Preliminary Report on Metrolink Route and its Potential Effect on the Cadenza Building

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This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
Issue 1	03/03/2024	R.Osborne	R.Osborne	

Comments

Executive Summary

The Issue of concern to Irish Life Assurance plc is that although a submission was made to the TII informing the structural form and geometry of the existing Cadenza Building, the TII has ignored the information.

The elevation of the Metrolink Tunnel as it passes under the Cadenza Building does not properly consider the existing Cadenza Building structure, and as a result, the Metrolink Tunnel is going to clash with key elements of the basement structure.

The Exclusion Zone, as defined in the "Draft Guidance Note For Developers" document dated May 2023 prepared by the TII, results in the entire lower basement structure falling within the exclusion zone. Refer to Appendix C of this Report. The reduction of the Limits of Deviation has reduced the level of the exclusion zone, so it no longer includes the existing basement slab, but it does encompass the existing piles and tension anchors, refer to Appendix D of this Report.

The EIAR prepared by Jacobs/IDOM does not correctly identify the Cadenza Building and refers to Davitt House, a building that previously occupied the site and was demolished in 2019. Therefore, all the assessments undertaken are inaccurate and do not properly consider the impact of the Metrolink Tunnel on the Cadenza Building.

We have also identified that the loading imposed by the existing foundations of the Cadenza Building, 1000kN/m^2, is significantly in excess of the 75kN/m^2 that is proposed once the Metrolink Tunnel has been developed. We are concerned that the level of foundation loading so close to the Metrolink Tunnel has not been properly considered by the TII, as they have used the wrong building (Davitt House) in their assessments.

An assessment of the subsidence/settlement induced by the Metrolink Tunnel under the Cadenza Building has been undertaken and found that the damage to the Cadenza Building varies between Very Slight (up to 1.0mm and Slight (up to 5.0mm) as defined in the EIAR (Appendix A5.17 Table 4.4).

An additional assessment of the subsidence/settlement induced by the Metrolink Tunnel under the Cadenza Building has been undertaken, with the MetroLink Tunnel elevation reduced by 5.0m. The damage category to the Cadenza Building varies between Very Slight (up to 1.0mm) and Slight (up to 5.0mm) as defined in the EIAR (Appendix A5.17 Table 4.4). However, the estimated subsidence/settlement magnitudes are lower.

The level of damage the Cadenza Building could reasonably accommodate is Negligible (cracks less than 0.1mm). Even at this level, there are still concerns that the Basement Waterproofing System is going to be compromised and require remedial works to an occupied building.

If the Metrolink Tunnel is to pass under or close to the Cadenza Building, we require a detailed Phase 3 assessment using the correct building geometry and structural form to be completed and independently verified, ensuring the maximum damage caused to the Cadenza Building is limited to 0.1mm cracking. The proposed tunnel elevation may require to be lowered more than the current LOD downwards, i.e. more than the 10.0m indicated in the Wider Effects Report submitted as part of the application, considering the proximity and sensitivity of the Cadenza Building.

The major concern for Irish Life Assurance plc is physical damage to the Cadenza Building, either through the Tunnel Boring Machine damaging the existing structure or the secondary effects caused by the Tunnel Boring Machine, such as subsidence/settlement of the ground damaging the integrity of the waterproofing system, structure and facades.

Based on the findings of this Report, we believe that the Metrolink Tunnel should either be:

1) rerouted around the substructure of the Cadenza building or,

2) the elevation of the Metrolink tunnel should be significantly lowered to a level that no damage will be caused to any part of the Cadenza Building.

Content

Appendices

Disclaimer

1. Introduction

1.1 Qualifications & Experience

I, Richard Osborne, Director of Waterman Moylan Consulting Engineers Limited, have prepared this Report based on a review of the documents and information provided. I have over 25 years of experience in the design, construction and management of an extensive range of building and civil engineering projects. I am a Chartered Engineer ("CEng"), a Fellow of the Association of Consulting Engineers ("FConsEI") and a Member of the Institution of Engineers of Ireland ("MIEI"). I hold a Bachelor's Honour Degree in Engineering ("BENG (Hons)") from Bradford University, England. I have been retained by Irish Life Assurance plc. with respect to the impact of the MetroLink tunnel passing under the recently completed Cadenza Building.

1.2 Background

Waterman Moylan was the original civil and structural designer of the Cadenza Building located at the corner of Earlsfort Terrace and Adelaide Road. The purpose of this Report is to provide the Inspector and the Board with a high-level understanding of the impact of the proposed Metrolink route on the structure of the Cadenza Building. The Cadenza Building is a 12,958 sq m seven-story commercial building with a 2,024 sq m two-story basement platinum LEED-certified building that was permitted under Ref. ABP-300914-18. The structure of the Cadenza Building generally comprises an insitu concrete basement and insitu concrete columns supporting insitu concrete post-tensioned slabs. The façades to the Cadenza Building comprise several bespoke systems that were developed specifically for the development. These facades generally incorporate large glazed panes.

Waterman Moylan has previously prepared the submission that was submitted to the TII concerning the route of the Metrolink. This submission highlights various potential issues that could cause damage to the Cadenza Building, including vibration, noise, settlement and damage to the foundation and basement structure.

This Report concentrates on the damage to the foundations and the basement due to the proximity of the proposed Metrolink tunnel to the existing piled foundations and flotation anchors. Other experts cover the other elements raised in our previous submission under separate reports.

2. Findings

2.1 Metrolink Building Damage Assessment of the Cadenza Building

The proximity of the proposed tunnel to the existing structure has not been correctly assessed or considered by the Jacob / IDOM team. I have reviewed the Building Damage Report ("the BDR") produced by Jacob/IDOM, which was included in Appendix A5.17 of the Environmental Impact Assessment Report ("the EIAR"). In the BDR, the property referenced at the chainage of the Cadenza Building, the Davitt Building was demolished at the end of 2019, four years ago.

The Davitt Building (B147) described in the BDR is a four-story building with a 2.5m basement. It is clearly incorrect and does not represent the Cadenza Building that has been constructed. The findings of the BDR concerning the Building Damage Categorisation are incorrect as the data used was not checked or verified. Therefore, the expected Category of Damage present by Jacob / IDOM cannot be relied upon, which, if followed, would result in damage to our Client's building.

The empirical degree of damage thresholds in the TII risk classification table in the BDR are for masonry structures and do not take account of the main characteristics of the Cadenza Building, including the basement waterproofing system and façade construction, which are referred to in more detail in the next section.

2.2 Metrolink Settlement Assessment at the Cadenza Building

Jacob / IDOM drawing number ML1-JAI-EAI-ROUT_XX-DR-Y-21146, revision P02 dated 23 February 2024 (which appears to supersede ML1-JAI-EAI-ROUT_XX-DR-Y-21149 revision P02, which was included in Appendix C of the BDR), indicates the Jacob / IDOM engineers predict subsidence/settlement of up to 30mm under the footprint of the Cadenza Building. A copy of Jacob / IDOM, drawing number ML1-JAI-EAI-ROUT_XX-DR-Y-21146 Rev P02, has been included in Appendix A of this Report for ease of reference.

The magnitude of the subsidence/settlement under the Cadenza Building is not uniform and varies from 0mm to 30mm. The maximum subsidence/settlement is experienced directly under one of the main stair cores, which provides stability to the building.

The settlement contours presented by Jacob / IDOM indicate that differential settlement/distortion of the Cadenza Building is going to occur, resulting in the following damage:

- The basement uses a Whitetank waterproofing system, which relies on the watertightness of the reinforced concrete basement floor slab and walls. Therefore, even minor cracking could lead to groundwater ingress;
- The internal reinforced concrete frame uses post-tensioned reinforced concrete floor slabs for large spans, which would be more sensitive to differential settlement than conventional RC slabs;
- The tunnel passes under one of the main structural cores for the building, and this incorporates a complex transfer structure at the first-floor level to accommodate a shift in the position of the core for the upper floors of the building;

- The building has a modern steel and glass façade, which would be more sensitive to distortion due to differential settlement along the perimeter secant pile wall than a masonry or blockwork structure.

The Cadenza Building can not accommodate movement of this magnitude without damage to the structure, waterproofing and facades being caused.

2.3 Proposed Metrolink Tunnel Location

Following the publication of the Metrolink Rail Order, including the drawings, Waterman Moylan has reviewed the proposed alignment and level of the Metrolink tunnel under the footprint of the Cadenza Building.

The proposed route of the Metrolink tunnel passes under the Cadenza site, entering at the southern boundary and exiting at the northern boundary. The level of the proposed Metrolink rail varies between c. -9.7m AOD at the southern boundary and c. -10.9m AOD at the northern boundary. Based on the information in the Metrolink Rail Order, we understand the outside diameter of the tunnel to be 9.2m and that the cutting diameter of the proposed Tunnel Boring Machine ("TBM") is 9.53m. We note that the final diameter of the TBM is to be left to the discretion of the contractor and could be larger than currently presented by Jacobs /IDOM.

We have also included in Appendix B of this Report Jacobs/IDOM drawing number ML1-JAI-ARD-ROUT_XX-DR-Y-01018, which was included in the Metrolink Rail Order information pack and is titled "Metrolink - Alignment Long Section 18".

We have reviewed the "Draft Guidance Note For Developers" document dated May 2023, which was submitted at the beginning of the Oral Hearing. In section 2.1.4 Tunnels, Figure 11:Bored Tunnel Protection and Exclusions Zones is presented indicating the exclusion zone to the tunnel extending 5.0m above the top of the tunnel and 10.0m below the bottom of the tunnel. There is also a lateral exclusion zone, which is 15.0m on either side of the tunnel.

We have included drawing number EARL-WMS-ZZ-ZZ-DR-S-21300 in Appendix C of this Report, which indicates the existing structure of the Cadenza Building overlaid with the proposed Metrolink tunnel route and the tunnel exclusion zones set out in the Draft Guidance Note For Developers document.

It is clear to see that the exclusion zones presented in the Draft Guidance Note For Developers document were not developed with consideration for the existing Cadenza Building, as the lower basement substructure is located within the proposed exclusion zone.

We note that DOC ML1-JAI-GEO-ROUT_XX-RP-Y-00034, dated 10 November 2023 and prepared by Jacob/IDOM, has also been submitted as part of the Oral Hearing. In this document the Level of Deviation ("LOD") upwards has been reduced from 5.0m to 1.0m.

We have also included drawing number EARL-WMS-ZZ-ZZ-DR-S-21301 in Appendix D of this Report, which indicates the existing structure of the Cadenza Building overlaid with the proposed Metrolink tunnel route and the reduced tunnel exclusion zones set out in document DOC ML1-JAI-GEO-ROUT_XX-RP-Y-00034.

Based on the findings of drawing number EARL-WMS-ZZ-ZZ-DR-S-21301, it is clear to see that both the tension anchors to the attenuation tank and the secant piled wall to the basement still extend into the exclusion zone.

The tension anchors clash with the location of the proposed tunnel. Based on our assessment of the existing structure versus the proposed Metrolink alignment, the TBM is going to cut through the bottom 1.0m of the existing tension anchors. Any damage to the tension anchors or the secant piled wall is going to result in damage to the basement structure and the integrated basement waterproofing system provided through the Whitetank waterproofing system.

A detailed Phase 3 assessment using the correct building geometry and structural form should be completed and independently verified, ensuring the maximum damage caused to the Cadenza Building is limited to 0.1mm cracking. The proposed tunnel elevation may require to be lowered more than the current LOD downwards, i.e. more than the 10.0m indicated in the Wider Effects Report submitted as part of the application, considering the proximity and sensitivity of the Cadenza Building.

The impact of implementing the LoDs, either upwards or downwards, on differential settlement and building damage (Ch.5 of EIAR) has not been assessed in the Wider Effects Report. Moreover, the likely significant **positive** impact of lowering the tunnel has not been considered in the EIAR.

2.4 Future Extension of the Cadenza Building

The Cadenza Building is a modern building. However it is likely that at some point in the future, there will be a need to either extend the existing building vertically or demolish the existing building and replace it with a new building.

Currently, the existing building could be vertically extended through the removal of the upper step back floors and four additional floors added to the existing structure without causing any distress to the existing structure or foundations. The foundation loads would increase to support the additional floors of the building.

There is also potential that the Cadenza Building, at some point in the future, will be redeveloped through the demolition of the existing structure and basement and a new basement and building constructed in its place, subject to the improvement in building technologies and sustainable targets being achieved or exceeded through the reconstruction of the site.

In both scenarios above, either the extension vertically or the replacement structure would be subject to limitations imposed by the Metrolink Tunnel being located so close to the existing substructure of the Cadenza Building. In this regard, in section 2.1.1. of the Draft Guidance Note For Developers document, the zones are defined as follows:

- ***Exclusion Zone*** *is the volume of subsoil along the bored tunnel, cut and cover tunnel and retained cut alignment in which no future works or developments are allowed to encroach. Future surface works or developments are allowed above a subsurface Exclusion Zone, provided the foundation does not intrude into the Exclusion Zone and the MetroLink structures are not adversely affected.*
- ***Protection Zone*** *is the volume of subsoil and the area on the ground surface along the bored tunnel, cut-and-cover tunnel and retained cut alignment in which future works or developments could impact the MetroLink structures. Future works or developments are allowed in the Protection Zone with any depth of foundation, provided it does not adversely affect the MetroLink structures and is subject to written agreement with TII.*

In addition, section 2.1.4 of the Draft Guidance Note For Developers document and figure 10 confirm:-

- *The tunnel lining design has been prepared on the basis that the bored tunnels are able to carry an over-site load of 75kN/m². The imposed vertical loading for the tunnels is shown diagrammatically in the following.*

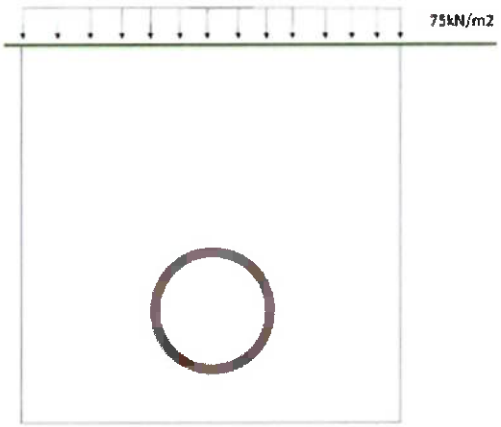


Figure 10 Imposed vertical Loadings - Bored Tunnel

If this level of load limiting is imposed due to the Metrolink Tunnel, it would not be possible to build a traditional house, let alone rebuild the Cadenza Building, which imposes 1000kN/m2 at the underside of the foundation level directly above the tunnel.

The conditions being imposed by the Metrolink Tunnel would preclude either the vertical extension or the demolition and redevelopment of the Cadenza Building, and the exclusion zone would also appear to preclude the deepening of the existing basement level.

2.5 Damage to the Cadenza Building Substructure in the Exclusion Zone

We understand that the Cadenza Building could not have been developed in its current form had the Metrolink Tunnel been previously constructed, as there are substructure elements required to extend into the exclusion zone, which could cause damage to the Metrolink Tunnel.

As the Metrolink Tunnel is a significant piece of infrastructure and has been designed to resist significant earth pressures, it is equally likely that such a significant piece of structure could cause damage to the existing substructure elements of the Cadenza Building that are currently in place and providing support to the Cadenza Building.

2.6 Mitigation Measures to Protect the Cadenza Building

Based on the geometrical findings of drawing number EARL-WMS-ZZ-ZZ-DR-S-21301, we believe that :

a) The route of the Metrolink Tunnel should be diverted to avoid clashing with the existing substructure of the Cadenza Building and damaging the existing building or

b) The elevation of the Metrolink Tunnel should be significantly lowered to the extent necessary toi ensure that no damage will be caused to any part of the Cadenza Building.

3. Metrolink Responses to Previous Submission

Below, we have set out our original points raised in our submission to the TII response to the Metrolink Rail Order, followed by TII's Response and further commentary on the TII response.

Query 1: *The route selection including horizontal alignment, vertical alignment and depth of MetroLink below ground in the area between Chainage 18+900 and Chainage 19+100 should be reviewed by NTA/TII to satisfy themselves and to ensure that:*

(a) MetroLink does not cause structural damage to the foundation system supporting our Client's building which comprises a mixture of CFA piles (some extending 16.5m below ground level) and pads foundations which are founded on the competent rock.

(b) MetroLink does not cause structural damage to our Client's building at the basement level. The basement structure forms the waterproof envelope to our Clients building and any damage would result in the ingress of water into the basement.

(c) MetroLink does not cause damage to the bespoke cladding; glazing and fragile finishes of our Client's building.

(d) MetroLink provides the necessary vertical and/or horizontal clearance between the existing basements and the tunnels.

(e) We note the existing piles and tension anchors appear to clash with the proposed route of the MetroLink route, these elements form part of the substructure and cannot be ignored. We believe that these elements have not been correctly assessed by MetroLink and the impact the proposed route will have on our Client's building. We have enclosed a copy of our drawing EARL-WMS-ZZ- ZZ-DR-S-21209, for your information and reference.

TII Response 1: *"TII notes the additional drawings provided included piles and tension anchors. On the MetroLink Project, the approach to ground movement and building damage assessment follows the industry standard three-phased ground movement impact assessment process that is undertaken on tunnelling and underground projects around the world, that includes Channel Tunnel Rail Link (CTRL), Dublin Port Tunnel, Crossrail and High Speed 2.*

EIAR Appendix A 5.17, Building Damage Report, covers the Phase 2 assessment of construction generated ground movements and settlement on property. Tables 5-2 and 5-4 of this Report show that the building has been assessed as falling within the "Slight/Very Slight damage". An explanation for which can be found in Table 4-4 of the aforementioned Report. Nonetheless a Phase 3 Assessment will be undertaken for this building.

The Phase 3 assessment will be a more detailed building specific assessment. A detailed survey will be carried out as part of the Phase 3 assessment to provide the necessary additional information to inform this detailed analysis of how the individual elements of the building would be affected by the predicted ground movements. The method and extent of the detailed analysis will be determined on a case-by case basis and may include a more sophisticated semi-empirical or a detailed soil-structure interaction using finite element modelling methods. Normally a Stage 3 assessment results in lower predicted settlement estimates than the Stage 2 assessment (which is more conservative). It should also be noted that TII will

commit to monitoring and mitigation measures will be employed as developed at detailed design and referenced with Appendix 5.1 and 5.17"

Further Commentary 1: Although the TII has acknowledged that the drawings provided included piles and tension anchors. They do not address the fact that the piles are within the exclusion zone, and the tension anchors are going to clash with the tunnel, which is a fundamental problem concerning the alignment of the proposed Metrolink Tunnel.

The TII refer to the EIAR Appendix A 5.17, Building Damage Report and confirms that the building has been assessed as falling within the "Slight/Very Slight damage". This response is deficient for the following reasons:

1. The building that has been assessed (reference B147 in the EIAR) incorrectly describes the property as a four-storey building and a single-storey basement. This description does not correctly represent the Cadenza Building, which is a seven-storey building with a two-storey basement structure. The description describes one of the buildings on the site that was demolished in 2019. Therefore, any assessment that has been completed can not be relied upon.
2. The definition of Very Slight damage (in accordance with the EIAR Table 4.4) is crack widths of a magnitude between 0.1mm and 1.0mm. The definition of Slight damage (in accordance with the EIAR Table 4.4) is crack widths of a magnitude between 1.0mm and 5.0mm. The basement waterproofing system relies on the integrity of the concrete basement structure and limits the crack width to less than 0.2mm. Clearly, the existing basement can not accommodate the level of damage that is being predicted without causing significant damage to the integrity of the basement waterproofing system.
3. TII recommends a Phase 3 ground movement assessment as the solution. However, they suggest that the Designer /Contractor should be responsible for this, in addition to the design and implementation of any necessary mitigation measures. Waterman Moylan recommend as essential a detailed Phase 3 assessment using the correct building geometry and structural form to be completed and independently verified, ensuring the maximum damage caused to the Cadenza Building is limited to 0.1mm cracking. This Phase 3 assessment should be carried out prior to approval being granted so that it can be reviewed by Waterman Moylan and any other experts acting on behalf of Irish Lish Assurance plc to ensure that any necessary mitigation measures can be adopted in any decision of the Board to approve the proposed railway works and/or in the conditions attached to the decision.

Query 2: "*We note that drawing ML1-JAI-EIA-ROUT-XX-DR-Y-13038 (a copy is attached to this submission) does not identify any potential receivers in the area of our Clients building, therefore essentially ignoring potential damage to our Client's building. We refer to the following points: a) Metrolink has assessed the "Ground Borne Noise from Tunnel Boring Machine" and presents its findings on drawing no. ML1-JAI-EIAROUT-XX-DR-Y-14009 (a copy is attached to this submission). This drawing indicates MetroLink will generate an additional 50db directly under the location of our Client's building which is unacceptable."*

TII Response 2: *"The drawing ML1-JAI-EIA-ROUT-XX-DR-Y-13038 presents the receptors considered in the assessment of airborne noise during construction works at the overground sites, where the closest receptors are modelled. According to Chapter 13 Section 13.2.3.1 the key study areas during the Construction Phase include all surrounding sensitive receptors (occupied buildings) to surface construction works areas. Depending on the sources in question and the local area under consideration, the study area extends out to between 50m from construction works to 300m from construction works. However, it should*

be noted in this case, that the site is located a significant distance from any above ground works area and as a result there is not predicted to be any exceedances of airborne noise levels resulting from the proposed works.

The drawing ML1-JAI-EIA-ROUT_XX-DR-Y-14009 indicates the groundborne noise contours of the passage of the tunnel boring machine. The predicted level of groundborne noise at the named building is predicted to be 50 dB LASmax, exceeding the threshold level of 45 dB LASmax during a relatively short term period of 2-weeks when the TBM passes. These noise levels may be audible for a short period as the TBM passes beneath the building but will not cause any building damage.

Unfortunately, there are no effective methods available to reduce groundborne noise from TBMs at source. The principal mitigation measures aimed at minimising impacts are as follows:

• Advance public consultation and stakeholder engagement can greatly reduce the significance of groundborne noise effects during construction, as building occupants would be prepared for the passage of the TBM and resultant elevated noise and vibration levels.

• TII will accept and consider applications for additional measures on a case-by case basis, in accordance with its Noise and Vibration Mitigation Policy (see EIAR Appendix A14.6 Airborne Noise & Groundborne Noise Mitigation Policy)."

Further Commentary 2: The response suggests that we need to accept the nuisance caused by the proposed works, and there is nothing that TII are willing to undertake to prevent this nuisance.

The detailed Report submitted by Allegro Acoustics Limited has responded in detail and raised serious concerns about the level of noise and vibration that the occupiers of the Cadenza Building are going to experience.

Query 3: *b) Metrolink has assessed the predicted "Settlement" and presents its findings on drawing no. ML1-JAI- EIA-ROUT-XX-DR-Y-21149 (a copy is attached to this submission). This drawing indicates MetroLink will be causing a 45mm settlement directly under the location of our Client's building which is unacceptable. Settlements of this magnitude cannot be accommodated by the building's structure and will cause damage to foundations; basement; superstructure; facade and internal finishes. As previously stated the basement structure forms the waterproof envelope to our Client's building and any damage would result in the ingress of water into the basement."*

TII Response 3: *"Please refer to Item 1. The settlement contours calculated were used to undertake the building damage assessment and conclude that damage would be limited "slight / very slight" damage. The damage categories are described in section 4.3.2 of the EIAR Appendix A 5.17, Building Damage Report. However, given the additional details provided this assessment would be taken to Phase 3."*

Further Commentary 3: It appears that TII has decided not to properly consider the implications of their proposed tunnelling operations so close to the existing basement substructure of the Cadenza Building.

Again, the TII refer to the EIAR Appendix A 5.17, Building Damage Report and confirms that the building has been assessed as falling within the "Slight/Very Slight damage". This response is deficient for the following reasons:

1. The building that has been assessed (reference B147 in the EIAR) incorrectly describes the property as a four-storey building and a single-storey basement. This description does not correctly represent

the Cadenza Building, which is a seven-storey building with a two-storey basement structure. The description describes one of the buildings on the site that was demolished in 2019. Therefore, any assessment that has been completed can not be relied upon by the Board.

As discussed above, the empirical degree of damage thresholds in the TII risk classification table in the BDR relate to masonry structures and do not take into account the main characteristics of the Cadenza Building.

2. The definition of Very Slight damage (in accordance with the EIAR Table 4.4) is crack widths of a magnitude between 0.1mm and 1.0mm. The definition of Slight damage (in accordance with the EIAR Table 4.4) is crack widths of a magnitude between 1.0mm and 5.0mm. The basement waterproofing system relies on the integrity of the concrete basement structure and limits the crack width to less than 0.2mm. Clearly, the existing basement can not accommodate the level of damage that is being predicted without causing significant damage to the integrity of the basement waterproofing system.
3. The TII suggests a Phase 3 ground movement assessment as the solution. We require a detailed Phase 3 assessment using the correct building geometry and structural form to be completed and independently verified, ensuring the maximum damage caused to the Cadenza Building is limited to 0.1mm cracking.

Query 4: *"We note that drawing ML1-JAI-EIA-ROUT-XX-DR-Y-13038 (a copy is attached to this submission) does not identify any potential receivers in the area of our Clients building. We refer to the following point:*

a) Metrolink has assessed the "Groundborne Noise from Operation" and presented its findings on drawing no. ML1-JAI-EIA-ROUT-XX-DR-Y14041 (a copy is attached to this submission). This drawing indicates MetroLink will be generating an additional 35db directly under the location of our Clients building which is unacceptable."

TII Response 4: *"The drawing ML1-JAI-EIA-ROUT-XX-DR-Y-13038 presents the receptors considered in the assessment of airborne noise during construction works at the overground sites, where the closest receptors are modelled. According to Chapter 13 Airborne Noise & Vibration, 13.2.3.1 Study Area Construction Phase from an airborne noise and vibration point of view, the key study areas during the Construction Phase include all surrounding sensitive environments to surface construction compounds. Depending on the sources in question and the local area under consideration, the study area extends out to between 50m from construction works to 300m from construction works.*

The drawing ML1-JAI-EIA-ROUT_XX-DR-Y-14041 presents contours of groundborne noise during railway operation. The predicted level of groundborne noise during the railway operation is 37 dB LASmax, which is below the 40 dB LASmax threshold, resulting in a not significant impact on the building."

Further Commentary 4: It appears that TII has decided not to properly consider the implications of their proposed operations so close to the existing basement substructure of the Cadenza Building.

The building that has been assessed (reference B147 in the EIAR) incorrectly describes the property as a four-storey building and a single-storey basement. This description does not correctly represent the Cadenza Building, which is a seven-storey modern building with a two-storey basement structure. The description describes one of the buildings on the site that was demolished in 2019. Therefore, any assessment that has been completed can not be relied upon by the Board.

Query 5: *"MetroLink has proposed to acquire the substratum land located under our Client's building, which is outlined in drawing no. ML1-JAI-EIAROUT-XX-DR-Y-01097 (a copy is attached to this submission). This is unacceptable to our Client, as the future potential to develop this prominent commercial site in the future will be damaged."*

TII Response 5: "*TII notes the concerns about the potential impact of MetroLink Project on future potential development of your site. The acquisition of substratum land beneath the Irish Life Assurance plc. building and premises is to enable the construction of the Metrolink tunnel.*

MetroLink will be a catalyst for and provide opportunity for future development and regeneration. While the MetroLink Railway Order does not include for future neighbouring or overhead development, the tunnels and stations are designed to support appropriate future imposed loads.

TII will be required to make submissions in relation to planning applications for proposed future developments on or adjacent to MetroLink and there will necessarily be some engineering constraints (such as permissible loadings) required. However MetroLink is committed to engaging with known development proposals and new development proposals as they emerge with the intent of facilitating such developments as they emerge to the maximum extent consistent with the safe operation of the proposed Project.

Again in common with other existing rail and tunnel projects, following grant of the Railway Order and development of detailed design, TII will produce "Guidance Note for Developers" that will be the subject of bye-laws following the grant of Railway Order and which is designed to facilitate future adjacent or over-site development while protecting the integrity and safety of the MetroLink works and operations.

Therefore at this stage TII is dealing with known development proposals on a case by case basis, TII will work with parties in the future to assist with the wider development of sites over and above stations and tunnels. In this context TII has successfully engaged with a number of developers over the last two years to accommodate development over and in proximity to the alignment and there have been no material restrictions on development subject to the implementation of agreed design and mitigation measures and it is not anticipated that MetroLink will have a material impact on the development potential of sites above and in proximity to the alignment in future."

Further Commentary 5: As set out in section 2.4 of this Report, the conditions being imposed due to the location of the Metrolink Tunnel as set out in the "Draft *Guidance Note for Developers"* would preclude either the vertical extension or the demolition and redevelopment of the Cadenza Building, and the exclusion zone would also appear to preclude the deepening of the existing basement.

In addition, the magnitude of future loading that is permitted to be applied at ground level above the MetroLink Tunnel (75kN/m^2) is only sufficient to enable two/three storey residential properties to be built over the Metrolink Tunnel, which is clearly inappropriate for this city-centre site.

Query 6: *"In summary, our client requests that the route of the proposed MetroLink tunnels are diverted away from their current proposed location (under our client's building) to either below the public carriageway or buildings that will not be damaged or compromised by the presence of the tunnels located under."*

TII Response 6: *"The design includes for a limit of deviation which is required to allow for unforeseen obstructions and construction tolerances which may necessitate a change to the alignment. In the highly*

unlikely event that this were to occur, any resulting environmental impacts will comply with the limits set by the enforceable Railway Order.

TII has carried out a comprehensive set of ground investigations in accordance with relevant guidelines and best practice. It has a high confidence that MetroLink can be constructed along the proposed alignment without requiring vertical or horizontal adjustment. However, in order to guard against rare and undetectable subterranean conditions that might interfere with construction, the Railway Order provides for limits of deviation (as have other railway authorisation since at least the 1840s). The impacts of potential changes within the Limits of Deviation are considered in the Wider Effects Report (Appendix A5.19)."

Further Commentary 6: It appears that the TII has decided to ignore the information that has been provided to them through the Irish Life Assurance plc submission. TII, in their response, states, "It has a high confidence that MetroLink can be constructed along the proposed alignment without requiring vertical or horizontal adjustment".

This statement is clearly incorrect as we have demonstrated that the proposed Metrolink Tunnel is going to clash with the existing ground anchors of the Cadenza Building and cannot be constructed on the proposed alignment. Even if the Limits of Deviation set out in the Wider Effects Report (Appendix A5.19) or the Jacobs / IDOM Technical File Note are applied, the existing basement structure remains within the Exclusion Zone.

4. Summary

TII was made aware of the existence of the two-story basement under the Cadenza Building through a submission made on behalf of Irish Life Assurance plc. The response to the submission confirms that the TII and their team have failed to identify the correct structural form of the Cadenza Building. The TII also appear to have failed to grasp the proximity of the existing structure and substructure to the proposed Metrolink Tunnel route. The responses provided to the submission are generic and do not fully consider the impact of the Metrolink Tunnel route on the existing Cadenza Building.

The proposed Metrolink route, as currently presented in the Metrolink Rail Order, if constructed as per the current design, is going to result in damage to the Cadenza Building.

If the tension anchors restraining the attenuation tank located below the basement slab are damaged, the basement slab and structure are going to be significantly damaged.

If the secant piled wall is damaged or compromised by the installation of the Metrolink Tunnel, there is a significant risk that the basement waterproofing, which is provided through the concrete structure, is going to be compromised and result in water ingress into the basement of an occupied building.

Additionally, if the secant wall is damaged or compromised by the installation of the Metrolink Tunnel, there is a significant risk that the concrete superstructure above is going to be damaged as a result.

The key areas of damage that are going to be caused to the Cadenza Building if the Metrolink Tunnel is progressed as per the current design are as follows:-

- The basement uses a Whitetank waterproofing system, which relies on the watertightness of the reinforced concrete basement floor slab and walls. Therefore, even minor cracking could lead to groundwater ingress;
- The internal reinforced concrete frame uses post-tensioned reinforced concrete floor slabs for large spans, which would be more sensitive to differential settlement than conventional RC slabs;
- The tunnel passes under one of the main structural cores for the building, and this incorporates a complex transfer structure at the first-floor level to accommodate a shift in the position of the core for the upper floors of the building;
- The building has a modern steel and glass façade, which would be more sensitive to distortion due to differential settlement along the perimeter secant pile wall than a masonry or blockwork structure.

If the Metrolink Tunnel is to pass under or close to the Cadenza Building, we require a detailed Phase 3 assessment using the correct building geometry and structural form to be completed and independently verified, ensuring the maximum damage caused to the Cadenza Building is limited to 0.1mm cracking. The proposed tunnel elevation may require to be lowered more than the current LOD downwards, i.e. more than the 10.0m indicated in the Wider Effects Report submitted as part of the application, considering the proximity and sensitivity of the Cadenza Building.

The Phase 3 assessment referred to above should be carried out prior to approval being granted so that it can be reviewed by Waterman Moylan and/ or any other experts acting on behalf of Irish Life Assurance plc. This will ensure that any necessary mitigation measures (including lowering of the tunnel elevation) can be adopted in any decision of the Board to approve the proposed railway works and/or in the conditions attached to the decision.

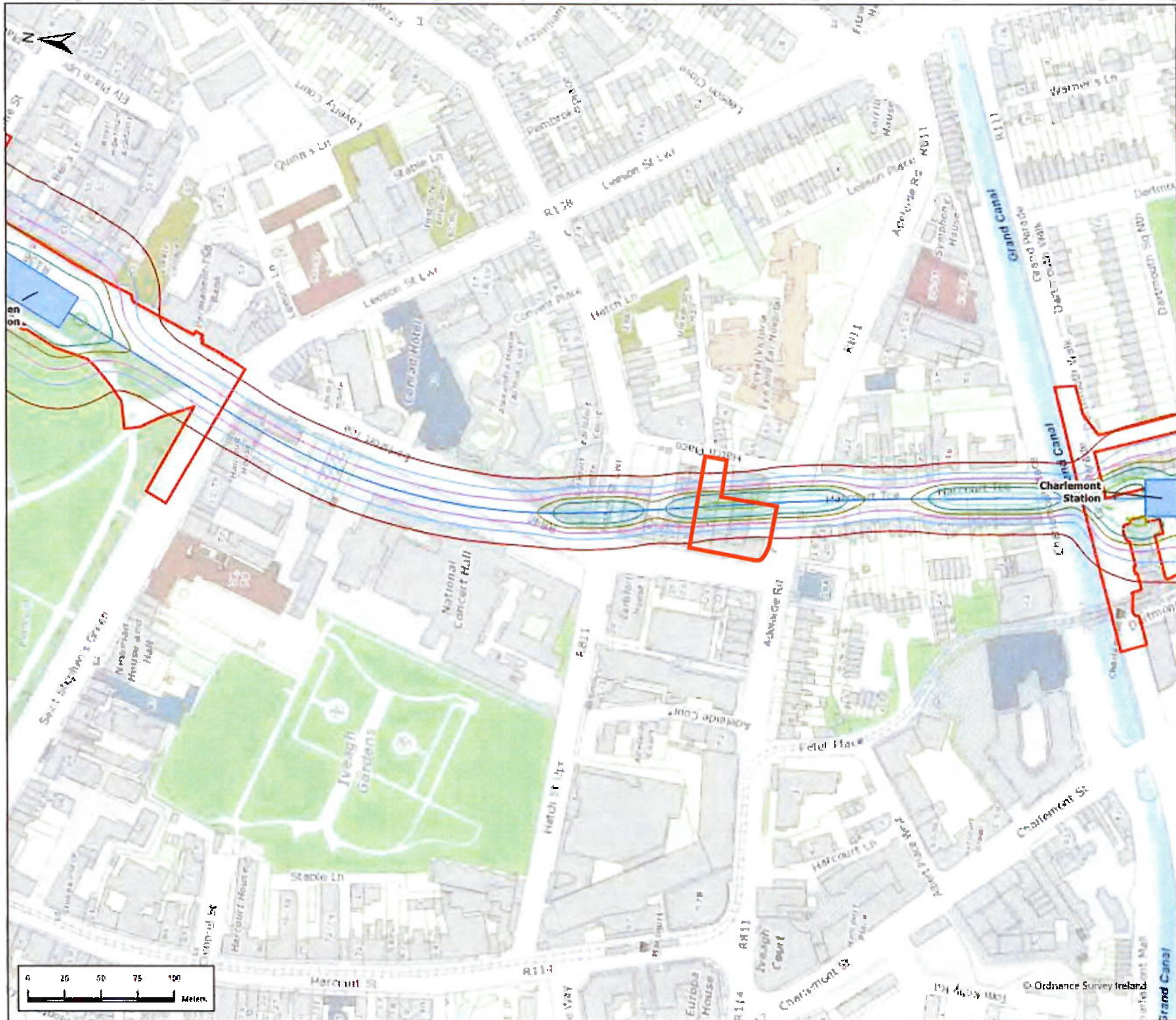
Based on the findings of this Report, we recommend that the Metrolink Tunnel should either be:

1) rerouted around the substructure of the Cadenza building or,

2) the elevation of the Metrolink tunnel should be significantly lowered to a level that ensures that no damage will be caused to any part of the Cadenza Building, to be confirmed by the Phase 3 assessment referred to above.

APPENDICES

A. Jacob / IDOM drawing number ML1-JAI-EAI-ROUT_XX-DR-Y-21146



Legend

Alignment

- Tunnel
- Station Locations
- Project Boundary

Geographic Split

- A74 Northwood to Charlemont

Settlement Contours

- 1mm
- 5mm
- 10mm
- 15mm
- 20mm
- 25mm
- 30mm
- 35mm
- 40mm
- 45mm
- 50mm
- 60mm
- 70mm
- 80mm
- 90mm
- 100mm
- 110mm
- 120mm
- 130mm
- 140mm
- 150mm

Rev	Date	Purpose of revision	Drawn	Check'd	Rev'd	Apprv'd
P02	2/2/2024	First Issue	JL	[illegible]	[illegible]	[illegible]

JACOBS IDOM

Client: TII

Project: METROLINK

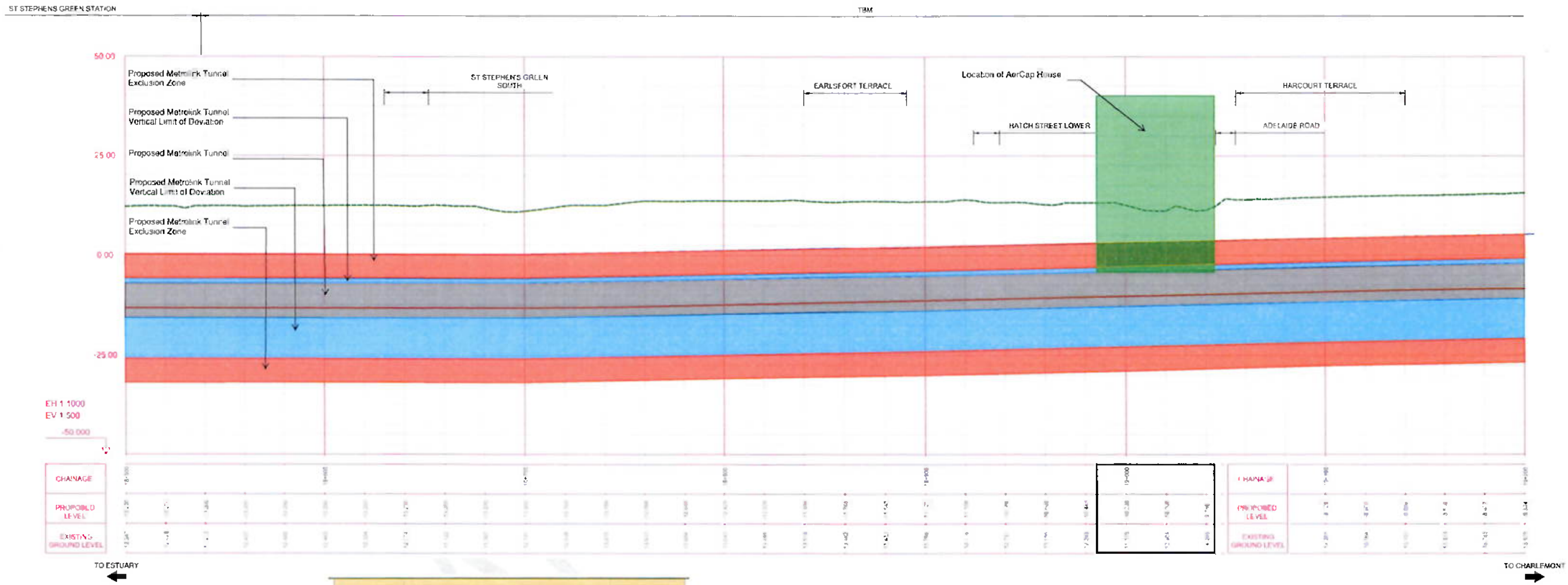
Drawing Title: Figure 20.16 Settlement Contours
Sheet 27 of 28

Drawing Status: Final

Scale @ A3: 1:2,500 | DO NOT SCALE

Drawing No: ML1-JAI-EIA-ROUT_XX-DR-Y-21146 | Rev: P02

B. Jacob / IDOM drawing number ML1-JAI-EAI-ROUT_XX-DR-Y-01018



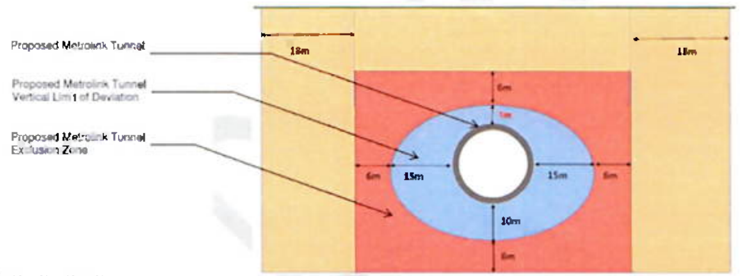


Figure 11. Bored Tunnel Protection and Exclusion Zones

0 10 20 30 40 50 60 70 80 90 100
METRES
SCALE 1:1000 (A1)
SCALE 1:2000 (A3)

DRAWING LEGEND
RAIL LEVEL — EXISTING GROUND LEVEL

REV	DATE	Description	DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
P01	29/07/21	For Railway Order	JD	JR	RS	NC
P02	21/12/21	For Railway Order	GJ	RS	AS	NC
P03	12/05/22	For Railway Order	BJ	JR	AS	PB

Client: TII, NTA
Project: METROLINK
Consultant: JACOBS, IDOM

Drawing Title: METROLINK - ALIGNMENT LONG SECTION 18

Drawing Status: S0

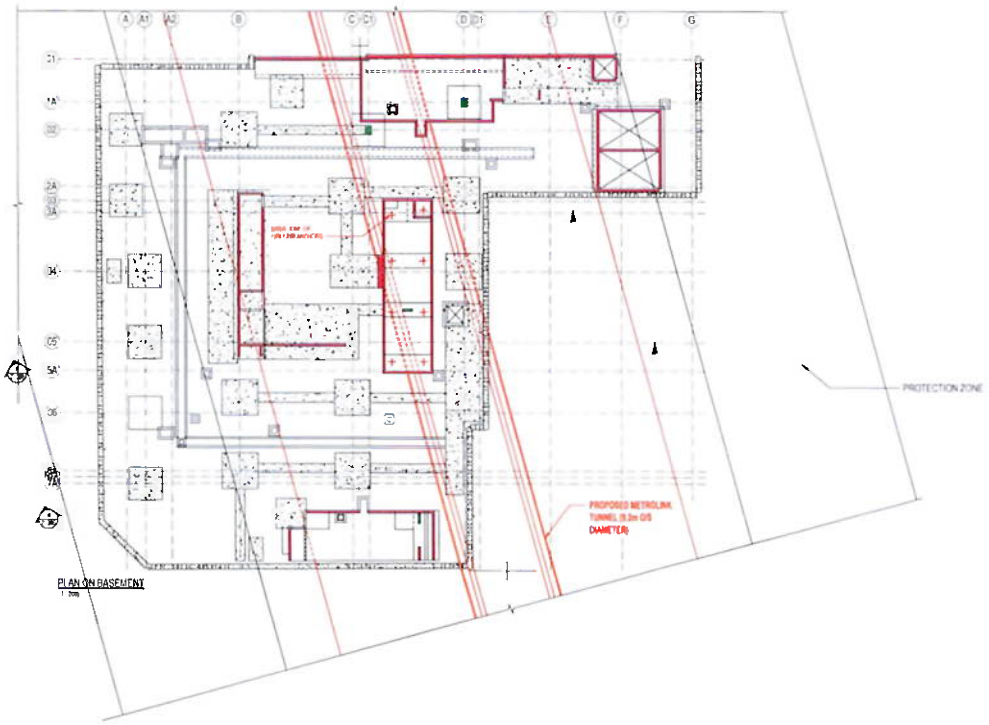
Drawing Nº: ML1-JAI-ARD-ROUT_XX-DR-Y-01018

Plan Drawing Nº: ML-LN-O-018

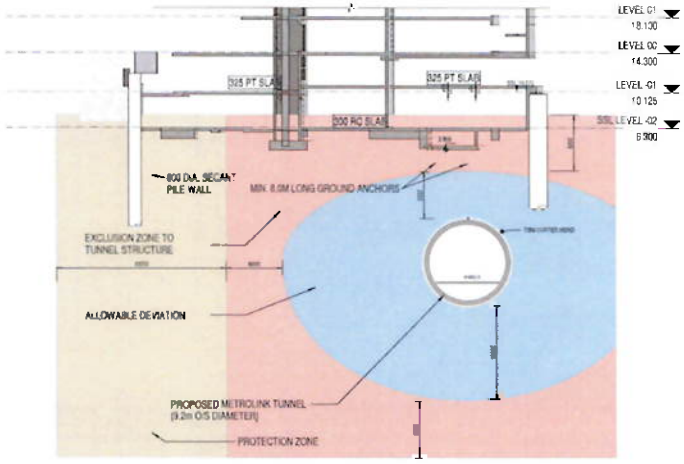
Scales Original Size A1: 1:1000

Sheet 18 of 19

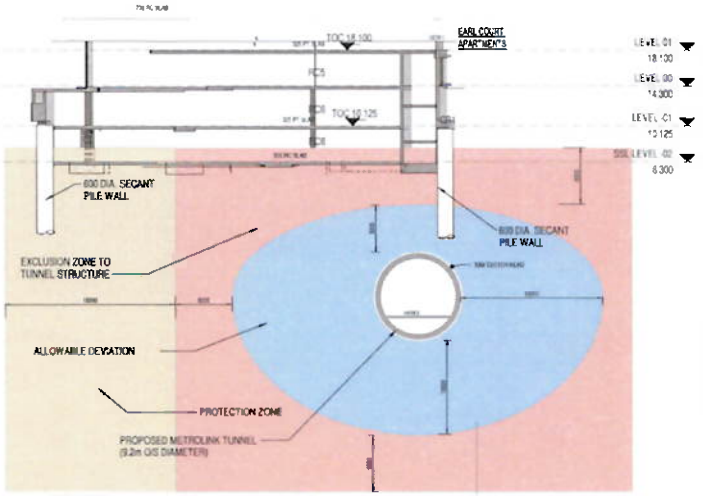
C. Waterman Moylan Drawing Number EARL-WMS-ZZ-ZZ-DR-S-21300



PLAN ON BASEMENT
1 : 200



SECTION B B
1 : 200



SECTION A A
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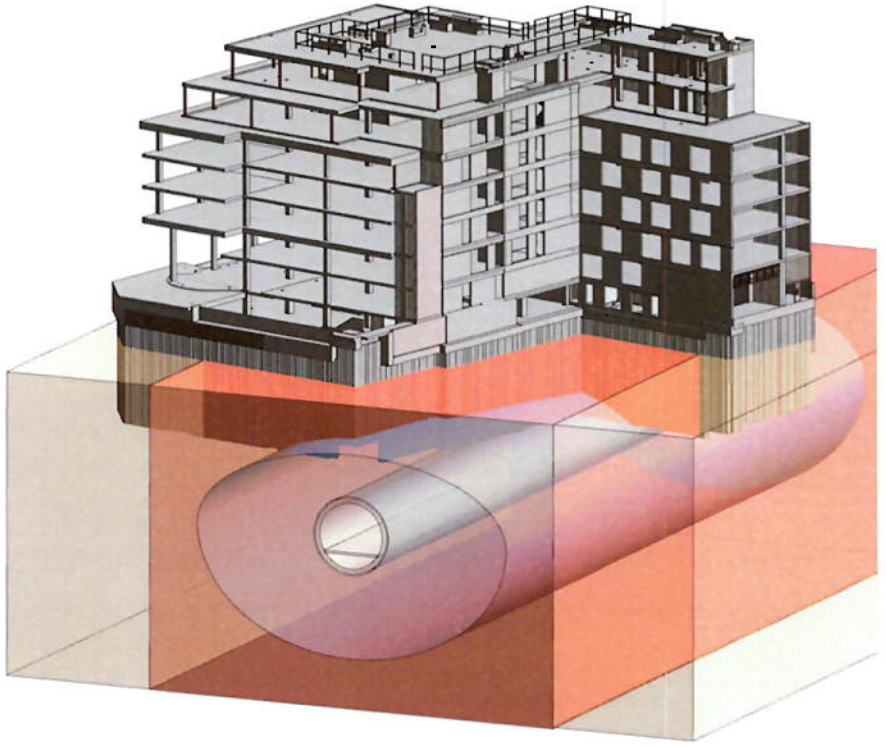


ISOMETRIC VIEW
N.TS

GENERAL NOTES

EARLSFORT TERRACE

GA
CADENZA - PROPOSED METROLINK INTERFACE

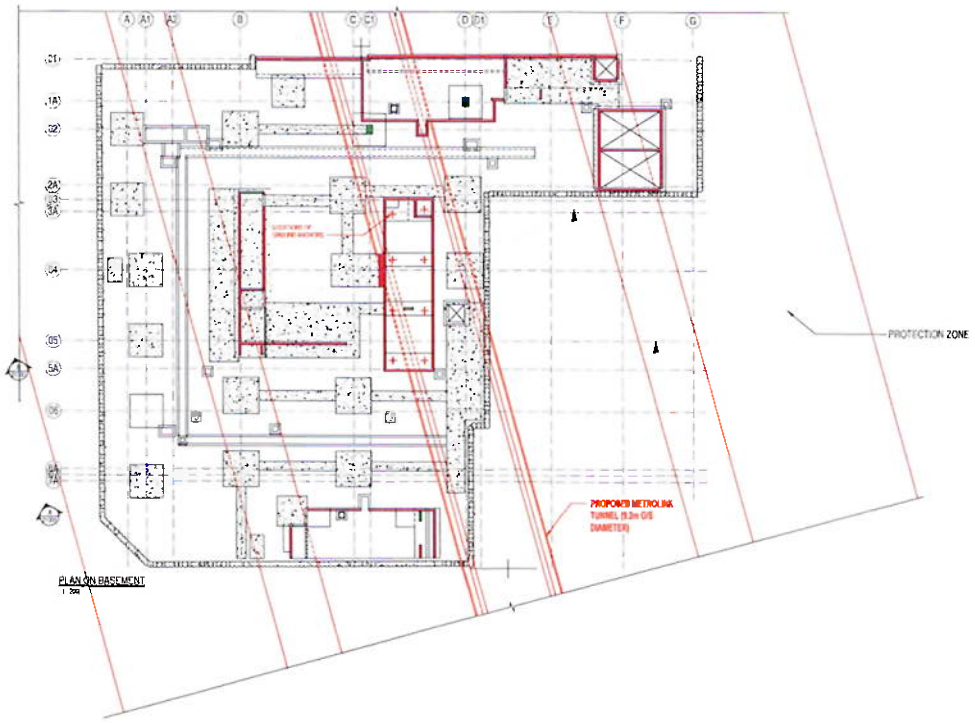
IRISH LIFE ASSURANCE PLC

Waterman Moylan
Engineering Consultants

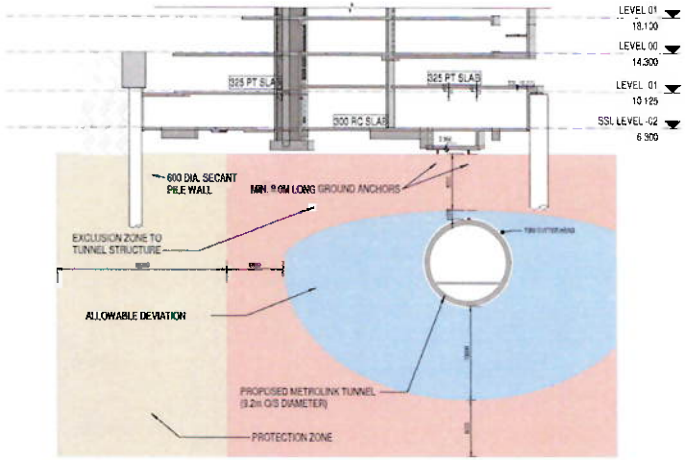
FOR INFORMATION

EARL-WMS-ZZ-ZZ-DR-S-21300

D. Waterman Moylan Drawing Number EARL-WMS-ZZ-ZZ-DR-S-21301



PLAN ON BASEMENT
1 : 200



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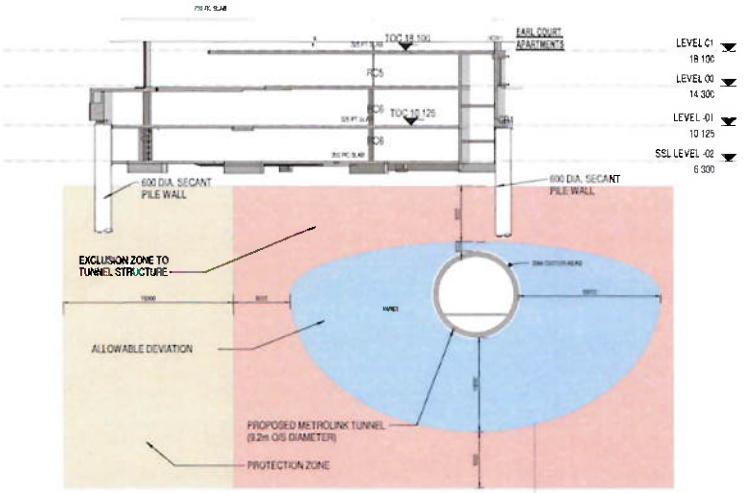

SECTION A-A
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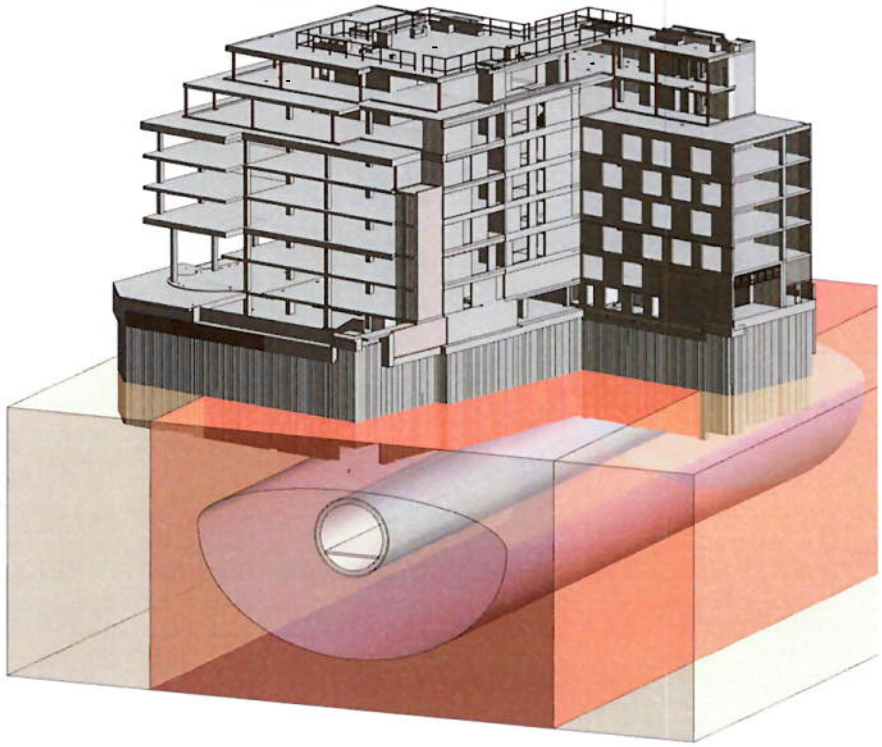

ISOMTRIC VIEW
(NTS)

GENERAL NOTES

EARLSFORT TERRACE

GA
CADENZA - PROPOSED METROLINK INTERFACE REDUCED DEVIATION

IRISH LIFE ASSURANCE PLC

Waterman Moylan
Engineering Consultants

FOR INFORMATION

EARL-WMS-ZZ-ZZ-DR-S-21301

UK and Ireland Office Locations