Drift Filled Hollows – Examples from Crossrail

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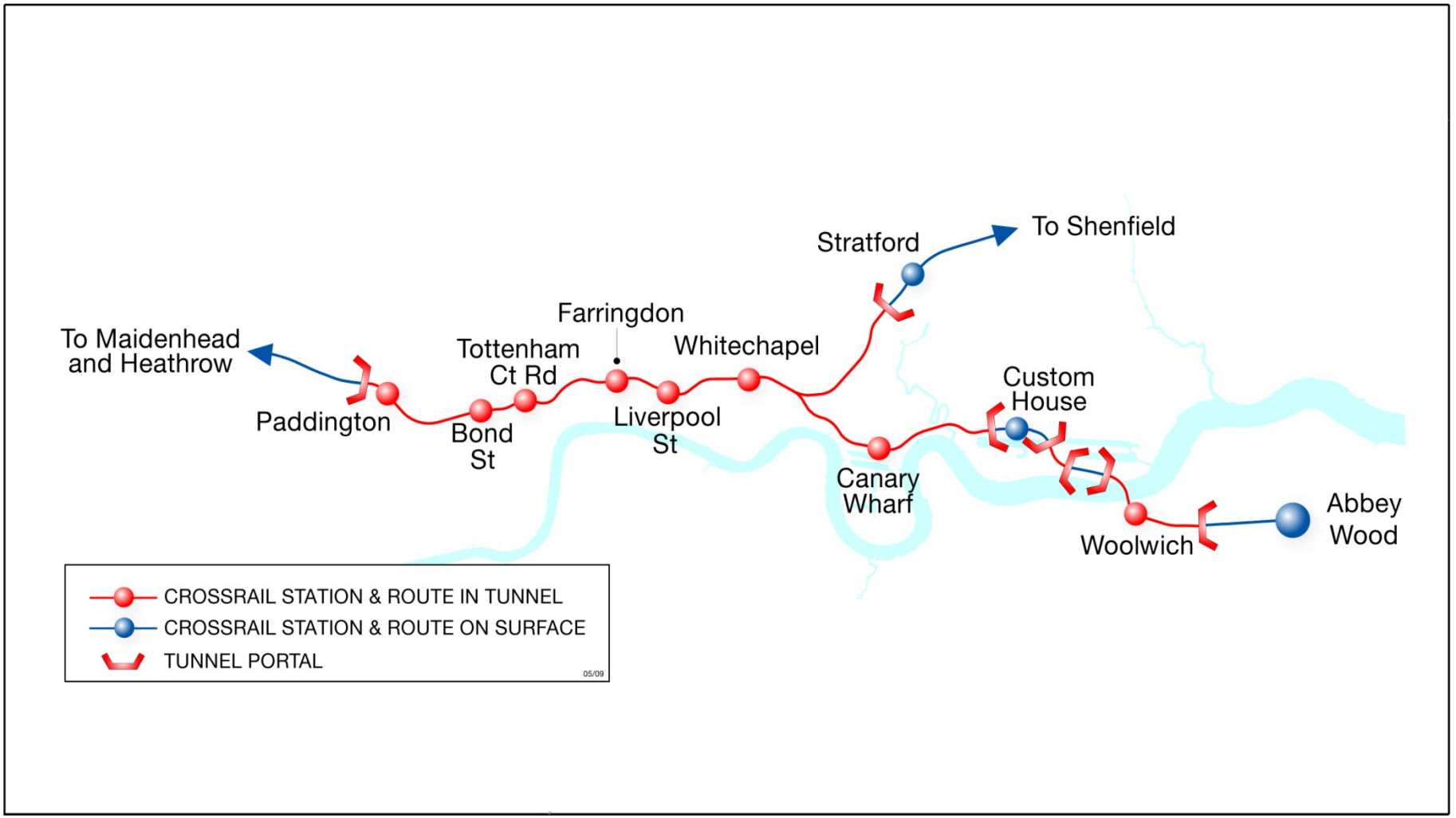
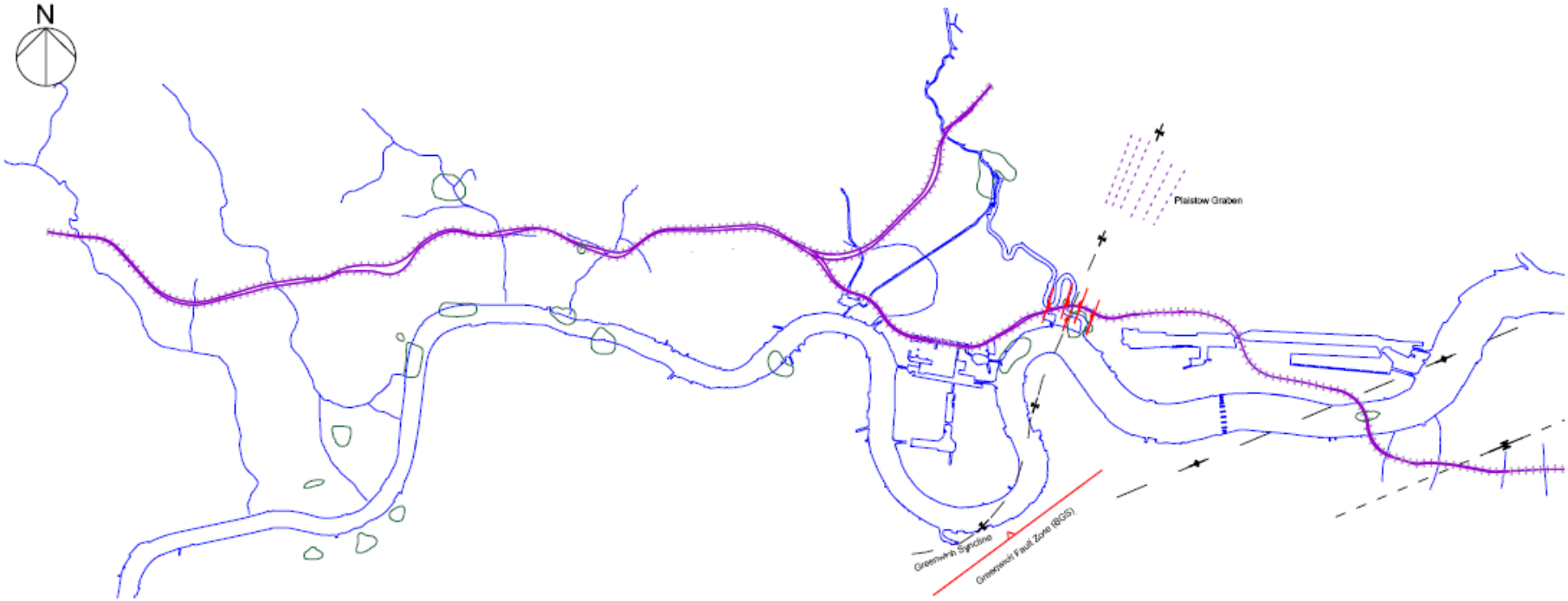
- Crossrail Chief Engineer's Group

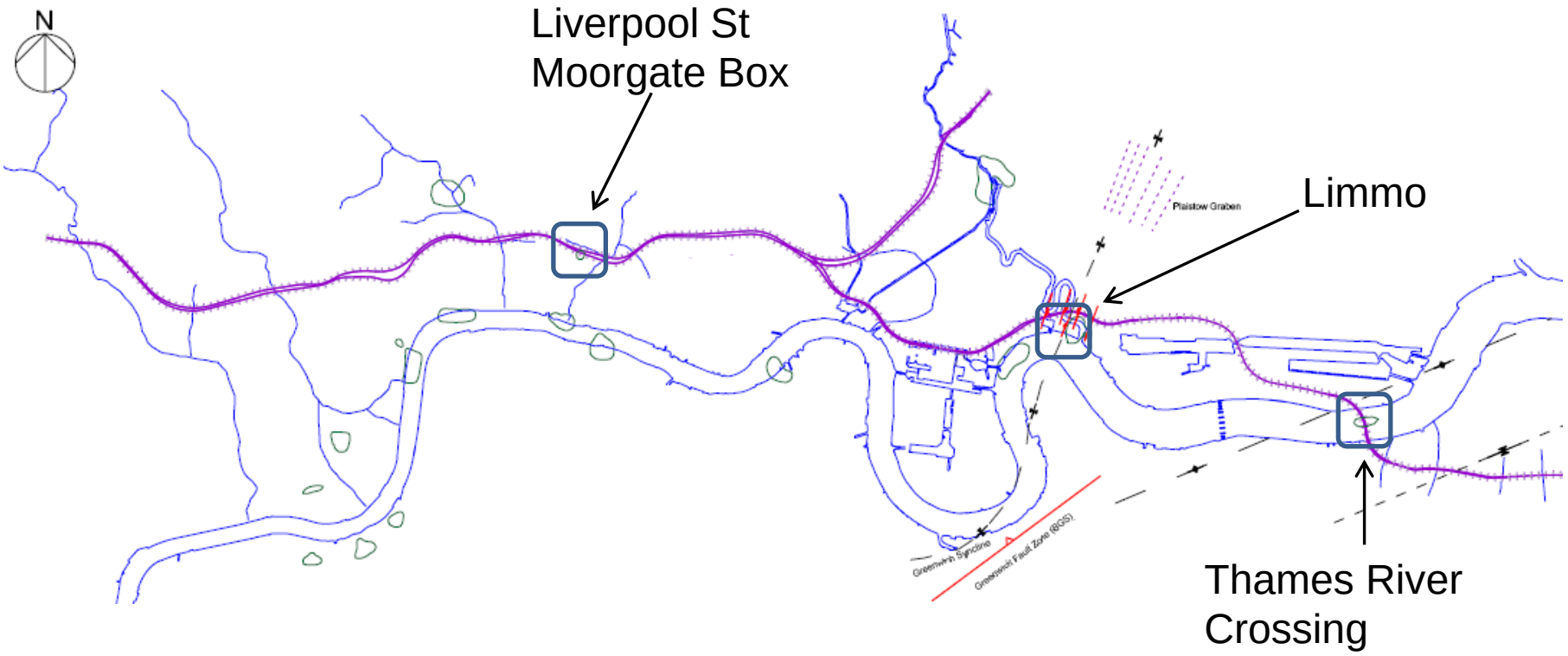
The Crossrail route in Central London



Crossrail route with the northern Thames Tributaries & some major geological structures



Crossrail Drift Filled Hollows



Crossrail Ground investigation data

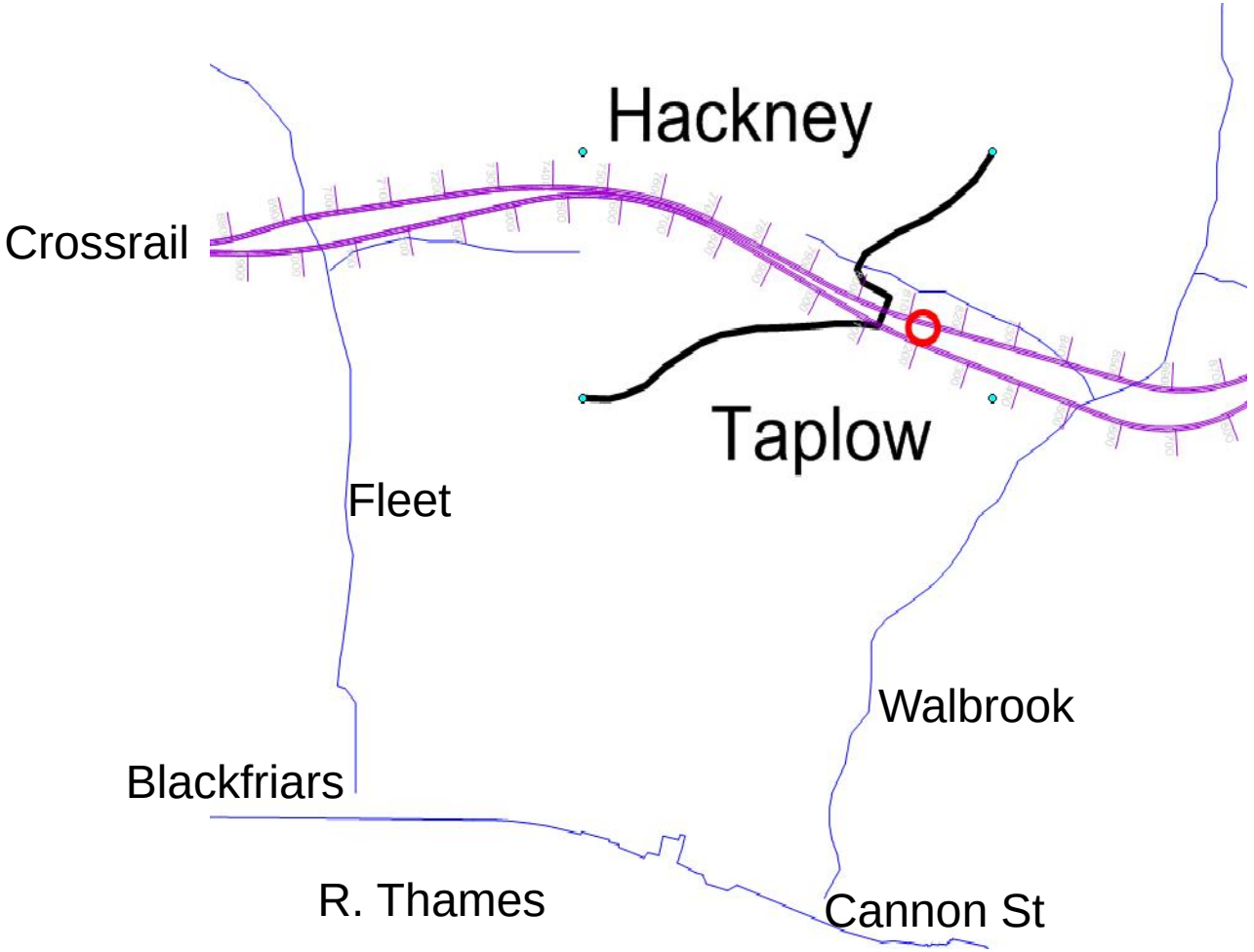
> 1000 Crossrail Boreholes
≈ 34000m of data

≈ 650 3rd Party Boreholes
≈ 25000m of data

1,200,000+ line AGS database

Drift Filled Hollow at Liverpool Street / Moorgate Box

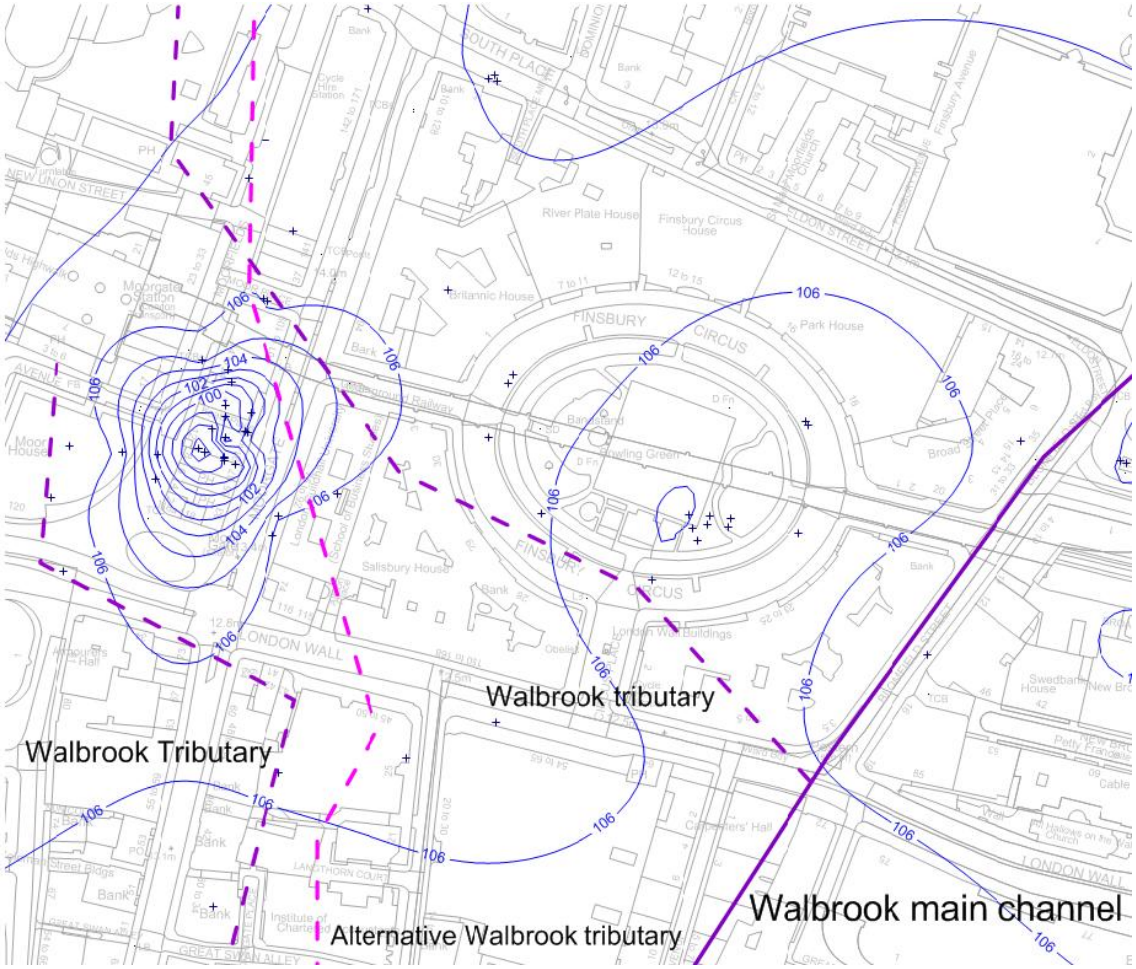
Context



Drift Filled Hollow at Liverpool Street / Moorgate Box

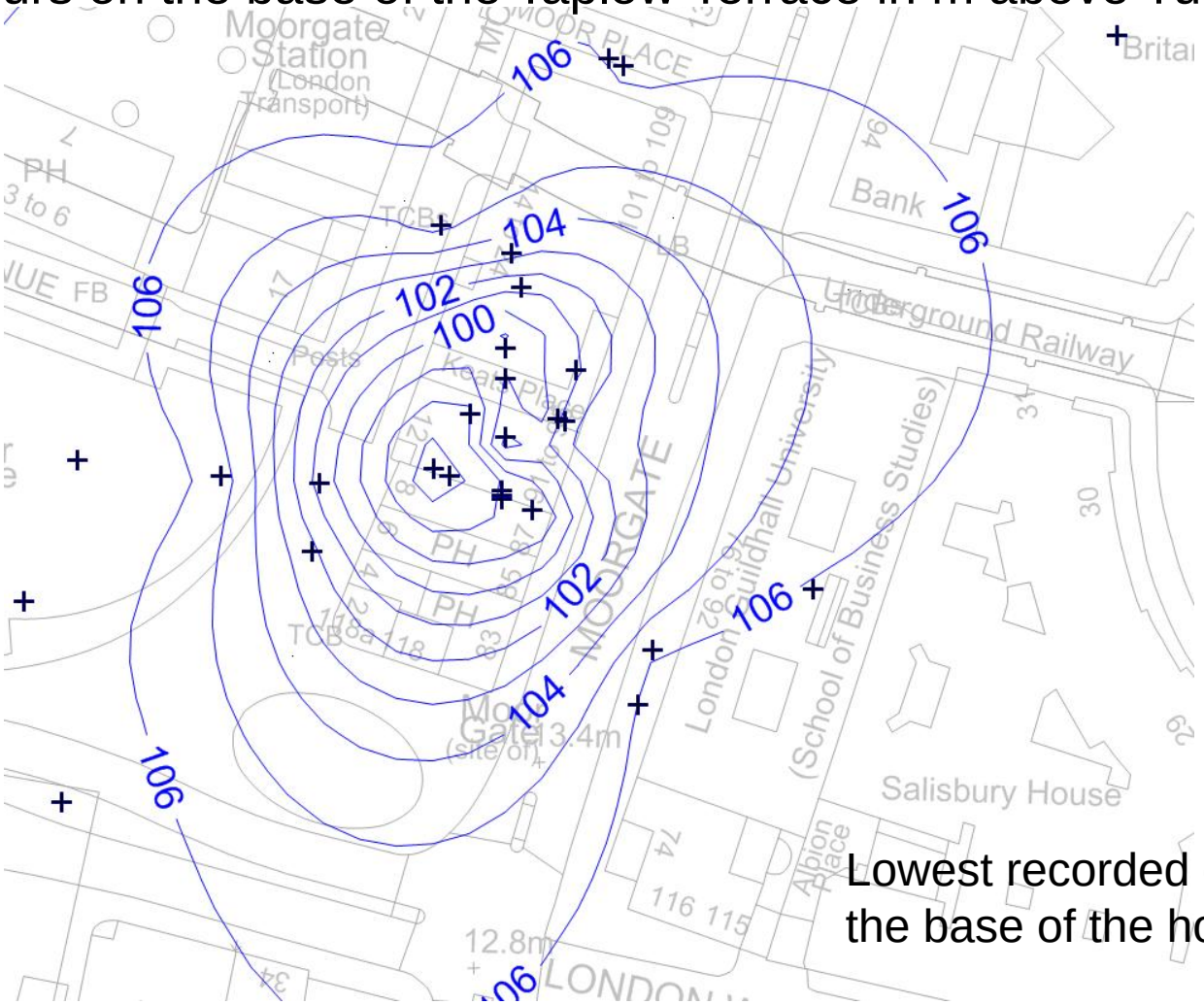
Drift Filled Hollow at Liverpool Street /Moorgate Box

Contours on the base of the Taplow Fm



Liverpool Street Moorgate Box Hollow

Contours on the base of the Taplow Terrace in m above Tunnel datum



Lowest recorded elevation of the base of the hollow = 96m

Liverpool Street / Moorgate Box Hollow:

Dimensions, Strata & Shape

- ‘Normal’ strata sequence = Alluvium / Taplow Fm / LC
- Hollow strata sequence = Alluvium / Taplow Fm / LC
- Shape - broadly conical, diameter = approx 70m
- Natural thickness of Taplow Fm away from the Hollow = approx 4m
- Thickness of LC away from the Hollow = approx 30m
- Natural thickness of Taplow Fm in the Hollow = approx 15m
- Thickness of LC remaining below the Hollow = approx 20m

Liverpool Street / Moorgate Box Hollow
Geological context

- Broadly coincident with the upper reaches of a recent minor Walbrook tributary.
- Located close to the current Fleet / Walbrook watershed.
- Located at the back edge of the Taplow Terrace.
- Surrounding Taplow Fm is thin & flat.
- No evidence of channels in the adjacent & higher sub Hackney Terrace surface.
- Slightly thicker Alluvium/Peat above than elsewhere locally
- No obvious vertical component of faulting at depth.
- Very small Lambeth Group Sand Channels are present.
- Not in an area of reduced LC thickness

Liverpool Street / Moorgate Box Hollow
Detail

•The infill is variable, but dominated by Sands and Gravels.

•Broadly speaking there is more Gravel at higher levels than at lower levels.

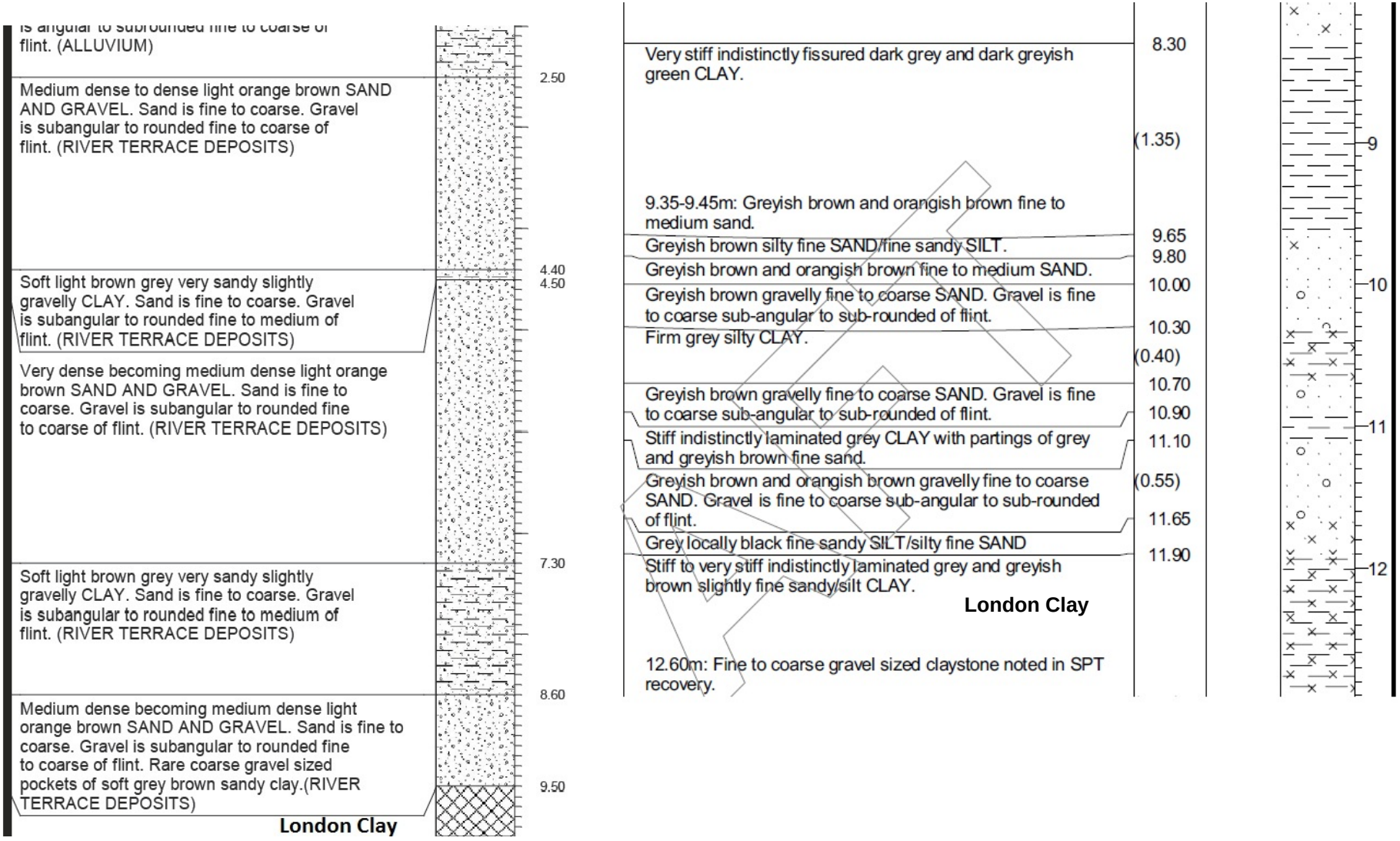
•The boundary between the Gravelly and less Gravelly is approximately coincident with the base of the Terrace away from the Hollow

•At lower levels the infill is dominated by Sands with less Gravel. Also present are ‘inclusions’ of Clay, often with London Clay like descriptions.

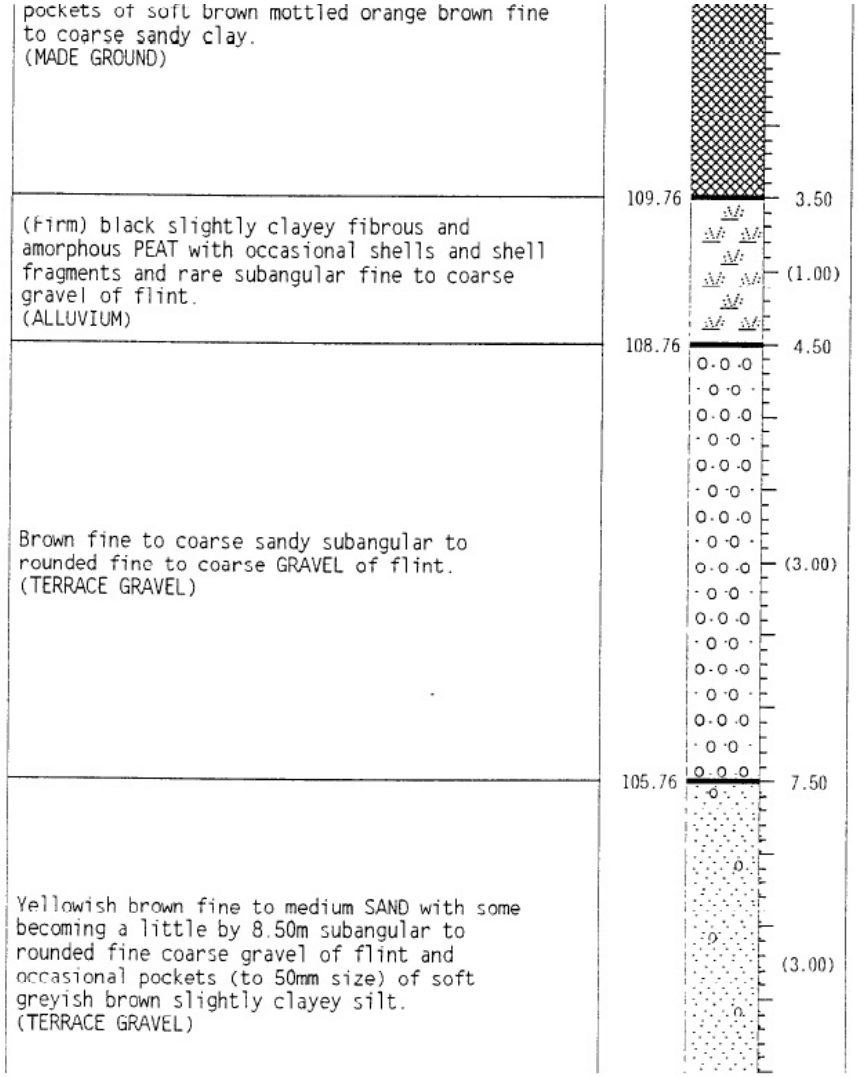
•The data tentatively suggests the overlying Alluvium may be slightly thicker & have a slightly lower base within the Hollow compared to just outside it.

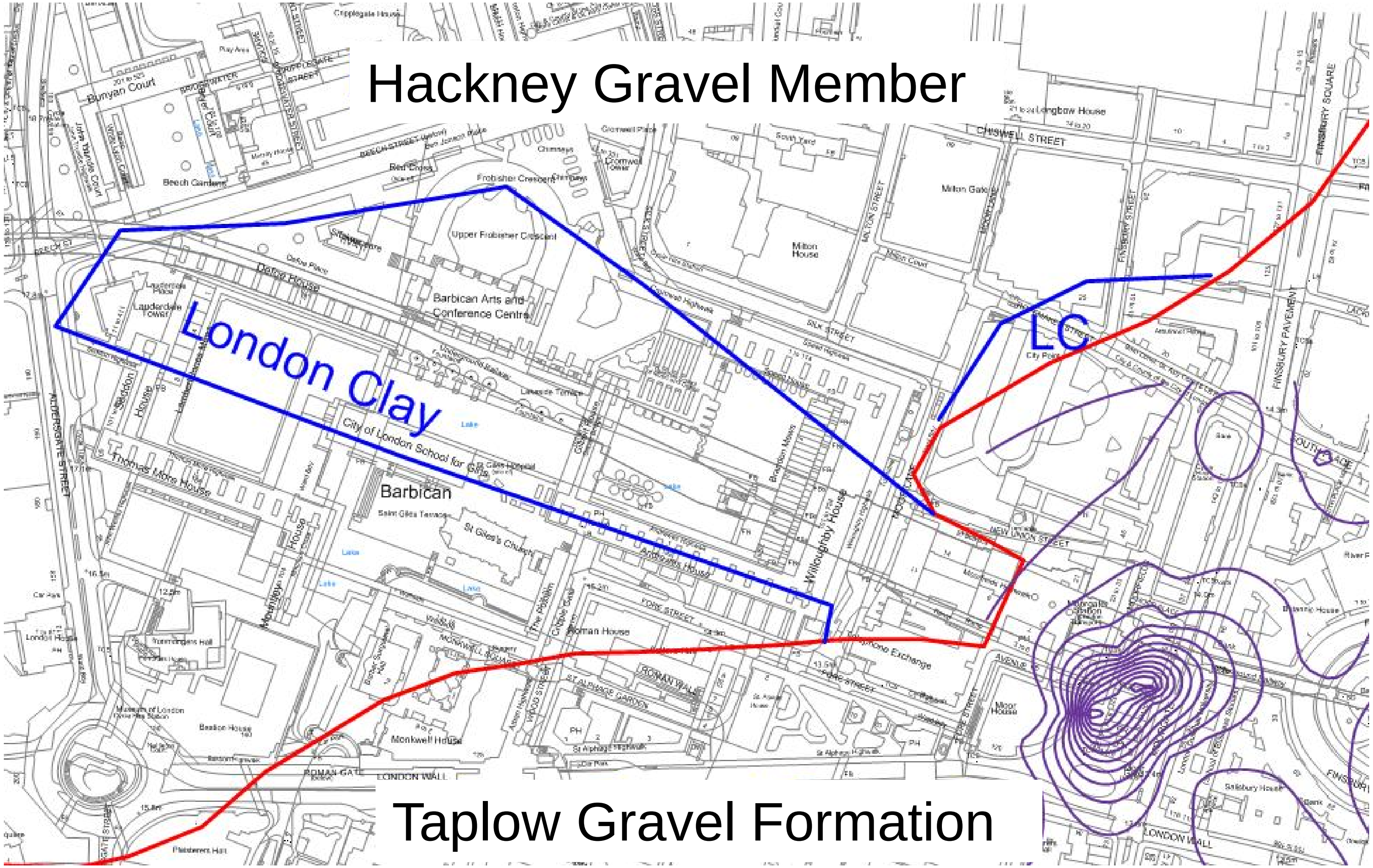
•The maximum Hollow slope angle is approximately 1V:2.5H

Moorgate Hollow Bh Log extracts



Moorgate Hollow Bh Log extracts

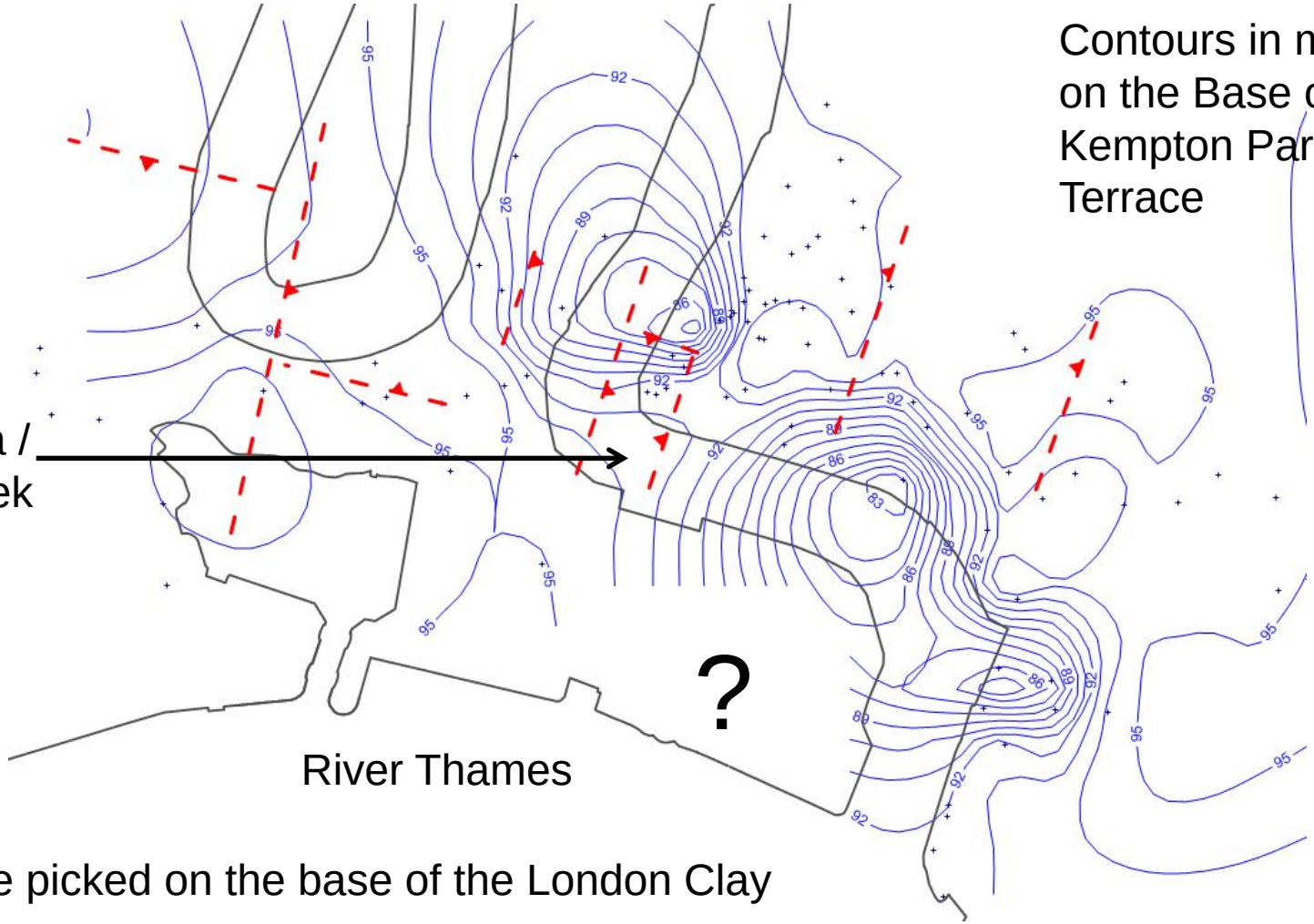



Hackney Gravel Member
London Clay
LC
Barbican
Taplow Gravel Formation

Drift Filled Hollow at the Lea/Thames confluence (‘Limmo’)

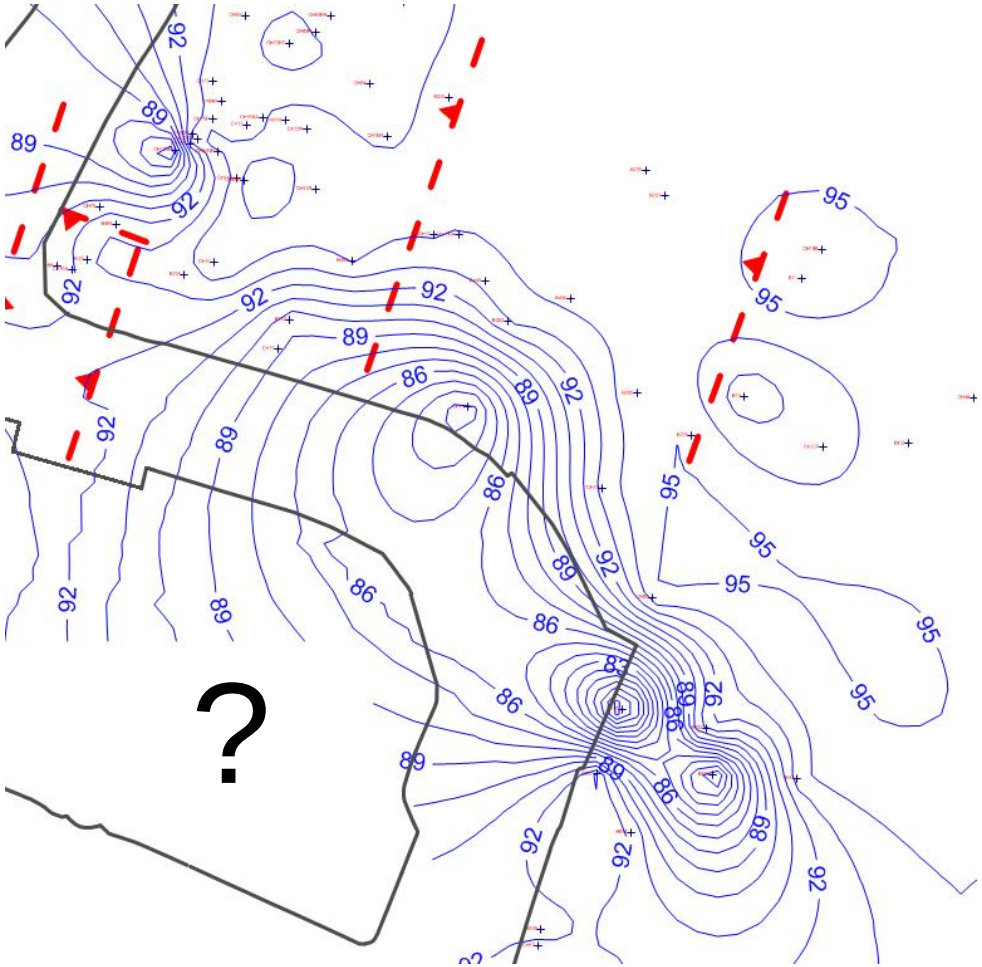
Drift Filled Hollow at Limmo

Context



Faults are picked on the base of the London Clay

Drift Filled Hollow at Limmo

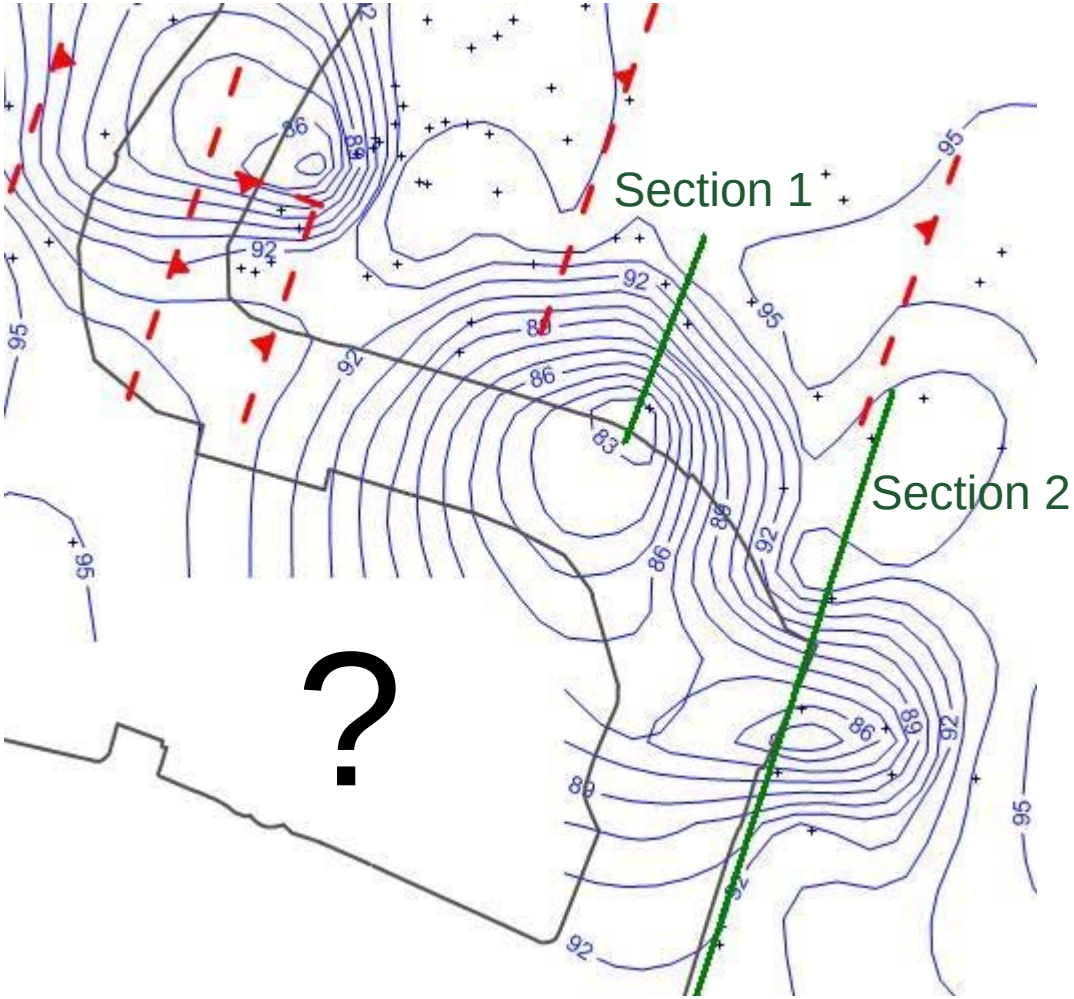


Drift Filled Hollow at Limmo Strata & Shape

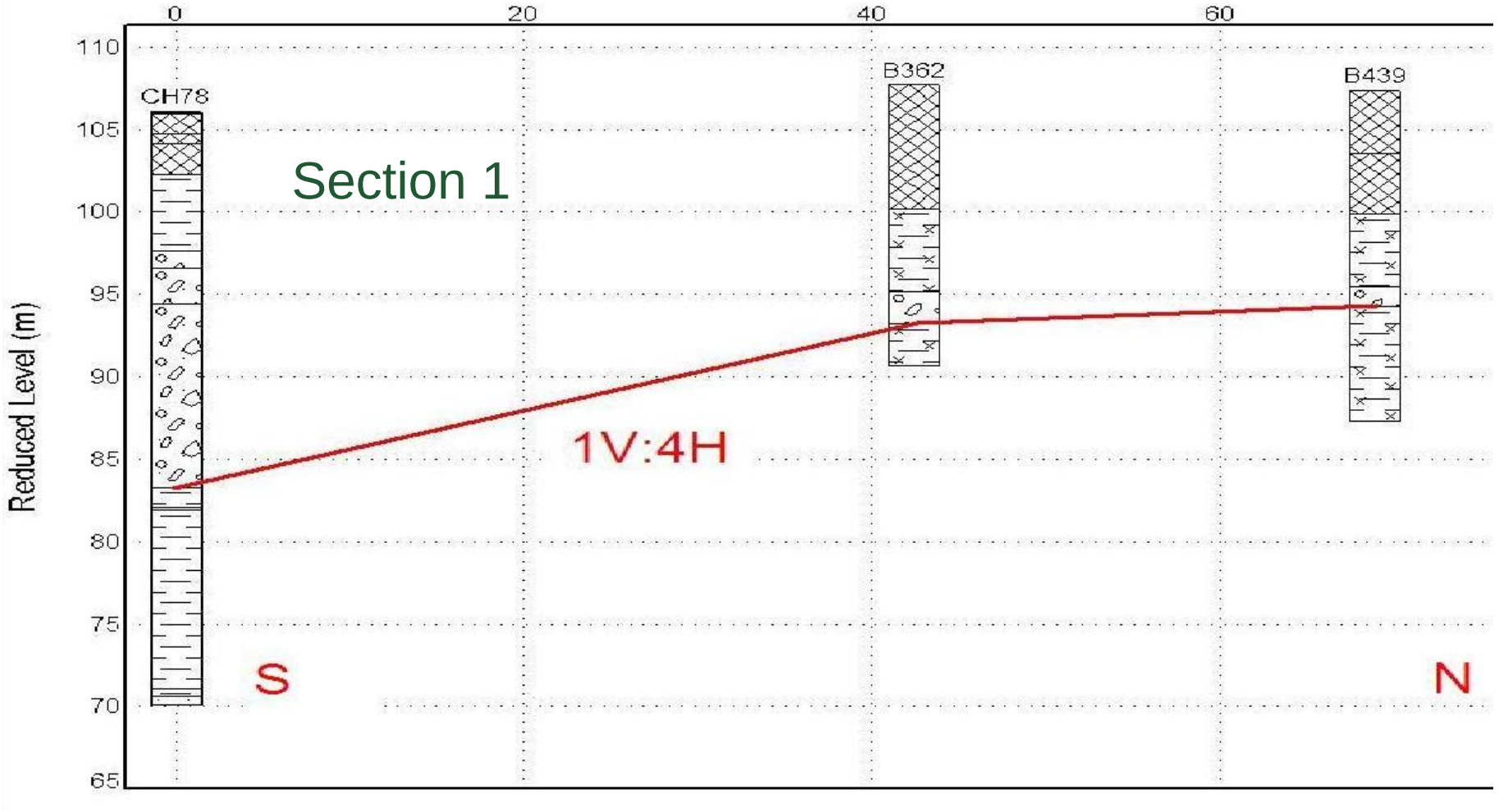
- ‘Normal’ strata sequence = Alluvium / Kempton Park Gravel / LC
- Hollow strata sequence = Alluvium / Kempton Park Gravel / LC
- Shape – complex, unknown to the SW.
- Natural thickness of Kempton Park Gravel away from the Hollow = approx 2m (but Alluvium is thick)
- Thickness of LC away from the Hollow - max 37m (but faulted)
- Natural thickness of Kempton Park Gravel in the Hollow = approx 23m
- Thickness of LC remaining below the Hollow = approx 1.5m
- Maximum known width = approx 450m, maximum known depth 20m
- Close to, but entirely different to the Blackwall Tunnel Hollow

Berry shows a small shallow hollow just west of the Bow Creek / Thames junction
BGS Sheet 256 doesn’t show a hollow here.

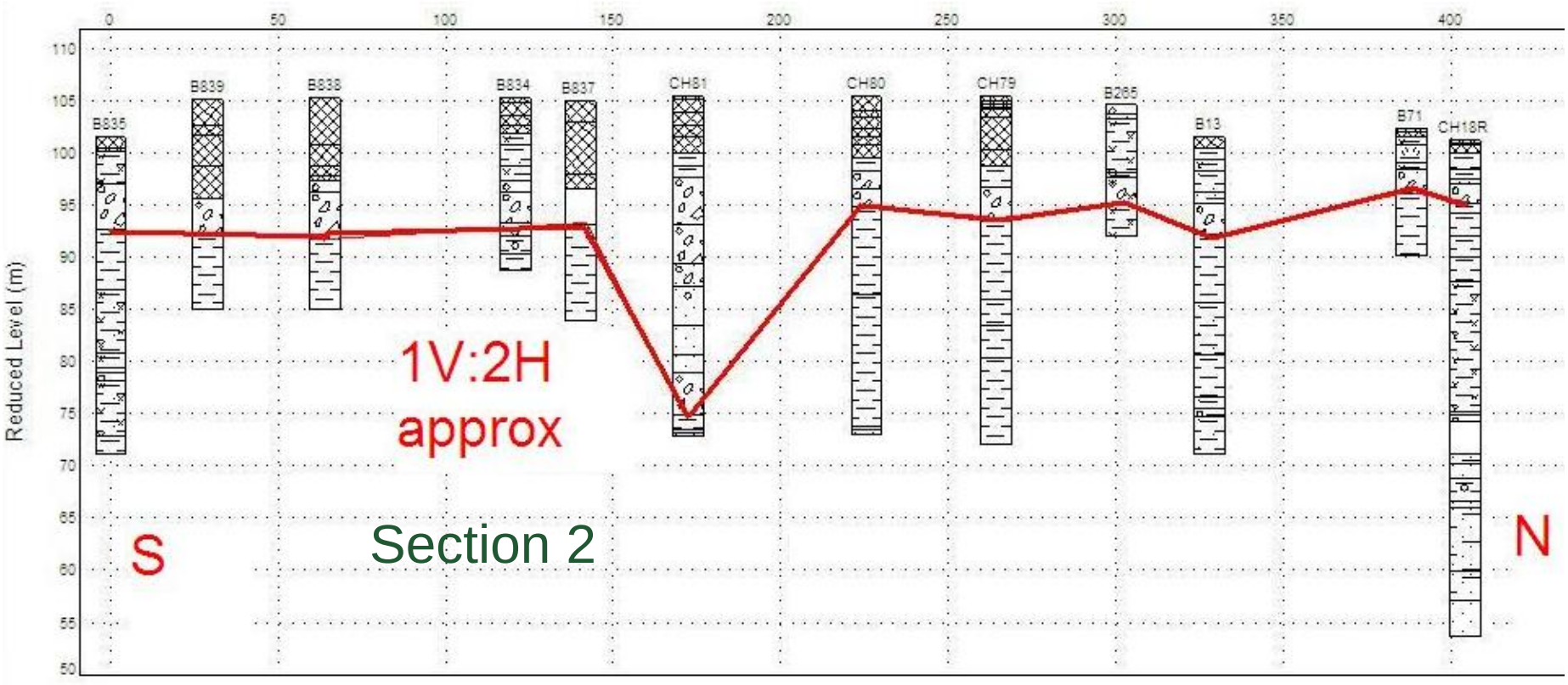
Drift Filled Hollow at Limmo



Drift Filled Hollow at Limmo



Drift Filled Hollow at Limmo



Drift Filled Hollow at Limmo - Features

- Multiple coalescing hollows

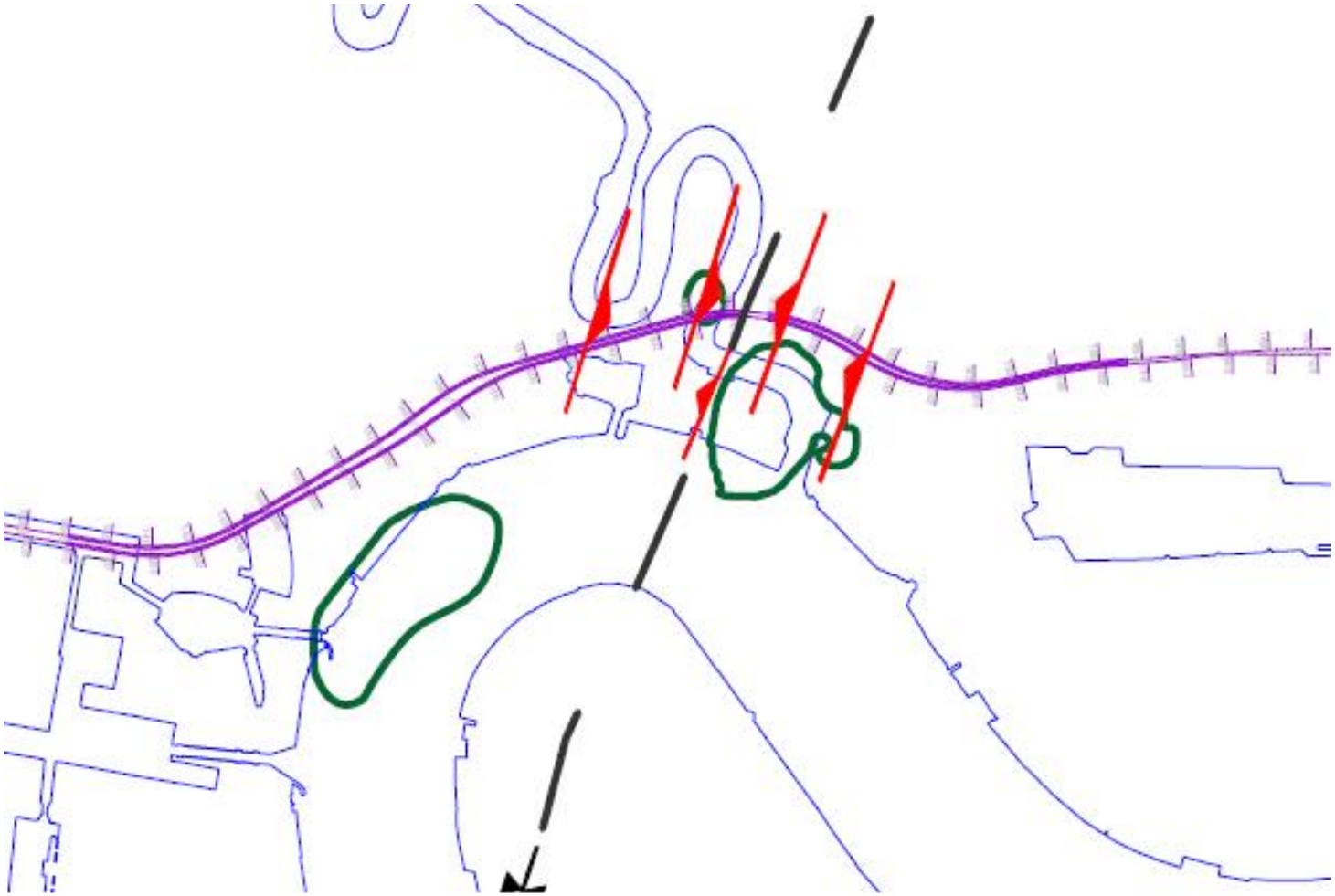
- Elevation at the top = 95maTD
- Deepest elevation at the known base = 75maTD
- Strata below *known* base = London Clay (<2m thick)

- Infill materials : Sandy Gravel & Gravelly Sand
- No record of clay layers or large ‘inclusions’

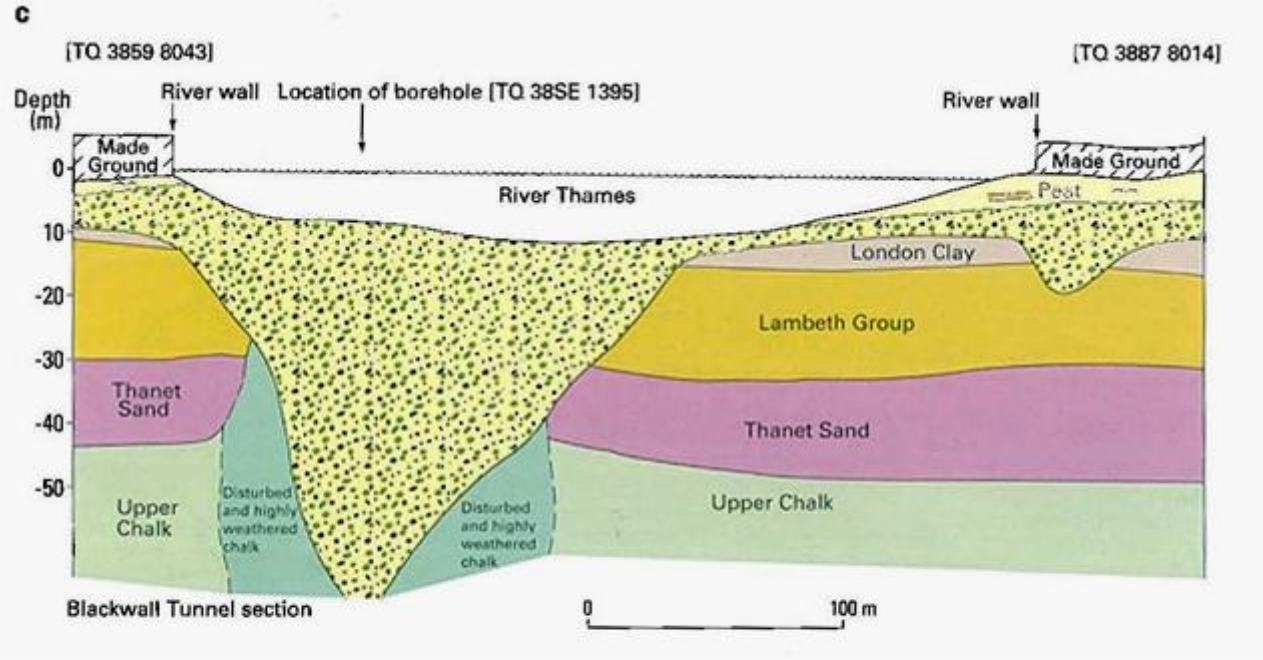
- There is some evidence of fault control over the shape and location of the hollows.

- Max slope angle = approximately 1V:2H
- All strata adjacent to the Hollow to the North, including the London Clay, show a tidal response.

Drift Filled Hollows at Blackwall & Limmo



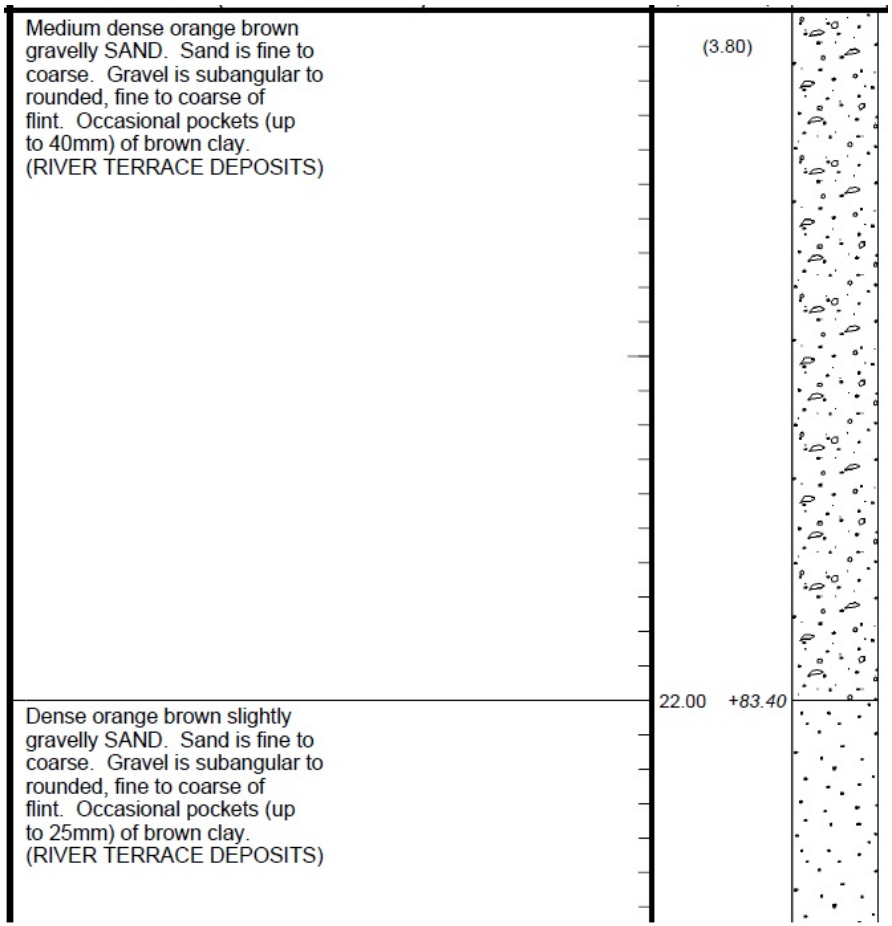
Comparison with the Blackwall Hollow

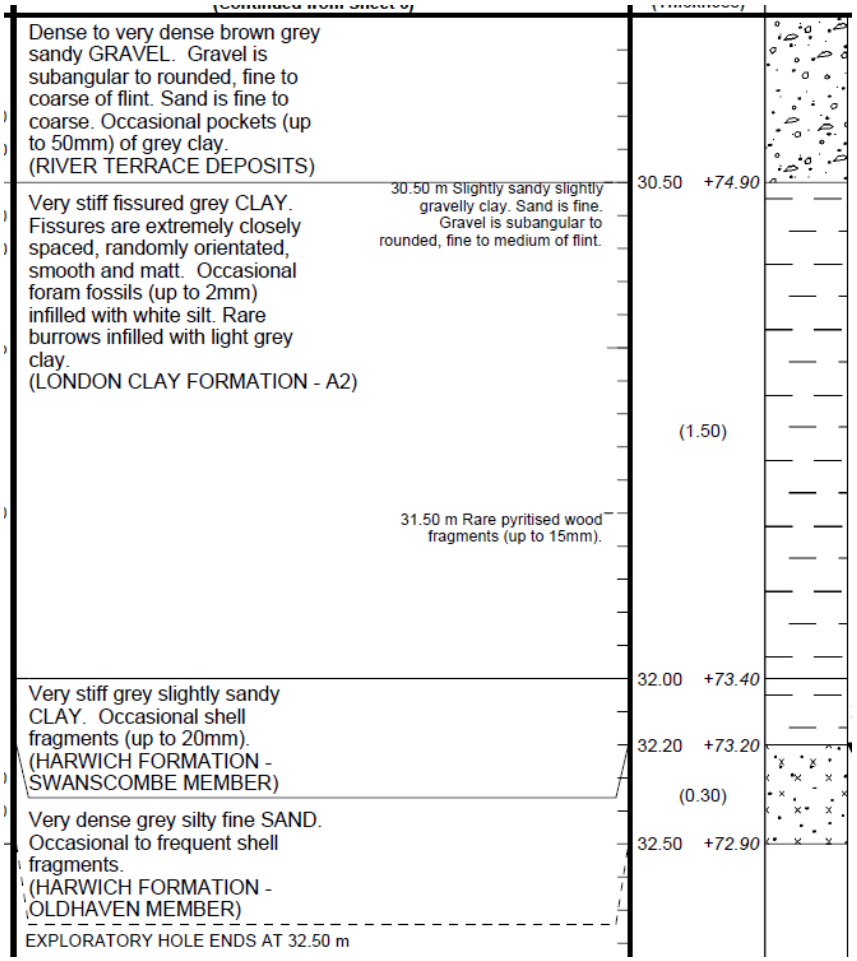


The known data suggests the Limmo Hollow is entirely contained within much thicker London Clay just to the east.

- The section suggests the maximum Blackwall slope angle is approaching 1:1
- The Blackwall Hollow has much thinner impermeable cover to the lower aquifer.
- The Blackwall Hollow has evidence of diapirism.

Limmo Hollow Bh Log extracts

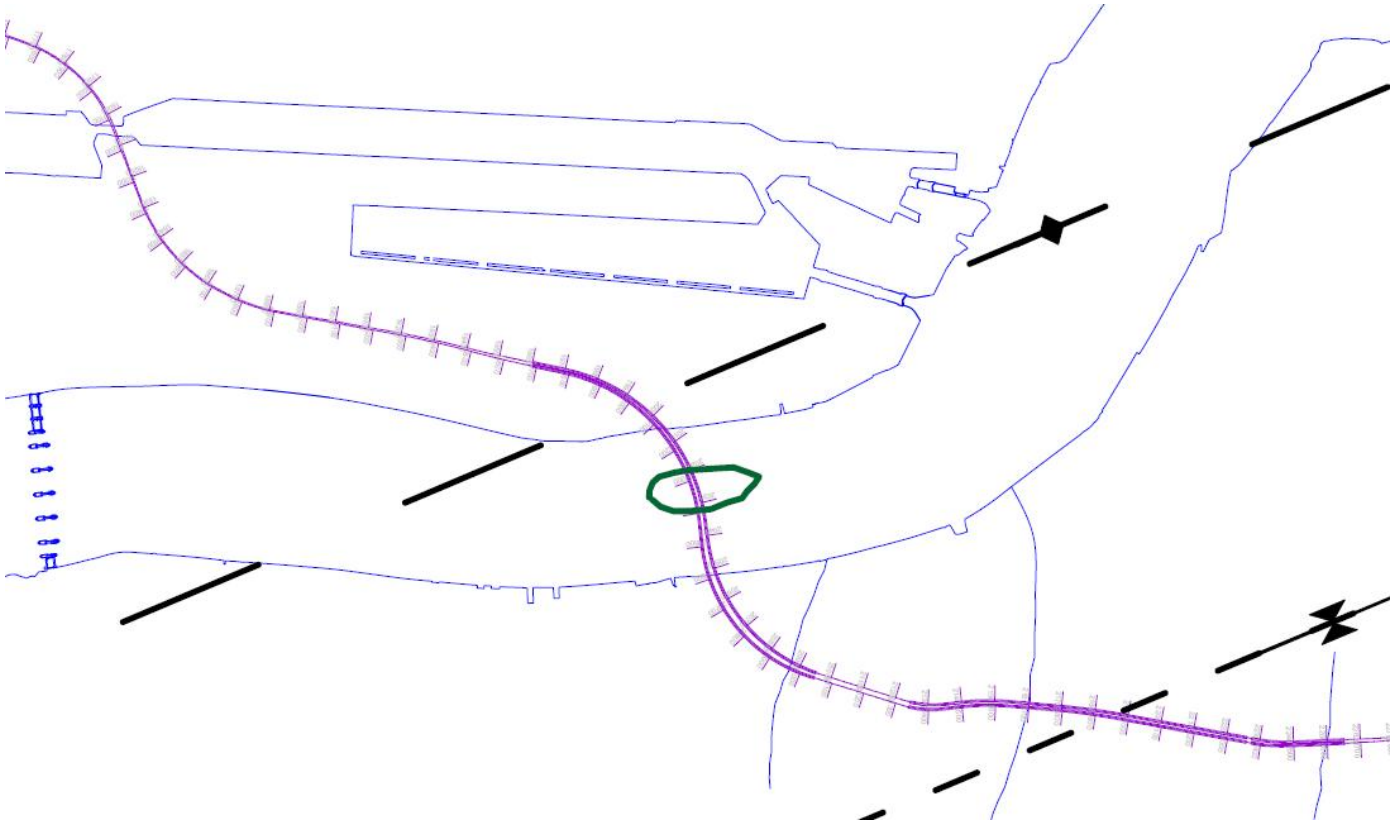




Drift Filled Hollow at the Thames River Crossing

Drift Filled Hollow at the Thames River Crossing

Context



Thames River Crossing Hollow

- Reported in Lenham et al Proc. ICE,Civil Engineering 2006

- Entirely within the current River course & elongated parallel to it
- Sub-parallel to the structure axes
- Presence of minor faulting of the Chalk

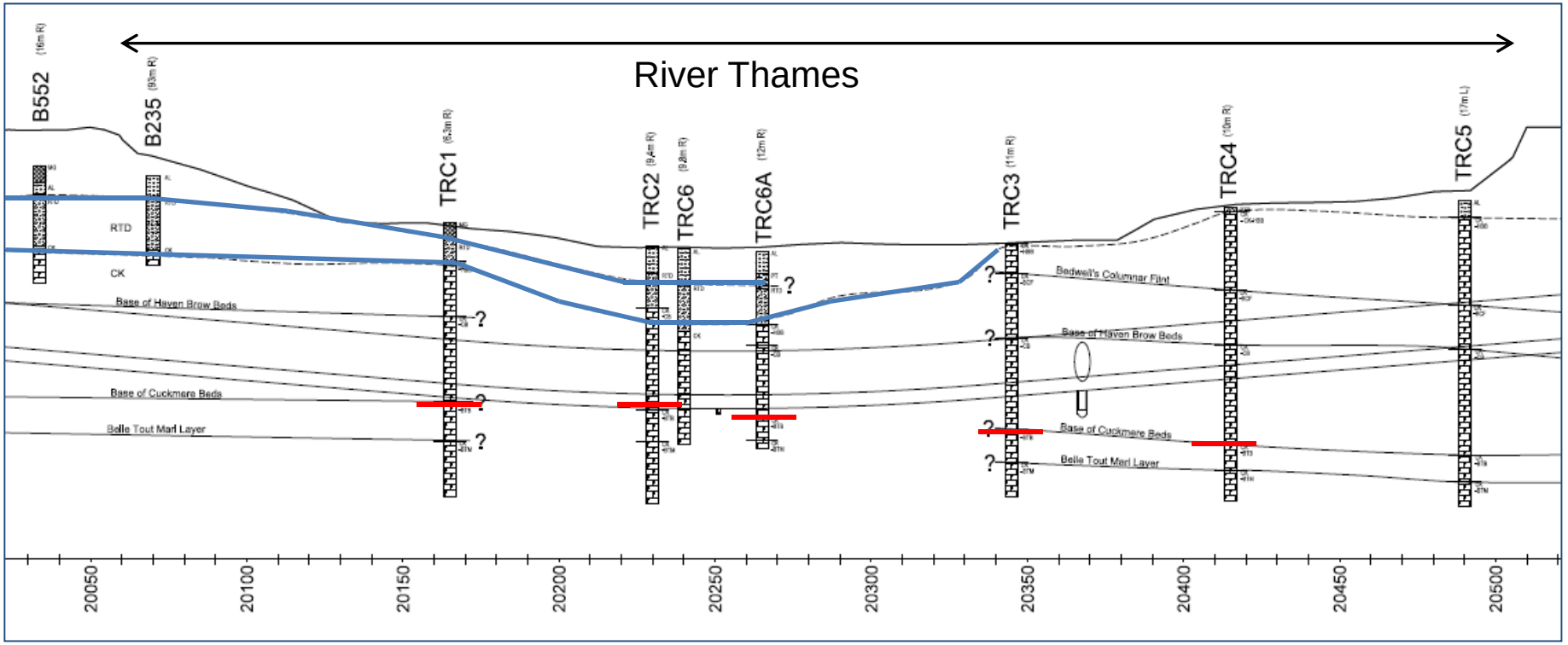
- Elev at top 90m
- Elev at known base 80m
- Approx 400m long & 200m wide

- Strata below base = Chalk
- Infill materials = Kempton Park RTD & Alluvium
- No record of clay layers or large ‘inclusions’ – but data limited.

- Limited thickness of weathered Chalk in the base ?
- Scour ?

- This location was outside the scope of Berry’s paper.

Thames River Crossing Hollow



Thames River Crossing Hollow

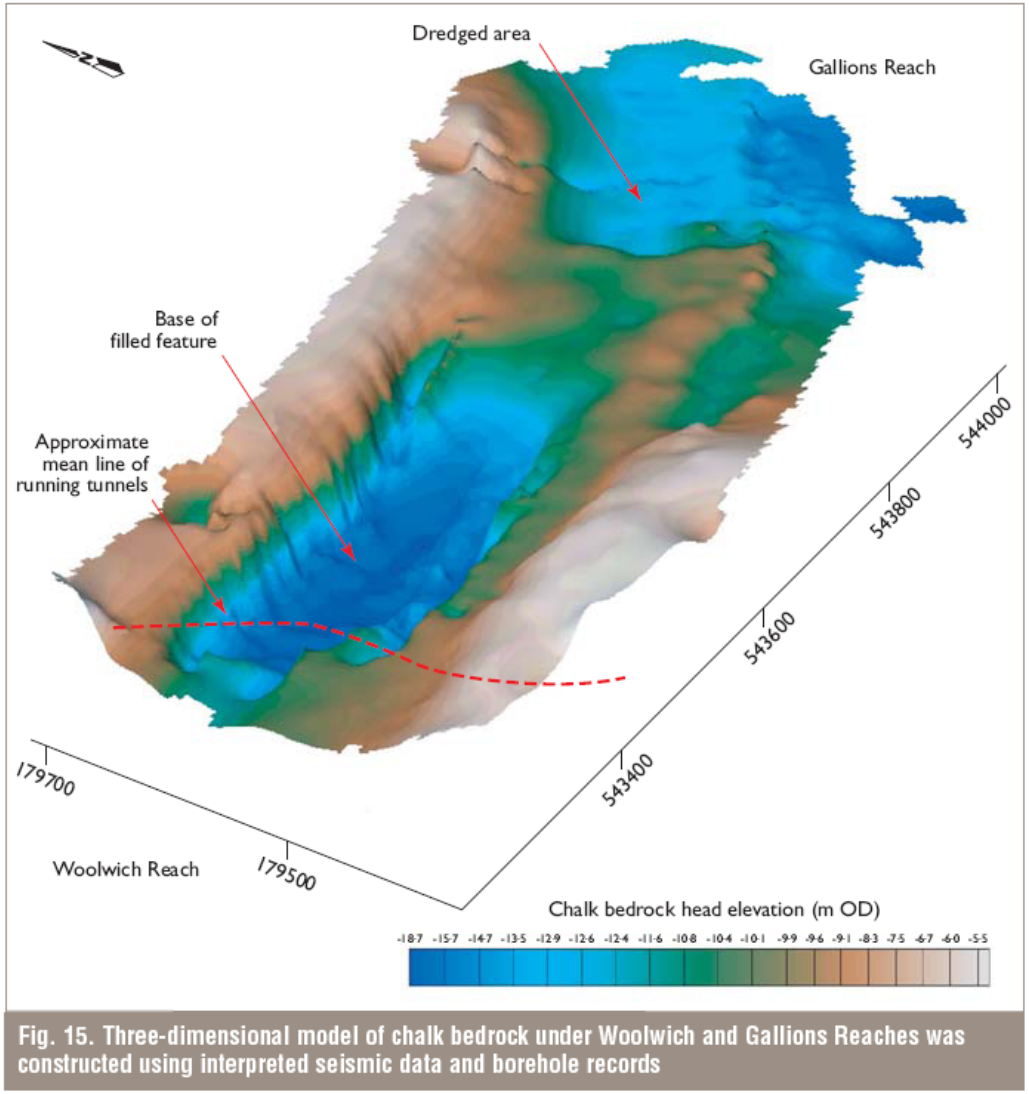


Fig. 15. Three-dimensional model of chalk bedrock under Woolwich and Gallions Reaches was constructed using interpreted seismic data and borehole records

Taken from Lenham et al Proc. ICE, Civil Engineering 2006

Thames River Crossing Hollow

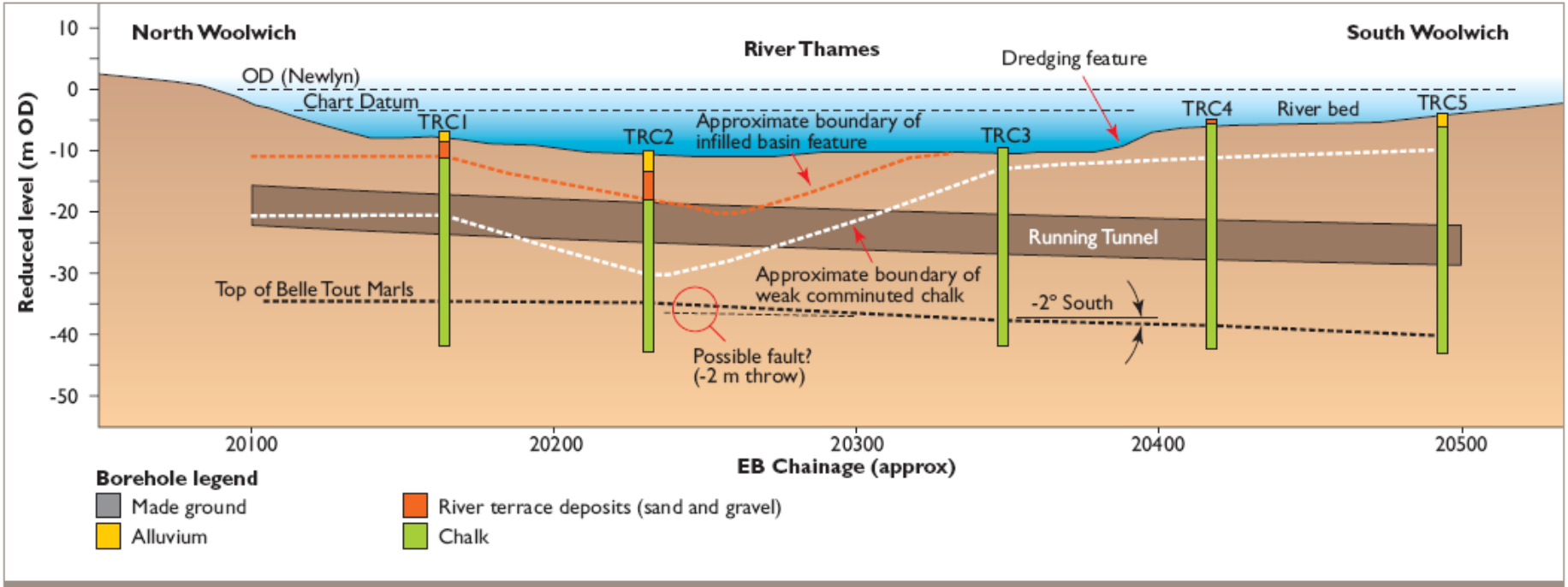
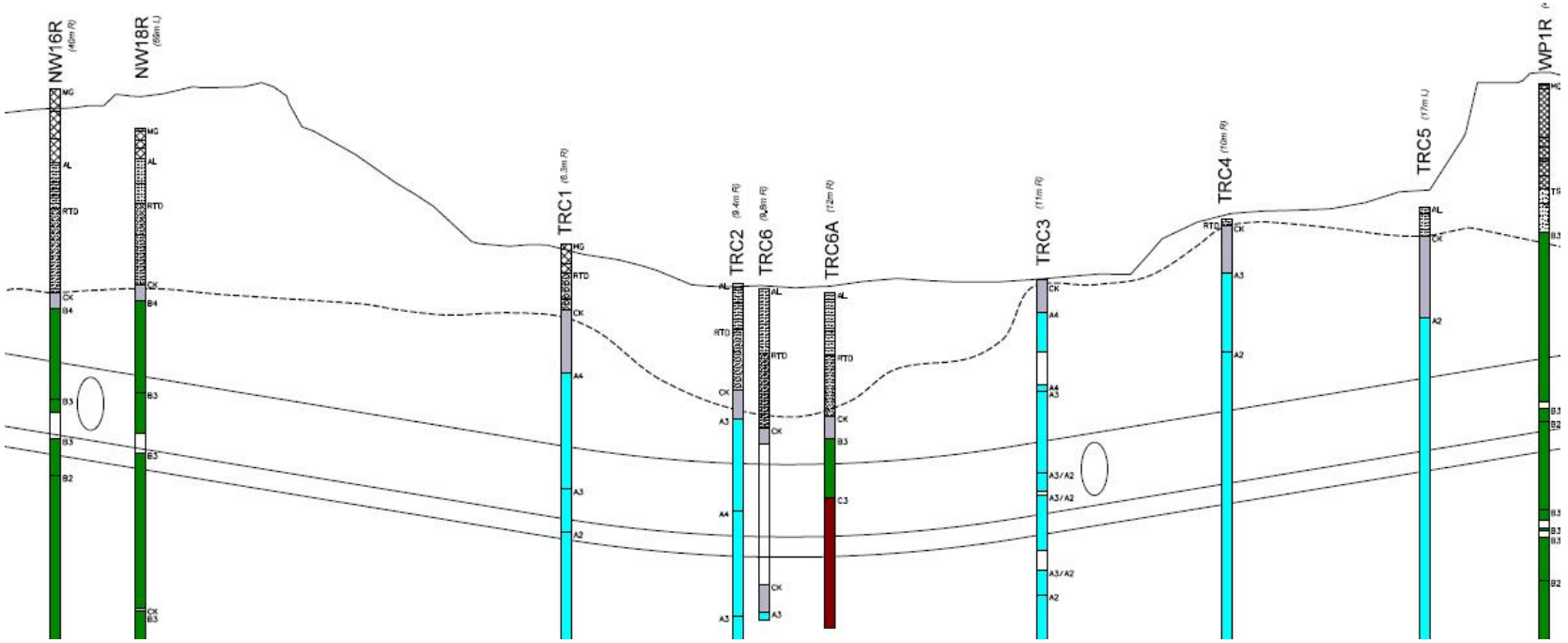


Fig. 16. Cross-section along the proposed tunnel alignment showing the riverbed bathymetry, borehole stratigraphy, approximate boundaries of the filled-basin feature and the base of the weak comminuted chalk

Taken from Lenham et al Proc. ICE, Civil Engineering 2006

Thames River Crossing Hollow



Comparison

Feature	Moorgate	Limmo	Thames River Crossing
Terrace ?	Edge of Taplow	Kempton Park	Kempton Park
Modern watercourse ?	Yes but minor	Yes	Yes
Faulting ?	No	Yes	Yes but minor
Depth ?	10m	20m	10m
Max width ?	70m	≈ 450m	400m x 200m
Infill ?	Alluvium, Gravel, Sand with large Clay inclusions	Alluvium, Sand and Gravel	Alluvium, Sand and Gravel
Area of thick LC ?	Yes	Yes, located in a faulted syncline	N/A
LG Sand Channel ?	Yes but minor	Yes	N/A
Max Slope angle	1V:2.5H	1V:2H	1V:6H
Clay layers or large inclusions ?	Yes	No	No

Thankyou !

MOVING LONDON FORWARD