

London Legacy Development  
Corporation  
**Stratford Waterfront**  
Engineering Feasibility Report

ARUP-REP-001

Draft 1 | 19 March 2014

Draft

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 234453

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## 2 Site constraints

### 2.1 The site

The site is in the Queen Elizabeth Olympic Park and is known as Development Parcels 1.1a and 1.1b within Planning Development Zone 1 (PDZ1) of the Legacy Communities Scheme, for which outline planning permission has been granted for predominantly residential use with some retail and/or leisure use at ground floor level.

The site is located to the north-west of the London Aquatics Centre and the F10 footbridge. It is bounded to the south-west and west by the Waterworks River and to the north-east by Carpenter's Road. Beyond Carpenter's Road to the north-east are railway tracks.

Refer to figure 2.1 for the approximate extent of the site.

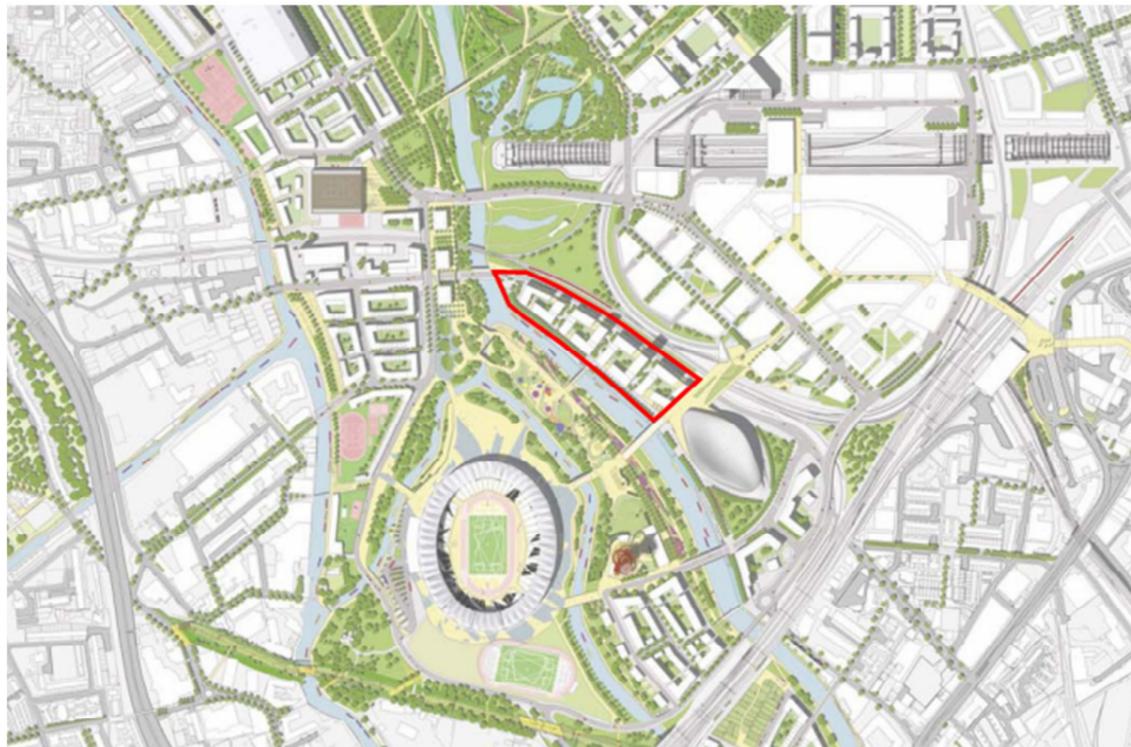


Figure 2.1 Site plan

## 2.2 Site Constraints

### 2.2.1 Levels and adjacencies

The site consists of made ground that was imported as part of the development of this area for the Olympic Games. Ground level is at +5.5mOD to +6.5mOD over most of the site, rising locally to +8.0 mOD in the vicinity of bridge F09 which crosses the Waterworks River to the south-west, approximately halfway along the length of the site.

The Waterworks River runs at a normal water level of +2.3 mOD. The assumed flood level is +5.7 mOD.

Bridge F10 to the south-east of the site delivers pedestrians at approximately +14.5 mOD, adjacent to the London Aquatics Centre. This is the primary level of future entry to the site to visitors who would pass the site at this level on their journey from Stratford Regional Station towards the South Plaza area and the stadium beyond.

The International Quarter (TIQ) and Westfield lie to the north-east of the site beyond the railway tracks, at a level of approximately +14.5 mOD, and the possibility of another footbridge linking this site to TIQ across the railway has been identified and incorporated into the masterplanning of both developments.

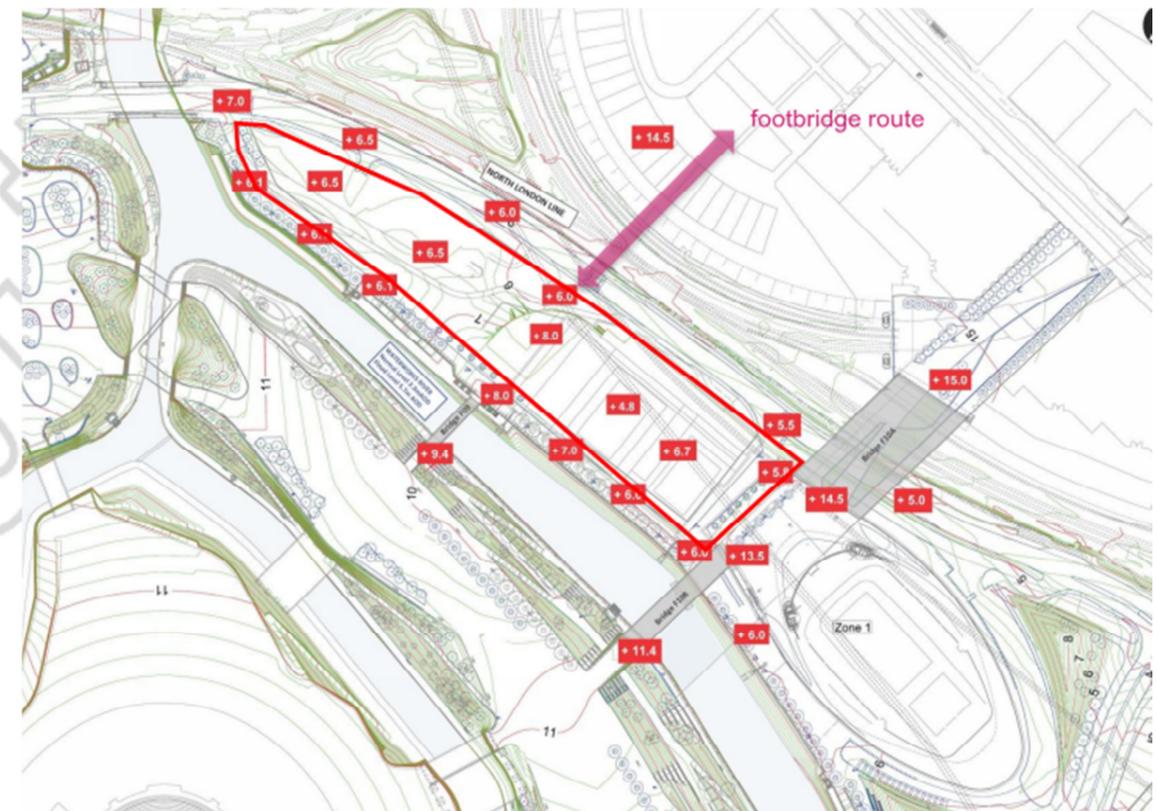
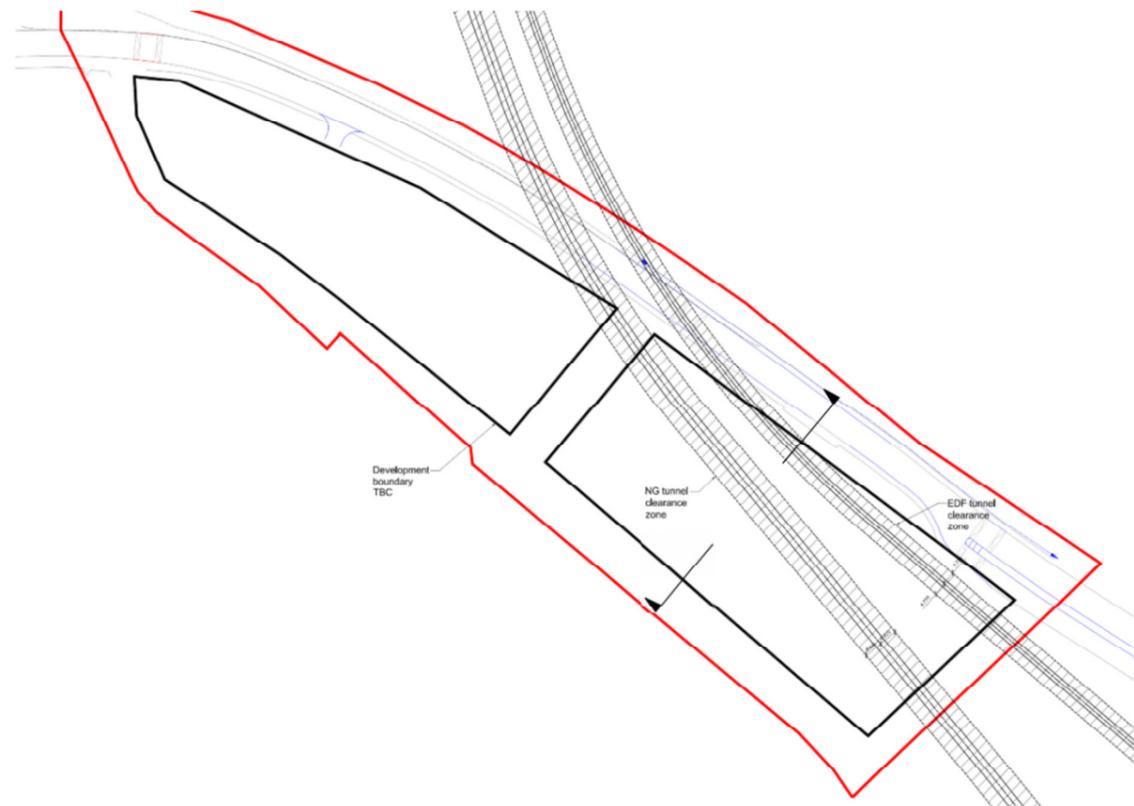


Figure 2.2 Site levels and adjacencies

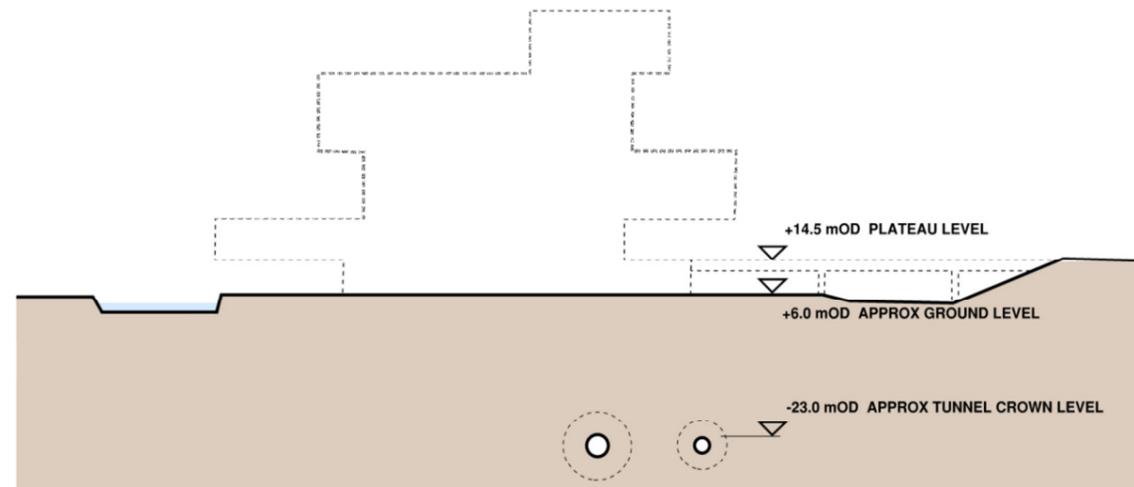
### 2.2.2 Existing Power Lines Under Ground (PLUG) tunnels

The Power Lines Underground Tunnels (PLUG) were constructed in 2006/07 to facilitate removal of pylons crossing the proposed site of the Olympic Park. Arup acted as Project Managers for delivery of these tunnels. Both the UK Power Networks (UKPN) and National Grid (NG) tunnels pass beneath the Stratford Waterfront site.

Figures 2.3 and 2.4 indicate the approximate location of the PLUG tunnels under the site.

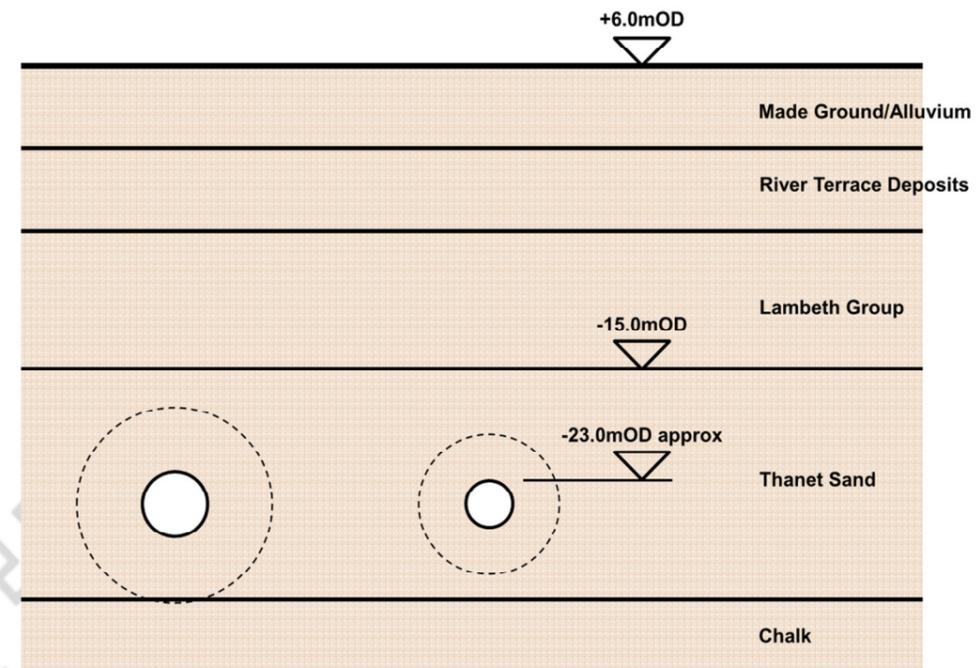


**Figure 2.3** Plan showing approximate location of PLUG tunnels below the development plots PDZ1a and PDZ1b.



**Figure 2.4** Indicative section through the site showing PLUG tunnels.

The external crown elevation for both tunnels is at a level of approximately -22mOD.



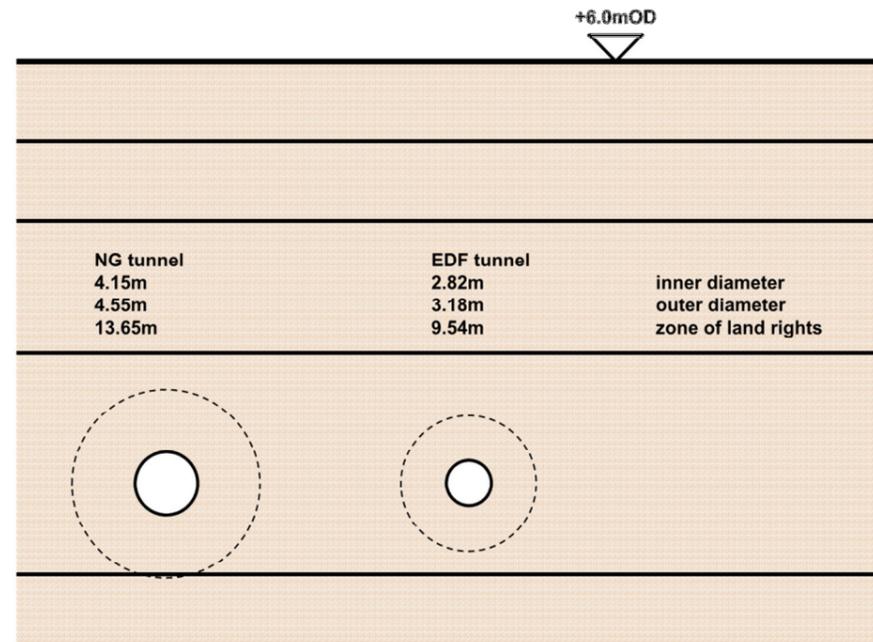
**Figure 2.5** PLUG tunnel locations and ground conditions

The PLUG tunnels have the following dimensions:

- UKPN tunnel, external diameter = 3.18m (180mm thick expanded concrete lining)
- NG tunnel, external diameter = 4.55m (200mm thick expanded concrete lining)

NG and UKPN own the land rights around the tunnel extrados to a distance of 1 times the external diameter of the tunnel. It is understood that if piles are proposed to encroach within this zone then separate legal agreements would need to be obtained between the owners of the tunnel structures and the project promoter.

These areas are summarised in figure 2.6.



**Figure 2.6** Zones of land rights around the PLUG tunnels

An ‘interface protocol’ defining the approach to gaining approval for physical works to be carried out in the vicinity of the tunnels was agreed to between the ODA, UK Power Networks and NG for the formation of the Olympic Park.

Drawings and condition surveys providing the alignment, geometry and condition of the as-constructed tunnels are retained by Arup.

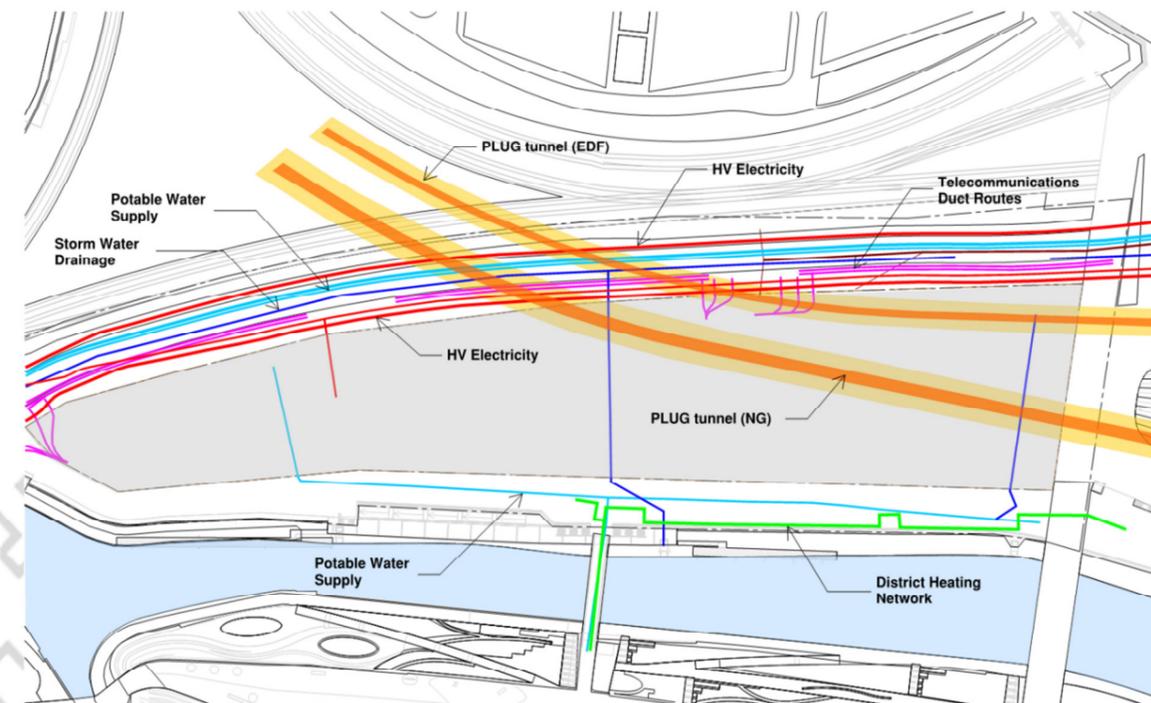
### 2.2.3 Utilities infrastructure

Most of the existing utilities infrastructure for the site runs along Carpenter’s Road to the north-east.

The primary infrastructure utilities around the site consist of the following:

- 132 kV HV electrical ducts running between Carpenter’s Road and the development boundary.
- Two sets of 11kV HV electrical ducts running along both sides of Carpenter’s Road
- Telecommunications networks running between Carpenter’s Road and the development boundary
- 1200mm diameter potable water main running underneath Carpenter’s Road
- 250mm diameter potable water main running into the site from the west across the F09 footbridge and branching out alongside the canal.
- 225-600mm storm water drains running underneath Carpenter’s Road and then passing across the site to the west before discharging into the Waterworks River.
- 200mm diameter district heating main supplying the site from the west via the F09 footbridge

These are shown indicatively in figure 2.7 below.



**Figure 2.7** Summary of primary utilities infrastructure

### 2.2.4 Construction access constraints

Construction access to the site will be via Carpenter’s Road to the east. The phasing of construction will need to be planned in a way that maintains this access route.

## 2.3 Ground conditions

### 2.3.1 General

Ground and groundwater conditions were established for the purpose of carrying out the London Aquatic Centre (LAC) design. The LAC is immediately to the south of the proposed development site. However, most of the site investigations were also carried out across the Stratford Waterfront site too.

At this stage a desk study of the site has yet to be carried out. The desk study will allow risks associated with the proposed development to be better defined.

### 2.3.2 Site investigations

Geotechnical site investigations have been carried out by several companies across the site as part of either the Olympic Park works or earlier development proposals. Table 2.1 lists these investigations.

Company	Year	Location
Soil Mechanics	2006	Along Waterworks River wall
Harrison Group	2005	Whole site
Soil Mechanics	2005	Along route of National Grid and UK Power Network tunnels
White Young Green	2004	Whole site, including contamination testing
Enviros Aspinwall	1995, 2001	Mainly contamination, most information around Warton Road
Geotechnical Engineering Ltd	2000	Whole site
White Young Green	2007	Geotechnical and soil and groundwater contamination, carried out along river wall and remainder of site
Ritchies	2007	Whole site

**Table 2.1 Previous site investigations**

### 2.3.3 Stratigraphy

Using the factual information from the ground investigation, table 2.2 provides brief descriptions of the stratigraphy that underlie the Stratford Waterfront site. Approximate levels of the top of each strata have been included for scheme design purposes.

Strata	Description	Approximate top level of strata (mOD)
Made Ground	Highly variable in composition consisting of a mixture of both fine and coarse grained material. A significant number of obstructions such as timber piles and beams, reinforced / mass concrete and brick foundations were also found in the Made Ground.	+5
Alluvium	The alluvium comprises of a soft to firm silty, sandy clay deposit. Peat bands were also found within the deposit.	+2.5
River Terrace deposits	The River Terrace deposits comprise medium dense silty gravelly sand. The shallow aquifer is contained in the River Terrace deposits.	+1

Lambeth Group	The constituents of the Lambeth Group vary considerably with depth and laterally across the site. In general the formation consists firm to very stiff clay /silt with variable thicknesses of silt and sand layers. Towards the base of the deposit there are layers of sand and rounded flint gravel present.	-2.5
Thanet Sand	The Thanet Sands consist primarily of dense to very dense grey-green silty occasionally clayey sand. The deposit becomes increasingly silty with depth.	-15
Chalk	The Chalk encountered is classified as Structured White Chalk (Upper Chalk Formation) of Grade B3. Distinctive flint bands were encountered within the Chalk at levels ranging from approximately -34mOD to -39mOD.	-31

**Table 2.2 Description of stratigraphy**

### 2.3.4 Groundwater conditions

Groundwater pressures will vary in the shallow aquifer depending on the groundwater level in the superficial deposits and the nearby Waterworks River. Due to the presence of significant quantities of fine grained deposits in the Lambeth Group, the strata will act as an aquitard and the groundwater pressure profile will not respond in a hydrostatic manner corresponding to the near surface groundwater levels.

It should be noted that a drawn down pressure profile will exist across the site throughout the design life of the structure. This is due to the de-watering taking place at the nearby High Speed 1 (HS1) Stratford Box which reduced groundwater pressures at the site. The de-watering at the HS1 Stratford Box site is a design requirement for the structure to relieve groundwater pressures on the base slab.

Assessment of groundwater monitoring data as part of the Olympic Park and London Aquatic Centre development has demonstrated that this profile exists at radial distances corresponding to where the Stratford Waterfront site is.

Significant benefit can be gained in terms of the load carrying capacities of the pile design if the design relies upon continued pumping from the HS1 Stratford Box. This design assumption has been assumed for the purpose of the London Aquatic Centre and much of the infrastructure design across the Olympic Park site.

### 2.3.5 Contamination, unexploded ordnance and archaeology

Risks relating to unexploded ordnance, contamination and archaeological risk have been appraised as part of a number of studies carried out as part of the Olympic Park development. There are a number of risks associated with each of these with respect to the proposed Stratford Waterfront development. These will need to be better quantified from carrying out a desk study covering the proposed development site.