



Geotechnical Study

*A228 Leybourne & West Malling Bypass
Environmental Statement
Volume 2 (part)*

Peter Brett Associates



July 1995

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1.0 INTRODUCTION

Peter Brett Associates have been commissioned by Kent County Council to provide an Environmental Statement for the proposed A228 Leybourne and West Malling Bypass.

This specialist report on the Geology of the Area has been prepared in accordance with the Department of Transport's Design Manual for Roads and Bridges (DMRB) Volume 11, Environmental Assessment. It forms part of volume 2 of the Environmental Statement for the proposed scheme.

The following text provides detailed information on the geology of the area surrounding the A228 together with a summary of the geology that will be encountered along the proposed route.

2.0 ASSESSMENT OF EXISTING CONDITIONS

2.1 GEOLOGICAL HISTORY

The solid geology of the study area was laid down during the Cretaceous Period of the Mesozoic Era. During this time the whole area was initially a shallow fresh water lake (Reference 1) with a connection to the sea. Over a period of several million years this connection gradually widened, turning the water brackish, until the sea completely invaded the lake. This area then became a shallow marine bay into which deposits of weathered material were washed down, forming a series of interbedded sedimentary rocks known as the Lower Greensands. These rocks were uplifted in the Wealden Anticline where they have been exposed by weathering of the overlying rock.

The strata that outcrop along the route of the road are part of the Lower Greensand series. The dip direction of the sequence in this area appears to be northerly, however, local distortions in the Hythe Beds give rise to a southerly dip direction just north of the A20 (Reference 2).

2.2 STRATIGRAPHY

The geological maps of the area (References 2 and 3) and Regional Memoir (Reference 4) indicates that the regional geology comprises the following sequence:

Recent Deposits	Head, Brickearth, River Terrace Gravels and Alluvium					
Lower Greensand of Cretaceous Period	<table> <tbody> <tr> <td rowspan="4" style="font-size: 3em; vertical-align: middle;">}</td> <td>Folkestone Beds</td> </tr> <tr> <td>Sandgate Beds</td> </tr> <tr> <td>Hythe Beds</td> </tr> <tr> <td>Atherfield Clay</td> </tr> </tbody> </table>	}	Folkestone Beds	Sandgate Beds	Hythe Beds	Atherfield Clay
}	Folkestone Beds					
	Sandgate Beds					
	Hythe Beds					
	Atherfield Clay					

The Lower Greensand forms an escarpment on the northern limb of the Wealden Anticline. The West Malling airfield lies on top of this escarpment, and where the road runs north from the airfield, it is underlain by the Hythe Beds. The younger Folkestone and Sandgate Beds occur 'down dip' travelling north towards the M20 along the line of the proposed road. The geological maps also indicate that Head or Brickearth occurs at the surface of the Hythe Beds in this area and is of a variable thickness.

The regional geology in accordance with the British Geological Survey is shown on Figure 1 and the anticipated geology around the area of interest is presented on Figure 2.

2.3 ENGINEERING GEOLOGY

The strata in this area lie upon the northern limb of the Wealden anticline (Figure 3), with a dip of approximately 1° to 2° to the north-east. The dip of the strata has been described as having localised inclinations of up to 30° where there has been cambering or localised folding.

The geological records (Reference 5) indicate that a normal fault with a southerly down throw of approximately 16m, crosses the route to the north of Lavender Road. Springs are associated with this fault line. This is the only fault indicated along the route of the road.

The Regional Geological Memoir (Reference 4) indicates that cambering has occurred throughout the Maidstone area. Cambering is a type of structure developed adjacent to valleys where hard strata, such as sandstone or limestone overlying clays, are deformed by valley erosion of the clay. The harder beds are curved over the crests of escarpments and lowered towards valleys. This gentle arching is accompanied by the development of fissures aligned parallel to the contours of the cambered slope, and by valley-ward tilting of the strata between the fissures.

In the Maidstone area these fissures are termed 'gulls' and have been formed as a result of the mineralogical and tectonic characteristics of the area. Lateral stress relief resulting from valley erosion has caused deformation of the competent Hythe Beds that cap the anticlinal escarpment with the consequential development of the 'gulls'. The underlying weaker soils (incompetent Atherfield Clay) deform and squeeze into the valley to be removed by erosion. The gulls then become infilled with the overlying materials such as Head and Brickearth.

In quarries at Tovil, less than 5 miles to the east of the site, gulls have been recorded with widths of 18m. These were seen to extend to depths greater than 9m and at this point it was noted that there was no sign of their walls coming together. Along the escarpment from Mereworth and Ulcombe to the south of the site the gulls have been noted to be well developed. One is reported to have been 45m wide and 400m long, with others extending to depths of more than 25m. These features are less well developed within wide interfluvies such as the area through which much of the route passes. However, evidence at sites such as Kings Hill Business Park would suggest that they are likely to be present.

Natural drainage through the Hythe Beds is likely to have produced solution features that may have become infilled with more recent overlying material near to the ground surface. The solubility of hard limestone is low at normal temperatures and neutral pH conditions and direct solutioning of the hard Ragstone would act slowly and is only likely to be significant on a geological time scale. This process is also likely to have led to an increase in the fissure width of gulls.

2.4 DETAILED GEOLOGY

The following is a summary of the geological and geotechnical conditions drawn from the general area of study, based on various ground investigations undertaken in the area (references 6 to 12).

2.5 RECENT DEPOSITS

Recent deposits within the site area comprise Head, Brickearth, River Gravels and Alluvium.

The head deposits which overlie the Hythe Beds cannot be readily distinguished from the weathered Hythe Beds material itself. There is not a sharp boundary between the unweathered underlying rock and the recent deposits but a gradual transition from a highly weathered material

and residual soil to slightly weathered rock. These deposits are variable comprising orange brown sandy silty clay to sandy silty clayey angular fine to coarse sandstone and limestone gravel.

The Brickearth comprises light brown very silty clay becoming a clayey silt with depth.

It is anticipated that alluvium will be encountered over a small area associated with the stream crossing the A20 near Pump Close. An area of flint and ragstone gravel, termed alluvial gravels, was encountered at the Leybourne roundabout during the ground investigation for the West Malling Bypass.

2.6 FOLKESTONE BEDS

The Folkestone Beds or Folkestone Sand is a medium to very dense yellow fine to medium grained sand and sandstone. Within this uniform sand there are some layers of clayey silt and ironstone.

2.7 SANDGATE BEDS

The Sandgate Beds are very variable consisting of medium dense to very dense yellow, dark grey, dark green clayey silty fine grained sand. Associated with the Sandgate Beds is a thin layer of Fullers Earth comprising of stiff dark greyish, blue grey clay of almost pure montmorillonite.

The Sandgate Beds are reported to have a thickness of between 15 and 21 metres, however, a maximum thickness of only 12m was encountered during the ground investigation for the West Malling Bypass.

2.8 HYPHE BEDS

The unweathered Hythe Beds generally consist of interbedded limestone and sandstone. Occasional medium thick layers of siltstone and thin to medium sandy silty clay layers are also encountered.

The limestone locally known as Ragstone is comprised of sandy fine to medium grained limestone which is strong to very strong. The layers of limestone are thinly to thickly bedded. The material is difficult to excavate and backhoe type excavators are generally unsuccessful.

The sandstone, locally known as Hassock, is green grey to pale brown, poorly cemented to uncemented silty sand. The poor cementing results in a very weak to medium weak material.

The Hythe Beds are very closely to closely spaced sub horizontal to vertically jointed with frequent iron staining on the joints. In this area solution features and gulls are encountered.

2.9 ATHERFIELD CLAY

The Atherfield Clay typically consists of shales and mudstones, which can also be grey, blue, green and brown mottled clays and silty clays if weathered. The topmost part can be sandy and glauconitic, but the lower part of the formation can include clay ironstone and sandstone. This strata is not exposed in the area of study and has also not been encountered in the borcholes.

2.10 HYDROGEOLOGY

The published hydrogeological map (Reference 4) of the area indicates that regionally the Folkestone and Hythe Beds act as aquifers separated by the Sandgate Beds which act as an

aquiclude. These aquifers are confined by the Atherfield Clay below the Hythe Beds and in some areas by the Gault Clay overlying the Folkestone Beds.

In the area of interest the overlying Gault is not present leaving the Folkestone Beds aquifer unconfined. The Sandgate Beds which regionally act as an aquiclude, are in this area comprised of a silty fine sand and hence permeable. Within the Sandgate Beds, however, a layer of Fullers Earth is known to cause locally perched water tables.

The Folkestone Beds form a porous non fissured aquifer with groundwater movement controlled by inter-granular flow.

The interbedded and fractured nature of the Hythe Beds causes groundwater movement to occur predominately via fissure flow. Where large open fissures are encountered, the effective permeability can be very high. Springs are common both at the base of the formation, where the Hythe Beds overlie the Atherfield Clay, and also at the top junction where they are overlain by the Sandgate Beds. The ground investigation carried out by PBA for the Kings Hill Business Park (Reference 11) noted that the more clayey horizons within the Hythe Beds produce perched water tables.

The British Geological Survey's outline geological report (Reference 5) indicates that the groundwater level is related generally to the topography with a minimum water level ranging from + 30 to + 45m AOD. This report also indicated that a spring line will be associated with the Folkestone Beds and Sandgate Beds boundary.

The KCC ground investigation for the West Malling Bypass (Reference 7) records a well located in Swan Street (Figure 4), West Malling. A ground level of 36.3 metres A.O.D. and ground water level of 22.5 metres A.O.D. (in the Hythe Beds) is noted. This well is located approximately 700 metres to the west of the proposed road.

A perched water table is present to the south of Lavender Road and is associated with the layer of Fullers Earth within the Sandgate Beds (Figure 4). This high water level was recorded in the KCC ground investigation report. The fault line is also a source of water seepages and cuts through the zone of the perched water table. The B.G.S. report (Reference 5) also describes ponds that are associated with the fault line. The fault is encountered at the northern end of the existing Lavenders Road Cutting.

Two streams converge just to the north of the A20 where the proposed road crosses the A20. These streams rise to the west and south west of Leybourne. The first rises some 6km away and flows eastward principally parallel to the A20. The second is fed by the lake at Manor Park Country Park to the south of West Malling. This lake appears to be formed by spring flow with the resulting overflow feeding the stream which runs principally north east falling over a small waterfall before being culverted under the A20. The converged stream continues to flow in a north easterly direction away from the road.

The converged stream is fed by two catchment areas located to the west and south as shown in Figure 4. The general geology of Area to the south comprises the Hythe Beds overlain by Head Deposits. However, the geology passes through the younger rock sequences moving northwards, comprising the Sandgate Beds, Folkestone Beds, Gault Clay and finally the Lower Chalk just outside the northern boundary of the western area.

3.0 ASSESSMENT OF PROPOSED SCHEME

3.1 SUMMARY OF THE GEOLOGY ALONG THE PROPOSED SCHEME

A summary of geology along the proposed route is presented by commencing at the southern end in the vicinity of the M20 and describing conditions encountered in a northerly progression.

The interchange over the M20 motorway (see Figure 6) will comprise two overbridges. On the northern side the ground consists of made ground and superficial deposits overlying the Folkestone Beds, however, a man-made pond is located just to the north of the motorway. The banks of the pond, and therefore the water level within it are about 5 to 6m deep below the surrounding ground level, and hence the pond is within the Folkestone Beds. The pond has a clay lining with artesian conditions below. Seepages have been observed on the side of the banks. The bridge footings will be founded in the Folkestone Beds. The foundations on the southern side of the motorway are also likely to be within the Folkestone Beds although a layer of Superficial Deposits is also present here.

A short section of the proposed route will be on an embankment over the Folkestone Beds from the M20 Interchange to about ch 200 where it enters a cutting until ch 1280. The road will remain within the Folkestone Beds for most of this stretch until about ch 1050 where it passes through the Sandgate Beds, and then into the Hythe Beds at about ch 1140. The road eventually 'daylights' to existing ground level at ch 1280 after it passes through a layer of Superficial Deposits.

The Folkestone and Sandgate Beds excavated from the cutting are to be used in the earthworks embankments elsewhere on the site. The Hythe Beds may also be workable where they are weathered, however the other Superficial Deposits will probably not be used.

The Park Road Bridge, which will be diverted to ch 320, and the new Leybourne Wood Bridleway bridge at ch 850 will both be founded on the Folkestone Beds.

In the area of the A20 between ch 1280 and ch 1350, the road will be virtually at grade before entering cut again. This area possesses soft alluvial deposits over the Hythe Beds. Two streams, which converge here, lie perched on the alluvial deposits but the actual groundwater table lies 2 to 3m below the proposed road level. The soft alluvium will not be used in the earthworks operations. The proposed A20 bridge and associated retaining walls will be founded on the Hythe Beds.

The road will remain in cut within the Hythe Beds from ch 1350 to ch 1700, with a maximum cut height of 9.5m. The road then runs along a low embankment at about 1m high to ch 2100. Along this stretch of the road, there is a layer of Superficial Deposits which are up to 5m thick. The road will rejoin the existing West Malling Bypass at ch 1919. Between ch 2100 and ch 2260, the road passes through a cutting within the Folkestone beds. The road passes over the railway bridge and is then carried on the Railway Crossing Embankment to ch 2800. The embankment will be raised to 6.5m in height. The existing embankment overlies the Superficial Deposits which in turn overlie the Hythe Beds and isolated patches of the Sandgate Beds. Foundations for the Lucks Hill Underbridge and the railway bridge are likely to be founded on the Sandgate Beds.

The road enters a cutting at ch 2800 until ch 3610. Along this stretch, the road will lie over the Sandgate Beds, Folkestone Beds and occasionally the Superficial Deposits. The road also passes over the fault at ch 2900. The remaining stretch of the road lies on a low embankment to ch 3780 which overlies the Superficial Deposits and Sandgate Beds. Between ch 3780 and ch 4030, the Bypass is currently in a cutting which passes through the Sandgate Beds into the Hythe Beds.

The following sections discuss in more detail the individual soil types that will be encountered along the proposed route, together with their engineering characteristics.

3.2 TOPSOIL AND MADE GROUND

Generally the exploratory holes revealed a layer of at least 0.25m of Topsoil or Made Ground. Two areas, along the proposed Leybourne Bypass have significant thicknesses of fill.

To the north of the M20 motorway, these deposits were found to be up to 2.1m in thickness and consisted of clays with flint gravel, cobbles, organic material, and brick.

The second location was identified to the west of Pump Close in an area which forms part of the existing A20 road embankment. As much as 3.5m of Made Ground was encountered which consisted of silty sands and soft clays again with flint gravel, brick and concrete. Previous old road bases were also found beneath the surface to a depth of 3.0m below the existing A20 road level.

3.3 SUPERFICIAL DEPOSITS

Superficial Deposits comprising head and alluvium mantle virtually the entire section of the proposed road. These materials vary in composition, depending in part on the underlying strata.

Two areas of alluvium were encountered. These are associated with the lakes to the north of the M20 (up to 2.5m thick) and the water courses in the area of the A20 (up to 3.0m thick). In both areas the alluvium comprised soft grey sandy silty clay/clayey silt with peaty laminations and layers.

The head material overlying the Folkestone and Sandgate beds comprises typically stiff orange/red brown clayey fine very sandy silt with some gravel. The material is up to 2.3m thick and in the northern area is frequently marked by a coarse flint gravel layer at its base. However, where this marker horizon was absent and, in particular, where it overlies the Folkestone Beds, the boundary with the underlying material is very difficult to establish from visual inspection. Particle size distribution analysis however, reveals that generally a much greater silt content may be associated with the superficial material.

The high silt content of the majority of the superficial deposits and low plasticity will render these materials moisture susceptible and problematic in compaction. These together with the alluvial clays are unlikely to be used in earthworks other than for landscaping purposes.

The head deposits encountered overlying the Hythe Beds comprise orange brown sandy silty clay to sandy silty clayey angular fine to coarse sandstone and limestone gravel and occur as a gradual transition from a highly weathered material and residual soil to slightly weathered rock. These weathered materials have been used successfully in earthworks for other projects in the area and would be suitable for use in the A228 embankments.

3.4 FOLKESTONE BEDS

The Folkestone Beds were encountered below Superficial Deposits in three areas. These are; at the northern end of the proposed route up to approximate ch 1000; as the capping layer to Lucks Hill between ch 2030 and ch 2250; and in the area of Lavenders Road between ch 2960 and ch 3340. This latter area coincides with the position of the fault between subway MR 116 and Lavenders Road Bridge.

The Folkestone Beds consist generally of a medium dense to very dense greenish yellow brown/greenish grey slightly silty fine to medium grained sand. There is usually a weathered zone of up to about 3m thick which tends to be slightly clayey and with a slightly higher silt content.

Cutting and embankment slopes will not be graded steeper than 1 in 3 (vertical to horizontal).

3.5 SANDGATE BEDS

The Sandgate Beds underlie the Folkestone Beds and were encountered below Superficial Deposits in six areas of the road. These are;

- i) in the south facing slope of Leybourne Castle Cutting between approximate ch 1000m and ch 1200m;
- ii) possibly as a very thin layer above the weathered Hythe Beds on the high ground of Hermitage Junction cutting (ch 1550m);
- iii) two areas on the northern and southern flanks of Lucks Hill between ch 1800m and ch 2010m (Hermitage Embankment) where it thickens southwards, and ch 2250m and ch 2320m (Railway crossing embankment) where it thins out;
- iv) two areas, one to the south of the fault from ch 2760m to ch 2960m where it then underlies a thin mantle of Folkestone Beds before this is eroded and again encountered between ch 3360m to ch 3950m.

The Sandgate Beds typically consist of layers of very dense reddish and greenish brown clayey silty fine sand and firm brown fine sandy silty clay. The lower beds, which include the Fuller's Earth deposit are firm to stiff orange brown or blue grey sandy silty clays frequently interlaminated with clayey fine sands.

Cutting and embankment slopes will not be graded steeper than 1 in 3 (vertical to horizontal).

3.6 HYTHE BEDS

The Hythe Beds were encountered directly below Superficial Deposits in three areas. The first in the central area (southern end of the new road section) from ch 1180m to ch 1750m. The second area is within the railway crossing embankment from ch 2330m to ch 2740m and the third is in the Windmill Lane area from ch 3980m southwards.

The Hythe Beds consist of alternating layers of limestone 'Ragstone' and sandy 'Hassock' beds. The Ragstone is typically a light grey/blue grey slightly weathered strong limestone with closely spaced sub-horizontal and 45° discontinuities. Penetration through these layers could only be achieved using rotary coring methods. The Hassock was found to be generally a creamy greenish yellow/yellow brown/green grey moderately to highly weathered weak to moderately weak sandstone with sub-horizontal closely to very closely spaced discontinuities.

The interbedded layers vary from 0.1m to 0.7m in thickness, and combinations of the two rock types were also evident in the form of quartzitic limestone, and calcareous sandstone and quartzite.

In the area of Pump Close and the A20 the valley topography partly reflects the underlying surface of the Hythe Beds. The overlying alluvium however, mantles and smooths out the variations in the rock elevation. A variable and potentially steeply inclined rock surface may be encountered.

A slope angle of 2 to 1 (vertical to horizontal) is proposed for the competent Hythe Bed material in the Hermitage Cutting.

3.7 ENGINEERING GEOLOGY

Natural drainage through the interbedded limestones and sandstones of the Hythe Beds is likely to have produced solution features that may have become infilled with more recent overlying material near to the ground surface. These sinkhole type features have been observed at adjacent sites and may combine with 'gulls' (tension cracks associated with cambering) to form zones of instability, as experienced elsewhere.

Large diameter conventional soakaways could be adopted within both the Folkestone and Sandgate Beds although the fines content of each strata will result in a relatively poor soakage rate. Higher discharge rates can be achieved within the Hythe Beds where soakage will be dictated by fissure flow. Deep bored soakaways will be required in this strata, designed in accordance with the Kent County Council design guide, in order to avoid the potential of causing instability to adjacent solution features. An appropriate groundwater protection zone will be adopted to ensure that soakaway discharge is restricted to the unsaturated zone.

3.8 HYDROGEOLOGY

In summary the published data indicate that regionally the Folkestone and Hythe Beds act as an aquifer separated by the Sandgate Beds which act as an aquiclude. However, the Sandgate Beds which although regionally acting as an aquiclude, are in this area composed of silty fine sand and hence are permeable. Water level readings in standpipe piezometers installed during the various phases of investigation and those placed by (KCC) during their ground investigation are shown on Table 1.

Three areas along the route of the bypass are noted for their near surface groundwater levels, see Table 1. These are in the vicinity of the proposed junction with the M20; the valley area at Pump Close; and to the south of the fault at ch 2910.

In the first area immediately to the south of the M20 a groundwater level was recorded at 10.4m AOD. The standing water level in the ponds to the north of the motorway is approximately 6.7m AOD. The window sampled boreholes and dynamic probe undertaken through the pond base indicated sub-artesian water after penetrating a layer of clay with the water rising to ground level which is at approximately 7.0m AOD. Seepages were also noted in the face of the slope between the motorway and the ponds at an elevation of approximately 7.7m AOD.

In the second area of Pump Close two streams converge just to the north of the A20, where it is crossed by the proposed road. These streams rise to the west and south west of Leybourne and the converged stream continues to flow in a north easterly direction away from the A20. The latest investigation indicates that these streams lie 'perched' upon the less permeable alluvial clays. The water table within the weathered Hythe Beds varies seasonally but typically exists some two metres below the stream level at an elevation of between 17m and 18m AOD.

Within the third area to the south of Lavender Road and the fault at Ch 2910m the layer of Fullers Earth within the Sandgate Beds results in a perched water table at an approximate elevation of 58m AOD rising to 60m AOD at Ch 3350m.

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TABLE 1: STANDPIPE PIEZOMETER MONITORING RESULTS

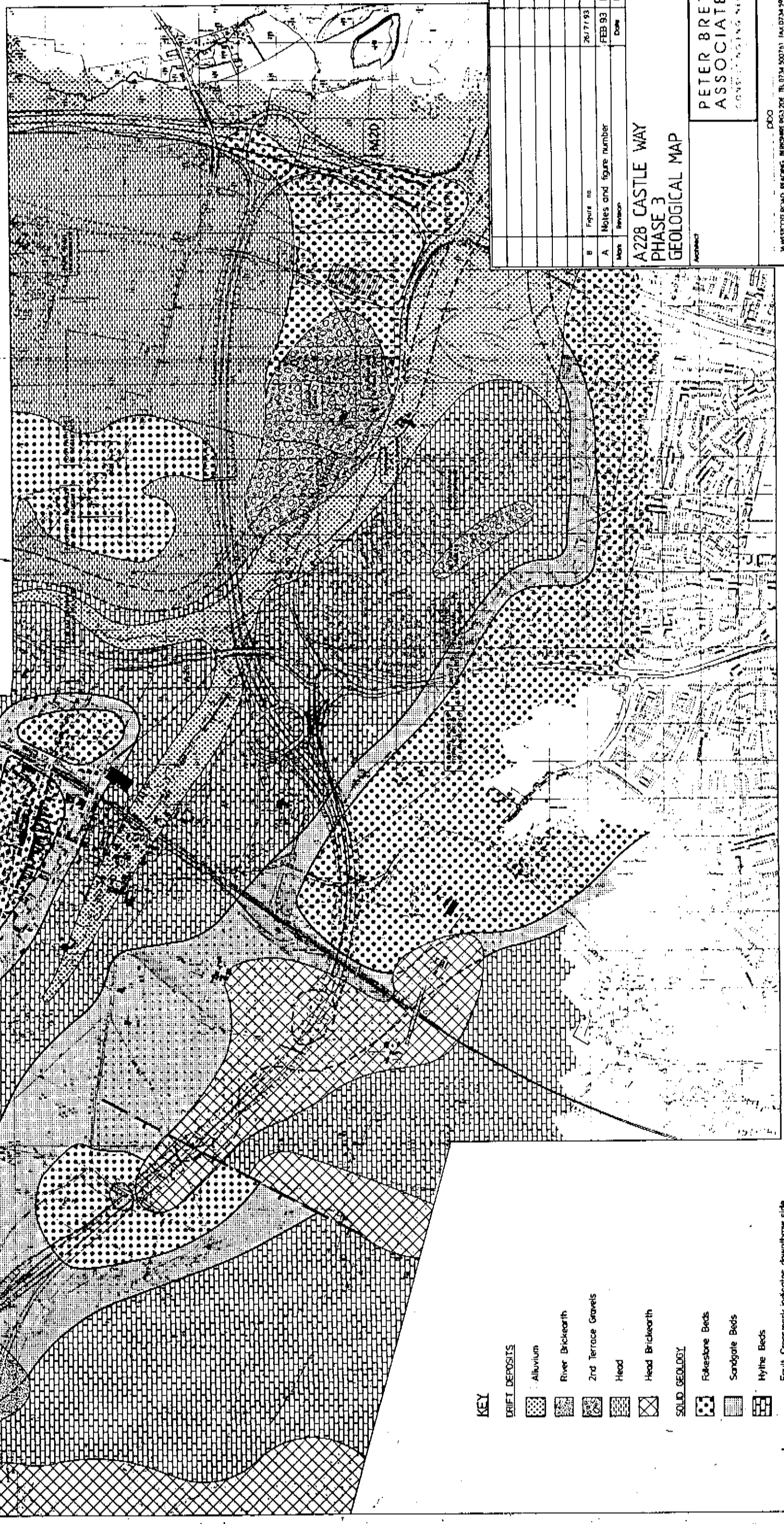
BH/TP No	Level (m AOD)	Structure	-/05	19/9	20/9	1/10	-/12	4/2	27/3	13/5	24/9	20/10	12/11	16/7			
			1984	Water Level (m above AOD)													
			1991											1992			1993
SBH44	15.98	M20 Junction Roundabout		8.83	9.67	10.50	10.45	10.42	10.40	10.41	10.42	10.43	10.44	10.54			
SBH285	21.59	Park Road Overbridge		<14.09	<14.09	<14.09	<14.09	<14.09	<14.09	<14.09	<14.09	<14.09	<14.09	<14.09			
SBH768	31.77	Leybourne Wood Bridle Bridge		<26.27	<26.27	<26.27	<26.27	<26.27	<26.27	<26.27	<26.27	<26.27	<26.27	<26.27			
FBH333	20.20	A20 Retaining Wall															
SBH1330	23.76	A20 Overbridge		17.69	17.63	17.88	17.60	17.14	17.08	17.24	17.14	17.15 ^a	17.53	18.38			
SBH1520	30.12	Hermitage Junction Cutting		<17.62	<17.73	<17.62	<17.62	<17.62	<17.62	<17.62	<17.62	<17.62	<17.62	<17.50			
KBH580	40.44	Lucks Hill Cutting	33.34														
FBH321	41.80	Lucks Hill Underbridge															
KBH770	45.78	Railway Crossing Underbridge	36.12									33.26	<22.30	<22.30			
FBH323	45.30	Railway Crossing Underbridge															
KBH800	42.08	Railway Crossing Underbridge															
KBH1330	54.59	Lavenders Rd Cutting	<34.04														
KBH1460	61.22	Lavenders Rd Cutting	<50.59														
KBH1600	64.46	Lavenders Rd Overbridge	56.90														
KBH1610	62.92	Lavenders Rd Overbridge	58.25														
FBH329	60.20	Lavenders Rd Overbridge	57.77									51.77 ^a	52.29 ^a	55.83			
KBH1765	62.73	Lavenders Rd Cutting	58.84														
FBH331	65.20	Windmill Lane Embankment												<54.70			

Key:
 . Fluctuated between 17.15m and 14.75m AOD due to rainfall
 ^ Water levels measured soon after installation, piezometers may not have reached equilibrium
 K = KCC



NOTE: Geological information based primarily on that shown on the British Geological Survey sheets 267 and 268 and modified along the route of the road to reflect actual ground conditions encountered during the ground investigations phases 2 and 3.

Sandgate Beds
Below Head



KEY

DRIFT DEPOSITS

- Alluvium
- River Brickearth
- 2nd Terrace Gravels
- Head
- Head Brickearth

SOLID GEOLOGY

- Folkestone Beds
- Sandgate Beds
- Hythe Beds

- Fault. Crossmark indicates downthrow side
- Geological Boundary, Drift.
- Geological Boundary, Solid.
- Inferred boundary

Notes	Revision	Date	Drawn
B	Figure no.	26/7/93	SFS
A	Notes and figure number	FEB 93	LJJ

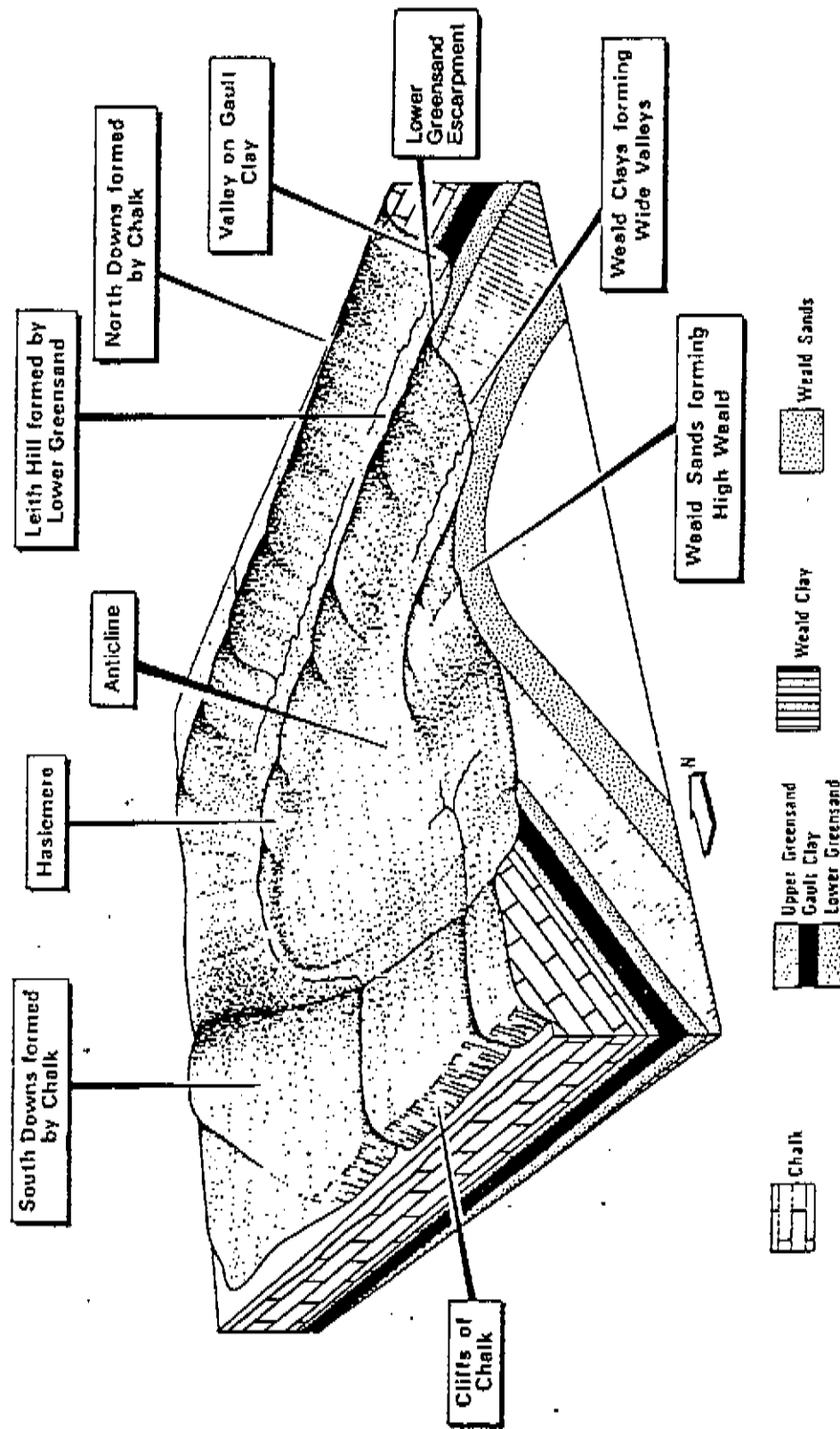
**A228 CASTLE WAY
PHASE 3
GEOLOGICAL MAP**

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Scale	1:5000 APPROX	Drawing No.	
Date	SEPT 91	Drawn	SFS
Checked		Revised	

FIGURE 2



Site: A228 Leybourne & West Malling Bypass - Wealden Anticline

Client: Kent County Council

Date: May 1995

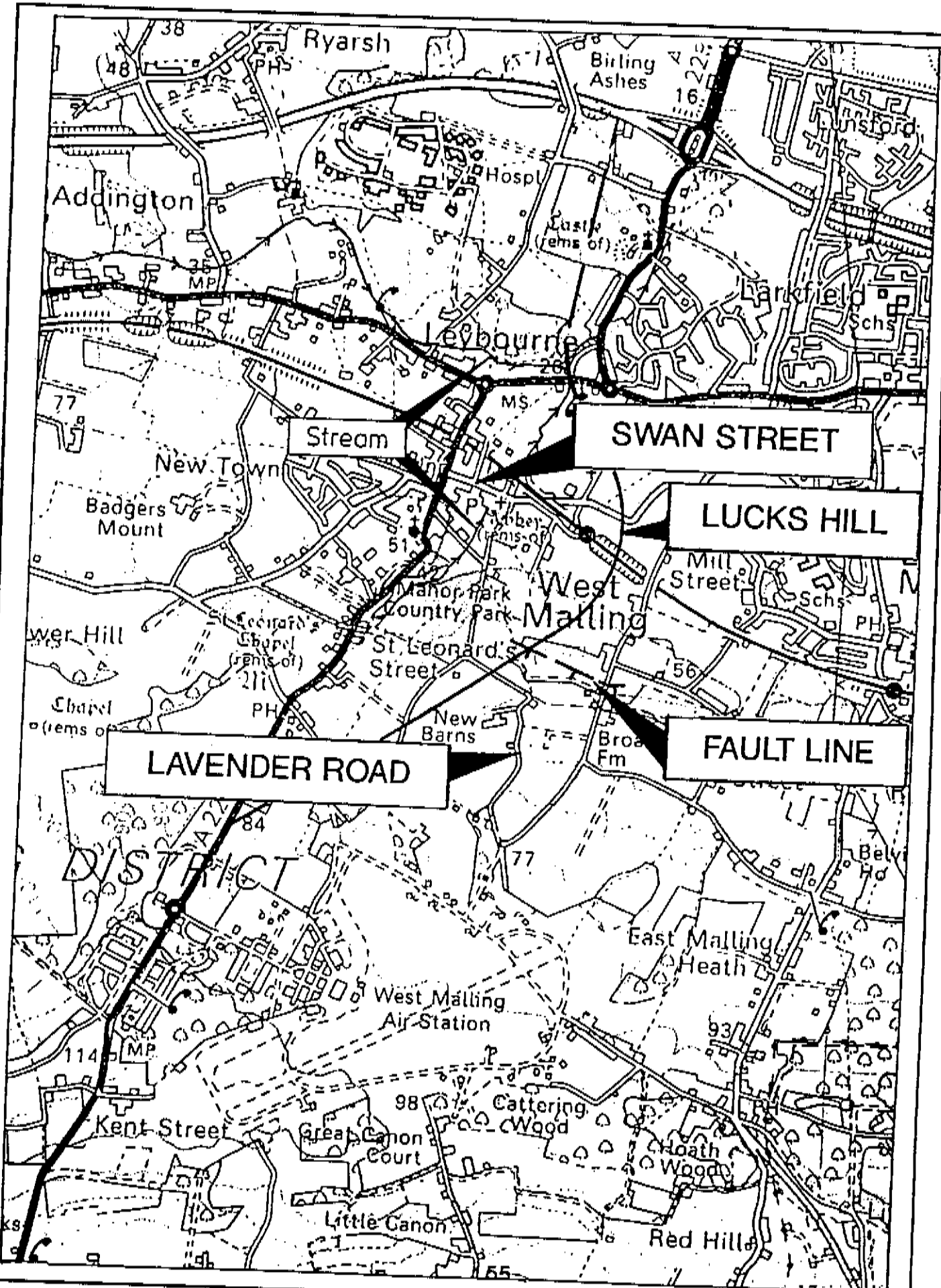
Job No: 5839/216

Peter Brett Associates Consulting Engineers

By: ljj

Checked:

Figure: 3



Site: A228 Leybourne & West Malling Bypass - Plan of Existing Site Details

Client: Kent County Council

Date: May 1995

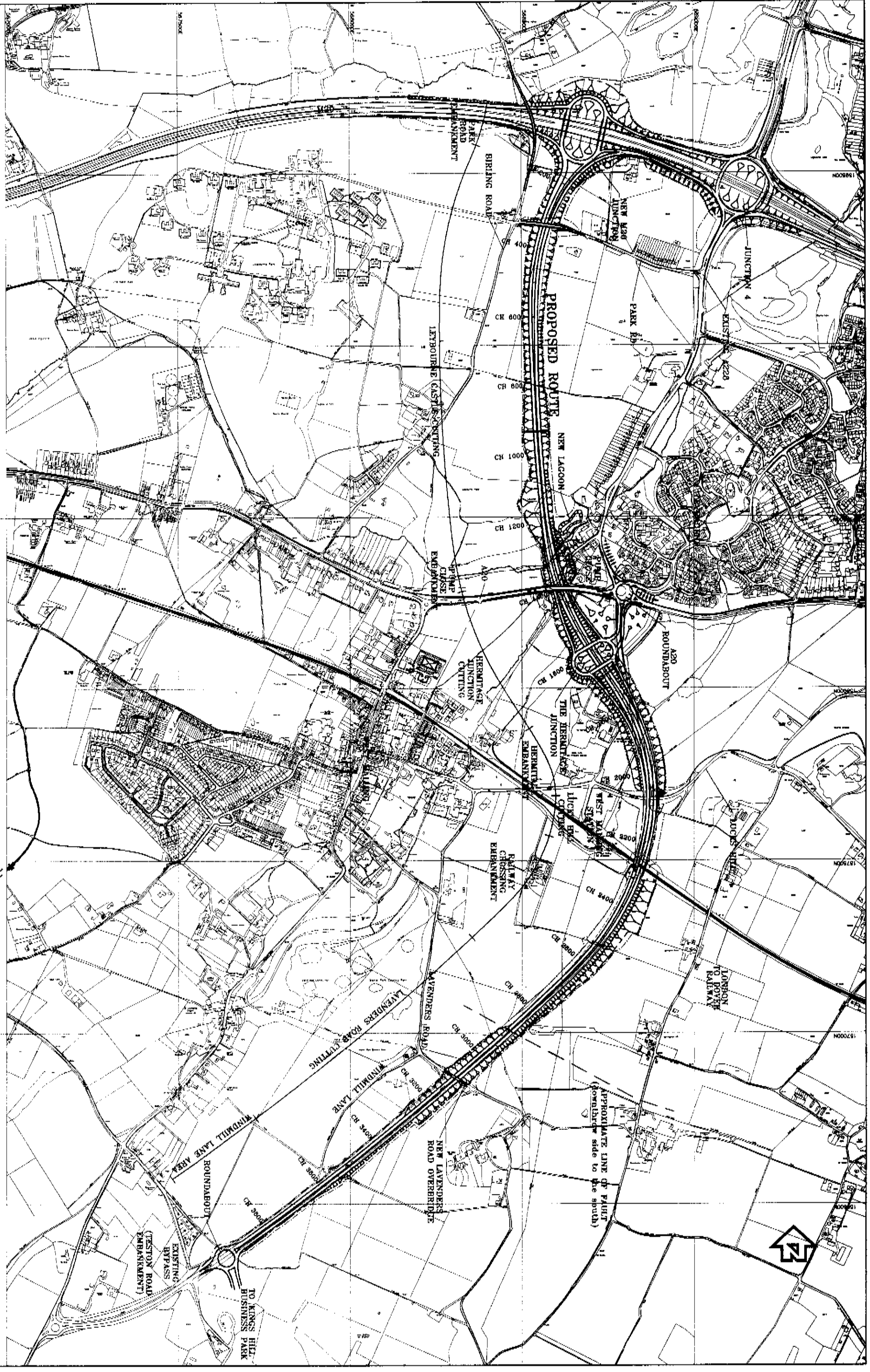
Job No: 5839/216

Peter Brett Associates Consulting Engineers

By: IJJ

Checked:

Figure: 4



Client
Highways
Transportation

Scale
1/10000

Date
7/95

Drawn
MAB

Checked
PJS

Project
A228 LEYBOURNE AND WEST MALLING BYPASS
LAYOUT PLAN

Item	Rev	Date	Drawn	Checked

Peter Brett Associates
Consulting Engineers

FIGURE 6



UNCLASSIFIED

TOLLGATE HOUSE

HA 044/027/000135 1

ENVIRONMENT & LANDSCAPE
Environmental Statement

11/03/2001 15:56:48

**A228 LEYBOURNE & WEST MALLING BYPASS
– ENV. STATEMENT VOLUME 2 – GEOLOGICAL
STUDY 07/95**



HA 44/27/135* 1*

EXPLANATION OF GEOLOGICAL SYMBOLS AND COLOURS



Landslips

DRIFT

Calcareous Tufa

Alluvium

River Brickearth

1st Terrace

2nd Terrace

3rd Terrace

4th Terrace

5th Terrace

Dry Valley and Nailbourne Deposits

Head

Head Gravel

Head Brickearth

Clay with flints

PLEISTOCENE AND RECENT

River Gravels

+

Horizontal strata

10/

Inclined strata, dip in degrees

----- Geological boundary, Drift

----- Geological boundary, Solid

--- Fault, cross mark indicates downthrow side

Broken lines denote uncertainty

○

Borehole

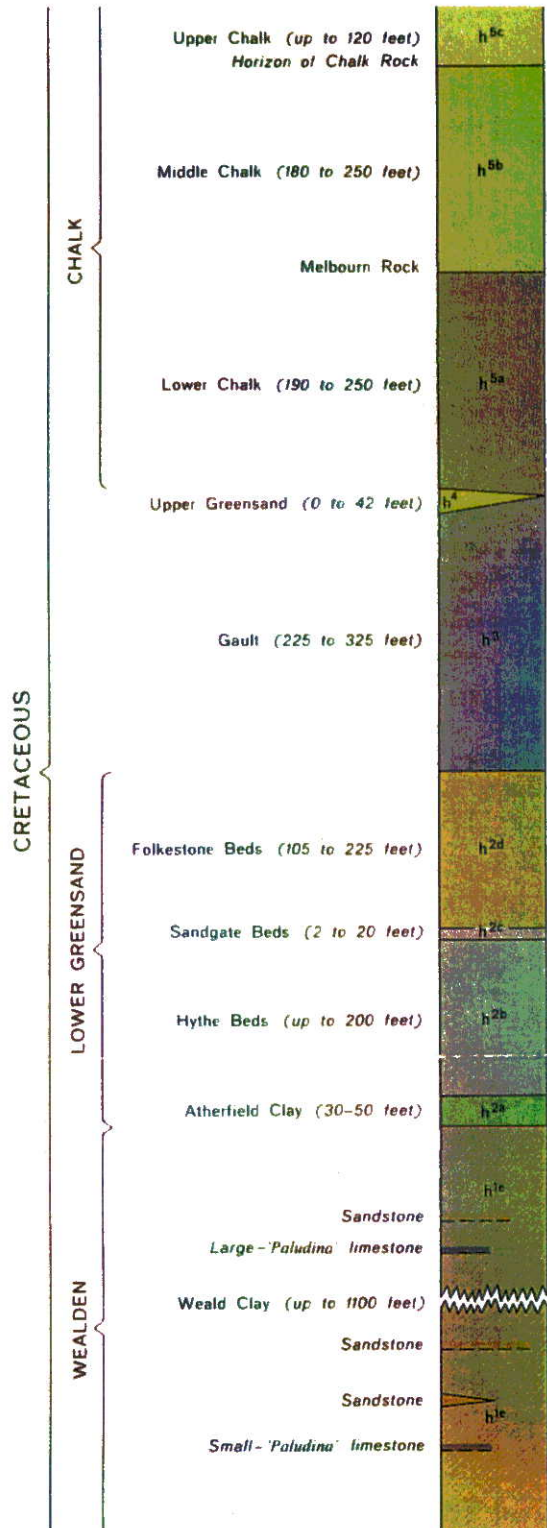
○w

Water well or borehole

For detailed description see explanatory Memoir

SOLID GENERALIZED VERTICAL SECTION

Scale: 1 inch to 200 feet



Site: A228 Leybourne & West Malling Bypass - Key to Regional Geology Map

Client: Kent County Council

Date: May 1995

Job No: 5839/216

Peter Brett Associates Consulting Engineers

By: Ijj

Checked:

Figure: 1.2

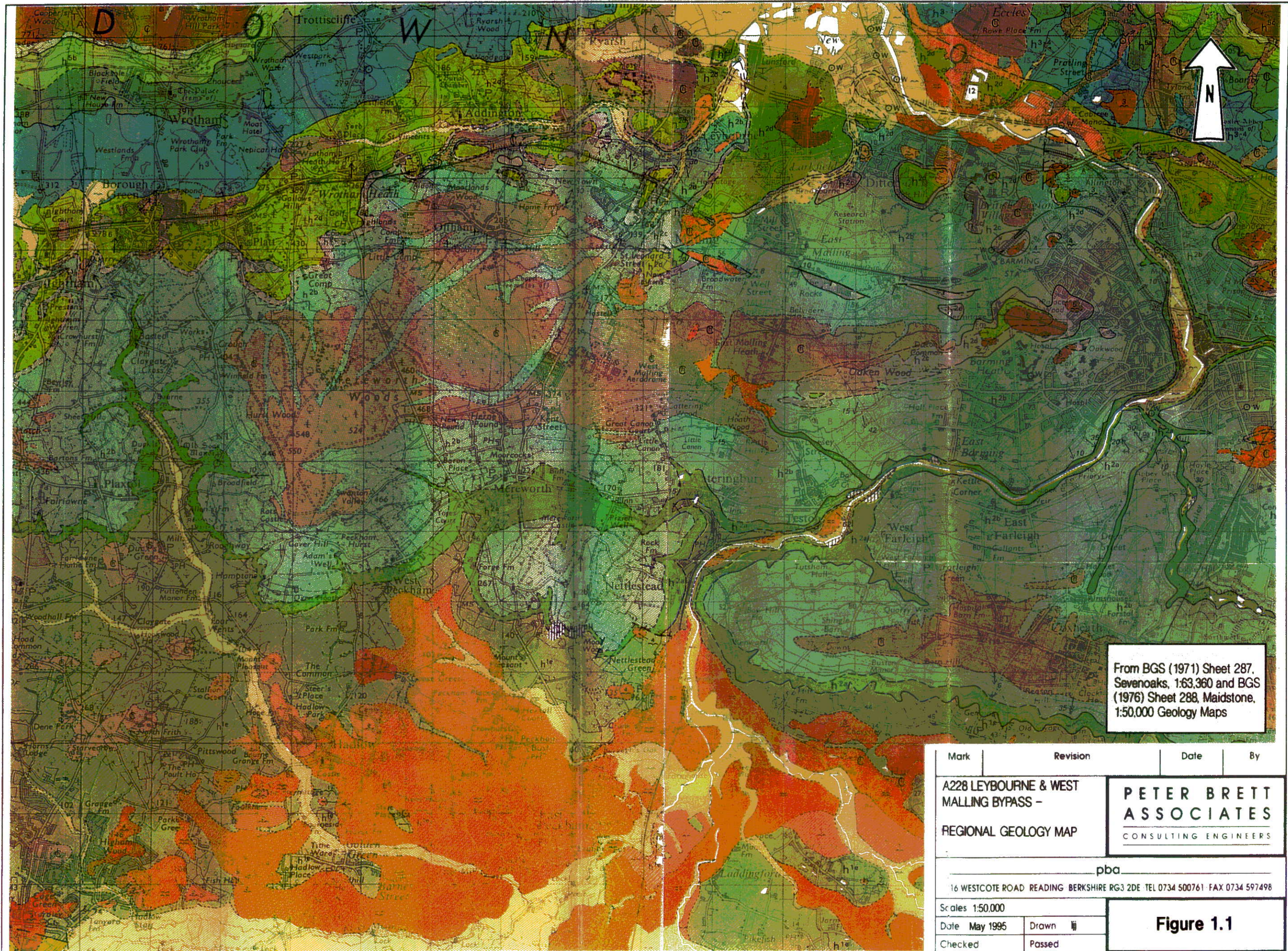
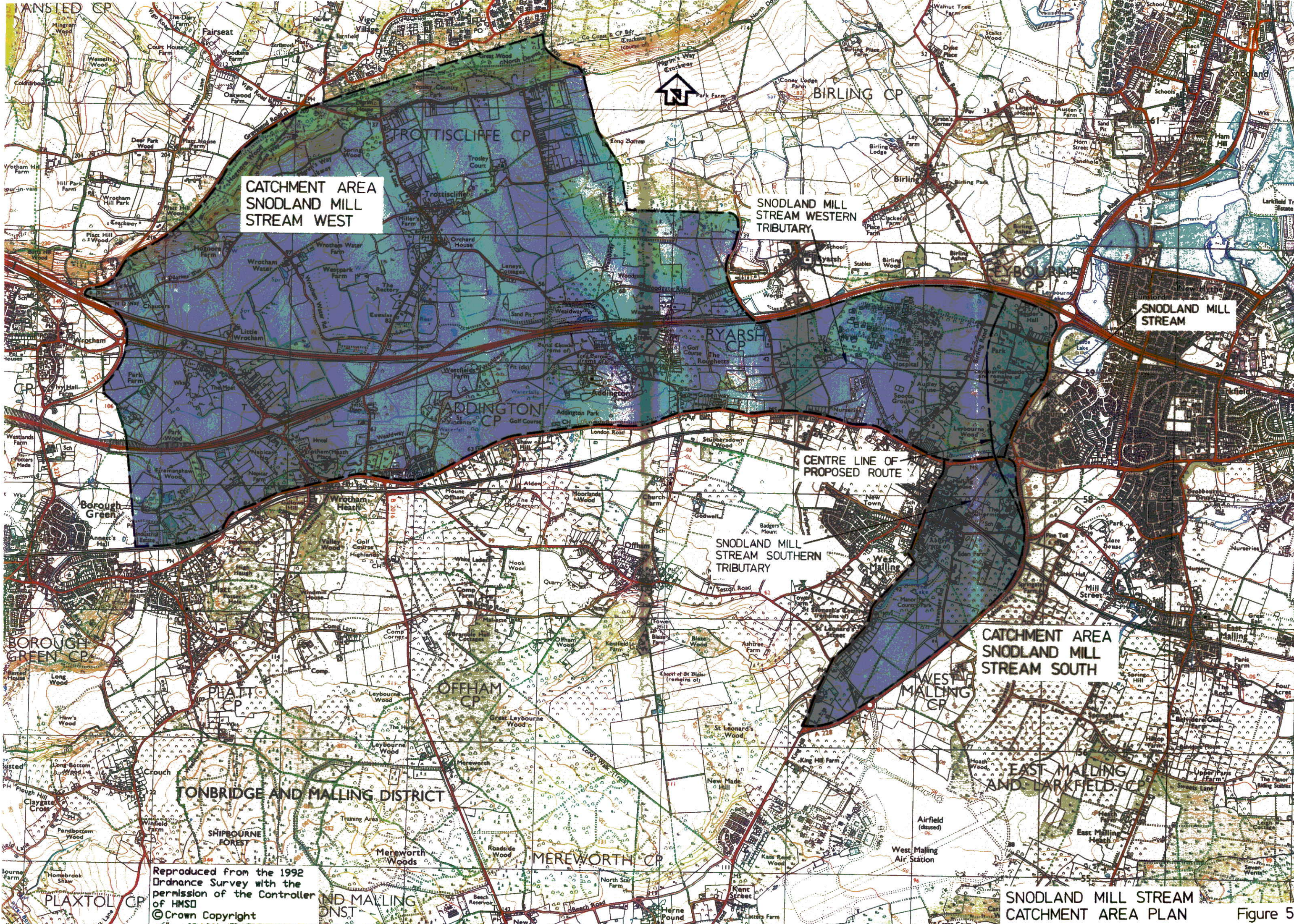


Figure 1.1



CATCHMENT AREA
SNODLAND MILL
STREAM WEST

SNODLAND MILL
STREAM WESTERN
TRIBUTARY

SNODLAND MILL
STREAM

CENTRE LINE OF
PROPOSED ROUTE

SNODLAND MILL
STREAM SOUTHERN
TRIBUTARY

CATCHMENT AREA
SNODLAND MILL
STREAM SOUTH

TONBRIDGE AND MALLING DISTRICT

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SNODLAND MILL STREAM
CATCHMENT AREA PLAN

Figure 5