Chapter 6

Clast lithology

by David R. Bridgland, Francis Wenban-Smith, Tom S. White and Peter Allen

INTRODUCTION

The objectives of clast lithological analysis at the site were two-fold: first, to complement the sedimentological data in developing interpretations of deposit formation, and in particular to support interpretation of the Phase 8 gravels as fluvial, and second, in the case of confirmed fluvial deposits, to identify their provenance and river system; in particular to distinguish between the Thames and its tributary gravels. For the first, roundness/angularity of the flint clast component was analysed and the resulting distributional profile compared with various data of known depositional origin. For the latter, the variety and proportions of different clast lithologies were recorded, to distinguish between post-Anglian Thames gravels, which have a higher proportion of exotic lithologies, and the deposits of south-bank Thames tributaries, with more restricted local and Wealden composition. This second line of enquiry was particularly salient at the Southfleet Road site, it being located close to where the current Ebbsfleet Valley intersects the Swanscombe Boyn Hill/Orsett Heath Formation (100-ft terrace) outcrop. As recapped earlier (Chapter 3), one of the primary objectives driving initial investigation of the site was to establish whether the Phase 8 gravels that capped the sequence were of fluvial Thames origin, and if so, whether they formed an extension of the Lower Middle Gravel of the Orsett Heath Formation.

Clast lithological analysis was carried out on six gravel samples from the site (Table 6.1). Three of these, samples <40001>, <40002> and <40004>, were from the main body of gravel (Phase 8) that capped much of the site. One sample, <40003>, came from the junction between this gravel and the underlying context 40167 (Phase 7, upper part). Two samples, <40361> and <40420>, came from different levels within the Phase 7 synclinal infill, one entirely from context 40167, and the other from 40164, a thin gravel bed at the very base of the syncline infill sequence (Fig. 6.1). The results of these analyses were then considered in conjunction with analyses carried out at various locations in the surrounding area (Table 6.1; Fig. 6.2).

METHODS

Samples were separated, by wet sieving, into 16–32 and 11.2–16mm fractions for clast analysis. Clast-lithological analysis was applied to both size fractions (as recommended in the appropriate QRA Technical Guide, Bridgland 1986) and, as a separate procedure, the angularity/roundness characteristics of the flint component of the coarser fraction was also assessed. The latter analysis used a modified version of the Powers (1953) method, adapted for gravel-sized clasts (Fisher and Bridgland 1986) and using the categories defined here (Table 6.2).

ELEPHANT SITE RESULTS

Angularity/roundness

The principal purpose of this analysis was to determine environment of deposition (see Fisher and Bridgland 1986; Bridgland 1999). Unbroken Tertiary flints were excluded, as their extreme roundness is clearly derived from their original marine environment of deposition. The results show the angular class to be modal in all six samples, followed by the very angular (Table 6.3). Very little of the broken flint has edges that have been smoothed even to the subangular condition. The three samples from the Phase 8 gravel (samples <40001>, <40002> and <40004>), thought very likely to be of fluvial origin and all analysed by DRB, show very similar profiles. However the fourth analysed by DRB (sample <40003>), from the basal junction of the Phase 8 gravel with the underlying context (40167), thought more likely to be emplaced by mass movement, shows a slight increase of clasts in the very angular category. The two other samples (both analysed by TW), both from the Phase 7 synclinal infill and one of them thought likely to be from a very similar level to sample <40003>, showed a much stronger modality in the angular category than any of the other samples, including those thought much more likely on independent sedimentological grounds to be fluvial origin. This is most likely to result from variability between classification by the individual analysts, since other instances where DRB and TSW have provided independent analyses of the same gravel in Eastern Quarry (eg samples <4> and <3>) show that TSW generally allocates less material to the 'very angular' in favour of the 'angular' class. It is well established that this technique, which employs mere visual comparison, suffers from subjectivity (and therefore operator bias), despite the use of objective

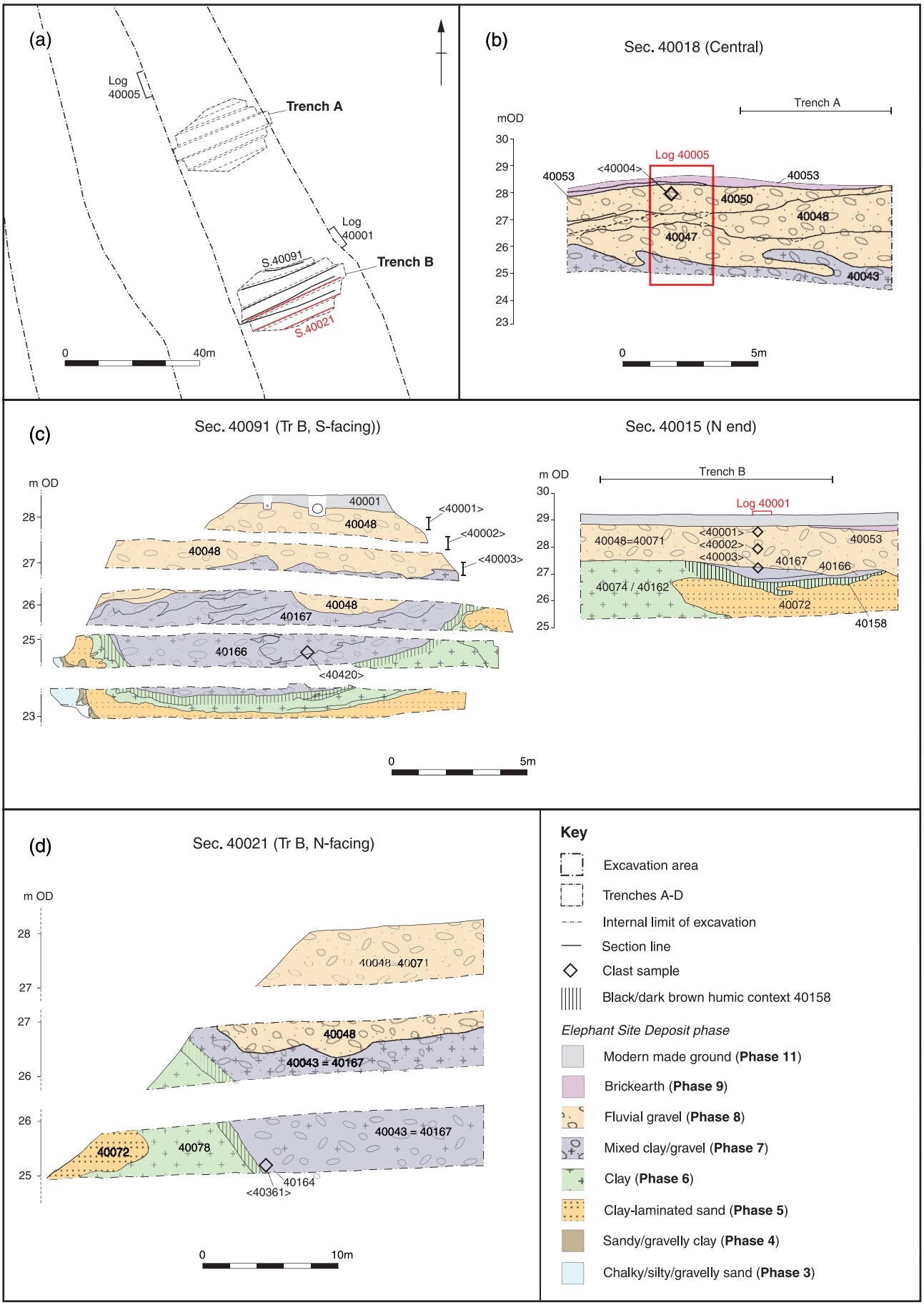

Figure 6.1 Stratigraphic contexts of clast lithological sampling at the Southfleet Road site: (a) thumbnail sketch of sampling locations; (b) Log 40005, sample <40004>; (c) Section 40091 and Log 40001, samples <40001>, <40002>, <40003> and <40420>; (d) Section 40021, sample <40361>

Table 6.1 Clast lithological sampling at the Southfleet Road site (ARC 342 W02) and other projects in the surrounding areas

Project area	*Location*	*Sample <>*	*Context*	*Site deposit (phase)*	*Clast interpretation*	*Report reference*
Southfleet Road site (ARC 342 W02)	Log 40001 (Sec 40018)	40001	40006 [=40071]	Fluvial gravel (8c)	Palaeo-Ebbsfleet gravel	-
		40002	40008 [=40071]	Fluvial gravel (8c)	Palaeo-Ebbsfleet gravel	-
		40003	40009-lower [=40071/40167?]	Fluvial gravel/ Syncline infill? (8c/7?)	Palaeo-Ebbsfleet gravel, reworked by solifluction	-
	Log 40005 (Sec 40015)	40004	40018 [=40050]	Fluvial gravel (8c)	Palaeo-Ebbsfleet gravel	-
	Trench B	40361	40164	Syncline infill, base (7)	Palaeo-Ebbsfleet gravel, reworked by solifluction?	-
		40420	40167	Syncline infill (7)	Palaeo-Ebbsfleet gravel, reworked by solifluction?	-
Springhead (54924)	TP 1121	1121-1	112105	-	Palaeo-Ebbsfleet gravel	Wessex Archaeology 2004
		1121-2	112108	-	Palaeo-Ebbsfleet gravel	Wessex Archaeology 2004
Station Quarter South (63542)	TP 32	8	3207	-	Palaeo-Ebbsfleet gravel	Wessex Archaeology 2006a,b
	TP 30	10	3003	-	Palaeo-Ebbsfleet gravel	Wessex Archaeology 2006a,b
Eastern Quarry (61040)	TP 16.2	2	16.2.03	-	Thames gravel (post-Anglian)	Wessex Archaeology 2006b
	TP 4.1	4	4.1.03	-	Thames gravel (post-Anglian)	Wessex Archaeology 2006b
Eastern Quarry (61041)	TP 104	50	7403	-	Palaeo-Ebbsfleet gravel, reworked by solifluction?	Wessex Archaeology 2008a
		51	7403	-	Palaeo-Ebbsfleet gravel, reworked by solifluction?	Wessex Archaeology 2008a
	TP 112	60	8205	-	Palaeo-Ebbsfleet gravel	Wessex Archaeology 2008a
Eastern Quarry (61042)	TP 127	96	12706	-	Thames gravel (post-Anglian)	Wessex Archaeology 2008b
		101	12708	-	Thames gravel (post-Anglian)	Wessex Archaeology 2008b
Eastern Quarry, septic tank (68990)	Septic Tank, Tr 3	3	11-b	-	Thames gravel (post-Anglian)	Wessex Archaeology 2009

Table 6.2 Angularity/roundness categories used in Table 6.3. These are based on verbal descriptions by Schneiderhöhn (1954, in Pryor 1971) of the categories devised by Powers (1953). Simplified from Fisher and Bridgland (1986)

Category	*Characteristic features*
WELL-ROUNDED— wr	No flat faces, corners or re-entrants discernible; a uniform convex clast outline
ROUNDED— r	Few remnants of flat faces, with corners all gently rounded
SUBROUNDED— sr	Poorly to moderately developed flat faces with corners well rounded
SUBANGULAR— sa	Strongly developed flat faces with incipient rounding of corners
ANGULAR— a	Strongly developed faces with sharp corners
VERY ANGULAR— va	As angular, but corners and edges very sharp, with no discernible blunting

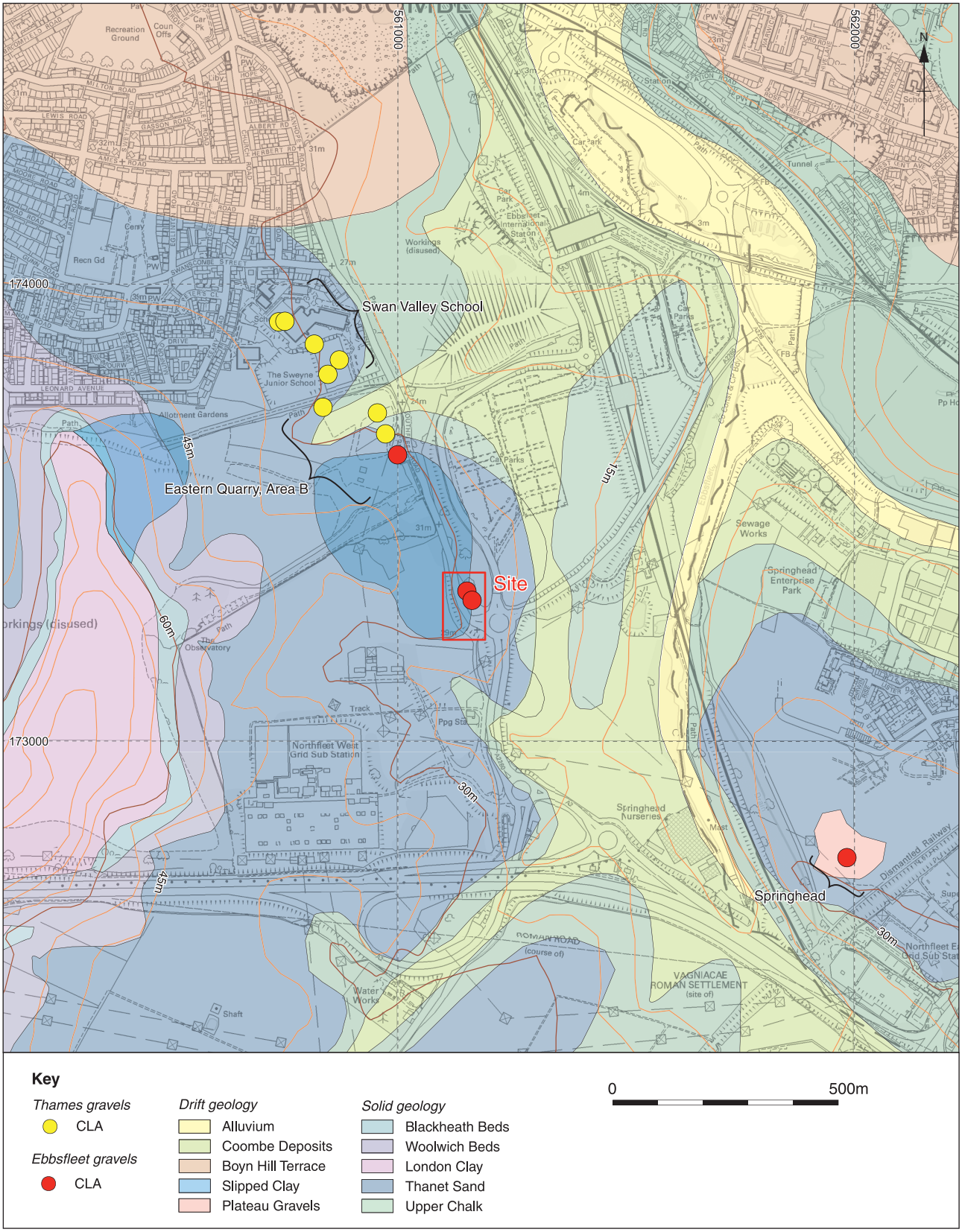

Figure 6.2 Locations of clast lithological sampling (CLA) in project areas surrounding the site [pre-quarrying base geology follows 1922 Geological Survey mapping, 6" sheet 12.1, NW]

Table 6.3 Angularity/roundness of Southfleet Road gravel samples, and comparisons with data from other nearby locales

Locality		*Category (see Table 6.2)*						*Total*	*Notes*	
	Site Phase	*wr*	*r*	*sr*	*sa*	*a*	*va*			*Analyst*
Southfleet Rd, Elephant site										
Southfleet Road <40004>	8.3 - top				7.1	65.7	23.9	67		DRB
Southfleet Road <40001>	8.3			1.1	9.7	66.7	22.6	93		DRB
Southfleet Road <40002>	8.3				9.0	67.0	24.0	100		DRB
Southfleet Road <40003>	8.3/7				8.5	59.8	31.6	117		DRB
Southfleet Road <40420> (40167)	7 - top				6.7	75.5	17.8	279	context 40167	TW
Southfleet Road <40361> (40164)	7 - base				7.3	79.2	13.5	82	context 40164	TW
Comparative material										
Other surrounding locales										
Springhead 1121-1					5.6	59.0	35.4	178		DRB
Springhead 1121-3					7.8	72.0	20.3	232		DRB
Eastern Q (61040) <2>			0.6	1.7	36.3	42.9	18.4	347		DRB
Eastern Q (61040) <4>				2.7	26.4	52.1	18.8	261		DRB
Eastern Q (61041) <50>					4.0	79.8	16.1	124		DRB
Eastern Q (61041) <51>					9.8	73.2	17.1	82		DRB
Eastern Q (61041) <60>				0.5	4.9	85.4	9.3	205		DRB
Eastern Q (61042) <96>				3.5	30.0	61.1	5.7	283		TW
Eastern Q (61042) <101>				2.0	43.3	48.4	6.3	252		TW
Eastern Q (68990) <3>				1.9	23.1	73.1	1.4	216		TW
Station Quarter South (63542) <10>					5.3	67.5	27.2	206		DRB
Station Quarter South (63542) <8>					6.9	48.3	44.8	58		DRB
Northfleet Cement <5> (602)				1.1	55.2	37.9	5.8	377		TW
Northfleet Cement <9> (1003)				0.6	61.0	32.8	5.5	344		TW
Crossways Business Park <18> (1104)				2.0	56.9	29.4	11.7	197		TW
Crossways Business Park <19> (1008)					7.5	72.6	19.9	146		TW
Pleistocene beaches										
Boxgrove 1		1.9	5.8	23.0	29.9	21.0	18.0	618		DRB
Boxgrove 2		1.4	7.4	38.5	28.8	19.1	4.8	351		DRB
Bembridge 1		9.6	21.0	30.5	24.6	11.4	2.9	509		DRB
Bembridge 2		4.6	11.7	30.0	35.9	13.6	4.3	582		DRB
Southwold 1		37.7	27.1	16.9	10.7	3.2	4.4	591	(Westleton Beds)	DRB
Pleistocene fluvial gravels										
Barvills Farm 1		24.8	7.2	3.1	24.1	21.2	19.6	638	(Lower Thames)	DRB
Barvills Farm 1.				1.0	36.8	32.3	29.9	418	(Lower Thames)	DRB
Shakespeare Pit 2A		24.1	6.9	1.3	18.5	22.3	26.8	622	(Lower Medway)	DRB
Shakespeare Pit 2A.				0.7	27.1	32.8	39.4	424	(Lower Medway)	DRB
Aylesford 1				0.8	31.1	17.6	50.4	119	(Middle Medway)	DRB
Aylesford 2			0.7	0.7	26.8	28.9	43.0	142	(Middle Medway)	DRB
Little Hayes 1				0.6	26.7	34.8	37.9	546	(R. Crouch)	DRB
Little Hayes 2				0.6	30.5	41.0	28.6	466	(R. Crouch)	DRB
Rampart Field 4					18.3	54.5	27.2	226	(Ingham River)	DRB
Knettishall 2				1.5	14.1	52.0	32.3	474	(Glacial outwash)	DRB
Solifluction gravels										
Great Fanton Hall 1				0.6	35.2	34.4	29.8	540		DRB
St. Mary's Marshes 1				0.6	15.7	32.9	50.9	540	(TQ 8413 9812)	DRB
Skinners Wick 1					0.6	18.9	74.8	222	(TQ 8106 7804)	DRB
Lodge Hill 1				0.7	14.6	27.2	57.6	151	(TQ 7566 7389)	DRB

parameters in the category definitions (see Table 6.2). Nonetheless, these problems rarely affect interpretations arising from the analyses.

Comparison with previous analyses from known depositional environments shows no perfect match (Table 6.3). Counts with modal angular flint are known only from fluvial gravels, however. The paucity of subangular flint in comparison with the angular class is almost unprecedented, although it can substantially be explained by the fact that the deposits are probably the product of a very small tributary stream, rather than the larger rivers from which most comparative data have been obtained. Furthermore, as discussed above (Chapter 4, *Deposits at the site*), what is suggested here is substantial input by downslope sediment movement of pre-existing Tertiary gravel from the high ground to the west, so this is probably entering the putative river channel in a very angular state. Although many fluvial gravels have more subangular than angular flint, these tend to be from large river systems in which the flint has probably been transported significant distances and/or reworked on multiple occasions. In the lower reaches of the Thames system, for example, where the flint has been carried considerable distances in a large river, the subangular class is generally modal. Solifluction gravels typically peak in the very angular category (Table 6.3), due to the prevalence of frost shattering and pitting in the periglacial environment required for the solifluction process. Even minimal fluvial transport is generally sufficient to dull the edges of fractured flint and result in its classification as angular.

The moderate % very angular in the Southfleet Road samples is typical of fluvial gravels, most of which have probably been deposited under cold (periglacial) climatic conditions, ensuring a rich supply of frost-shattered flint to the bedload, although this is not necessarily the case here, as there is no palaeo-environmental evidence. The gravels are tentatively (although by no means confidently) correlated with the Swanscombe Lower Middle Gravel, which are thought to have been laid down under interglacial conditions. Indeed, the angularity characteristics of the Southfleet Road gravel suggest short-distance fluvial transport in a small stream. The dominance of angular material could result either from modest fluvial discharge or from close proximity to the flint source. These results most closely resemble data from smaller rivers, nearer to flint sources, such as the Medway gravels of north and west Kent and the gravels of the Crouch in Essex (Table 6.3). Comparison with Ingham/Bytham River gravels from Rampart Field, Icklingham, Suffolk is also pertinent (Table 6.3). This was by all accounts a very large river (Rose 1987 and 1991), yet the flint is angular. This is thought to be because the river has only reached a flint source in the close proximity of the Icklingham area and therefore the flint has not been transported far (Bridgland *et al.* 1995). In summary, the data from Southfleet Road suggest that the majority of the flint has been frost-shattered and then transported a short distance before emplacement at the site. Note that the subangular material in the Southfleet Road gravel, like the Greensand chert, may well have been reworked from older (Darent) gravels.

It is worth noting too, that the data for the Phase 8 gravel are very similar to the results from Springhead (Table 6.3). It seems quite likely that these two gravels represent the same system, if not the same gravel body. The Springhead samples are slightly richer in Tertiary flint and poorer in other material, perhaps reflecting the relative positions of these two locations in the tributary valley, into which the other material was being introduced (probably from high-level Darent gravels such as those centred on Darenth Woods).

Clast lithology

All the Southfleet Road gravel samples contain only flint (96 – >99%) and Greensand chert (0.6–1.1%), with a few ironstones and sandstones of probable southern, Wealden provenance (Table 6.4). The great majority (75–95%) of the flint is of Tertiary origin, in the form of unbroken rounded or broken marine pebbles. Flint from other sources is found in the Southfleet Road deposits; there is 0.5–4.5% nodular flint, as well as weathered and broken flint (not shown in the table), much of which may have come from the Tertiary, although this cannot now be determined. The only other components of the gravel are ironstones of various types (0.2–1.4%) and occasional sandstones of Greensand or (more probably) Tertiary origin (0–0.3%). The ironstones include argillaceous (clayey) and arenaceous (sandy) types, as well as mixtures of the two. They may come from the Greensand, the Tertiary or from iron-cemented Quaternary deposits. Some of the flints show evidence of an origin in the Bullhead Beds (counted with nodular, since these are invariably weathered nodules).

Several samples contained flint pebbles with fire-crazing and red/grey discoloration indicative of burning. This was quantified (Table 6.4) to investigate whether the Phase 7 deposits were associated with a mass movement (landslip) event, and whether this was perhaps associated with a wild-fire event, and indeed perhaps the proposed fire identified as a non-arboreal pollen phase by Turner (1970) in the Hoxnian pollen sequence at Marks Tey. No particular pattern was found; burnt pebbles were generally rare, and were present in samples from all three phases covered by the investigations (Ph 8.3, Ph 8.3/7 and Ph 7). The presence of fire-crazed material is likely to indicate occasional natural conflagrations, Tertiary material having had much longer exposure to successive natural fire events or lightning strikes.

The lithology of the Phase 8 gravels at Southfleet Road demonstrates unequivocally that they are not of Thames origin, and thus not part of the Swanscombe Orsett Heath Formation, which crops out a short distance to the north-west, in Eastern Quarry and at Swan Valley School (Chapter 2). As the comparative data (Table 6.5) show (see also Bridgland 1988 and 1994; Bridgland and D'Olier 1995), Lower Thames gravels, including those at Swanscombe, contain a typical mixture of flint (85–98%),

Greensand chert from southern tributary valleys (0.5-5.0%) and 'exotic' material, derived from outside the London Basin (1.5–12%). The dominance of Tertiary flint pebbles is also informative; these are common in the Thames gravels, but rarely account for more than 70% of the total flint (Table 6.5). The composition of the Phase 8 gravel is suggestive of a south-bank Thames tributary, in other words a palaeo-Ebbsfleet. The range of lithologies includes material that could reflect headwaters draining the Lower Greensand, ie from a catchment basin extending south into the Weald. However, this is not particularly likely, since some of the hills to the south of the Dartford – Swanscombe area are capped with Greensand chert-bearing gravels of probable Darent origin (for example at Darenth Wood). Reworking from such sources is a much more likely origin of the chert in the Southfleet Road gravel. The dominance of Tertiary flint suggests a fairly local source, within the Tertiary outcrops capping the North Downs, and most likely from the now-quarried high ground to the west of the site, where gravel-rich Tertiary beds were mapped (Fig. 2.3). The complete absence of exotics, as well as ruling out a Thames origin, indicates deposition either before the Thames was diverted into its present lower valley (see Bridgland 1988 and 1994) or in a location upstream from any pre-existing Thames deposits, from which occasional exotic material would have been reworked. The supposed correlation between the Southfleet Road Phase 8 gravel and the Swanscombe Lower Middle Gravel deposits, based on their altitudes (Chapter 4, *deposits in the site vicinity*), would mean that they were deposited at a time when there were no pre-existing Thames higher-level deposits for slopewash processes and secondary tributary streams to rework upstream into the Ebbsfleet stream, as is often seen in advance of confluences. The lithology of the other gravel samples, from Phase 7 and the Phase 8/7 junctions, is identical to that from the Phase 8 gravel, suggesting an identical source.

DISCUSSION AND CONCLUSIONS

The results from the Southfleet Road site confirm that the Phase 8 gravels are fluvially deposited, and that they represent an early course of the Ebbsfleet, rather than the main Thames. As discussed above (Chapter 4), they

Table 6.4 Clast lithologies from Southfleet Road gravel samples

		Flint				*Southern*			*Exotic*										
Sample <>	*Clast size*	*Tertiary*	*Nodular*	*Weathered*	*Broken*	*Greensand chert*	*Hastings Beds sandstones, siltstones and ironstones*	*Ironstone*	*Vein Quartz*	*Metaquartz*	*Orthoquartzsite*	*Carboniferous Chert*	*Schorl*	*Rhaxella Chert*	*Arkose*	*Igneous*	*Clinker*	*TOTAL*	*Fire-crazed Tertiary pebbles*
<40004>	16-32mm	136	7	6	1	5		1										156	
	%	87.18	4.49	3.846	0.64	3.205		0.64											
	11.2-16mm	257	3	9	2	6		4										281	
	%	91.46	1.07	3.203	0.71	2.135		1.42											
<40001>	16-32mm	168	7	22	3	13												213	
	%	78.87	3.29	10.33	1.41	6.103													
	11.2-16mm	406	4	27	6	9	2	2										456	
	%	89.0	0.9	5.9	1.3	2.0	0.4	0.4											
<40002>	16-32mm	225	6	10	3	5		1										250	1
	%	90.0	2.4	4.0	1.2	2.0		0.4											
	11.2-16mm	414	7	9	4	3		1										438	6
	%	94.52	1.6	2.055	0.91	0.685		0.23											
<40003>	16-32mm	234	10	2		2												248	
	%	94.35	4.03	0.806		0.806													
	11.2-16mm	579	3	24	4	9	2											621	
	%	93.24	0.48	3.865	0.64	1.449	0.32												
<40420>	16-32mm	554	23	25	4	7												613	5
(40167)	%	90.4	3.8	4.1	0.7	1.1													
	11.2-16mm	1360	22	56	9	38	5	1										1491	13
	%	91.2	1.5	3.8	0.6	2.5	0.3	0.1											
<40361>	16-32mm	151	6	7	4	1												169	
(40164)	%	89.3	3.6	4.1	2.4	0.6													
	11.2-16mm	386	11	14	11	9	3											434	1
	%	88.9	2.5	3.2	2.5	2.1	0.7												

Table 6.5 Comparisons of Southfleet Road clast lithologies with data from nearby locales

Gravel	*Site*	*Sample Identifier*	*Flint*			*Chalk*	*Southern*		*Exotics*						*Total count*
			Tertiary	*Nodular*	*Total*	**Chalk*	*Greensand chert*	*Total*	*Quartz*	*Quartzite*	*Carboniferous Chert*	*Rhaxella Chert*	*Igneous*	*Total*	
Swanscombe, Lower Middle Gravel	Barnfield Pit	1 D	58.2	9.8	93.9		0.9	1.2	2.4	1.8	0.5			4.8	1081
	11.2-16	1 D	50.9	5.3	89.9		2.1	2.3	4.4	2.0	0.8		0.1	7.7	1730
		2 D	48.5	12.7	92.7		1.9	2.0	1.9	1.8	0.5	0.1	0.2	5.0	992
	11.2-16	2 D	41.6	5.5	89.7		3.0	3.1	3.5	1.5	0.5	0.2	0.2	6.8	1785
Swan Valley School	LMG	1 D	63.9	7.4	94.3		1.5	1.5	0.6	2.7	0.6	0.2	0.2	4.2	474
	11.2-16	1 D	52.3	4.7	89.2		2.6	3.0	2.1	3.9	0.6	0.1	0.4	7.5	1085
	Trench D	D	66.4	7.3	95.7		1.8	1.8	0.3	1.0	0.6	0.3	0.2	2.5	672
	11.2-16	D D	51.5	6.3	90.5		2.8	3.0	1.4	3.6	0.8		0.1	6.5	1055
	Trench E	D	46.0	13.2	93.1		3.6	3.6	1.1	0.8	0.5	0.3		3.3	889
	11.2-16	E D	42.0	7.1	91.6		3.3	3.4	0.9	2.8	0.8	0.5	0.1	5.0	1089
	Trench K	D	71.6	8.4	95.0		2.0	2.5	0.2	1.5	0.3		0.2	2.3	641
	11.2-16	K D	60.6	3.7	91.4		1.8	1.9	1.8	3.1	0.6	0.3	0.1	6.5	791
	Trench P	D	51.9	13.9	93.5		1.7	1.7	0.2	3.2	0.2	0.3	0.2	4.8	584
	11.2-16	P D	42.1	6.5	89.8		3.7	3.8	1.7	3.4	0.4	0.3	0.2	6.4	999
Springhead	1121/1		92.6	1.1	96.8		1.1	1.1							380
	11.2-16		92.6	0.7	96.6		0.8	0.8							1101
	1121/3		89.5	3.1	96.8		1.1	1.1							551
	11.2-16		95.3	0.8	99.2		0.6	0.6							1331
Eastern Quarry (61040)	TP 4.1	4	51.8	14.6	92.6		4.3	4.5	1.3	0.9	0.7	-	-	2.9	446
		11.2-16	44.1	5.6	90.9		3.3	3.5	1.1	3	1.2	0.2	0.1	5.6	1087
	TP 16.2	2	47.1	13.4	93.2		3.5	3.5	0.9	2	0.4	-	-	3.3	546
		11.2-16	43.8	7.3	90.2		4.4	4.5	1.6	2.5	0.7	0.1	0.2	5.2	1144
Eastern Quarry (61041)	TP 104	50	71.5	18.5	92.7		5.8	5.8							260
		11.2-16	76.5	15	99		2.5	3							200
	TP 104	51	70.7	16.2	94.2		5.2	5.8							154
		11.2-16	78.6	9.3	96.5		2.6	2.6							150
	TP 112	60	90.6	5.6	98.5		0.4	0.6							461
		11.2-16	91.7	3	98.3		0.8	1.4	0.1	0.1					1042
Eastern Q (61042)	TP 127	<96>	80.0	4.1	94.3		4.8	4.8	0.2	0.4				0.7	459
		11.2-16	81.4	2.0	95.5		3.1	3.7	0.1	0.3	0.3		0.1	0.8	1027

	TP 127	<101>	60.1	7.5	93.4	3.4	3.4	2.0	1.0	0.2			3.2	411
	11.2-16	11.2-16	67.0	3.6	93.6	3.9	4.1	1.5	0.5	0.1	0.2		2.4	1234
Eastern Q, Septic	<3> (68990)	<3>	57.4	7.8	93.3	4.7	4.7	1.0	1.6	0.3	0.3			387
tank (68990)	11.2-16	11.2-16	52.2	3.8	89.3	4.6	4.6	2.5	2.3	0.1				853
Station Q South		10	91.8	2.2	97.6	1.8	2.4							490
(63542)		11.2-16	91.8	0.5	98.1	1.2	1.2		0.1		0.1		0.2	1215
		8	94.8	0.9	99.1	0.9	0.9							116
		11.2-16	90.8	2.4	96.3	0.3	0.3			0.3			0.3	295
Northfleet Cement	<5> (602)		61.2	7.0	94.3	4.0	4.0	0.7	0.4	0.3			1.6	670
Works	11.2-16		62.4	3.1	94.8	3.0	3.0	0.9	0.1	0.1	0.1		1.3	1293
	<9> (1003)		68.1	4.9	95.3	3.2	3.2	0.7	0.1				1.1	758
	11.2-16		72.2	2.0	96.3	2.0	2.0	0.8	0.1	0.2		0.1	1.3	1203
Crossways Park	<19> 1003		65.1	17.4	96.9	3.1	3.1	1.6	0.3	0.9			3.1	287
	11.2-16		66.3	18.1	98.4	2.4	2.7	0.8	0.1	0.1	0.4		1.6	1069
Crossways Park	<18> (1104)		48.5	9.3	91.9	5.7	5.7	0.6	0.3	0.3	0.3		1.8	332
	11.2-16		50.8	4.2	91.9	4.8	4.8	1.5	0.6	0.4	0.1	0.2	3.0	826

can be interpreted on topographic grounds as being broadly equivalent to the Swanscombe Lower Middle Gravel. The Southfleet Road results can be integrated with recent lithological analyses in the surrounding area (Table 6.5) to develop an updated model of the palaeo-landscape, showing the extent of the Swanscombe Lower Middle Gravel channel, the course of the contemporary palaeo-Ebbsfleet and their point of confluence. These new analyses have confirmed the southward extension of Lower Middle Gravel deposits, not only so far as the Swan Valley School (Wenban-Smith and Bridgland 2001), but now well into Eastern Quarry, more than 600m further south than the currently mapped boundary (Fig. 6.2). These new data show the Ebbsfleet passing over the elephant site and entering the Thames from the south-east, with the point of confluence about 400m to the NNW at *c* TQ 61000 73650 (Fig. 4.44).