national highways

A57 Link Roads

TR010034

9.55 Justification for the proposed Compulsory Purchase of No. 21A Old Road

Rule 8(1)(k)

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

March 2022

Infrastructure Planning

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A57 Link Roads Scheme

Development Consent Order 202[x]

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Regulation Number	Rule 8(1)(k)
Planning Inspectorate Scheme Reference	TR010034
Application Document Reference	TR010034/EXAM/9.55
Author	A57 Link Roads Project Team, National Highways and Atkins

Version	Date	Status of Version
Rev 1.0	March 2022	Deadline 6

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1. Executive Summary

1.1.1. This report provides justification for the proposed Compulsory Purchase of number 21A Old Road (also known as Craig Dean) in the Compulsory Purchase Order as requested by the examiner in the first 'issue specific' hearings of the A57 Link Road Examination.

1.1.2. Section 4 of this report considers the long term movement damage effects resulting in several slight fractures to the inside and outside of the property of between and 1mm and 5mm in width which may require some internal redecoration or external repointing if the property were to be retained. Property settlement values due to the permanent works effects can also be found in this chapter. The ground at the edge of the property nearest the works is expected to move up to 20mm vertically and 21mm horizontally due to the permanent works. The overall differential vertical and horizontal movement settlement is expected to be up to 5mm and 8mm respectively, between the front and rear of the property.

1.1.3. Section 5 considers effects on statutory utilities and identifies the potential need for a proposed foul water pumping station located in the rear garden of the property. It is noted that access is required to survey the extent of the foul water main at the rear of the property to confirm its exact location.

1.1.4. Section 6 considers temporary works options and the associated risks with each option considered. It is key to note that the permanent works detailed design has not been completed, this design will contain key parameters for calculation and effects of the temporary works on the property. The section concludes that there are risks of damage to the property associated with each of the temporary works options considered to enable the construction of the submitted DCO preliminary design. There are also risks during the detailed design phase that could change the temporary works detail (as discussed further in section 6.1.4). The temporary works methodology will be re-considered on the completion of the permanent works detailed design.

1.1.5. Further to Section 1.1.4 above, it is noted that further investigation into the property foundations will not materially affect the statement in 1.1.4.

1.1.6. Section 6 considers potential temporary works settlement values in addition to the permanent works settlement values.

1.1.7. Section 6 concludes with the incorporation of 21A Old Road within the Compulsory Purchase for the draft Order.

1.1.8. Section 7 confirms the National Highways intention to include 21A Old Road under the compulsory acquisition powers of the draft Development Consent Order.

2. Introduction

2.1.1. This document provides details on potential impacts of the A57 Link Roads Scheme on 21A Old Road. It provides further information to the Examining Authority (ExA) for consideration within the DCO examination as committed to by National Highways in its response to Item 5(c) on the agenda of Compulsory Purchase Hearing 1, held 8 February 2022.

2.1.2. This document considers ground movement in the permanent case, ground movement in the temporary case and identifies the risks with each of the temporary case scenarios.

2.1.3. It should be noted that this document has been written with respect to the preliminary design submitted for examination and not the permanent works detailed design which is currently being developed.

3. Location

3.1 Location Summary

3.1.1. As shown on the 'Buildings for which rights are to be acquired' plan (submitted into examination as document AS-005) 21A Old Road is located on the eastern side of Old Road, with No. 23 Old Road, known as "The Villa", located to its north and 21 Old Road, located to the south. Both 21 and 21A Old Road are located within the red line boundary. Number 23 Old Road is located to the north of, and outside, the red line boundary. Consistent with the land plans (APP-007) and Book of Reference (REP1-011) 21A Old Road is identified on the 'Buildings for which rights are to be acquired' as plot reference 3/6.

4. Effects due to Permanent Works

4.1.1. This section provides an assessment of vertical settlement and horizontal ground movement at 21A Old Road associated with permanent works of the underpass. Specifically, the ground movements have been split into:

1. Movement associated with underpass permanent works pile installation;
2. Movement associated with permanent works underpass pile deflection during excavation in front of the underpass piles, and;
3. Movement associated with long-term changes in groundwater level caused by the presence of the underpass.

4.1.2. Any prediction of ground movement requires the simplification of ground models and an engineering estimation of soil properties due to the inherently variable nature of the actual natural ground. Therefore, the results presented in this section provide a 'best estimate' of ground and structural risk of damage based on the ground investigation information available. It should be noted that actual movements may vary from those predicted and so a range of values have been provided to reflect this uncertainty.

4.2 Geometry

4.2.1. This assessment is based on the Preliminary Design structure geometry and design works as shown on the Engineering Drawings and Cross Sections Plans Sheet 3 of 5 (REP5-005). The following geometry has been considered:

- Underpass wall (pile) depth above rockhead = 13.5 m (depth of glacial till deposits)
- Excavation depth in front of wall from existing ground level = 10 m.
- Offset distance from the back of the pile wall to front edge of the property is 7 m and 17 m from the rear of the property.

4.3 Existing ground conditions at 21A Old Road

4.3.1. The ground model used for this assessment considers 13.5 m of Glacial Till superficial deposits (firm becoming stiff) overlying Millstone Grit (bedrock). The compressibility of bedrock has not been considered in this settlement assessment as the magnitude of any settlement due to stress changes in the rock is considered to be negligible.

4.3.2. 21A Old Road is situated on a NW-SE trending geological fault, that extends for approximately 700 m to the northwest and 13 km to the southeast. The depth to rockhead level varies significantly around the fault, to the west of the fault the rockhead is approximately 13.5 m below ground level (mBGL), to the east it rises to approximately 3 mBGL. The assessment of pile installation and movement therefore considers the case of deeper rock, as this is more conservative for settlement calculations.

4.4 Ground movement due to pile installation and deflection

Methodology

4.4.1. This settlement and ground movement assessment is based on methods outlined in Section 6.2 of CIRIA C760. The CIRIA guide presents methods of estimating movements due to pile installation, as well as movements due to excavation in front of the piles, based on a semi-empirical method. The assessment is based on this method and uses pile deflection results from the outline design retaining wall analysis performed using the GEO-Solve Wallap software programme.

4.4.2. The following assumptions were made as part of this initial assessment:

- The movements due to pile installation assume a stiff clay profile overlying bedrock. The Glacial Till at the site is generally described as firm becoming stiff with depth.
- The installation of piles below rockhead level has negligible impact on adjacent ground movements.
- Adjacent ground movements are unaffected by any buried structures present.

4.4.3. As part of the assessment the ground movements were divided into horizontal movements and vertical movements (settlement) for both installation and

excavation works. The results of this assessment are summarised in the sections below.

4.5 Ground movement due to changes in groundwater level

Groundwater conditions

4.5.1. The existing groundwater conditions at 21A Old Road are affected by the presence of the geological fault beneath the property. To the east of the fault groundwater levels are at or near ground level, to the west the groundwater levels are significantly lower within the bedrock. A significant change in groundwater levels can cause settlement and/or heave in the Glacial Till material beneath the property.

4.5.2. An analysis into the impact of dewatering on the long-term groundwater levels has been conducted. The results, showing the change in groundwater level from existing levels are shown in Figure 1-1. As highlighted in Figure 1-1, the presence of the fault has a significant impact on the groundwater levels. The area east of the fault experiences a drop in groundwater level, in the north-eastern corner of the property, this is modelled to be approximately 0.5m. In comparison, the majority of the area west of the fault experiences an increase in groundwater level. This increase in groundwater level is shown to be up to 1.5 m beneath 21A Old Road.

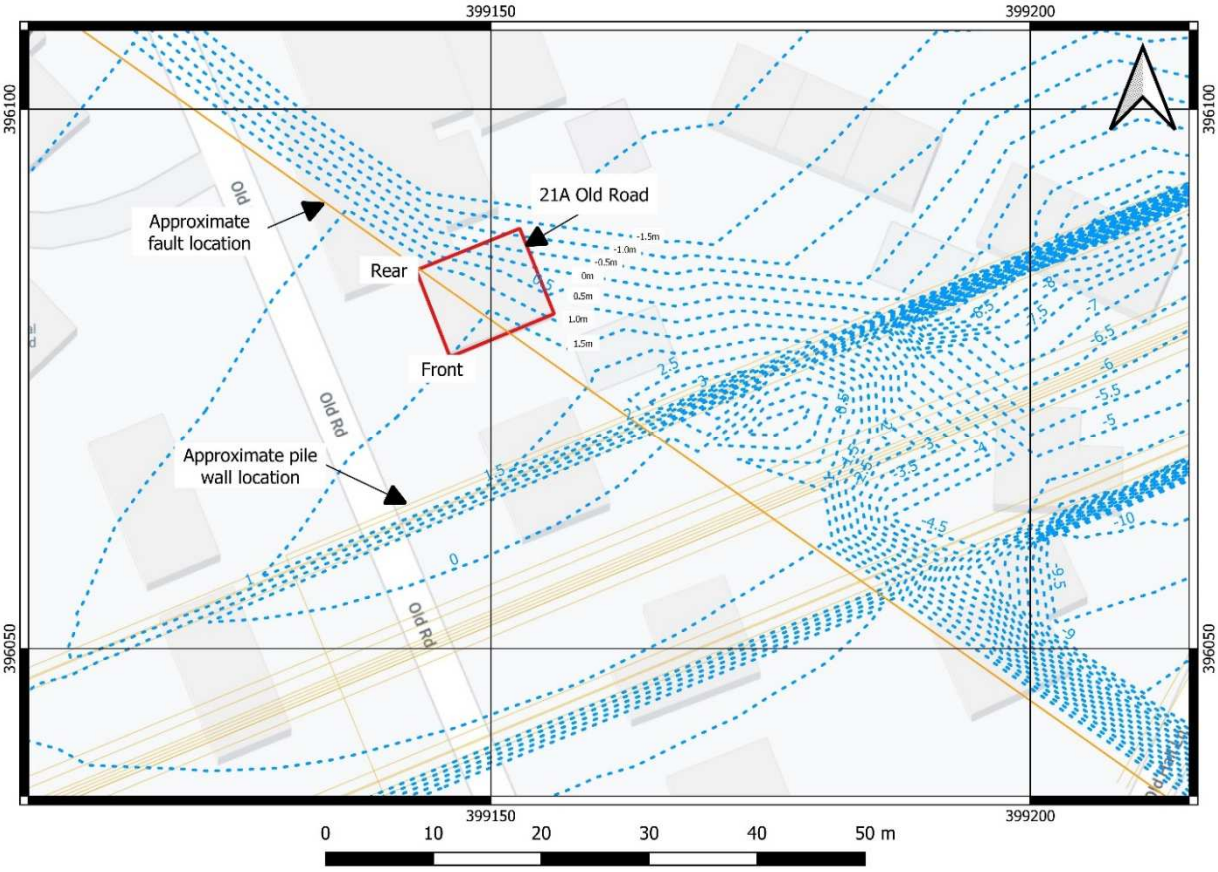


Figure 1-1 – 0.5 m contours showing change in groundwater level due to construction of the underpass

Methodology

4.5.3. The settlement analysis associated with long-term changes in groundwater level was undertaken using PDisp software by Oasis Ltd. considering an elastic analysis and using the Boussinesq method for the stress distribution induced by the change in groundwater levels.

4.5.4. The effects caused by the changes in groundwater level were modelled by applying a vertical distributed load at the final groundwater level. The load is calculated as the difference between the unit weight and the buoyant weight of the soil, multiplied by the height difference of groundwater before and after the change in groundwater level.

4.5.5. This uses the calculation below where:

$$UDL = (\gamma - \gamma')(H_{initial} - H_{final})$$

- UDL is the applied uniform distributed load (kN/m2)
- γ is the unit weight of the soil (kN/m3) (~20kN/m3)
- γ' is the buoyant unit weight of the soil (kN/m3) (~10 kN/m3)
- $H_{initial}$ is the existing groundwater level
- H_{final} is the final groundwater level

4.5.6. The Oasys PDisp software uses the applied load and calculates a long-term vertical settlement due to this load.

4.5.7. The results are presented in the below section.

4.6 Ground movement results

4.6.1. The results of the vertical ground surface settlement due to long-term changes in groundwater level are shown in Figure 1-2 – Total vertical ground surface settlement results

4.6.2. The figure reports settlement along the centre-line of the house with increasing distance from the back of the underpass piles. The total settlement line in Figure 1-2 shows the combined settlement due to pile wall installation, pile wall deflection and changes in groundwater level. The highlighted distances of 7 m and 17 m represent distance from the pile line to the front and rear of 21A Old Road.

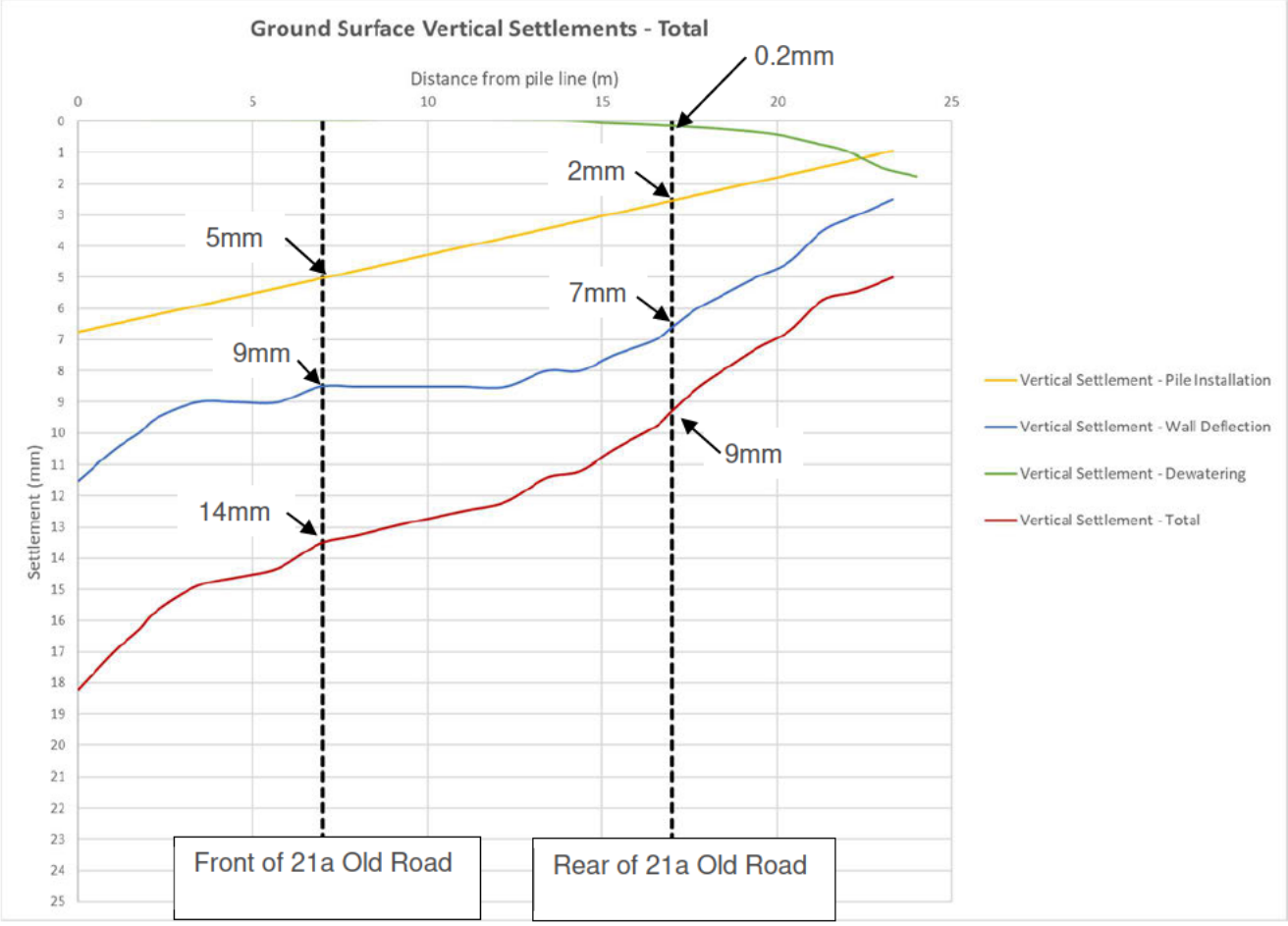


Figure 1-2 – Total vertical ground surface settlement results

4.6.3. The settlements presented Figure 1-2 are summarised in Table 1-1. Table 1-1 shows an estimated overall differential vertical settlement of approximately 5 mm between the front and rear of 21a Old Road. It is noted that these are best estimate values, however a range of values should be considered. Therefore, upper and lower bound estimates, deemed to represent a likely range of possible ground movements, have also been presented.

Table 1-1 – 21a Old Road vertical settlement summary

Analysis stage	Calculated values				Anticipated range	
	Pile wall installation (mm)	Pile wall deflection (mm)	Settlement due to changes in groundwater level (mm)	Total (mm)	Lower bound estimate (mm)	Upper bound estimate (mm)
Settlement– near edge of house	5	9	0	14	10	20
Settlement– far edge of house	2	7	0.2	9	5	15
Differential settlement	3	2	0.2	5	3	8

4.6.4. presents the horizontal movement results due to pile installation and pile wall deflections (horizontal movement due to changes in groundwater level are assumed to be negligible). As with the settlements presented, it is noted that these are best estimate values, and a range of values should be considered. Therefore, upper and lower bound estimates, deemed to represent a likely range of possible horizontal ground movements, have also been presented.

Table 1-2 – 21a Old Road horizontal ground movement summary

Analysis Stage	Calculated values			Anticipated range	
	Pile wall installation (mm)	Pile wall deflection (mm)	Total (mm)	Lower bound estimate (mm)	Upper bound estimate (mm)
Horizontal displacement – near edge of house	6	9	15	7	21
Horizontal displacement – far edge of house	1	7	8	3	11
Differential horizontal displacement	5	2	7	4	10

4.7 Building damage assessment – pile installation and excavation

4.7.1. An initial building damage assessment was undertaken based on the results presented above, using the methodology outlined within Section 6.4 of CIRIA C760.

4.7.2. The method uses a combination of deflection profile across the property and horizontal strain to calculate a structural damage category. Horizontal strain is calculated as the ratio of differential horizontal displacement to the width of the property. Based on the best estimate of vertical settlement profile and differential horizontal deflection across the width of the structure, the results indicated a predicted damage category of 1 to 2 (very slight to slight) as described within CIRIA C760 and below in Table 1-3. The results are presented below in Figure 1-3.

Table 1-3 – Description of typical damage for categories 1 and 2

Category of damage	Description of typical damage	Typical crack width
Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1mm
Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5mm

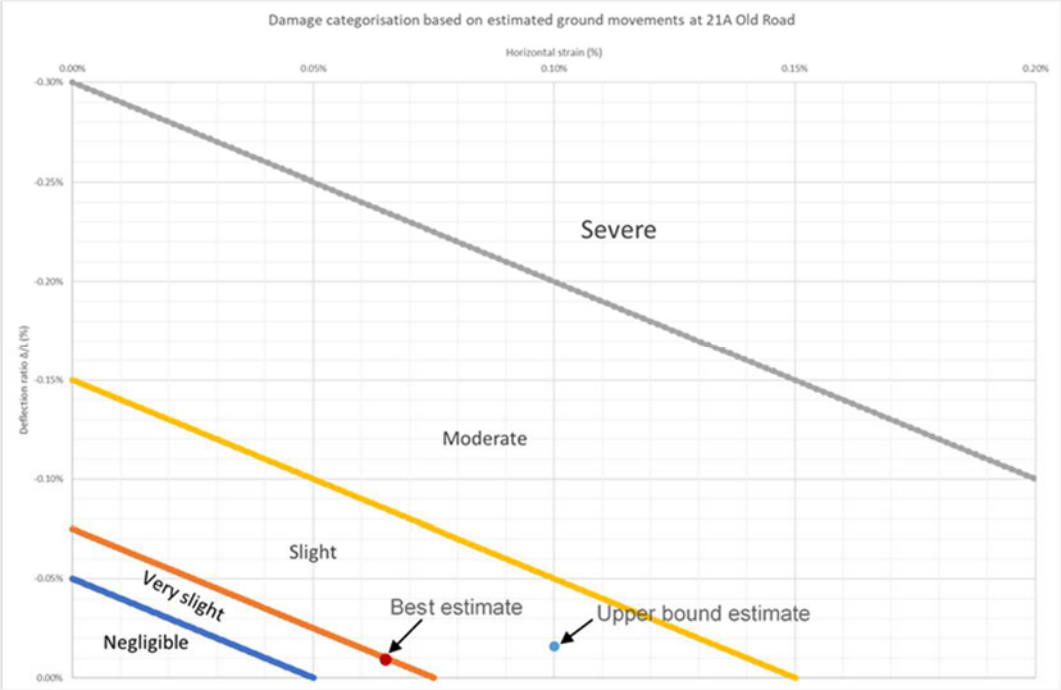


Figure 1-3 – Building damage assessment for 21a Old Road

4.8 Summary of effects due to permanent works

4.8.1. The ground movement and building damage assessment presented within this technical note is intended to provide an estimate of ground movements and possible building damage at 21A Old Road due to the construction of the proposed Mottram Underpass. This assessment considers the short-term impacts of the ground movement caused from pile wall installation and pile wall deflection, and the long-term settlement due to long-term changes in groundwater levels.

4.8.2. Table 1-1 shows that the impact of long-term groundwater level change caused by change in groundwater levels is minimal and appears to have the slight effect of reducing the differential settlement between the front and rear of 21A Old Road. This is shown in Figure 1-2. Overall the impact of the settlement is anticipated to cause very slight to slight damage to the property. Even with the upper bound estimates, the damage is anticipated to fall within the slight category.

5. Effects on Statutory Undertakers Equipment

5.1 United Utilities Foul Water

5.1.1. The 21A Old Road is situated over an existing main foul sewer line which is subject to diversion as a result of the proposals. The main is 225m in diameter and takes effluent from north to south. An indication of the foul water routes is shown in Figure 1-4.

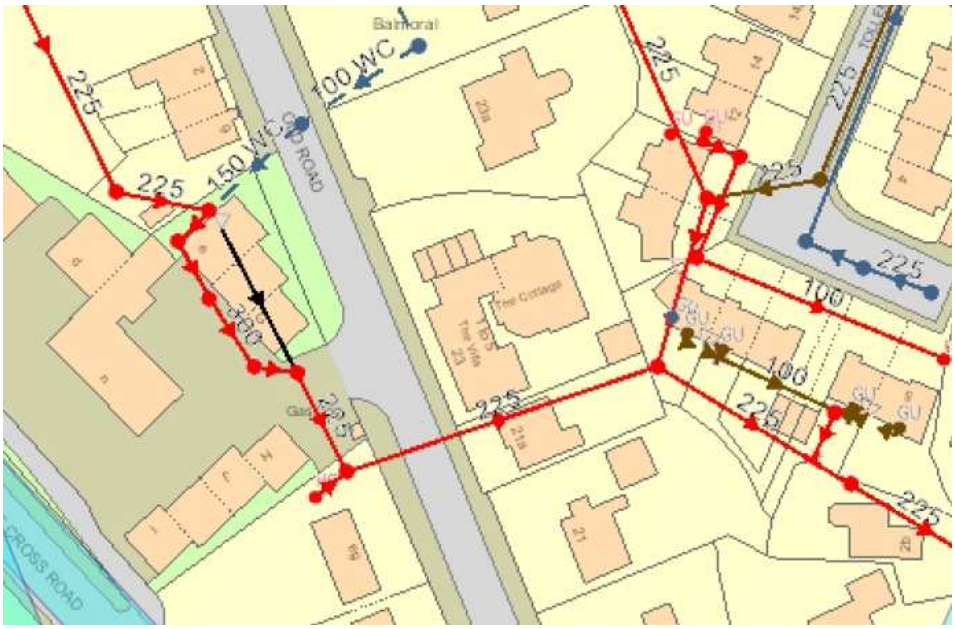


Figure 1-4 – Utilities Diagram around No. 21A Old Road

5.1.2. The information assessed to date includes the existing records information from United Utilities (asset owner), and preliminary site investigations. As these investigations were inconclusive in determining the exact alignment of the sewer and its current condition, further investigation works are planned which include a CCTV review of the sewer and survey of the associated manholes.

5.1.3. The planned diversion of the existing main foul sewer is required for the construction of the underpass. The existing line of the sewer is shown on the United Utility records as running west to east along the northern side of the property before turning towards south-east towards the rear of the property.

5.1.4. The manhole located at the rear of the property has not currently been located. Figure 1-5 shows an indicative location of the manhole and the indicative positioning of a potential pumping station which may be required as part of the sewer diversion works.

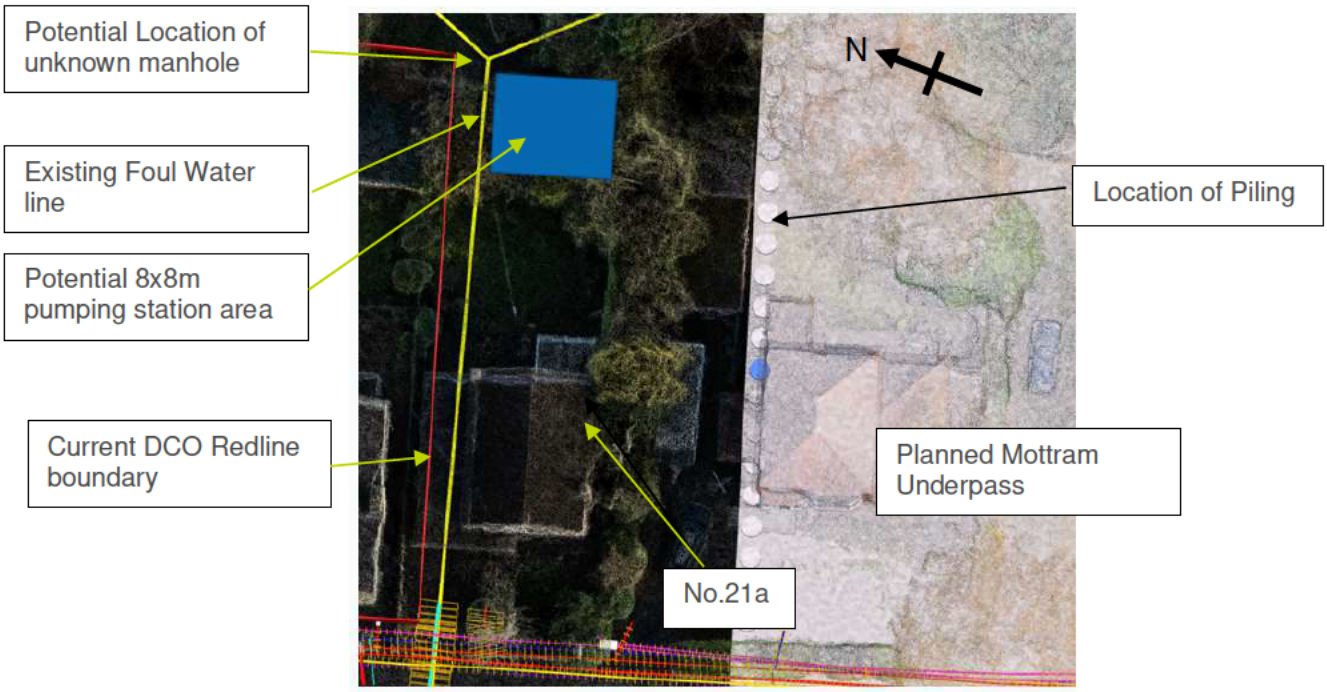


Figure 1-5 – Foul Water Layout around No. 21a Old Road

5.2 Electricity

5.2.1. The existing Low Voltage power supply to 21A Old Road is fed via an existing low voltage (LV) cable route in the eastern footpath of Old Road. The cable is owned and operated by Electricity North West.

5.2.2. In order to construct the underpass, both the high and low voltage cables from Old Road are to be diverted to Roe Cross Road, which will remove the existing supplies to this area of Old Road.

5.2.3. In order to maintain a supply to 21A Old Road, it may be necessary to install a new LV Cable from the point of diversion to the existing meter in the property. The specifics of this would not be known until detailed surveys were carried out to determine the condition of the existing LV cable.

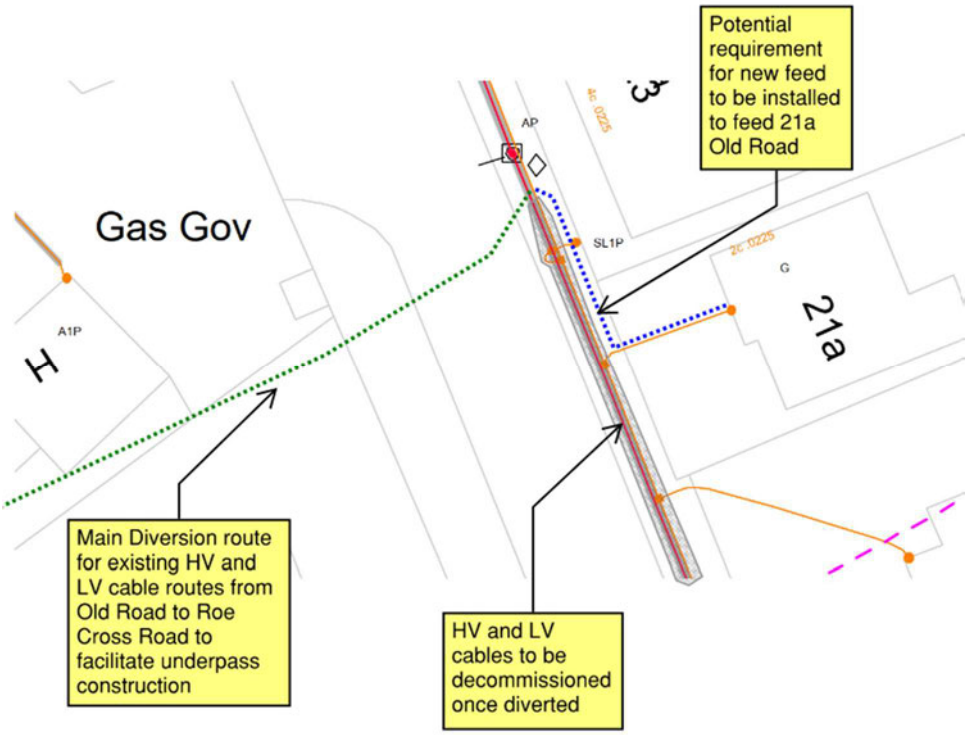


Figure 1-6 – Electricity layout around No. 21a Old Road

5.3 Gas

5.3.1. It is believed that the existing low pressure gas supply to 21A Old Road is fed via an existing low pressure gas main route in the eastern footpath of Old Road. The cable is owned and operated by Cadent Gas.

5.3.2. In order to construct the proposed underpass, both the medium and low pressure gas mains from Old Road are to be diverted to Roe Cross Road, which will remove the existing supplies to this area of Old Road.

5.3.3. In order to maintain a gas supply to 21A Old Road, it may be necessary to install a new low pressure gas feed from the point of diversion to the existing meter in the property. The specifics of this would not be known until detailed surveys were carried out to determine the condition of the existing gas feed pipe.

6. Potential Options in the Temporary Condition

6.1 Introduction

6.1.1. This section aims to explore some potential options to facilitate the construction of the permanent works based on the preliminary design submitted in to examination and highlight the risks associated with each option.

6.1.2. It should be noted that the existing foundation depths of the property are not known. However, it is unlikely that the property's foundation arrangement will materially affect the outcome of the assessment of each option discussed.

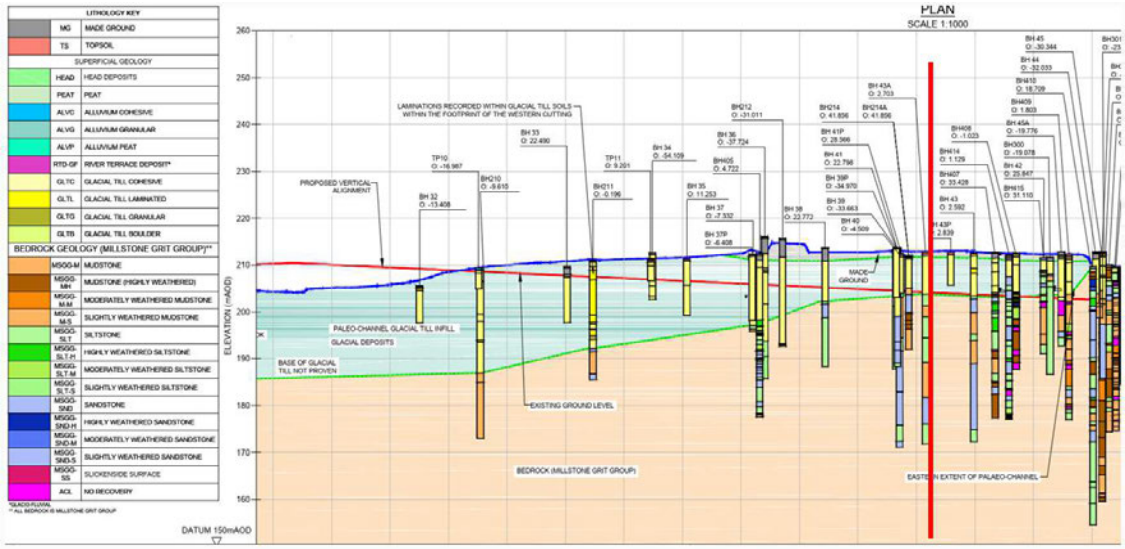
6.1.3. Any ground settlement indicated in the options below should be taken as additional settlement to the permanent works settlement as described in section 4.

6.1.4. It is noted that the permanent works detailed design has not been completed creating risks to the options considered. These elements are:

1) Underside of pile cap level
    a. This will affect the first stage excavation depth to the top of piling mat level which in turn will affect either the slope angle if an open cut methodology is used, or, effect the retained height of a retaining structure.
2) Final diameter of piling
    a. This will affect the selection of piling equipment and subsequently the depth of pile mat required below the level of the bottom of the first stage excavation to safely operate machinery considering its stability. This in turn will affect any potential retained height, or the extent of the excavation in an open cut scenario.
3) Final depth of stage 1 excavation.
    a. Once items 1) and 2) are known, a temporary dewatering scheme is required in the area to dewater the stage 1 excavation throughout the Mottram underpass area, the full effects of the dewatering are currently unknown and would be detailed once the depth of the excavation is known.

6.2 Ground Conditions

6.2.1. The below diagram is an extract from the ground investigation showing bedrock approximately 10m below the property overlaid by Glacial Till. The red line indicates the location of 21A Old Road.



6.3 Temporary Works Option 1 – Open Cut Excavation

6.3.1. Option 1 is considered as an open cut excavation to the top of the stage 1 excavation.

6.3.2. The excavation would be used to lower the ground level to the underside of the pile cap plus the depth of an appropriate piling mat for the permanent works piling to the underpass.

6.3.3. There is approximately 9 meters from the permanent works piling to the wall of the existing house on the plot of land at 21A Old Road.

6.3.4. A slope stability assessment has been undertaken using the Ground investigation data obtained and it has been confirmed that a 1:2 slope would be required for the slope to be stable in the temporary condition. A 1:2 temporary slope would extend at least to the wall of the property. It is noted that the overlying Glacial Till material is a soft cohesive material.

6.3.5. An indicative arrangement is shown below regarding likely proximity of equipment in the temporary condition in an open cut scenario and an indication of the 1:2 slope superimposed on 3D scan data overlaid on the permanent works design for the underpass.

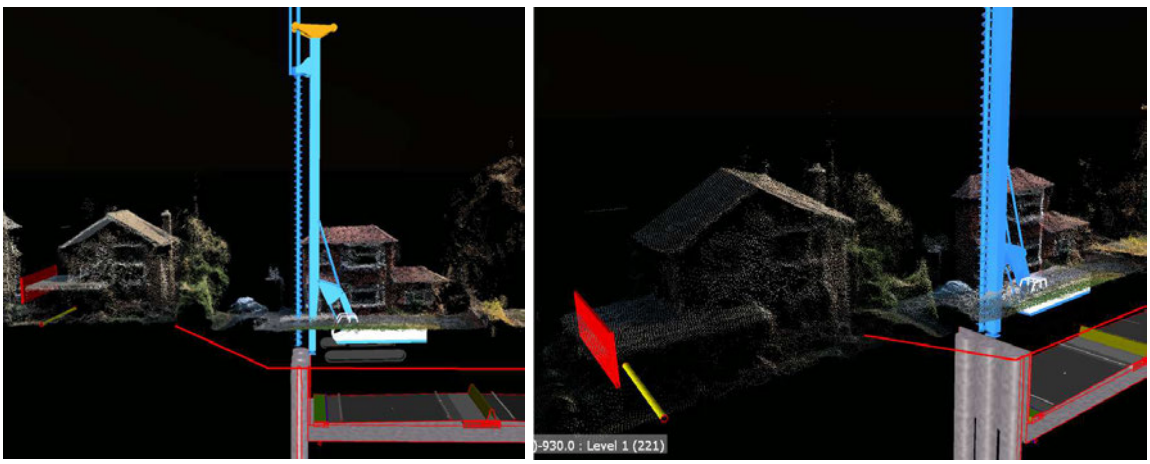


Figure 1-7 – Indicative piling arrangement at 21A Old Road

6.3.6. There are risks which are associated with this cut option which include:

1) Available room to allow for a 1:2 slope, safe working room around the piles for cropping and pile cap construction (including formwork), and edge distance from the house foundations to top of slope.
2) Prolonged exposure of a slope to weathering may cause slippage within the glacial till, and eventual undermining of the house foundations.
3) Settlement due to cutting of slope is unpredictable over time and is likely to cause movement in this scenario over and above the permanent works movement and damage assessment.
4) Although the foundation layout for the house is unknown, it is unlikely to have a material impact on the initial assessment.
5) Boundary trees into the property boundary would need to be removed as a minimum, once the stage 1 excavation depth is fully known, the full width of the excavation may clash with the building located on the property.
6) Ground water de-watering is to be carried out prior to excavation which incorporates further risk to the property. Dewatering would add additional settlement discussed in 3) above.

6.3.7. The recommendation is that this option should not be considered further due to high likelihood of the risks occurring, particularly slope stability of the 1:2 slope

6.4 Option 2 – Retaining Wall with Slope

6.4.1. Option 2 was considered as a sheet piled retaining wall 2m from the existing building.

6.4.2. The sheet piled retaining wall is installed 2m away from the house foundations. A sloped excavation at 1:2 is carried out to the required depth (2m retained height, with a 2m high 1:2 bund. Note; Option 3 below includes a 4m retained height).

6.4.3. This option was considered to create safe working room around the pile cap for formwork installation which was not possible within option 1.

6.4.4. The initial assessment for the temporary works design has concluded and incorporates 10m deep PU22 Sheet pile sections.

6.4.5. An indication of the layout of this option is included below in Figure 1-8

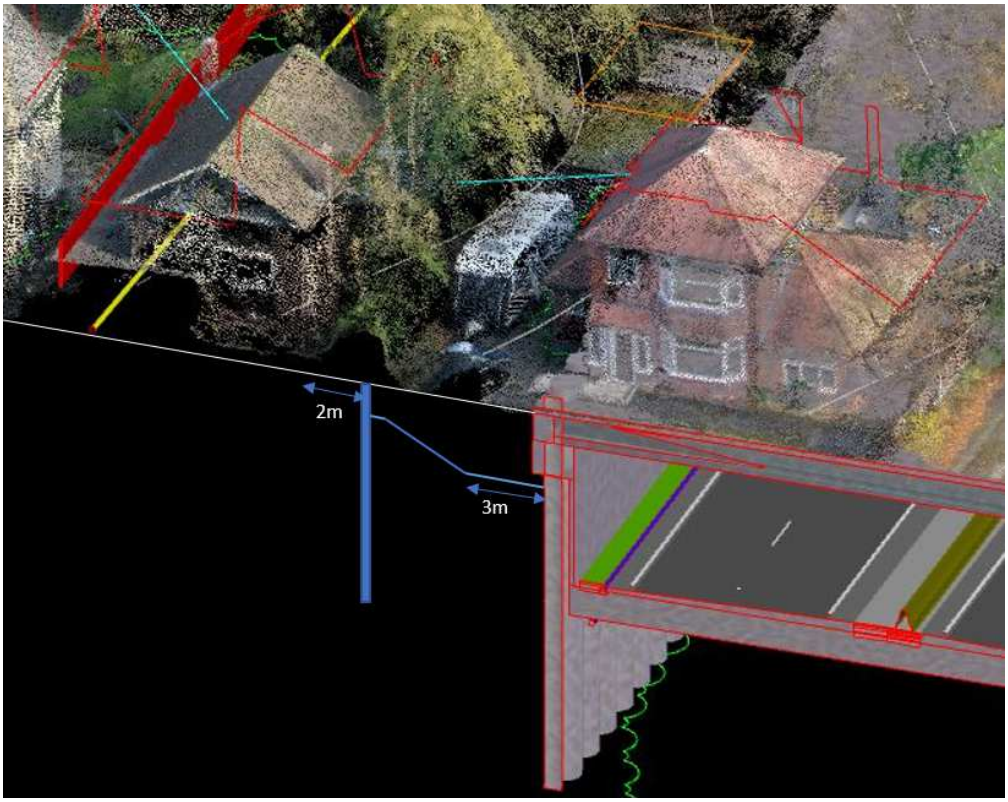


Figure 1-8 – Option 2 Indicative arrangement at No. 21A Old Road

6.4.6. There are risks which are associated with this option which include:

6.4.7. Vibration during sheet piling works could cause further damage to property. There is the potential for the bedrock to be shallower than 10m, this introduces a risk to the pile striking the bedrock. There is also the potential for the stage 1 excavation to be deeper than assumed which would also cause a clash with the bedrock.

1) Sheet piles are required to toe into hard ground to reduce deflection. The hard ground conditions anticipated and the sheet pile length required are likely to result in the need to use impact driving which will increase the vibration risk.
2) Further settlement in addition to the permanent works settlement below the property could be in the order of 7mm. (potential settlement of 27mm vertical settlement when considered with permanent works settlement)
3) A differential settlement between near and far house foundations of 6.5mm.
4) Ground water de-watering is to be carried out prior to excavation which incorporates further risk to the property. Dewatering would add additional settlement to that discussed in 3) above.
5) Although the foundation arrangement for the house is unknown, it is unlikely to have material impact on the initial assessment.

6.4.8. The recommendation is that this option should not be considered further due to the likelihood of the risks occurring, particularly with respect to potential vibration damage and combined settlement effects.

6.5 Temporary Works Option 3 – Cantilevered Retaining Wall

6.5.1. Option 3 was considered as a sheet piled retaining wall installed 6 m away from the house foundations, allowing for 3 m working room to the underpass piled wall. A full depth (considered as 4 m) excavation is carried out.

6.5.2. The initial assessment indicates the sheet piles would be 10 m long PU22 sections.

6.5.3. An indication of the layout of this option is provided in Figure 1-9 below.

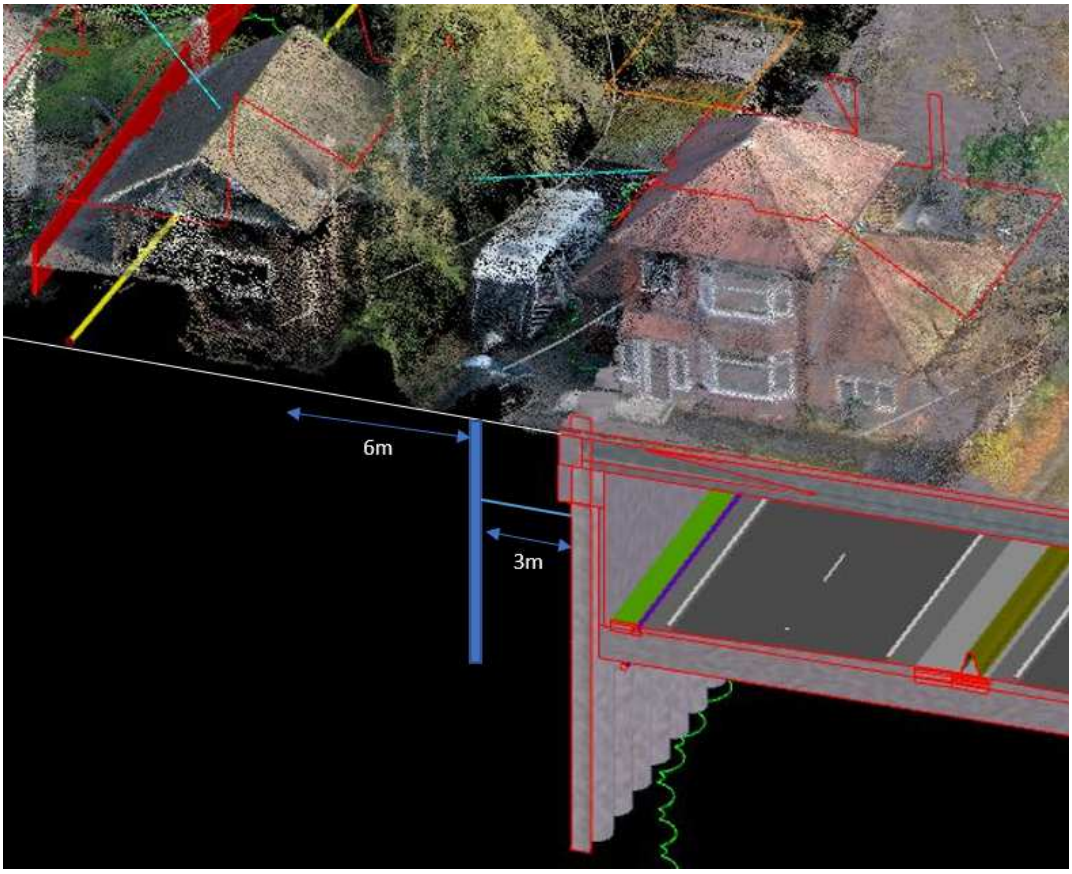


Figure 1-9 – Indicative Option 3 piling arrangement at No. 21a Old Road

6.5.4. There are risks which are associated with this option which include:

6.5.5. Vibration during sheet piling works is likely to cause damage to property. It is noted that the bedrock is located at a depth of 10m with the potential for outcrops in the bedrock.

1) Sheet piles are required to toe into hard ground to reduce deflection. The hard ground conditions anticipated and the sheet pile length required are likely to result in the need to use impact driving which will increase the vibration risk.

2) Further settlement, in addition to the permanent works settlement below the property could be in the order of 5mm (potential settlement of 25mm vertical settlement when considered with permanent works settlement)
3) A differential settlement between near and far house foundations of 5mm.
4) The area between sheet piled wall and house will be largely unusable during the construction process, as minimal surcharge will be required to minimise the potential pile deflection.
5) Ground water de-watering is to be carried out prior to excavation which incorporates further risk to the property. Dewatering would add additional settlement to that discussed in 3) above.
6) Although the foundation arrangement for the house is unknown, it is unlikely to have a material impact on the initial assessment.

6.5.6. The recommendation is that this option should not be considered further due to the likelihood of the risks occurring, particularly with respect to potential vibration damage and combined settlement effects.

6.6 Option 4 – Inclusion of No.21A in the Compulsory Purchase powers in the draft Order

6.6.1. Option 4 is to include the property in the Compulsory Purchase powers of the draft Order until further design development is undertaken, and the risks can be further understood from the effects of the permanent works design development.

6.6.2. Having considered potential temporary works options and the short-term effects of temporary works on the property, the recommendation is to pursue Option 4 and include the property within the Compulsory Purchase powers of the draft Order.

7. Compulsory Purchase Requirements

7.1 Summary

7.1.1. The information in this report confirms that the compulsory acquisition of 21A Old Road is required as the land is required to facilitate or is incidental to that development.

7.1.2. National Highways is satisfied that there is a compelling case in the public interest for the land and property to be acquired compulsorily.

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