Technical information sheet F011

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Piling in Brownfield Sites

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Development of Brownfield sites is becoming more commonplace in Ireland. The following describes the possible risks associated with piling in Brownfield sites.

Development of Brownfield site is becoming more commonplace due to the increased scarcity of suitable development land.

In most cases, these developments require piling and/or deep foundations, due to the unsuitable nature of near surface material to conventional foundation methods *(ie: low bearing capacity values or unsuitable for excavation and removal from site).*

The following describes the specific risks associated with piling in *Brownfield* sites.

Risk:

Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface

Where pile excavation creates arisings, there is a potential for such arisings to contain contaminated soil which is brought into contact with sensitive receptors. The piling process is likely to mix contaminated and uncontaminated soils, leading to an increased volume of contaminated materials for disposal. If the soil contains asbestos or other forms of relatively non-mobile but hazardous contaminants (e.g. PCBs and dioxins) the creation of arisings may be particularly undesirable. Contaminated piling arisings may also cause cross-contamination to isolation layers.

Risk:

Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an aquifer

A typical situation is where filled (contaminated) ground is situated above clay drift deposits, that in turn sits on solid strata such as the Limestone. Frequently perched water exists within the made ground, with the drift deposits inhibiting downward movement of the perched groundwater.

Disturbance of this aquitard layer has the potential to create a migration pathway, provided that a downward hydraulic gradient exists between the perched groundwater and the aquifer.

A similar situation could arise if a closed landfill, with a basal liner, was to be redeveloped, with structural loads supported on piles founded in solid strata below the basal liner.

Risk:

Creation of preferential pathways, through a low permeability surface layer, to allow migration of landfill gas, soil gas or contaminant vapours to the surface.

This situation may be encountered where development is proposed on an old landfill, or a Brownfield site, when ground levels have been raised using contaminated (gas generating) fill. Alternatively, this may occur where land has been contaminated with volatile compounds, such as petroleum spirit. Frequently an impermeable cap is present as part of the remediation solution to manage the existing gassing regime. Disturbance of this capping layer has the potential to create a migration pathway for landfill gas, or could create air-flow pathways that might render an active gas extraction system ineffective. The introduction of air may affect the existing gas generation within the fill, for example, increasing the rate of degradation and increase the volume of gas generated.

Risk:

Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials

Some contaminants or constituents of contaminated soil or leachate may be aggressive to materials used in piles. This has the potential to cause degradation to the piles, reducing or eliminating their load carrying capacity, and possibly creating migration pathways. In an extreme case, this could lead to catastrophic failure of building structures, although a building designer and local authority building control officer should be expected to take into account any aggressive properties of the ground in preparing and approving their designs. From a purely environmental point of view, the most significant impact could be created by subsequent remedial works designed to maintain the building's stability.

Risk:

The driving of solid contaminants down into an aquifer during pile driving

The primary movement of soil during piling is in a lateral direction, but there is potential for soil in contact with the sides of a driven pile and material below the butt end of a solid or closed-end pile to be dragged down slightly before it is displaced laterally. There is also a potential for open-ended tubular piles to become 'plugged' with soil, enabling material captured near the surface to be transported downwards within the tube towards the founding level. This is most likely to occur when stiff or dense soils are present.

Risk:

Contamination of groundwater and, subsequently, surface waters by wet concrete, cement paste or grout

Loss of wet concrete, cement paste or grout may occur in fast-flowing groundwater, probably associated with fractured or jointed rocks such as limestone or permeable gravel formations. Migration may occur until setting of the concrete, cement paste or grout occurs; this would generally occur on a timescale of a few minutes. Use of retarder additives could extend this timescale to a few hours, although their effectiveness would be reduced by dilution. In most circumstances, therefore, the impact, if any, is likely to be localised.

All in all, the development of Brownfield site is a positive development. It allows for large areas of previously unsuitable land to be converted into useful and often prime development sites. However, these sites have very specific risks and it is vital that the risks are properly understood and managed.

Recommended reading:

'Methods on Land Affected by Contamination: Guidance on Pollution Prevention (May 2001)'
F J Westcott, C M B Lean & M L Cunningham
UK Environment Agency, National Groundwater & Contaminated Land Centre report NC/99/73

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