Guidance Notes for Developers

The assessment of surface and sub-surface developments in the vicinity of the Dublin Port Tunnel

GUIDANCE NOTES
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1 Dublin Port Tunnel

The Dublin Port Tunnel was commissioned in December 2006. The alignment of the tunnel extends from the Santry interchange in the north of the scheme to an area west of the Port of Dublin.

The tunnel project employed a base reference, zero chainage, point 600m from the northern portals on the M1 road alignment. This nomenclature is used consistently through this document.

The northern extent was constructed using the cut and cover method from the northern portals at project Ch. 0+600[m] to an area roughly opposite Whitehall Church (Ch. 1+900). This portion of the tunnel is entirely overlain by the N1 national road from the church to the north tunnel portals at the Santry interchange.

From Ch. 1+900 to Ch. 4+537 at Fairview Park, the tunnel was constructed as twin bored tunnels and is overlain by green-field sites and densely populated housing/retail development. These tunnels were driven by tunnel boring machines (TBMs) from a 56m diameter shaft, centred at Ch. 2+250 which was subsequently backfilled.

Within Fairview Park, the tunnel was constructed using cut and cover methods which continued on the south side of the railway where the southern portals are located north of the Tolka river (Ch. 5+100).

Taking the above into consideration and for the purpose of this document, the alignment has been divided into areas of potential future surface development. In addition, these areas have been further subdivided, where applicable, on the basis of the prevailing geological conditions and the structure of the tunnel lining.

It is anticipated that future developments in the vicinity of the tunnel will take place in three main geographical areas notably:

A. From Ch. 2+000 to Ch. 2+170 – Currently designated and used as the church car park.
B. From Ch. 2+210 to Ch. 4+537 – "Green-field" land from Collins Avenue to Griffith Avenue and the housing/retail areas of Marino and Fairview.
C. From Ch. 4+950 to Ch. 5+000 – Approximate area between the railway wayleave and Alfie Byrne Road.

Area (B) has been sub-divided as follows:

i) Ch. 2+210 to Ch. 2+400 – Area above bored tunnel constructed within soils
ii) Ch. 2+227 to Ch. 2+283 – Area above Vehicular Cross Passage 2 (VCP 2)
iii) Ch. 2+400 to Ch. 3+330 – Area above bored tunnel constructed within rock with low rock cover
iv) Ch. 2+950 to Ch. 3+050 – Area above VCP 3
v) Ch. 3+330 to Ch. 4+430 – Area above bored tunnel constructed within rock with high rock cover
vi) Ch. 4+100 to Ch. 4+200 – Area above VCP 4
vii) Ch. 4+430 to Ch. 4+537 – Area above bored tunnel constructed partly within soils and partly within rock

The above sub-division takes into consideration the variable nature of the ground along the tunnel and the special geometry associated with the large VCPs.

1.1 DPT Information

The following information will be submitted to the developer. The documents are primarily in Portable Document Format (pdf files), augmented by several CAD and MS Excel files:

- Site investigation profiles and interpretation; Long sections and plans (5 files)
- Geological logs – Additional boreholes (18 files)
- As-built tunnel geology (11 files)
- DPT Employer's Requirements – Relevant clauses (2 files)
- Bored Tunnel Alignment - as-built drawings (20 files)
- Bored Tunnel Primary Lining – calculations (2 files)
- Bored Tunnel Primary Lining – as-built drawings (7 files)
- Bored Tunnel Niches/ Cross-Passages - as-built drawings (6 files)
- Vehicular Cross-Passages (VCPs) 2, 3 & 4 – as-built drawings (17 files)
- Bored Tunnel VCPs - Design statement (1 file)
- Cut & Cover Horseshoe Structure – calculations (1 file)
- Cut & Cover Horseshoe Structure – as-built drawings (34 files)
- Mainline Alignment – setting-out data (1 file)
- Mainline Alignment – as-built wriggle data (4 files)
- Mainline Alignment – as-built drawings CAD format (14 files)
- NRA Specification for Road Works – Series 600 – Earthworks (1 file)
- Topographical Surveys - Local to National Grid conversion (2 files)

2 Assessment Criteria

2.1 Location

The NRA will employ the following diagrams to decide on the **initial** requirement for an assessment by the developer:

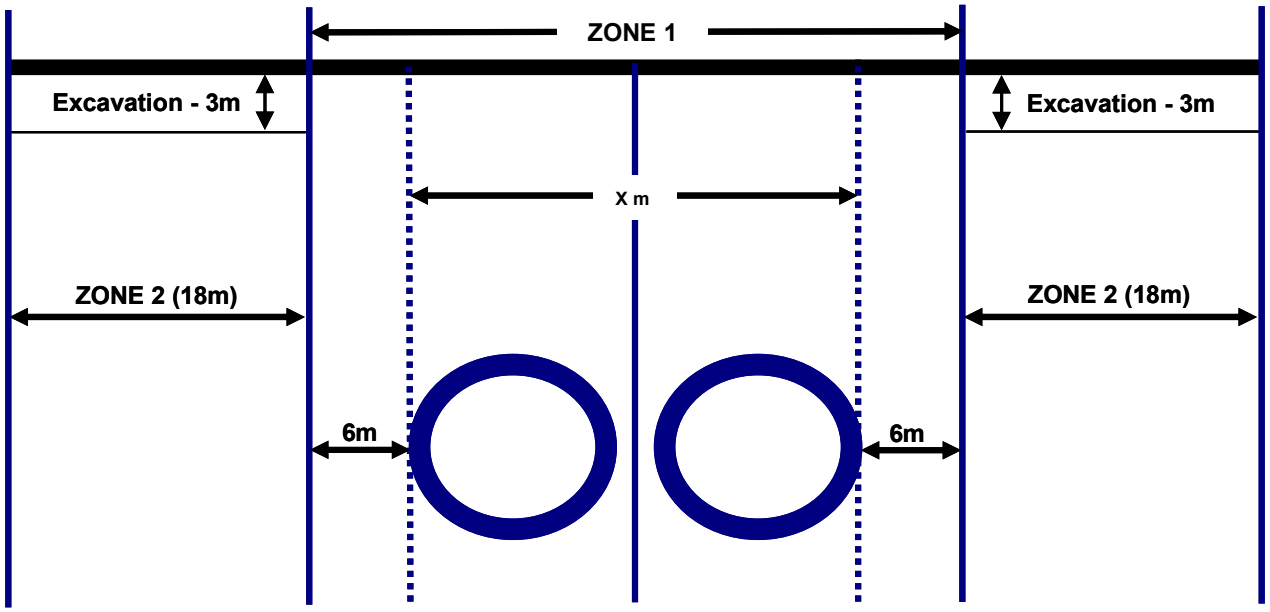

Figure 1: Bored Tunnel – Areas A&B [1]

Not to scale – Depth of Tunnel varies

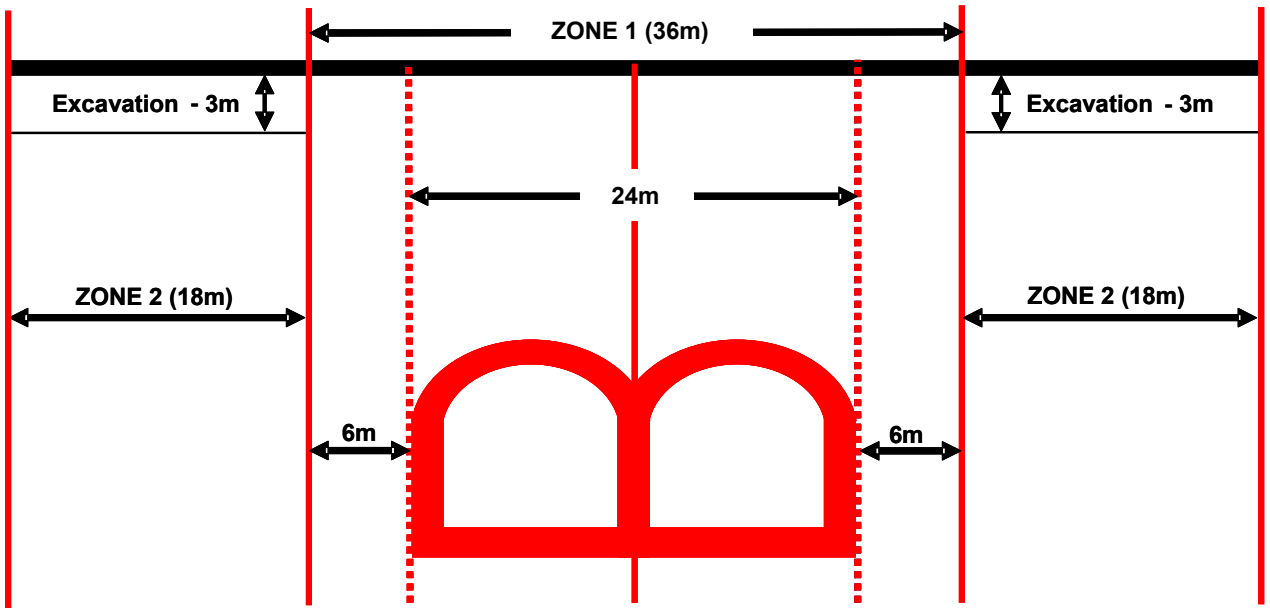

Figure 2: Cut & Cover Tunnel – Area C [1]

Not to scale – Depth of Tunnel varies

[1] Adapted from; Nye, Ted (2005). *Building around Tunnels – Case Histories,* AGS AUCTA Mini-Symposium: Geotechnical Aspects of Tunnelling for Infrastructure Projects

The following assessments are required by the NRA:

- All developments within **ZONE 1** are to be assessed by a qualified engineer with experience in the design of underground structures.

- Any development within **ZONE 2** which requires a basement excavation of greater than or equal to 3m depth and/or requires piles or ground anchors for building foundations is to be assessed by a qualified engineer with experience in the design of underground structures.

- Where a proposed development is sited over both Zones 1 and 2 or extends outside of Zone 2, an assessment is to be undertaken for the maximum requirement over the whole footprint of the development, by a qualified engineer with experience in the design of underground structures.

Not withstanding Figures 1 & 2, the following is also required:

- Any development sited in the vicinity of the tunnel which has the potential to affect the groundwater regime e.g. through extraction, is to be assessed by a qualified and experienced engineer with particular experience in groundwater hydrogeology and the design of underground structures.

2.2 Surcharge Loading

The DPT has been designed to sustain surcharge loading of 22.5kNm^{-2} and remain within limits for the SLS (Serviceability Limit State).

The NRA requires:

- The developer to demonstrate that a development does not incur a surcharge loading on the tunnel in excess of **22.5kNm^{-2}** either during construction or at completion. Cognisance must be taken of any surcharge loading at depth due to anchors or piles.

2.3 Unloading

The NRA requires:

- The developer to demonstrate that the method and sequencing of construction of the development minimises or eliminates the potential for tunnel deformation.

2.4 Assessment Variables

The NRA requires:

- The DPT geology model, supplied by the NRA, to be augmented by site investigation data gathered by the developer where applicable.

The NRA requires the developer to consider the following variables in its analysis:

- Depth and lateral location of the tunnel relative to the surface development
- Depth and breadth of the building excavations
- Sequencing of excavations
- Distribution and magnitude of the building loads
- Geological model of the site
- Groundwater levels and any changes that may arise in the short or long term
- Tunnel lining type and profile
- Geotechnical properties of the ground
- Positioning of any ground reinforcement or piles relative to the tunnel
- Direction of all stressing loads at all stages of the works

2.5 Location Specific Requirements

As noted in Section 1, the bored tunnel has been divided and sub-divided based upon location, geology and structure.

The NRA requires:

- All assessments in these areas include analysis based upon the variables listed above and the NRA requirements included in this document.

However, the NRA does not wish to cause delay to the planning approval process. It is possible to reduce the analysis requirements for certain areas.

The NRA will accept:

- A simple load calculation to demonstrate compliance with the $22.5kNm^{-2}$ requirement in Area **B(v)**.

- A simple load calculation to demonstrate compliance with the $22.5kNm^{-2}$ requirement in Area **B(vi)**; however cognisance of the specific structural geology of this area and the relative size and complexity of the underground structure must be demonstrated.

- A simple load calculation to demonstrate compliance with the $22.5kNm^{-2}$ requirement in Area **B(iii)** but **ONLY** if the developer's site investigation can demonstrate competent rock above the area.

Acceptance of the above is dependent on the size of the development and the nature of any ground intrusions e.g. piles. The developer is to make its own assessment on the suitability of availing itself of the reduced requirements. Acceptance of the above is not guaranteed by the NRA.

All other areas must be subjected to the full assessment and analysis as required by the NRA.

In addition to the above, the NRA also requires the developer to demonstrate that:

- Particular attention has been made to the groundwater and hydro-geological conditions that prevail in Area **C.**

- Special attention has been made to Area **B(ii)** not only due to the nature of the underlying structure (VCP 2) but also because of the condition of the overlying ground. In this location, from the VCP structure to the surface, the geology is categorised as made-ground (backfill of the shaft). The majority of the backfill is of type 2C material and complies with the NRA Specification for Road Works, Series 600. Cognisance of this material should be noted by the designer.

The NRA will consider:

- A comprehensive submission from the developer which demonstrates that surcharge loads, during construction and on completion, exceeding 22.5kNm^{-2} are not detrimental to the lining and its components with respect to the Ultimate Limit and Serviceability Limit States.