



Upton House
Market Street
Charlbury
Oxford OX7 3PJ
tel 01608 810374
fax 01608 810093
e-mail info@gwp.uk.com
www.gwp.uk.com

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FIRST REPORT OF THE INDEPENDENT ENGINEERING EXPERT PANEL,
DUBLIN METRO NORTH:
**A REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT
AND OTHER ELEMENTS OF THE RAILWAY ORDER
APPLICATION FOR DUBLIN METRO NORTH**

**FOR
RESIDENTS' GROUPS AND OTHER INTERESTED PARTIES
&
RAILWAY PROCUREMENT AGENCY**

**VOLUME I
(OF 3)**

**REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT
AND OTHER RAILWAY ORDER DOCUMENTATION**

MARCH 2009

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REVIEW OF THE RAILWAY ORDER APPLICATION

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- Appendix 2 Table summarising proposed and minimum depths from ground surface to the bored tunnel and inferred depths to rockhead. *(No amendment since final draft report in December 2008).*
- Appendix 3 RPA comments on GWP draft report (Version 3 (RJS/GFE)). *(No amendment since final draft report in December 2008).*
- Appendix 4 Document entitled: "RfR Tunnelling questions for Independent Expert (Jan 2009)". *(Minor amendments since first issued on 13th February 2009 to correct some factual information and qualify some comments as the opinions of the experts).*

FIRST INDEPENDENT ENGINEERING EXPERTS' REPORT:

A REVIEW OF THE RAILWAY ORDER APPLICATION FOR DUBLIN METRO NORTH AND CONSIDERATION OF THE CONCERNS OF RESIDENTS AND OTHER INTERESTED PARTIES**EXECUTIVE SUMMARY**

This report reviews the Railway Order Application (especially the Environmental Impact Statement) for Dublin Metro North. It is the first formal output of a team of Independent Engineering Experts commissioned in August 2008 by RPA, on behalf of residents' groups and associations and other non-commercial stakeholders with interests in the effects of the Metro North scheme. The terms of reference for the Independent Engineering Expert team were developed by the RPA in partnership with residents' representatives, who also participated in the selection process.

It is intended to be available to residents and others as a resource to assist them in their consideration of the Railway Order application for Metro North, and in participating in the consultation process (including, as appropriate, making written and oral submissions to An Bord Pleanála). Following a series of meetings with residents' groups and other interested parties in August and September, a draft report for comment and discussion was issued on 8th October 2008. Meetings were held during the week commencing 20th October 2008 to present the report and allow discussion and feedback. This final report takes account of the comments received from residents and the RPA.

The report is presented in 3 volumes:

- Following this executive summary, **Volume I** provides an introduction to environmental impact assessment and the design process, together with a review of selected sections of the Environmental Impact Statement and other Railway Order documentation;
- **Volume II** (based on Section 5 of the October draft) provides a summary of the particular concerns and questions of residents and other interested parties, cross references to sources of further information and brief comments where appropriate; and
- **Volume III** includes supporting appendices for Volumes I and II.

VOLUME I

Volume I of our report is based on a review of the Environmental Impact Statement (EIS), backed up by reference to the plans showing details of the proposed railway works. All of these documents (comprising the Railway Order Application for Dublin Metro North) may be found at www.dublinmetronorth.ie/. Our review has considered the adequacy and clarity of each of the elements of the EIS for topics of particular interest and concern to residents (see Volume II). We have also attempted to identify gaps or unanswered questions that arise from the Railway Order Application (especially the EIS and the drawings describing the scheme).

We have some specific reservations about the breadth of coverage and/or the way in which the results of the environmental assessment have been communicated for some topic areas. However, overall, we are satisfied that no major subject for concern has been overlooked in the EIS and we note that, in some respects, it goes beyond what is statutorily required to be covered in an EIS. The EIS is of limited usefulness to a non-technical readership without some additional guidance. Volume I of our report attempts to bridge this gap by presenting the findings of our review in three main sections following the introduction:

Section 2 includes an introduction to the EIS, and explains its structure and purpose.

Section 3 includes background sections that are intended to set the scene for residents to help them appreciate the stage that the engineering design of the scheme has reached and how it will be refined between now and the construction phase, as well as providing a non-technical introduction to tunnelling and associated works, such as station and shaft construction.

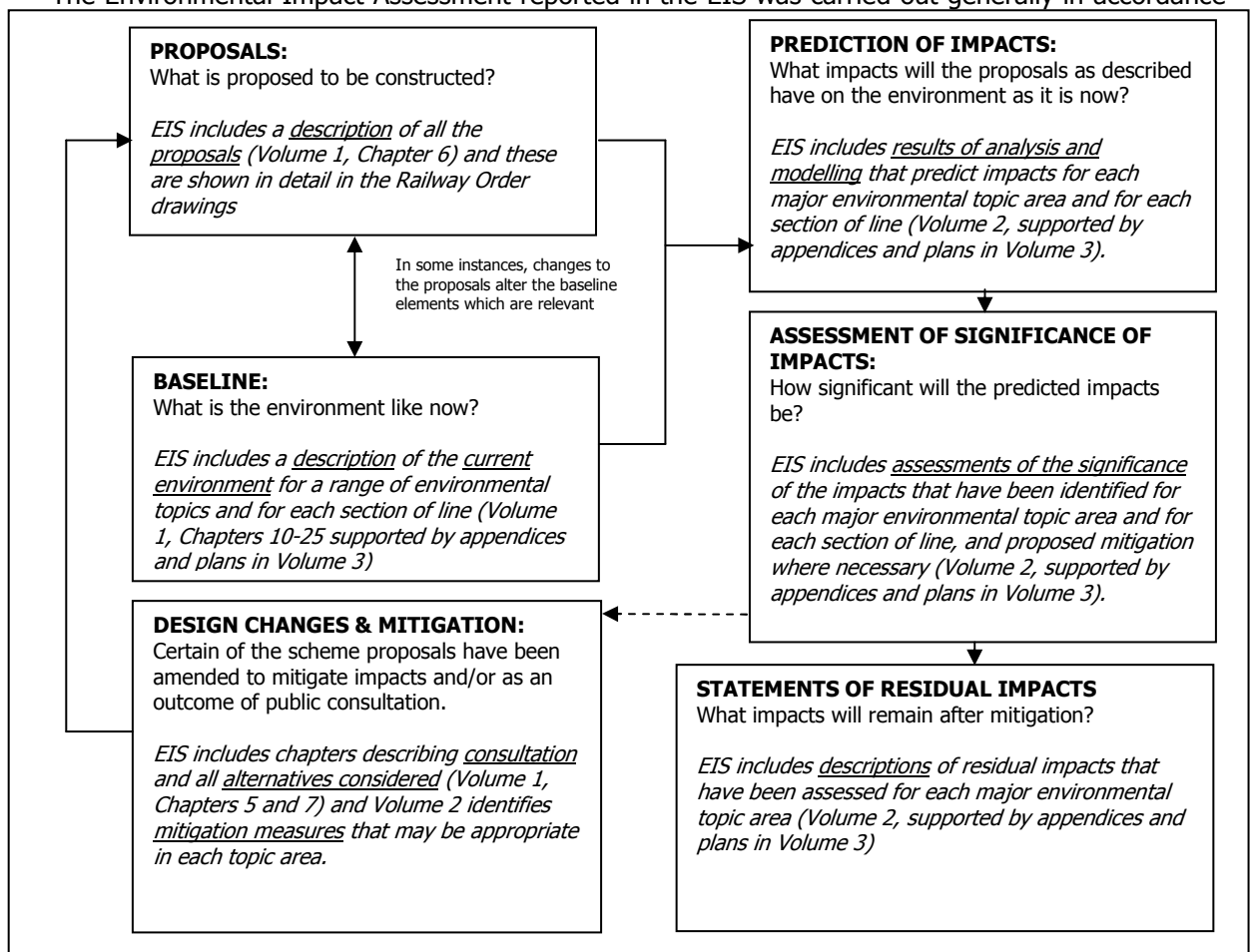
In **Section 4** key environmental impacts relevant to the project are described:

2. THE ENVIRONMENTAL IMPACT STATEMENT

Environmental Resources Management (Ireland) Ltd. (ERM) has co-ordinated the work of some 20 environmental experts to undertake an Environmental Impact Assessment. The findings of this assessment are reported in a 3-volume Environmental Impact Statement (EIS) for the Metro North scheme.

The objective of the EIS is to consider the likely impact that the proposed scheme described in the Railway Order application may have on the people who live close to it and their surroundings, and to describe the mitigating measures that can be taken to avoid (and, if not avoid, to reduce and constrain) hazards and disturbances to the local population, its resources and the natural environment. The EIS is a central part of the Railway Order documentation and records various conclusions reached by the ERM team. The EIS does not set out in full the basis upon which those conclusions; behind it there are many other investigations and analyses that the ERM team used to support its work.

The Environmental Impact Assessment reported in the EIS was carried out generally in accordance



with the standard methodology indicated in the sketch below (larger version at Figure 1, Volume I).

In response to comments on the discussion draft from members of the public regarding the accessibility of the EIS, given its specialist vocabulary, we have included a section (2.2) that aims to assist readers by putting into context some of the specialist vocabulary used in the main parts of the EIS (baseline studies, impact prediction and impact assessment). The way in which the **baseline environment** is categorised by allocating **functional values** to selected areas is described. Functional values are determined by reference to the **importance** and **sensitivity** of the area and the **receptors** within it as well as the presence of **existing adverse effects**. Some examples are given.

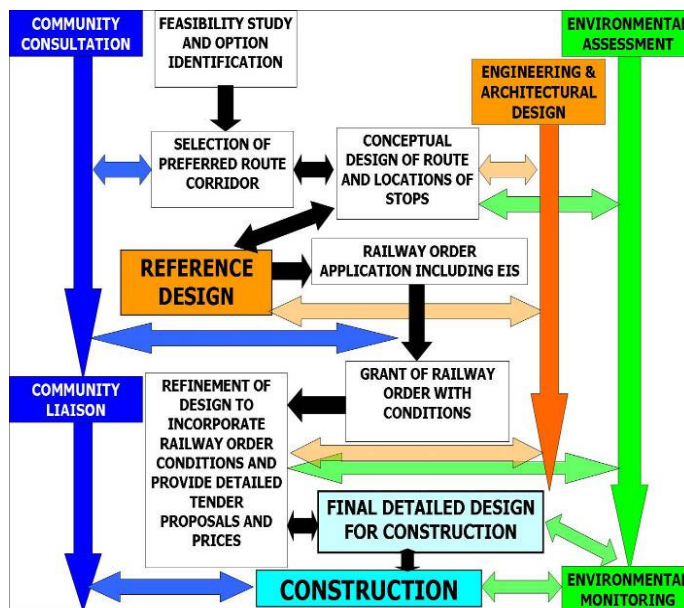
The methodology for *impact prediction and assessment* is then described in terms of the way in which *impact magnitude* is predicted. *Impact significance* is determined on the basis of the expected *magnitude* of the impact and the *functional value* of the receptor. Each of the assessment chapters in the EIS ends with a summary of *residual impacts* of the scheme taking into account *mitigation* (a residual impact is the degree of environmental change that will occur after the proposed mitigation measures have taken effect).

3. BACKGROUND SECTIONS

The design process for construction works

This section (3.1) provides a non-technical explanation of the way in which the design process evolves and the stage that it has currently reached, by reference to the diagram below (larger version at Figure 2, Volume I), under the headings:

- Evolution of the detailed design of the works
- Ground conditions (geology)
- Limits of deviation
- Instrumentation and monitoring
- Public consultation and liaison



How tunnels and underground stations are constructed

This section (3.2) provides a non-technical introduction to the construction of bored running tunnels, mined crossover passages and shaft and station box construction (also relevant to cut and cover tunnel construction).

4. CONSIDERATION OF KEY ENVIRONMENTAL IMPACTS RELEVANT TO THE PROJECT

In accordance with the scope of the tender and our commission, we have concentrated our detailed review of environmental impacts relevant to the project (and deployed relevant expertise) in the following topic areas:

- Airborne noise from construction works and railway operation (also referred to as “environmental noise”);
- Vibration and groundborne noise from metro construction and operation;
- Influence of proposed works on surface water;
- Influence of proposed works on ground water; and
- Settlement of ground around tunnels and excavations.

Each of the sections is structured as follows:

- (i) Introduction to the subject - important concepts and terminology;

- (ii) Description of the assumptions made in the Metro North assessments and the methodology used;
- (iii) Reference to relevant sections of the EIS;
- (iv) Summary of findings of the EIS;
- (v) Comment from the Independent Engineering Experts on the adequacy and clarity of the EIA (and other Railway Order documentation) in relation to the impact under consideration and identification of gaps and/or un-answered questions.

The summaries that follow focus on the 'summary of findings of the EIS' and 'comment' sections in Section 4 of the report.

Airborne noise from surface construction works and railway operation (Section 4.2)

The EIS identifies a number of locations where the threshold criteria for airborne noise assessment set out¹ will be exceeded during the construction and operational phase, based on the assumptions that underlie the assessment, even after mitigation is taken into account. However, the RPA's comments (Volume III, Appendix 3) provide reassurance that the contractor will be under an obligation to limit emissions of airborne noise so that the thresholds criteria upon which the environmental assessment is based are not exceeded. It will therefore be for the contractor to incorporate in the final detailed design and programming of the works measures to ensure that the airborne noise criteria will not be breached. In effect, the EIS draws to the contractor's attention locations where mitigation measures additional to those that have been assumed may be needed to achieve this (*e.g.* by programming the construction works to avoid the cumulative effects assumed in the EIS, by selecting different (quieter) construction plant, by adding barriers to reduce construction or operational noise, or by changing track design to reduce operational noise).

The threshold criteria for construction noise during the day and evening (75dB and 65dB) have each been set 5dB higher than those in the relevant National Roads Authority guidance ("*Guidelines for the Treatment of Noise and Vibration in National Road Schemes*") and the reasons for this are stated in the EIS². We have made some observations in paragraphs 4.2.26 to 4.2.31 in relation to these limits. Our opinion is that, even if the rationale for the 5dB over NRA guidelines is accepted, they ought to be lower where construction works continue for significant periods and/or where they take place in 'urban' areas where pre-existing noise levels are low. We further consider that planning conditions referring to airborne noise should specify a period of less than 12 hours to which L_{Aeq} noise levels will relate and that it would also be reasonable to impose a maximum noise level not to be exceeded in any event (and a time limit on the maximum).

Vibration and groundborne noise from metro construction and operation (Section 4.3)

The RPA has responded to questions relating to the amount of vibration that will be experienced, particularly during the construction phase as follows: "*Vibration limits have been chosen to avoid structural damage. Where any damage does occur, repairs will be made under the Property Owners' Protection scheme. This does not affect owners' statutory rights*" and "*Groundborne noise and vibration limits are set out in Volume 2 Chapter 5 of the EIS*". However, we note that no limits have actually been proposed in the EIS (Volume 2, Chapter 5) for vibration and groundborne noise during the construction period, although impact magnitudes have been defined (very low, low, medium, high, and very high).

The description of residual impacts (*i.e.* those that are expected to arise after mitigation) includes some that are identified as having high and very high impact magnitudes, giving rise to significant construction phase impacts. Given the RPA's assurance that "vibration limits have been chosen to avoid structural damage", it appears that the contractor will be expected to introduce more mitigation than is assumed in the assessments in order to reduce these impacts. It is implied in the EIS that the 'Low' impact thresholds may be those that are intended to provide upper vibration (and groundborne noise) limits, but this needs to be clarified as currently the limits are not stated in the EIS.

During the operational phase, we confirm that 25dB $L_{Amax,S}$ (the proposed limit for operational phase groundborne noise between Parnell Street and Albert College Park) is a very low limit for

¹ Tables 4.1 and 4.3 in Chapter 4 of each of the seven books comprising Volume 2 of the EIS
² Volume 2, Books 1-7, Chapter 4, paragraph 4.3.2.1

groundborne noise in residential properties; so low that people in these properties are very unlikely to hear a train passing beneath. Elsewhere, the proposed limit on groundborne noise inside residential property is 40dB $L_{Amax,S}$, which is a low level of groundborne noise. If there are locations that are deemed particularly sensitive to groundborne noise and where it is appropriate to impose a lower limit than 40dB $L_{Amax,S}$, the use of FST rather than resilient rail support would reduce the groundborne noise impacts to ≤ 25 dB $L_{Amax,S}$.

Vibration from blasting (not the TBM) could, in some circumstances, cause structural damage. RPA is well advanced with developing a Property Protection Scheme, and has already undertaken structural surveys at a representative sample of buildings (different types, ages, styles, materials, construction techniques etc) to establish their characteristics and potential vulnerability to damage caused by vibration (and settlement). Later stages of this scheme will involve detailed condition surveys of all properties within a pre-defined zone above and either side of the proposed bored tunnels and adjacent to underground stations and other deep excavations.

Influence of proposed works on surface water (Section 4.4)

Functional values relating to surface water are described as having been assessed by consideration of water quality as well as flood status. The water quality criteria are quantitative (based on Q-values), but it is not clear as to how flood risk has been taken into account either in defining functional values or in terms of assessing impact magnitudes. It would have been better in our view to have assigned functional values and assessed impact magnitudes separately for surface water quality and for the risk and consequences of flooding. The functional values that have been assigned to the various watercourses assessed appear to us to be reasonable in relation to water quality but do not highlight areas where flooding may occur and its impacts.

For most of the proposed alignment, impact on flood risk within the surface water catchments is likely to be negligible. This is because the 'footprint' of the works within the various catchments is relatively small, and because the amount of water to be discharged from the construction sites (and the finished metro facilities) into surface water courses is expected to be very small (and therefore will have a very small impact on flood flows in streams and rivers into which that water may be discharged).

However, the very large depot site at Belinstown is within an area where residents report that flooding that affects local roads and houses occurs fairly frequently (likely to be as a result of 'backing up' of flood waters in the drainage system). The potential for flood risk associated with the Belinstown Depot site has been recognised in the EIS and the following is stated in Volume 2, Book 1, Chapter 11, Section 11.4.2.2: *"The performance of the drainage system will also be assessed for extreme rainfall events (in excess of the design rainfall) to identify areas at risk of flooding. Adequate measures will be put in place to safely manage the flood water and reduce the risk of damage to lives and properties"*. To achieve this, a more comprehensive baseline survey will be needed in this area and a flood risk assessment will need to be carried out. This is an area where it may be possible to improve upon the current situation.

We consider that it would be appropriate for a condition to be imposed on the Railway Order requiring flood risk assessments to be carried out for the catchments to be affected by building on agricultural land (as at Belinstown) or discharge of storm water or groundwater to existing water courses, before construction proceeds. Such flood risk assessments may indicate the need for modifications to the significant land raising suggested in the flood plain of the Broad Meadow River, off site improvement works to drainage structures and receiving watercourses to mitigate flood risk, and possibly the deployment of tunnel spoil to provide flood defences in areas that are already vulnerable to flooding. They may also indicate the need for design modifications to culverts and bridges that are needed where the alignment crosses watercourses and flood plains.

Several watercourses are known to have been culverted or flow in tunnels or pipes beneath urban areas in North Dublin; where these will be intersected in cut and cover tunnels or station boxes, they will require temporary or permanent diversion to allow the works to proceed and maintain the flow in the watercourse. Intersection of such watercourses gives rise to the potential for contamination of the water flowing within them and also for changes to flow capacities. The detailed design will need to ensure that diverted tunnels or culverts have sufficient capacity to prevent backing up of water and flooding upstream. Where such watercourses are not actually intersected but cross the alignment of bored tunnels, they are potentially susceptible to settlement disrupting culvert or tunnel linings, giving rise to leakage. It will be important to identify all such

'underground' watercourses and monitor their condition before and after the works, providing for repairs to be carried out if settlement causes damage. Whilst this has not been recognised in the EIS, we have confirmed that RPA is aware of such streams and has made provision in its design to date for appropriate engineering measures to safeguard, replace or divert these structures where they cross the tunnel alignment.

Influence of proposed works on groundwater (Section 4.5)

Functional Values for groundwater, defined in the baseline study, are assessed to be either Low (II) or Medium (III). Impact magnitudes are assessed to be low (or in one case medium) and the impacts identified will affect areas of medium (III) or low (II) functional value. Therefore the assessment concludes that residual impacts will be of 'Low Significance' providing the mitigation measures described in this section are implemented.

The operational scenarios considered are necessarily somewhat generalised at this stage given the status of the design and associated ground investigations but they encompass all likely impacts on groundwater. The mitigation measures that are proposed are comprehensive and are appropriate to the construction and operational scenarios considered and the potential impacts identified.

Settlement of ground around tunnels and excavations (Section 4.6)

The 4 stage assessment process that is underway, which will eventually incorporating monitoring, should allow the identification of buildings where damage is expected to fall into the 'Moderate' category or worse and specific protective/mitigation measures can then be designed and implemented. Where possible, it appears that the design objectives will be to restrict building damage to the 'Slight' category or below. This level of damage would be rectified under the Property Protection Scheme.

Where there will be rock above the top of the tunnel, the predicted settlement is significantly smaller than for lengths of tunnel where the top of the tunnel will be in sediments overlying the rock (for estimated thicknesses of rock above the top of the tunnel, see Volume III, Appendix 2).

The prediction of settlement on a location-specific basis requires detailed knowledge of the geology, the groundwater and the interaction of these with the tunnel (or other) excavation. Not until the construction phase is underway will detailed information be available from monitoring at the surface, monitoring of the geology and hydrogeology at the tunnel face and forward drilling. Using this information, property specific predictions of settlement can be made and, where necessary, adjustments to the tunnelling operation made to reduce settlement effects to a minimum.

The success of the responsive approach to predicting and minimising settlement described in Section 4.6 in Volume I depends on a carefully designed monitoring scheme and a robust process for using the data which arises from it.

The 4 stage assessment process described in the EIS in relation to ground movements and their effects on buildings and infrastructure is logical and represents established good practice. Stages 2B and 3 are based on the detailed design and actual construction methods to be used and therefore this assessment process is ongoing (and will logically continue into the detailed design and construction phases).

The 4 stage assessment process, eventually incorporating monitoring, should allow the identification of buildings where damage is expected to fall into the 'Moderate' category or above and specific protective/mitigation measures can then be designed and implemented. Where possible, it appears that the design objectives will be to restrict building damage to the 'Slight' category or below. This level of damage would be rectified under the Property Protection Scheme.

The EIS reports maximum settlements to be expected at various locations along the alignment with no explanation of how those values have been derived, and what they mean or the expected distribution of ground movements (relevant to an assessment of differential settlement as described above). Similarly, the EIS does not discuss the anticipated time over which ground movements will develop where they occur.

VOLUME II

Volume II of the report summarises the general and specific issues raised by members of the public during meetings and correspondence with the Independent Engineering Experts during the period August to November 2008. It is an expanded version of Section 5 of the draft report issued by the Independent Engineering Expert team on 8th October 2008.

For each topic covered, the main objectives of this volume of the report are to:

- Provide cross references to information in Volume I of this report and the Railway Order Application that is relevant to the questions and concerns that have been raised with us to date (and which address the comments and feedback we have received on the October draft);
- Navigate the Railway Order Application documents (especially the EIS) so as to find information relevant to each issue considered below;
- Provide an update (where relevant) on the current status of ongoing discussions between residents' groups and RPA and on progress with important schemes for property protection and monitoring; and
- Provide assistance to residents and others in framing their questions, concerns and requests for information, whether made directly to RPA or at an oral hearing (or both).

In Section 2 we make some general comments relevant to the status of the design in the Railway Order Application. In Section 3 we summarise issues that we have found to be of general concern, and in Section 4 we record location-specific issues that have been raised with us. For each area of concern (both general and location-specific), we provide a summary of the nature of that concern (often through a series of questions) and reference to the relevant paragraphs in Volume I of this report and/or the EIS. In some cases, we provide a note of our understanding of the current status of ongoing discussions with the RPA and/or a summary of our opinions or observations on the subject being addressed.

VOLUME III

The report is supported by appendices in Volume III as follows:

- **Appendix 1** Schedule of groups of residents and other interested parties with which the experts have worked to date and a record of meetings held.
- **Appendix 2** Table summarising proposed and minimum depths from ground surface to the bored tunnel and inferred depths to rockhead.
- **Appendix 3** RPA comments on GWP draft report for comment issued in October 2008 (Version 3 (RJS/GFE))
- **Appendix 4** Document entitled: "*RfR Tunnelling questions for Independent Expert (Jan 2009)*". (First issued and circulated to residents, RPA and other interested parties February 2009).

We anticipate that our report (together with any future addenda required to cover further topic areas and our continued assistance) will provide a useful resource for residents in ongoing discussions and negotiations with RPA and during the Oral Hearing. In the future, it may be useful as a source of reference during the construction phase.