (162) geological map. The area was first surveyed by J H Blake and C Reid as part of the Old Series one-inch sheets 67 SE (JHB) and 66 SE (CR/JHB) published in 1882 and 1881 respectively. The primary six-inch survey of the Thurlton area was made by P M Hopson in 1985 under the direction of Dr R G Thurrell, Programme Manager, Eastern England Land Survey. Uncoloured dye-line copies of the map can be obtained from the British Geological Survey, Keyworth.

The area described covers part of the broad valley near the confluence of the lower Yare and Waveney rivers, together with some gently undulating country which rises towards the south west to a plateau founded on boulder clay.

There are no major towns in the area, the largest village of Thurlton (415 985) is linked by a network of minor roads to a number of small villages and hamlets. Thurlton is equidistant (14 kms) from Great Yarmouth to the northeast and Lowestoft to the southwest; Norwich is some 20 kms to the northwest and Beccles 8 kms due south. Apart from a number of gravel workings and patches of woodland and market gardening, the area is one of arable farming.

The broad floodplain of the Yare/Waveney covers some 6 square kilometres of ground in the north and northeast of the sheet. The river Waveney (and the New Cut), cross the area in the extreme northeast and the river Yare flows eastwards past Reedham [TG 420 016] some 2 km north of this sheet. The floodplain, which is usually between 1.5 and 2 kms wide, is known as the 'Marshes'; traditionally of permanent pasture grazed in summer, much of it has now been drained and ploughed for cereal and market garden crops. This broad expanse of estuarine alluvium and peat is generally at or just below sea level and falls from the rivers to the margins of the Marshes. The rivers which are

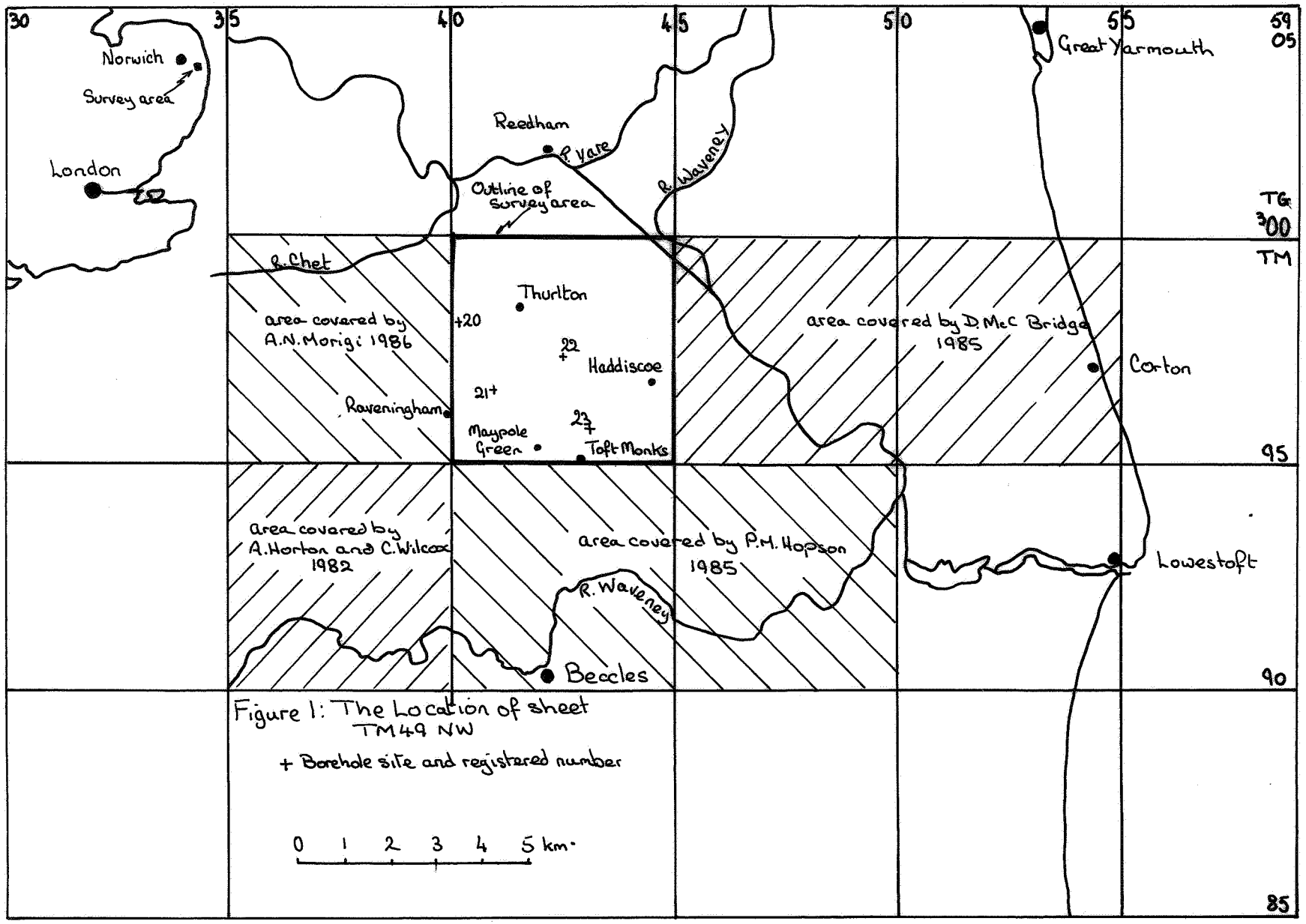

Figure 1: The Location of sheet TM49 NW

+ Borehole site and registered number

confined between levee's are above floodplain level and a number of 'mills' (now electronically driven pumps) regulate the water level in the Marsh drains.

The plateau developed on the Lowestoft Till is confined to the south and west of the sheet around Toft Monks [428 950], Maypole Green [417 955] and Raveningham [400 966] at between 23 and 36 m OD. A continuation of this plateau but at a lower level between 15 and 21 m OD stretches northeastward from Pockthorpe [409 965] to Thorpe Church [436 983]. The plateau which is predominantly flat is intersected by numerous shallow dry valleys with only gentle slopes.

Between the Marshes and the Plateau is an area of gently undulating ground founded on various sandy and gravelly deposits. Slopes are usually moderate but on the margins of the Marshes between Haddiscoe [445 968] and Thorpe Church slopes of over 30 degrees have been recorded (Corbett and Tatler 1970).

No solid formations are exposed but the Crag, London Clay, Lower London Tertiaries and Chalk have all been encountered in deep boreholes. Overlying the Crag, at or just below floodplain level, are a series of quartz and quartzite rich pebbly sands and sandy gravels. These have been eroded and cut out in places by thick deposits of glacial and glaciofluvial origin which culminate with the Lowestoft Till and superposed fluvioglacial outwash. It is these later deposits which crop out on the valley flanks and over the plateau.

The thick Flandrian deposits of Peat and Estuarine Alluvium mapped over the floodplain rest on minerogenic sands, pebbly sand and gravels of ? fluvial or fluvioglacial origin.

The geological sequence in the area together with details of lithology and maximum thicknesses are shown in Table 1.

TABLE 1 GEOLOGICAL SEQUENCE OF THE THURLTON AREA (MAXIMUM THICKNESS ARE DERIVED FROM BOREHOLES UNLESS OTHERWISE STATED)

DRIFT	QUATERNARY		PEAT	Black fibrous peat with wood fragments and silty in parts	up to C.3.7 + m
		FLANDRIAN	ESTUARINE ALLUVIUM	Brown becoming pale grey silty clay with shells and pockets of peat	up to 15.8 m
			HEAD	Dark yellowish brown sandy pebbly earthy clay and clayey sand with pebbles	up to C.3.5 m1
		POST-ANGLIAN	HADDISCOE SANDS AND GRAVELS	Well-rounded flint gravel and fine yellow-sands	up to C.15.0 m1
			FLUVIOGLACIAL SANDS AND GRAVELS (UNDIFFERENTIATED)	Cryotubated clayey well-rounded and angular gravel with sand	up to C.3.0 m1
		ANGLIAN	GLACIAL SILTS	Laminated pale grey chalky silt with fine chalky sand seams	up to C.2.5 m1
			BOULDER CLAY (LOWESTOFT TILL)	Dark grey silty, fine sandy clay with flint and chalk pebbles	up to C.13.0 m1
			CORTON SANDS	Fine, very fine and medium pale yellow sand	up to C.13.0 m
			LEET HILL SANDS AND GRAVELS	Pebbly sand and sandy gravel with Scandinavian erratics	up to 7.8 m
			NORWICH BRICKEARTH	Dark yellow brown sandy silty clay with pebbles. Scandinavian erratics.	up to 2.7 m2
		CROMERIAN & ? BEESTONIAN	FLUVIATILE AND MARINE SANDS, GRAVELS AND CLAYS	Quartz and quartzite rich sandy gravels and thin silts and clay	up to 8.9 m2
SOLID	TERTIARY	PRE-BEESTONIAN	CRAG	Interbedded brown fine and medium sands and silts with ironstone Greenish grey stiff silty clays Green medium to coarse glauconitic, micaceous shelly sands	up to 36.2 m2
		EOCENE	LONDON CLAY	Dark grey, brown or bluish grey fine sandy silty clay	up to 35.0 m2
		PALAEOCENE	LOWER LONDON TERTIARIES	Interbedded grey and green silty clays and clayey sands, flints at base	
	CRETACEOUS		CHALK	Generally white well-jointed chalk with flint seams	up to 53.3 m2

1. Maximum thickness estimated from field evidence

2. Formations not exposed at surface

2. SOLID FORMATIONS

2.1 Chalk

The Chalk is not exposed in the area but is recorded in a number of boreholes. Regionally the Chalk dips in an easterly direction at less than 1 degree. The apparent dip on the eroded surface of the Chalk is locally towards the north-north-east. In the south the chalk surface is at -18.9 m OD in borehole NW 15 [4121 9501] and falls towards the NNE until in borehole NW 11 [424 974] the chalk surface is at -53.3 m OD.

The total thickness of the Chalk has not been proven in this area, but a deep borehole (TM59 SW23 [528 926]) to the southeast of the area at Lowestoft proved 320.1 m of Chalk over an attenuated sequence (29.6 m) of Upper Greensand, Gault and Lower Greensand resting on an eroded Palaeozoic platform.

The upper part of the Chalk proved in boreholes within the area comprises a soft, well-jointed, white fine-grained limestone with seams of nodular and tabular flint. The top few metres in most boreholes has a putty-like consistency with included fragments of fresh angular chalk and flint.

2.2 Lower London Tertiaries and London Clay

The Lower London Tertiaries and London Clay have been considered together in this report since the borehole records are of insufficient detail to adequately divide the sequence. The deposits have been proved in only two boreholes within the sheet area. Borehole NW 16 [4096 9660] shows 8.5 m of dark brown clay over green clay and a thin hard pan, and borehole SW11 proved 35.0 m of 'Plasterine' and clay.

Borehole information from other nearby sheets (Hopson, 1991) shows that the eroded feather edge of these deposits comprises a series of interbedded clays, silty clays and clayey sands with 'hard pan'. The clays (presumably the London Clay) predominate at the top of the sequence. In general the deposits are grey or green in colour but towards the base become variable and also include red, black, brown and 'blue' tints. Some boreholes record a flint pebble bed at the base of the deposits resting unconformably on the eroded Chalk surface.

2.3 Crag

As with the older Solid deposits the Crag has not been found at outcrop within the area. The Crag rests unconformably on the Chalk, Lower London Tertiaries and London clay on a surface which has a regional slope towards the east-north-east, but which is cut by numerous deep sedimentary basins trending in the same direction. By analogy with the Crag deposits described by Bristow (1983) further to the south-west in Suffolk, the sedimentary basins in the vicinity of this area (see Hopson 1991) are also likely to be fault controlled (Hopson and Bridge, 1987).

However the lack of adequate boreholes and their inappropriate distribution preclude any such reconstruction on this sheet. From the information available the base of the Crag ranges from -18.3 m OD in borehole NW11 to -28.9 m OD in borehole NW 17 [4228 9549]. The thickness as proved in boreholes ranges from 13.7 m in NW 11 to 36.2 m in NW 17.

Descriptions of the deposit within National Geosciences Information Centre records are poor, generally grey and green silts and shelly sands. However, a threefold lithostratigraphical division has been erected for the upper 14 metres or so of the Crag in this area, based on the results of the recent BGS borehole programme. Thicknesses of the individual units have not been quoted.

Green shelly sands occur at depth over the area. The sands are typically fine - and medium grained (Wentworth 1922) and well sorted, they contain a dinoflagellate cyst fauna indicating that deposition occurred in an open marine environment and probably during the Antian/Thurnian stages.

Their total thickness is unknown but registry records suggest that they have their maximum development in the basin to the east of Toft Monks.

The shelly sands are succeeded by a sequence of stiff greenish grey silts and silty clays containing wispy stringers and irregular lenses of fine and very fine white sand. Lithologically they resemble the Chillesford Clay (Prestwich 1871) and appear to have been deposited under comparable conditions in a restricted inshore and lagoonal environment.

Overlying the silts and clays are brown and orange fine and medium sands interlaminated locally with thin grey clay seams. Cores of this material display lenticular and horizontal parallel bedding on a scale ranging from a few millimetres up to 10 cms in thickness; the stratification is similar in style to sedimentary structures seen in modern tidally laminated sediments adjoining the North Sea Basin (Terwindt 1971). On the coast at Corton [546 965] towards the east, West (1980) considered these deposits to be of Pastonian age on pollen evidence, and this has been confirmed in part on dinoflagellate cyst evidence by Harland (pers comm) who regards them as Pastonian and/or Baventian.

Except for a few thin pebbly horizons consisting almost entirely of flint, the upper part of the Crag contains no appreciable gravel. However, the +4-8 mm washings have yielded variable amounts of secondary iron pan. The thickest and most highly indurated iron pan are developed within a metre or so of the top of the interlaminated facies and are believed to relate to a period of emergence and subaerial weathering at the close of Crag times. This erosional break has been recognised from the coast at Corton throughout much of the survey area. The change from a flint dominated regime to one in which considerable amounts of quartz and quartzite are found and the development of surficial iron pan suggests that this erosional break represents a major disconformity separating the Crag from the overlying deposits (Hopson and Bridge, 1987).

3. DRIFT DEPOSITS

Because of the complicated nature of the sequence within the Middle Waveney area (Wilcox and Horton 1982, Fig. 1) the term Beccles Beds was informally erected to distinguish an omnibus suite of sands, gravels and clays which underlie the Lowestoft Till and post date shelly Crag. In this area however, and towards the coast at Corton [546 965], it has proved possible to distinguish the individual units in the field. Thus the Fluviatile and Marine Sands, Gravels and Clays, the Norwich Brickearth, the Leet Hill Sands and Gravels and the Corton Sands could be considered together informally as Beccles Beds (Figure 2).

3.1 Fluviatile and Marine Sands, Gravels and Clays

Regionally spreads of quartz and quartzite bearing gravel, overlying the Pleistocene Crag, cover much of south-east Suffolk and have been referred by Rose and Allen (1977) and Rose, Allen and Hey (1976) to the Kesgrave Sands and Gravels. These deposits are believed to represent a periglacial aggradation of a braided river system which flowed across south-east East Anglia marking an early course of the Thames. Although the deposits cannot be dated *per se*, they have been assigned by Rose and Allen (1977) to the Beestonian since they are overlain by a widespread rubified horizon thought to represent a temperate sol lessive and regarded as Cromerian in age.

Extensive drilling in the middle and upper reaches of the Waveney (Wilcox and Stanczyszyn 1983; Auton 1982; Clarke 1983) has demonstrated the occurrence above the Crag (or Chalk) of similar deposits which have also been assigned mainly to the Kesgrave Sands and Gravels. Clarke (1983) has suggested that these deposits were laid down by eastward flowing streams separate but contemporaneous with the proto-Thames system and this contention has been further emphasised in Hopson and Bridge (1987). Associated with the Kesgrave Sands and Gravels of the Waveney area are patches of gravel containing very high proportions of well-rounded Bunter quartzite; these have been referred to a separate, probably older body, termed the Ingham Sands and Gravels (Clarke and Auton 1982).

In this survey area quartz and quartzite bearing gravels and sandy gravels overlying the Crag disconformably have also been proved in boreholes, and provide the first evidence of a major quartzose influx into the Lower Waveney

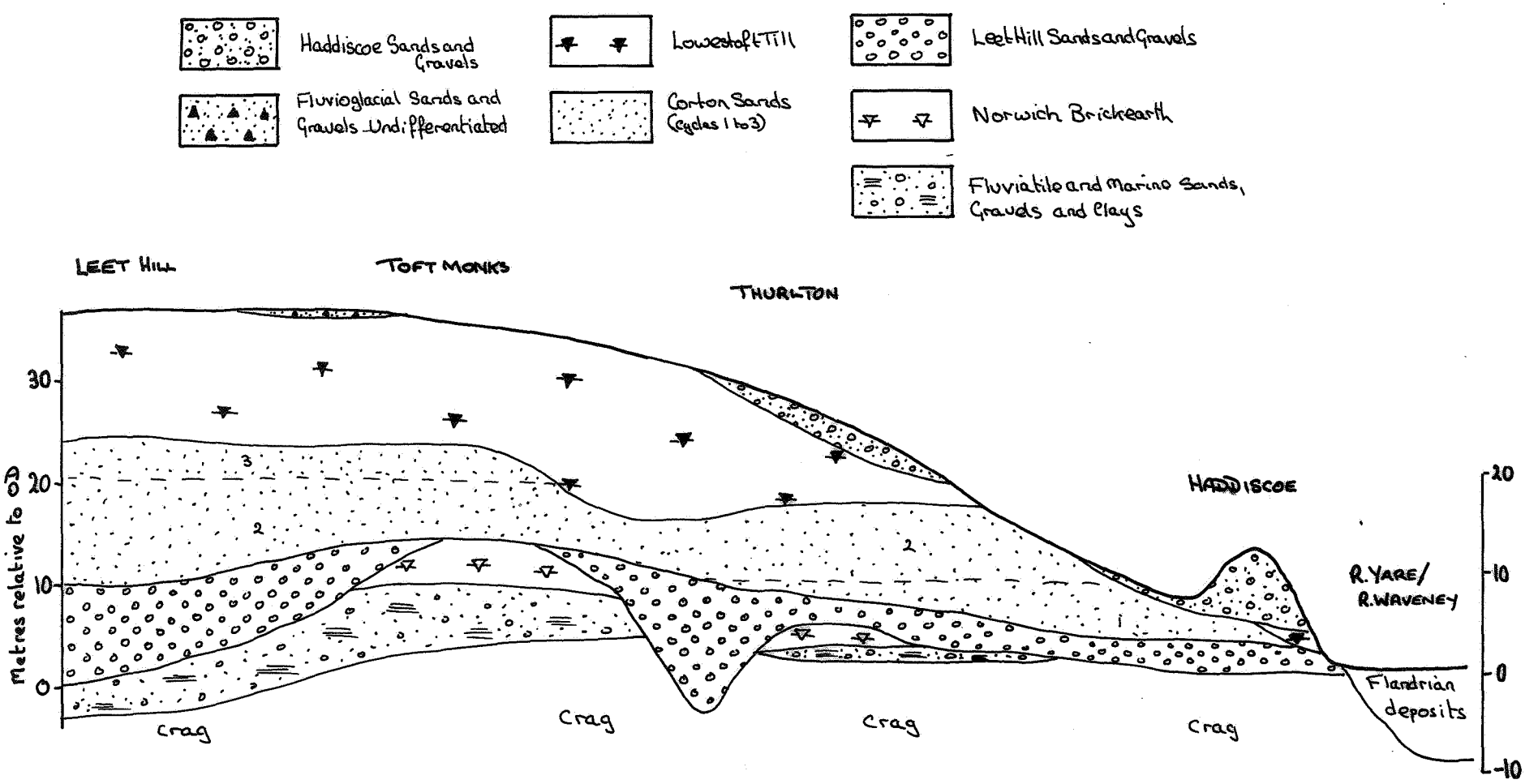

Figure 2: Schematic diagram showing the relationship of the deposits

valley. The deposits can be traced from the coast at Corton [546 965] westwards to Thurlton and beyond, although in places they have been removed by subsequent erosional events. However the variation in elevation and composition of the deposits suggests that they are not the product of one Beestonian periglacial event but a series of deposits ranging in age from Beestonian to Cromerian and the result of deposition from both fluviatile and marine environments.

At a relatively high level in boreholes to the west and southwest of Toft Monks on sheet TM 49 SW a spread of Bunter-rich quartzose gravels and sandy gravels has been proved. This deposit has not been unequivocably identified in boreholes on this sheet but it is likely to occur at depth in the vicinity of boreholes NW15 and NW17 near Maypole Green. The deposit which has a base between 7 and 11 metres above OD contains upwards to 29 per cent of pale coloured quartzite and 24 percent of white quartz pebbles. It probably represents the oldest pre-Anglian drift deposit in the area and as such must be relatable to the spread of Beestonian 'Kesgrave' material of the Middle Waveney.

At a lower level in boreholes to the north of Toft Monks a unit of quartz and quartzite bearing sands, pebbly sands and sandy gravels with thin silty clays has been proved. The base of this deposit is variable being within the range +4.8 m to -6.1 m OD, its top however appears to be relatively constant at about 4 to 5 metres above OD.

East of this area on sheets TM 49 NE and TM 59 NW (see explanatory notes D McC Bridge, 1985) this spread of quartzose sands, gravels and clays is divided by the Cromer Forest Rootlet Bed of Blake (1882) and West (1980), into an upper and lower unit, both of which show indications of marine and fluviatile deposition. Dinoflagellate cyst evidence shows that marine deposition occurred at least 7 m above present day sea level.

It seems probable therefore that an early (?Beestonian) relatively high level spread of quartzose sandy gravels and gravels of fluviatile origin (Kesgraves) has been dissected and incorporated at a lower level into deposits which show the influence of both fluviatile and marine environments.

3.2 North Sea Drift Group

The deposits of this group record the history of the first major ice advance into the area from the north and north-east. The group is characterised by its Scandinavian erratics and material of North Sea Basin derivation (Bridge and Hopson 1985). The group comprises a till unit, here termed the Norwich brickearth, and a sequence of outwash pebbly sands and sandy gravels, here termed the Leet Hill Sands and Gravels which are overlain by a sequence of sands called the Corton Sands. The Leet Hill Sands and Gravels have not been described in detail before since they are not well represented at the Anglian stratotype at Corton. The Corton Sands are well documented but have not previously been assigned specifically to deposition from the wastage of the North Sea Ice. Evidence that these sands were derived wholly from the North Sea Ice rather than the Lowestoft ice is proposed by some authors (Funnell 1955), has been presented in Bridge and Hopson (1985).

Prior to the deposition of the deposits of this group considerable erosion took place in the area. The erosional surface produced ranges from sea level on the flanks of the valley north of Thorpe Church to +9.1 m OD in borehole NW 23 [4301 9570] and the North Sea Drift Group deposits rest disconformably on both the Crag and Fluviatile and Marine Sands, Gravels and Clays.

In boreholes NW 21 [4097 9663] and NW 22 the North Sea Drift Group of sediments cut down to exceptionally low levels (at or just above OD). These sediments infill part of a depression which stretches from the coast at Hopton (536 997) through Lound (505 990) and on towards Raveningham. The term the Raveningham-Lound Depression has been used to describe this feature (see Bridge and Hopson 1985; Bridge 1991 and Hopson and Bridge, 1987). It appears to be a major distributary channel for North Sea Drift Group Sediments and it is in this channel that the thickest deposits have been proved.

3.2.1 Norwich Brickearth

The Norwich Brickearth is a dark yellowish brown very sandy, silty, clay containing scattered pebbles. Mechanical analysis of the (-) 2 mm material shows the deposit to be extremely uniform in character and is composed on average of 22.0% clay, 23.6% silt and 54.4% of fine - and medium-grained sand. Pebbles and granules (+2 mm) account for only 4.7% by weight and are dominated by flint with subordinate quartz and quartzite. In addition the till contains

clasts of chalk and shell debris together with a sparse but diagnostic suite of igneous and metamorphic rocks including, rhomb porphories, mica schists and granitoids believed to be of Scandinavian origin (Boswell 1916).

Heavy mineral analyses demonstrate the strong similarity between the Norwich Brickearth (and the North Sea Drift Group in general) and the Crag, and emphasising that considerable quantities of Crag sands must have been incorporated within the ice as it progressed across the North Sea Basin.

East of this area on the coast at Corton the till forms a continuous sheet with a base which gently rises from sea level on the coast to about +5.0 m OD inland. In this area however only sporadic occurrences have been proved in boreholes and the deposit has not been proved at outcrop. The till has a maximum recorded thickness of at least 2.7 m in borehole NW 14 [4148 9542].

3.2.2 **Leet Hill Sands and Gravels**

Spreads of pebbly sand and sandy gravel with subordinate sand lenses cover much of the survey area at depth and are interpreted as proximal outwash produced by wastage of the North Sea Ice. They are poorly exposed in this area but a full sequence can be seen in a pit near Leet Hill [378 929] some 3 kms west of Gillingham, and it is from this locality that the member has been named. Leet Hill Pit [3807 9294] was previously described by Wilcox and Horton (1982) in their geological notes for sheets TM 38 NW, NE and TM 39 SW, SE (p. 11). However, since the publication of that document the pit has been extended and considerably deepened and further notes were appended in the explanatory notes for sheets TM 49 SW and SW (Hopson 1991).

The deposit has been proved in a number of boreholes within the area but is only found at outcrop in two localities; on the flanks of the Waveney valley northwards from Low Farm [438 977] to Willow Farm and northeast of Marsh Farm, Lower Thurlton [432 992]. Within the former outcrop numerous small exposures of pebbly sand and sandy gravel with Scandinavian erratics can be seen, selected details are shown below:

In general the Leet Hill Sands and Gravels and the Norwich Brickearth are mutually exclusive deposits indeed the Leet Hill member cuts down to a lower level than the Brickearth. Where the Norwich Brickearth is present the outwash forms a thin bed above and rarely (as in borehole NW 20 [4008 9807]

below the till, however, up to 7.8 m (borehole NW 22 [4251 9746] of pebbly sand and sandy gravel has been proved where the Brickearth is absent. In these areas a persistent bed of sand and/or a thin interlaminated brown sandy clay (cf Leet Hill) within the sand and gravel has been proved.

The composition and grading of the Leet Hill member closely resembles that of the Fluviatile and Marine Sands, Gravels and Clays. Both deposits contain comparable proportions of flint, quartz and quartzite but the outwash can be distinguished by its assemblage of igneous and metamorphic pebbles which are identical to types found in the Norwich Brickearth.

Selected Details

North End Road [4348 9873] Surface level c7.0m

0 - 4.3 **Corton Sands** - pale yellow very fine to medium sand ripple drift and planar bedded.

4.3 - 5.0+ **Leet Hill Sands and Gravels** - dark yellowish brown sandy gravel. Predominantly rounded and angular flint with some quartz and a trace of shell.

Marsh Farm [4350 9861] Surface level c7.0m

0 - c.5.8 **Corton Sands** - pale yellow very fine to medium sand with some chalk grains. Ripple drift and planar bedded. No clear face, pit overgrown and degraded.

5.8 - 6.0+ **Leet Hill Sands and Gravels** - flint and quartz sandy gravel seen in floor of pit in roots of collapsed tree.

Thorpe Hall [4373 9804] Surface level c6.0m

0 - 0.8 **Leet Hill Sands and Gravels** - fine flint and quartz gravel in a medium to coarse quartz sand.

3.2.3 Corton Sands

This deposit, named after its principal exposure at Corton [546 965] to the east of this sheet, comprises a series of buff and pale yellow coloured, well sorted fine to medium grained quartz sands and 'clayey' sands. Their heavy mineral assemblages indicate that they accumulated on the wastage of the North Sea Ice. The sands contain disseminated chalk grains, calcite prisms and some mica flakes, and sporadically abraded shell material derived principally from the Crag. The bedding is usually of planar or climbing-ripple type, but at the type site slightly coarser sand with cross-sets up to 1 m high are seen near the base. All these sedimentary structures indicate a direction of flow from the north and north-west.

Pebbly horizons are rare other than at the base where a pebble lag is developed; and the Corton Sands contain only some 0.5% by weight of pebbles (+4 mm) overall. However some horizons within the sequence contain sufficient material to permit a statistically valid pebble analysis. In addition to angular and subangular flint (64%), quartz (20%) and some quartzite and rounded flint (5-10% each), the deposit also contains traces of porphyry, granitoids and metamorphic pebbles emphasising its direct association with the North Sea Drift Group.

The Corton Sands outcrop on the flanks of the Waveney/Yare Valley where they are not obscured by later deposits such as the Haddiscoe Sands and Gravels; and also along the flanks of tributary streams draining the Lowestoft Till Plateau. Their base is difficult to define at outcrop, due to the progressively pebbly nature of the deposit, but it must be at about 2 to 5 metres OD in the east, north of Thorpe Church. In the west the base is proved at 13.9 m OD in borehole NW 20. The eroded top of the Corton Sands as proved in boreholes ranges in height from about 16.9 m OD in borehole NW 22 to 23.8 m OD in borehole NW 15.

Based on the results from recent BGS boreholes within this area and towards the coast at Corton the deposit can be split into three sedimentary cycles each consisting of a fining upwards sequence culminating in silt and clay grade material. These three cycles cannot be recognised individually during field mapping but they must occur at surface where topography at the relevant level, and outcrop pattern coincide. The top of the first (lower) cycle is marked by a planar discontinuity at an elevation of around 10 m OD. This

cycle which has not been proved in boreholes in this area but is found to the south east of Toft Monks, does not overtop the 'bunter rich' sediments found at high levels under the Toft Monks [428 950] area (cf. 3.1). Its major exposure is at Corton towards the east, and here the discontinuity is associated with cryoturbation structures presumably formed during a period of non-deposition before sands of the second cycle invaded the area.

The second (middle) cycle has been proved in boreholes throughout the area. Again clay enrichment and disturbed bedding are characteristic of its top which is at about 20 m OD. The sands of the second cycle are exposed at Leet Hill Pit [3807 9294] to the south-west of the area and in a number of small pits dug through the Lowestoft till cover on the northern half of this sheet.

The third (upper) cycle is considerably finer in grade than either of the preceding cycles and represents the final influx of distal outwash from the waning North Sea Ice. It has been proved in a number of boreholes (eg NW 15 and NW 17) west of Toft Monks and is exposed in a number of small, heavily overgrown pits that were dug (through the Lowestoft Till cover for tile and brickmaking) in the area west of College Farm [412 950].

Following the deposition of the Corton Sands a major period of erosion ensued and it is probable that at this time a drainage pattern developed similar to that seen today. The duration of the period of erosion is unknown but it may have been considerable since the topography generated by it has at least 25 metres of relief. Locally the top of the Corton Sands has been cemented to form a calcrete.

Selected Details

West of Haddiscoe Church [4361 9700] surface level c.11.0m

0.0 - c.2.0	**Haddiscoe Sands and Gravels** - well rounded flint gravel uneven base in medium to coarse sand matrix.
c.2.0 - 4.0	**Corton Sands** - pale yellow fine and very fine with medium sand. Pit heavily overgrown.

West of Haddiscoe Church [4371 9682] surface level c.6.0m

0 - 0.5 **Haddiscoe Sands and Gravels** - Interbedded well rounded flint gravel and fine to medium yellow sands.

0.5 - 2.3 **Corton Sands** - Pale yellow fine and medium sand planar bedded, lowermost 1.0m of sand augered from base of exposure.

East of Raveningham Hall [4006 9682] Surface level c21.0m

0 - 0.4 **Lowestoft Till** - slumped yellow brown pebbly clay with included sand pockets.

0.4 - 4.5+ **Corton Sands** - pale yellow very chalky fine and very fine with some medium sand. Some planar and ripple drift bedding visible.

3.3 Lowestoft Till Group

The deposits of this group record the second major ice advance to effect the area. The ice, which crossed the area from the west, resulted in apparently little or no pre-till outwash and with only minor (micro-faulting and de-watering structures) disturbance of the underlying sediments. This suggests that the ice must have advanced rapidly over a frozen landscape. The deposits which emanated from the ice are characterised by their content of angular flint and chalk clasts and by their heavy mineral assemblage which is overwhelmingly dominated by opaque iron minerals. This character is primarily the result of incorporation of large quantities of Jurassic and Cretaceous rocks into the ice.

3.3.1 Lowestoft Till

The Lowestoft Till, which drapes the topography left at the end of Corton Sands time, is a dark grey or bluish-grey silty, occasionally sandy clay which weathers to a yellow-brown colour. It contains fragments of chalk and flint and less commonly quartz, red chalk and Jurassic limestone, fossil debris and black fossiliferous shale clasts. Locally at high levels within the deposit, chalky laminated silts and fine sands have been found. It is exposed in a number of overgrown pits and ditches throughout the district but no major exposures can be clearly seen.

The deposit forms the plateau in the south and west of the area and has been mapped to low levels within the Waveney/Yare Valley. Under the plateau its base is at about 23-25 m OD. To the north-west of Castell Farm [405 956] where the plateau rises about 35 m OD the Lowestoft Till attains its maximum thickness of about 13 metres. Towards the valley the base of the Lowestoft Till falls and the deposit can be mapped from the plateau to the level of the floodplain in a few localities, e.g. near Manor Farm [431 992] and Grange Farm [449 955]. A borehole at Pond Farm (TM 49 NE 21 [4566 9508], see D McC Bridge 1985), just east of the survey area, shows that the Lowestoft Till at low levels (in this case down to - 1.1 m OD) is of lodgement type, indicating that it was derived from in situ melting of ice and not by a later reworking.

In the area from Raveningham to Thurlton and westwards onto sheet TM 39 NE a number of east-west trending linear outcrops of Lowestoft Till have been mapped. They cut across the present day topography for distances of up to 4-5 kilometres and field indications point to them being deep, narrow, steep-sided channels cut into the Corton Sands. These channels have been filled predominently with very hard over compacted Lowestoft Till but also some laminated silts, and chalky sands and gravels (of presumed Lowestoft affinity) marginal to the outcrops. For the most part these marginal deposits have very thin outcrops and are rarely mappable. They have been included within the mapped outcrop of the Lowestoft Till.

The origin of the channels is problematical they may either result from pre-Lowestoft Till erosion or more likely be the product of sub-ice channelling.

3.2.2 **Glacial Silts**

The Glacial Silts are a sequence of buff and pale yellow to grey chalky interlaminated fine sandy silts, silty clays and clays with some small chalk fragments but otherwise free of pebble grade material. They appear to be the result of localised ponding of fine outwash during Lowestoft Group times and from field evidence grade into the Lowestoft Till.

The deposit is restricted in occurrence and outcrops in only two small patches west of Orchard Farm [420 965]. Elsewhere on the plateau thin chalky silts have been seen in ditches but they have proved to be of only limited lateral

extent. Only two boreholes have penetrated the deposit (see NW 22, 23 Appendix A) in this area; these and auguring have proved up to 2.3 m of deposits, field indications show that it can be only some 3.5 m thick at most.

Selected Details

Pond 250 m SSE of Pockthrope [4102 9630] Surface level c26.0 m

0 - 2.0+	**Glacial Silts** - fine and very fine sandy chalky pale yellowish brown silts.

Ditch at Long Plantation [4022 9543] Surface level c32.0 m

0 - 1.2 m+	**Glacial Silts** - Clayey fine sandy silts with fine fragments of angular chalk. Exceptionally chalky throughout very pale yellow.

Auger Hole [4269 9664] Surface level c22.0 m

0 - 2.1 m	**Glacial Silts** - Interlaminated silts and very fine sandy silts, pale yellow and pale grey.
2.1 - 2.3 m+	**Glacial Silts** - very clayey pale yellow brown chalky fine/medium sand with some chalk pebbles.

3.3.3 **Fluvioglacial Sands and Gravels** (Undifferentiated)

This omnibus term includes deposits of unknown affinity which rest on the plateau surface created by the Lowestoft Till and those deposits within the higher reaches of the tributary streams which do not appear to be of Haddiscoe Sands and Gravels type (cf 3.4).

The deposits are very variable in lithology and range from 'clayey' chalky angular flint gravels to medium and coarse sands with only rare pebbles.

In the vicinity of North Farm [408 978] two patches of sandy angular flint gravel with varying proportions of clay and chalk have been mapped either side of a channel in Lowestoft Till (cf 3.3.1). The contact between these sandy gravels and the Lowestoft Till is not seen; but the juxtaposition of a 5.0 m deep heavily overgrown pit in chalky sandy gravels and a pond up to 2.0 m deep

founded on Lowestoft Till [4073 9765] suggests that the contact is steep. The variability of the deposit is demonstrated by the following two examples:

Selected Details

Pit at North Farm [4081 9770] Surface level c9.0 m

0 - 1.5	**Fluvioglacial Sands and Gravels Undifferentiated** - coarse angular flint gravel interbedded with coarse and very coarse with medium pebbly sand.
1.5 - 2.3 m+	**Fluvioglacial Sands and Gravels Undifferentiated** - Medium with coarse and fine clayey brown sand indurated in part.

Auger hole 150 metres each of North Farm [4095 9776] Surface level c8 m

0 - 2 m	**Fluvioglacial Sands and Gravels Undifferentiated** - interbedded coarse and very coarse with medium sand with some angular flint pebbles and very chalky pale yellow sandy silts.
2 - 2.3 m+	**Lowestoft Till** - very silty yellowish grey soft chalky clay.

The Fluvioglacial Sands and Gravels Undifferentiated have been mapped west of Norton Plantation [404 984], and in the vicinity of Craft Plantation [401 977] and Silver Grove [403 968]. These deposits are generally only some 1 to 2 metres in thickness and for the most part composed of pebbly medium and fine with coarse sands. Their geomorphological expression in variable; at Norton Plantation they infill a shallow depression in the underlying Lowestoft Till and at Craft Plantation they form a low mound, on top of Corton Sands, within the valley. At Silver Grove the deposit gives rise to slightly hummocky ground on the Lowestoft Till plateau and appears to have been soliflucted into the valley to the west over Corton Sands.

In the valley north of Maypole Green three small patches of thin, angular coarse flint sandy gravel have been mapped. In places these deposits are very chalky.

On the plateau surface north of Toft Monks are three outcrops of clayey sandy gravel. The deposits are generally thin but have a very irregular base apparently as the result of intensive cryoturbation into the underlying Lowestoft Till (see Corbett and Talter p.25 1970). The cryoturbated deposits are analogous to those proved around Wheatacre [460 940] to the southeast on sheets TM 49 SW and SE (Hopson 1991).

3.4 **Haddiscoe Sands and Gravels**

The Haddiscoe Sands and Gravels outcrop on the flanks of the Waveney/Yare Valley from Haddiscoe [445 968] to Firs Farm [404 999] and onwards towards sheet TM 30 SE. The deposit, named after its major exposure at Haddiscoe Pit [445 963] is found as a series of low mounds abutting the floodplain. It is these mounds that the thickest sequences are found (up to c.15 m), elsewhere relatively thin spreads (3 to 5 m) of material are found on the valley side up to a maximum elevation of c.20 m OD.

At the type site and in other exposures within the mounds (eg Manor Farm Pit [442 972] along the valley (see selected details and also Hopson 1991, McC Bridge 1985) the deposit is very well rounded fine and coarse gravel predominantly of flint, resting on fine to medium yellow to very pale yellow sand. Elsewhere the spreads of Haddiscoe Sands and Gravels are interbedded fine well-rounded pebbly sands and, fine and medium and coarse sands. The sands at the type site show small scale microfaulting and some ice wedge structures and the upper part of the overlying gravels has been cryoturbated, indicating that the deposit has been effected by periglaciation throughout its deposition. The heavy mineral assemblage shows the deposit, both sand and well-rounded gravel facies, to be unrelated to the Lowestoft Till Group since it is low in opaque iron minerals and high in resistate species such as zircon and rutile. However, the exact age relationship with deposits of the Lowestoft Till Group and indeed with the very similar lithologies of the Corton Woods Sands and Gravels (formerly the Plateau Gravel) (see D McC Bridge 1985) is problematical.

Selected Details

Haddiscoe Old Pit [444 966] Surface levels c.15 m

0 - 14.0 m+ **Haddiscoe Sands and Gravels** - Old pit heavily overgrown in parts shows a number of sections between 2 and 4 metres thick at various levels. All exposures show well-rounded clast supported flint gravels (generally coarse with fine) and some thin stingers of medium to very coarse sand.

Haddiscoe New Pit [445 963] Surface level c.12 m

0 - up to 5.0 m **Haddiscoe Sands and Gravels** - Well-rounded clast supported fine and coarse flint gravel with thin stringers of medium to coarse sand. Base uneven but generally slopes towards the north west (to old pit) where the thickest sequence is found. The upper 1.0 - 1.5 metres is heavily cryoturbated and clay-enriched.

2.0 - 10.0 m+ approx **Haddiscoe Sands and Gravels** - Pale yellow fine and very fine with medium sands with very rare pebbles. Towards the top thin channel sequences with well rounded flints and mud breccias have been seen. All these channels show flow towards the southeast; ice wedge casts seen infrequently.

Manor Farm Pit [442 972] Surface level c.10 m

0 - 6.5 m+ **Haddiscoe Sands and Gravels** - Imbricated very well - rounded coarse with fine flint gravel with a pale yellow and orange brown medium with coarse and fine sand. Gravels generally clast supported, rare thin channels of medium to coarse sand. Bedding shows flow towards the southeast.

New Road Pit [413 993] Surface level c.10 m

0 - 4.0 m+ approx **Haddiscoe Sands and Gravels** - Pit partially back filled and regraded but numerous small exposures in breakers yard of well-rounded coarse and fine gravel with interbedded medium and coarse yellow brown sands.

Carr Farm Pit [4075 9945] Surface level c.13 m

0 - 2.0 m+ **Haddiscoe Sands and Gravels** - very well-rounded coarse flint gravel (clast supported) with yellow brown coarse to very coarse sand matrix.

Firs Farm Pit [402 995] Surface level c.19 m

0 - 6.0 m+ **Haddiscoe Sands and Gravels** - well-rounded flint gravels with fine to coarse sand matrix interbedded with medium and very coarse sands. Thin clayey seams throughout. Units show sharp high angle contacts in places.

3.5 Head

This deposit is generally regarded as a solifluction deposit although crude bedding is evident in a few places. This stratification may be original or the result of later sorting by streams. Head is typically a dark yellow brown unstratified, ill sorted clayey sand with an earthy texture and with varying proportions of pebbles dominantly of flint.

Head is found in most of the minor valleys draining the plateau where it is generally thin usually only some 1.5 metres thick. Thicker Head deposits (estimated to be at most 3.5 metres) are found at the lower end of these valleys where they merge imperceptively into deposits of the floodplain.

3.6 Flandrian Deposits

The stratigraphy of the Waveney Valley marshes between Beccles and Great Yarmouth has been constructed from a network of boreholes by Dr A M Alderton as part of a PhD Thesis (Cambridge) in 1983. An analysis of her results and a comparison with units mappable during the present survey is given in Table 2. The Stratigraphy of the Yare valley has not been investigated in such detail but it is likely that the same events occurred at least in its lower reaches.

The Barnby Peat Bed and Oulton Bed of Alderton are not seen in this area and are restricted to a narrow channel incised into the lower Waveney valley floor beneath the present day river. On sheets TM 49 SW and SE (See Hopson 1991) the Burgh Peat Bed and its apparently lateral equivalent, the Aldeby Peat Bed, outcrop extensively and the term Barnby Peat has been used for this deposit. The Barnby Peat has not been proved at outcrop or within boreholes on this sheet but may well be encountered at depth under Haddiscoe and Thorpe Marshes. To the east on Sheet TM 49 NE (See D Bridge 1985) two boreholes within the valley proved peat (Barnby Peat) beneath Estuarine Alluvium (Breydon Bed of Alderton).

3.6.1 Estuarine Alluvium (cf Breydon Bed of Alderton)

The Estuarine Alluvium outcrops extensively from Haddiscoe Marshes [447 997] to Norton Marshes [415 997] and northwards for some 2 kilometres to the levee of the R. Yare on sheet TG 40 SW. Most of the drains across the marshes

TABLE 2 **The stratigraphy of the Waveney Marshes (Dr A M Alderton) and its relationship to the units mapped**

TYPE SITE STANLEY CARRS (TM 49 SE)			TYPE SITE BOUNDARY DYKE (TM 49 SE)			PRESENT SURVEY TERMS USED IN THIS REPORT
Deposit	**Age (yrs)**	**Thickness**	**Deposit**	**Age (yrs)**	**Thickness**	
Stanley Carr Peat Bed	1755 bp	1.70 m	---	---		PEAT
Breydon Bed	1755-1985 bp	5.85 m	Breydon Bed	2170 bp	5.85 m	ESTUARINE ALLUVIUM
Aldeby Peat Bed	1985-3910 bp	6.50 m	Burgh Peat Bed	2170-4700 bp	4.25 m	BARNBY PEAT (not proved on this sheet)
			Oulton Bed Barnby Peat Bed	4700-6306 bp up to 6305-7750 by	14.0 m)	NOT SEEN AT SURFACE

expose between 1.0 and 2.5 metres of brown becoming pale grey soft sticky silty clay with some shells and rare pockets of peat and sandy gravels.

3.6.2 **Peat (cf Stanley Carrs Peat Bed of Alderton)**

This deposit outcrops on the margins of the Yare/Waveney Valley from Haddiscoe Dam [446 970] to Firs Farm [404 999] and also in the lower reaches of Landspring Beck [44 96] and The Beck (Soc Dyke) [41 98]. For the most part it is closely associated with modern Carr development (Alder and reed woodland marginal to the floodplain) and peat growth continues to the present day.

The deposit is only infrequently exposed, the Carrs being very wet with open water in places. However surface indications and boreholes show the peat to be black and fibrous with considerable wood debris. The thickest deposit proven was in borehole NW7 where at least 3.7 m of peat was noted.

3.7 **Geological History**

Following the deposition of the Chalk a long period of erosion and regional tilting ensued and it is on this surface that the deposits of the 'Tertiary Sea' (Lower London Tertiaries and London Clay) were deposited. A further extended period of erosion progressively attenuated the Tertiary deposits towards the west and northwest prior to the transgression of the shallow sea within which the Crag was deposited. Thus the Crag oversteps older beds towards the west.

Interlaminated marine sands and clays, dated as Pastonian in age, underlie much of the area and represent the final stage of sedimentation within the 'Crag' Sea. A period of faulting or gentle folding towards the close of Crag times is believed to have produced ridges and basins in the Crag surface, and these have affected subsequent sedimentation patterns. This tectonic episode may well have been penecontemporaneous with deposition of the Crag sediments and reactivated structures which originally effected the Chalk and Tertiary sediments.

A further period of erosion ensued before the deposition of the predominantly Cromerian Fluviatile and Marine Sands, Gravels and Clays. These deposits contain the first evidence of a major influx of quartz and quartzite material into the area but may themselves have been reworked from earlier (Beestonian)

deposits associated with a proto-Thames/Waveney drainage system (The Kesgrave Sands and Gravels). No unequivocal Beestonian deposits have been proved in the area although the deposits west of Toft Monks may be of that age.

The onset of glacial conditions is marked by deposits derived from the 'North Sea Ice' which encroached onto a gently inclined surface, from the northeast. Wastage of this ice produced the homogenous Norwich Brickearth and contemporaneously the outwash sands and gravels of the Leet Hill Sands and Gravels. Withdrawal of the ice margin to the northeast led to the accumulation of distal outwash sands (the Corton Sands) in a shallow widespread body of open water. Deposition in the Corton Sands occurred in three fining upwards cycles each separated by a minor discontinuity. These breaks in sedimentation may correspond to successive readvances of the North Sea ice as suggested by the repeated till sequences of the Northeast Norfolk Coast. (See Banham and Straw 1970); Hopson and Bridge, in press).

Following the Corton Sands a hiatus accompanied by erosion ensued during which the proto-Waveney was excavated. Subsequently the second major ice advanced into the area from the west and on wastage blanketed the sculptured landscape with Lowestoft Till.

Westward retreat of the ice produced a series of immature angular gravels, the Aldeby Sands and Gravels, on the flanks of, and deeply incised into the base of the Waveney valley in the area of sheets TM 49 SW and SE. The exact relationship of these angular gravels with the more mature Haddiscoe Sands and Gravels is unknown but they appear to be separated by the cryoturbation event which affected the Undifferentiated Fluvioglacial Sands and Gravels around Burgh St. Peter (see Hopson 1991) and Toft Monks. The Haddiscoe Sands and Gravels may well be the result of a subsequent glacial event. A long period of time elapsed before the deposits associated with the present day rivers were deposited.

During the Flandrian a complex interplay between marine or brackish conditions and freshwater conditions occurred. These fluctuations are represented by silts and clay, and peat respectively. At least two marine transgressions have been demonstrated by Dr Alderton and they are represented by her Oulton Bed and Breydon Bed deposits.

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APPENDIX A Abbreviated logs of recent British Geological Survey Boreholes

Appended here are the results from a borehole programme carried out in 1983. Fuller grading, heavy mineral and compositional data may be consulted or application to Dr R G Thurrell, Programme Manager, Eastern England Land Survey.

TM 49 NW 20 4008 9807 Surface level 22.77 m OD

0.0 - 0.5	**Topsoil** and **subsoil**
0.5 - 1.2	**Lowestoft Till**, pale yellow brown silty, sandy, stiff clay with pebbles of chalk and rare flint.
1.2 - 8.0	**Corton Sands**, pale yellow fine, very fine and medium sand with some fine chalk grains. Becomes medium sand with a few pebbles in lower 0.7 m.
8.9 - 10.4	**Norwich Brickearth**, dark yellow brown very sandy silty clay with pebbles of flint and rare quartz, chalk and Scandinavian erratics.
10.4 - 16.4	**Leet Hill Sands and Gravels**, sand becoming pebbly sand and sandy gravel with depth. Predominantly medium with coarse and fine sand with fine and coarse gravel. Scandinavian erratics prominent, yellow brown.
16.4 - 18.0	**Fluviatile and Marine Sands, Gravels and Clays**, dark orangish brown sandy gravel. Medium with coarse sand and fine with coarse gravel. Flint, quartz and quartzite prominant.
18.0 - 23.4+	**Crag**, greyish yellow brown becoming grey and dark green towards base. Fine sandy silt to 19.2 then fine becoming medium and fine sand. Packed with shell debris from 21.4 m.

TM 49 NW 21 4097 9663 Surface level 23.06 m OD.

0.0 - 0.4	**Topsoil.**
0.4 - 3.1	**Lowestoft Till**, dark yellow brown silty, sandy clay with pebbles of chalk and flint. Pockets of fine sandy silt below 2.4 m.
3.1 - 16.1	**Corton Sands**, pale yellow very fine, fine and medium sand with chalk in parts.
16.1 - 17.9	**Leet Hill Sands and Gravels**, pale yellowish brown pebbly sand becoming sandy gravel. Predominantly flint with some quartz and quartzite and a trace of Scandinavian erratics.
17.9 - 19.6	**Norwich Brickearth**, yellowish brown sandy, silty clay with pebbles of flint and a trace of quartz, chalk and Scandinavian erratics.
19.6 - 28.3	**Fluviatile and Marine Sands, Gravels and Clays**, sand with rare pebbles becoming from 23.4 pebbly sand and sandy gravel. Predominantly flint with some quartz and quartzite. Thin grey silt seams from 27.10.
28.3 - 29.0	**Crag**, pale green, stiff to very hard silty clay interbedded with sandy silty clay orange brown. Some comminuted shell debris.
29.0 - 30.0 +	**Crag**, greenish yellow brown clayey fine sand with comminuted shell debris.

TM 49 NW 22 4251 9746 Surface level 20.94 m OD

0.0 - 0.4	**Topsoil**
0.4 - 1.5	**Lowestoft Till**, yellow brown silty, sandy clay with chalk pebbles.

1.5 - 2.7 **Glacial Silt**, pale yellow interlaminated silty clay and clayey silt with some interleaved fine chalky sand.

2.7 - 4.0 **Lowestoft Till**, pale yellow brown sandy clay with pebbles of chalk and flint.

4.0 - 13.0 **Corton Sands**, pale yellow, very clayey fine and very fine sand becoming medium and fine sand and pebbly from 9.0 m.

13.0 - 20.8 **Leet Hill Sands and Gravels**, sandy gravel becoming gravel towards base. Medium and fine sand seam between 15.0 and 16.7 m. Predominantly flint with quartz and some quartzite with occassional Scandinavian erratics.

20.8 - 21.0 **Crag**, pale greenish grey fine sandy silt.

21.0 - 22.0 **Crag**, greenish yellow brown pebbly medium with coarse and fine sand. Predominantly flint with quartz and shell debris.

TM 49 NW 23 4301 9570 Surface level 26.90 m OD

0.0 - 0.2 **Topsoil.**

0.2 - 1.1 **Subsoil**, very clayey, dark yellowish brown, medium and fine sand. (edge of Fluvioglacial Sands and Gravels Undifferentiated).

1.1 - 3.2 **Lowestoft Till**, yellowish brown silty clay with pebbles of chalk.

3.2 - 5.3 **Glacial Silt**, pale yellow laminated silt, sandy in parts with chalky sand and granule chalk gravel at base.

5.3 - 7.35 **Lowestoft Till**, pale yellowish brown and dark ochre brown, silty clay with pebbles of chalk and some flint.

7.35 - 16.5	**Corton Sands**, very clayey sand becoming pale yellow sand. Predominantly fine with very fine becomes fine and medium below 11.3 m.
16.5 - 17.8	**Norwich Brickearth**, dusky greyish brown and orange brown very sandy silty clay with pebbles of flint and quartz and rare chalk, shell debris and Scandinavian erratics.
17.8 - 29.3	**Crag**, yellowish brown interbedded thin ironstained silts in a medium to fine sand matrix. Rare pebbles of flint. Sand generally quartz with some mica increasing with depth. Large amounts of secondary ironstone.
29.3 - 31.3 +	**Crag**, yellow brown fine with medium sand, micaceous with comminuted shell debris increasing with depth.

APPENDIX B Selected logs from the BGS National Geosciences Information Centre

The following are details of boreholes mentioned in the text. Additional boreholes are shown on the margin of Sheet TM 49 NW, and a full register of boreholes in the area may be consulted at BGS Keyworth.

TM 49 NW 11 424 974 Surface level c.22.8 m OD

0.0 - 3.0	Lowestoft Till
3.0 - 27.4	Beccles Beds (See Table 1)
27.4 - 41.1	Crag
41.1 - 76.1	London Clay and Lower London Tertiaries
76.1 - 99.2+	Chalk

TM 49 NW 14 4148 9542 Surface level c.30.4 m

0.0 - 24.4	Well
24.4 - 27.1	Norwich Brickearth
27.1 - 52.7	Crag
52.7 - 67.0+	Chalk

TM 49 NW 15 4121 9501 Surface level c.34.4 m

0.0 - 0.6	Topsoil
0.6 - 10.6	Lowestoft Till
10.6 - 13.7	Corton Sands
13.7 - 22.8	Beccles Beds (see Table 1)
22.8 - 53.3	Crag
53.3 - 106.6	Chalk

TM 49 NW 16 4096 9660 Surface level c.24.0 m

0.0 - 6.1	Lowestoft Till
6.1 - 9.1	Corton Sands
9.1 - 25.9	Beccles Beds (Table 1)
25.9 - 51.8	Crag
51.8 - 60.3	London Clay and Lower London Tertiaries
60.3 - 84.5+	Chalk

TM 49 NW 17 4228 9549 Surface level c.32.0 m

0.0 - 0.9	Topsoil
0.9 - 7.9	Lowestoft Till
7.9 - 24.7	Beccles Beds (see Table 1)
24.7 - 60.9	Crag
60.9 - 66.0	Chalk

TM 59 SW 23 538 926 Surface level c.3.7 m OD

0.0 - 21.2	Drift
21.2 - 22.6	Chillesford Clay (part of Crag)
22.6 - 73.2	Crag
73.2 - 122.0	London Clay
122.0 - 144.9	Lower London Tertiaries
144.9 - 465.0	Chalk
465.0 - 494.6	Upper Greensand, Gault and Lower Greensand
494.6 - 557.1+	Palaeozoic Basement