Good Grounding is Key to Gateway

Understanding ground conditions can save time and money. Dr Kate Royse explains why geology still has a key role to plat in the regeneration of the Thames Gateway

The 40-mile stretch of land along the River Thames that forms the Thames Gateway is the focus for the biggest building programme to be undertaken in the UK for over 50 years. The key areas for redevelopment have already been chosen, so one might reasonably ask, "Geology -why consider it now?"

The answer is straightforward. For the most part the key development areas have been selected primarily on the basis of socio-economic factors. However, environmental issues – sustainable urban drainage, biodiversity, flood control and foundation conditions – remain important considerations, for which an understanding of the geology can be critical.

Most major development projects in the Thames Gateway will necessitate construction on ground that would be classed as 'difficult' in engineering terms. Compressible soils, high groundwater levels and potentially contaminated brownfield sites are typical of the problems that will need to be faced.

Failure to fully appreciate the ground conditions at the planning stage of any development is likely to prove costly and may lead to project over-run. A report by the Institution of Civil Engineers in 1993 found that half of 5,000 industrial building projects surveyed overran their construction programmes by more than one month; those on redeveloped sites had all met unforeseen ground conditions.

Unlike the Environment Agency and the Countryside Agency, the BGS is not a statutory consultee in the planning process. However, the Thames Gateway planning framework document (RPG 9a) recognises numerous issues related to geology. These include existing and potential land contamination, preservation of the natural environment (including sites of geological and geomorphological value) and flood risk.

The Kent County Structure Plan which applies to much of the Thames Gateway, contains a strategic land use policy stating that '*In the Thames Gateway.. it is strategic policy to upgrade the quality of the environment, and to enhance the economic base of the area… Decisions affecting the environmental quality of the area should take into account the cumulative impact of the proposal in question, in the context of other development and proposals.*'

If sound decisions are to be made, then clearly those organizations involved in planning and development need easy access to all relevant information. Whilst some planners and developers have regularly used geological information (mostly as map data), a great deal of useful 'technical' information is either overlooked or not sought. As a consequence, ground related constraints and opportunities have not always been taken into account. BGS recognizes that the underutilisation of this national resource has partly been because public access to geological data has been relatively difficult and often only those with geological training fully understand the implications of the information. A new initiative within BGS has commenced to address these issues by providing users with answers rather than just data.

Based on the wealth of geological, geotechnical and other related subsurface information built up in over three decades of work in London, the BGS has recently launched a project focused on making geoscience information for the Thames Gateway more accessible, relevant and understandable to a wide range of users.

Through television documentaries, newspaper and magazine articles we have all become accustomed to clear colourful illustrations 'bringing to life' particular issues and themes. Unfortunately, the presentation of geological information useful to planners and developers has lagged behind this graphical revolution.

Traditionally, geological information has been displayed as two-dimensional (2D) - on maps supported by cross-sections and map keys. Recent digital advances have introduced the routine use of Geographic Information Systems (GIS), which enable an unlimited range of spatial data to be displayed as single or multiple 'layers' and, importantly, these layers may be queried. Further more, "what if?" scenarios (forward modeling) may be introduced that will better inform ground investigation and reclamation strategies.

Rapid developments in three-dimensional (3D) modeling software are now providing challenging and exciting possibilities for constructing high-resolution geological models of the shallow sub-surface. Using this new technology (supported by our geological and geotechnical archives), we can start to predict not only the type of rocks that lie beneath our feet, but also their engineering properties (rock strength, shrink-swell characteristics and compressibility) and hydrological properties (permeability, porosity, thickness of the unsaturated zone or the presence of perched water tables).

With escalating development and the growth in urban areas of hard paved surfaces, the problems associated with surface water runoff are a significant issue. The Foresight project (2004) predicted that the continued urbanisation of flood-prone areas, such as the Thames Gateway, would result in an increase in surface water runoff, such that the flood risk would be increased by up to 3 times its current level.

SUDS (Sustainable Urban Drainage Systems) are an alternative approach to conventional drainage systems that try to mimic natural drainage patterns as far as possible. The successful implementation of SUDS techniques, including swales, balancing ponds and porous pavements can save money, reduce pollution and alleviate flood risk (CIRIA 2001).

SUDS techniques need to be addressed at the early stages of project design to determine their suitability (PAN 61). The BGS has developed methods that allow the applicability of SUDS to be assessed quickly and simply, by reference to the 3D lithological model (rock type e.g. sand, clay, peat etc). Data used in the assessment includes: the topographic slope angle, the permeability of the near-surface deposits and the thickness of the unsaturated zone. BGS can then provide charts that combine all this information into a simple tri-category map; areas more suited to infiltration techniques can then be easily identified. Further information can be added such as the potential for past contamination, present day land use and aquifer vulnerability. All this data can be easily incorporated into the model resulting in a more sophisticated site-specific interpretation. These maps provide answers at a click of a button and can be viewed in most GIS software packages, making it easy and simple to use.

3D models of foundation conditions are derived by linking the lithological model with geotechnical (physical and mechanical) properties such as soil moisture content, strength, and consolidation characteristics. The BGS has created such a model for West Thurrock. The geology and hence the foundation conditions in this area are typical of much of the Thames Gateway region.

In the West Thurrock example the ground conditions were split into 6 different categories. These varied from very compressible, corresponding to the presence of peat, to areas classified as only slightly compressible, which included the river terrace deposits and engineered made ground. Chalk underlies the whole area and is considered to be variably compressible. The reason for this is that at rockhead (the surface between bedrock and overlying unconsolidated material) chalk may have weathered to "putty" chalk, which has

similar characteristics to silt. This results in chalk close to rockhead often having an irregular karstic surface characterized by sinkholes. In general, foundation conditions within the chalk improve with depth from rockhead. However, how deep do we have to go before we can be certain of reaching unweathered chalk? The 3D foundation model can answer this question, by using the geotechnical data to derive a zone of weathered chalk below which the chances of encountering sinkholes is much diminished.

The 3D model of foundation conditions gives the user the ability to evaluate the ground conditions at the level that building is to take place. In the West Thurrock area, ground conditions viewed at 2m below surface are different to those observed on the surface. At 2m, depth nearly half the area's ground conditions are classified within the highly to very compressible category. At 5m below surface, this situation has changed again; now only a very small proportion of the area is marked as highly compressible. This type of data can be used in a myriad of ways from predicting how difficult in engineering terms a project is going to be and hence how long it might take, to selecting preferred areas for development.

BGS is striving towards producing 3D geological 'property' models, which may be readily accessed, viewed and queried by a wide range of users as their needs arise, and without the need, necessarily, to involve a professional geologist.

Planning authorities, developers, consultants and any one with an interest in learning more about this project and the products and services that the BGS has to offer are invited to contact the author.

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