A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.8 Environmental Statement – Appendix 10.5 Road Drainage and the Water Environment DMRB Sensitivity Test

Part B

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

June 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

The A1 in Northumberland: Morpeth to Ellingham

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Environmental Statement - Appendix

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TABLES

1. INTRODUCTION

1.1. UPDATED DMRB GUIDANCE

1.1.1. The assessment reported in **Chapter 10: Road Drainage and the Water Environment**, **Volume 3** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/6.3**) has been undertaken in accordance with the methodology detailed within Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.1**). This guidance document has been replaced by DMRB LA 113 Road Drainage and the Water Environment (**Ref. 10.2**), which was released in March 2020.

1.1.2. The purpose of this Appendix is to report the findings of the following which supports the sensitivity test outlined in **Chapter 10: Road Drainage and the Water Environment**, **Volume 3** of this ES (**Application Document Reference TR010041/APP/6.3**):

a. A hydrogeological assessment which has been undertaken for Part B to identify any changes to the groundwater assessments in light of the updated DMRB guidance (LA 113) (Section 2).
b. A high-level piling risk assessment in line with LA 113 (Section 3).

2. HYDROGEOLOGICAL ASSESSMENT

2.1. INTRODUCTION

2.1.1. The objective of this Appendix is to supplement original work undertaken in the ES by determining the implications of the updated guidance (LA 113) to the conclusions of the ES. The changes in the guidance refer to more detailed assessments of groundwater flow impacts and subsequent receptors (e.g. groundwater dependent terrestrial ecosystem (GWDTEs)). The scope of this updated assessment is summarised as follows:

a. No impacts on groundwater dependent terrestrial ecosystems were identified due to lack of such ecosystems and lack of groundwater flow impacts (this element is therefore scoped out).
b. Loss of groundwater recharge from increased hard surface area is scoped out due to the low permeability of the underlying geology and the extra hard surface area being negligible compared to the catchment area.
c. There are two proposed bridge structures at Heckley Fence and Charlton Mires, which would require piled foundations to a maximum depth of 15 m. Exact design details are not available. Further consideration is required as the piles may intercept groundwater-bearing layers within the bedrock.
d. There are three new culverts and extensions to a further two proposed for Part B which locally reduce the interaction between groundwater and surface water. Their limited extent and depth are unlikely to cause significant changes to the groundwater regime but are given high-level consideration below in order to reduce their impact further as much as possible.
e. As part of the drainage strategy for Part B, a number of lined detention basins extending below the groundwater table are proposed. These require further consideration as there is the potential for impact on groundwater flow.

2.1.2. The following sections focus on assessing the potential impacts of the lined detention ponds, bridge foundations and culverts on groundwater flow. The overall impact assessment is undertaken in line with the approach adopted in the ES where the significance of the impacts of the aforementioned features on groundwater is identified based on the magnitude of change and the importance of the affected receptor. Changes to assessments of drainage discharges to surface water and the requirement for a Water Framework Assessment are not considered in this Appendix.

2.1.3. This Appendix should be read in conjunction with the following chapters and appendices of the ES:

a. **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**)
b. **Chapter 11: Geology and Soils, Volume 3** of this ES
c. **Appendix 11.3: Ground Investigation Report, Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8)**
d. **Appendix 10.4: Drainage Strategy Report, Volume 8** of this ES

2.2. BASELINE CONDITIONS

GEOLOGY

2.2.1. The proposed route for Part B is underlain by shallow superficial deposits comprising glacial till and glaciofluvial deposits which are overlain by localised alluvium and peat. The thicknesses of the superficial deposits vary across the site with typical thickness of 3.0 m, but locally can range between 13 m-20 m.

2.2.2. Shallow alluvium deposits generally less than 2.0 m thick, comprising sand, silt, clay, peat have been proven adjacent to the watercourses. These overlie extensive deposits of glacial till, glaciolacustrine laminated clays and glaciofluvial sand and gravels. The predominately cohesive glacial till deposit, which is classified as generally firm to stiff, is described as sandy gravelly silty clay, with occasional granular layers of gravel, cobbles and boulders. Glaciofluvial deposits (comprising gravelly silty sand and gravels) were widespread to the north of Charlton Mires, at Charlton Mires and at West Linkhall.

2.2.3. The underlying bedrock, the Oxford Limestone, Alston Formation and Tyne Formation are present across the majority of the site, comprising of a sandstone, siltstone, mudstone and limestone succession with a number of thin coal seams within the strata. The Scremeston Coal Member is located north of Heckley Fence up to Rock Lodge, comprising sandstone, siltstone, mudstone and coal. No significant coal seams have been identified in the immediate vicinity of Part B.

HYDROLOGY AND HYDROGEOLOGY

2.2.4. A number of surface watercourses have been identified crossing the current carriageway alignment and within 100m of the proposed alignment for Part B. These surface water features consist of: Denwick Burn, Whitehouse Burn, Kittycarter Burn, Shiperton Burn, two unnamed water courses and one unnamed drain. Denwick Burn is the largest surface water feature located in close proximity to Part B. All of the above-mentioned watercourses are flowing from east to west. These are summarised in **Section 10.7, Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**).

2.2.5. The cohesive glacial till deposits underlying most of the site are designated by the Environment Agency (EA) as a Secondary Undifferentiated aquifer. The EA define a Secondary Undifferentiated aquifer as "*assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type*". This indicates that groundwater is likely to be present within the deposits but may only yield small amounts of groundwater. The alluvial and glacio-fluvial deposits present at the site are assigned as Secondary A aquifers. The EA define Secondary 'A' Aquifers as "*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers*". The peat deposits are designated by the

EA as Unproductive Strata. The EA define Unproductive Strata as "*rock layers or drift deposits with low permeability that have negligible significance for water supply or river baseflow*".

2.2.6. The bedrock (Oxford limestone, Alston Formation and Tyne Formation) is designated by the EA as a Secondary A aquifer.

2.2.7. Groundwater was encountered at between 1.0m – 3.5 metres below ground level (mBGL) during the 2018 Ground Investigation site works. The relatively shallow groundwater table was predominantly located in the superficial deposits; within glacial and alluvial materials overlying bedrock. Groundwater levels were encountered at depths of approximately 1mBGL or less in close proximity to watercourses. Groundwater levels in the bedrock ranged between 4 mBGL (DB24) – 5 mBGL (BH\17\11), 83 mAOD – 94 mAOD.

2.2.8. The proposed route alignment for Part B is not located within a Source protection Zone (SPZ).

2.2.9. Four soakaway tests were undertaken in the cohesive glacial till, however very little infiltration was achieved indicating that the ground material has a very low permeability.

2.3. DESIGN DETAILS

DETENTION BASINS

2.3.1. The minimum base levels used in this assessment for the proposed detention basins are given in the table below. Their locations are indicated in the drainage strategy report within the ES.

2.3.2. The basins would be lined and would be discharging into local watercourses, not to ground. **Table 2-1** summarises relevant construction details of the features relative to estimated groundwater levels.

Table 2-1 - Detention Basin Details

Detention Basin Reference	Detention Basin Base Level (mAOD)	Geology	Approximate Metres Below Current Ground Level (maximum)	Detention Basin Position Relative to Water Table
DB22	57.06	Cohesive Glacial Till	6	4
DB23	84.45	Topsoil, Cohesive Alluvium	4	= / 2m below

Detention Basin Reference	Detention Basin Base Level (mAOD)	Geology	Approximate Metres Below Current Ground Level (maximum)	Detention Basin Position Relative to Water Table
DB24	84	Cohesive Glacial Till/Limestone Bedrock	4.8	=
DB25	85.5	Glaciofluvial Sand and Gravel	1.5	=
DB26	85.4	Cohesive Glacial Till (inferred)	2.2	=
DB27	85	Glaciofluvial Sand and Gravel	4.8	=
Based on available GI information; exploratory holes may not always be at the exact location of the feature, depth below ground level/above/below water table are approximate; = at water table, * water table in bedrock				

2.3.3. Based on the information gained from the geological long sections in the ground investigation report it is understood that the base levels are proposed to be approximately between 1.5 m and 6 m below current ground level, at most, the majority being between 2 m and 5 m below current ground level, as detailed in **Table 2-1.** Three of six detention basins are founded in low permeability, clay-rich cohesive glacial till, with only DB24 encountering bedrock. The remaining three detention basins are founded in glaciofluvial sand and gravel and cohesive alluvium. The base elevation of the majority of the basins are equal to or in close proximity (within 1 m) to the inferred groundwater table. The groundwater level may be localised groundwater perched within the cohesive superficial deposited, which is assumed to generally have a low permeability. Detention basin DB22 is located approximately 4 m below groundwater level within the cohesive glacial till. The superficial geology is variable on a local level and depending on the exact location of individual basins they may intercept higher permeability layers in the till.

BRIDGE PILING

2.3.4. It is understood that piled foundation structures are proposed at two bridge locations; Heckley Fence (Ch. 55300) and Charlton Mires (Ch. 58940). Only high-level design information is available for the two bridge locations at this time and therefore this assessment is also high level.

2.3.5. No specific design details relating to the exact depth, width or spacing of piles have been reviewed for the proposed bridges. No piling is proposed within a SPZ and it is understood that piling would typically be to a maximum depth of 15 mbgl. These below ground structures are predicted to intercept the superficial and bedrock groundwater table. This may create additional pathways for groundwater flow.

CULVERTS

2.3.6. The design details of the following proposed culverts have been considered in the context of the local geology and hydrogeology within the assessment: Linkhall Culvert, Shipperton Culvert, Whitehouse Burn Culvert, Rock Culvert and Denwick Burn Culvert. It is noted that the works to these culverts comprise of extensions of existing structures.

2.3.7. The majority of the culverts have outlets close to or slightly below the groundwater table and are less than 50 m in length.

2.4. ASSESSMENT

IMPORTANCE OF THE RECEPTOR

2.4.1. The importance of receptors has been determined using Table 3.70 in the updated guidance (LA 113) (**Ref. 10.2**).

2.4.2. The groundwater in the cohesive glacial till, as a secondary undifferentiated aquifer is classified as a receptor of low importance.

2.4.3. The groundwater in cohesive alluvium, glaciofluvial sand and gravel and limestone bedrock, all of which are Secondary A Aquifers are classified as a receptor of medium importance.

2.4.4. Therefore, for the assessments the overall importance of the receptor (shallow groundwater) is deemed to be medium.

POTENTIAL IMPACTS

Detention Basins

2.4.5. The detention basins would be mostly based within low permeability deposits; lined and situated close to or below the water table. There is therefore the potential the basins to act as a barrier to groundwater flow, which, due to the generally shallow groundwater in the superficial deposits could cause groundwater upwelling beneath or around the basins, in particular for DB22 which extends well below the groundwater table.

Bridge Foundations

2.4.6. The bridge foundations could impede groundwater flow in the higher permeability layers in the superficial layers and in the water bearing strata of the bedrock. The associated piling works could cause a change in connectivity of different groundwater bearing layers leading to a change in groundwater flow conditions.

Culverts

2.4.7. While below ground structures have the potential to obstruct groundwater flow and discharge to surface water courses.

2.5. LIKELY SIGNIFICANT EFFECTS

DETENTION BASINS

2.5.1. Higher permeability material would be placed beneath or around the detention basins to allow groundwater to move freely around the lined basins. It is understood this would be incorporated into the detailed design as outlined in the **Outline Construction Environmental Management Plan** (**Outline CEMP**) (**Application Document Reference: TR010041/APP/7.3**). With the implementation of this mitigation, it is considered that there would be a permanent minor adverse magnitude of impact upon groundwater level and flows and the overall significance of effect would be **slight adverse (not significant)**.

BRIDGE FOUNDATIONS

2.5.2. A piling risk assessment for the bridges is presented in **Section 3** below, this includes mitigation measures which would be applied.

CULVERTS

2.5.3. As a mitigation measure to reduce the potential magnitude of the impact of the culverts as much as possible, a granular layer would be placed beneath proposed culverts in order to ensure groundwater can flow beneath them unimpeded thereby preventing potential groundwater rise and flooding. This is outlined in the **Outline Construction Environmental Management Plan** (**Outline CEMP**) (**Application Document Reference: TR010041/APP/7.3**). In addition, the culverts are:

a. Shallow, the outlet level being at or close to that of the water table, (based on limited groundwater information at many locations)
b. Of limited length (most being <50 m)
c. Located beneath the proposed carriageway; an area of hardstanding which would reduce groundwater recharge locally

2.5.4. With implementation of this mitigation it is considered that there would be a permanent minor adverse magnitude of impact upon groundwater levels and flows and the overall significance of effect would be **slight adverse (not significant)**.

3. PILING RISK ASSESSMENT

3.1. INTRODUCTION

3.1.1. Within Part B, two structures with piled foundations are proposed and it was considered that the piles could cause change in connectivity of different groundwater bearing layers or act as a groundwater flow barrier leading to a change in groundwater flow conditions. Based on available design information the magnitude of this impact was deemed to be potentially moderate adverse with the significance of the effect potentially being moderate.

3.1.2. It was recommended to undertake piling risk assessments for the proposed foundations based on more detailed information to demonstrate the magnitude of the impact is minor to negligible, resulting in an impact of slight significance.

3.1.3. The objective of this section is to present a high-level piling risk assessment in line with the updated DMRB guidance (LA 113) and with the approach adopted in the ES.

3.1.4. Little contamination was encountered during the ground investigation within an environment of generally low ground permeability, therefore groundwater cross-contamination caused by piling is not considered a significant risk. The focus of this section is on changes to groundwater flows and levels caused by below ground structures (piled foundations).

3.1.5. This Appendix should be read in conjunction with the hydrogeological assessment set out in **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**)

3.2. METHODOLOGY

3.2.1. A high-level piling risk assessment has been undertaken in line with the DMRB guidance and with the approach adopted in the ES. The significance of the impacts of the features under consideration on groundwater are determined based on the magnitude of change and the importance of the affected receptor.

3.2.2. Detailed quantification of the groundwater level changes is not possible in absence of detailed site monitoring data and detailed design information. In order to achieve this a detailed hydrogeological assessment would be required involving long term groundwater monitoring within the area of each proposed location. A professional judgement approach has therefore been adopted whereby a moderate magnitude rating for piles extending more than 1m below expected groundwater level is given where:

a. Layered aquifers (combination of high and low permeability layers) are present
b. The exact extent of these layers (in particular the water bearing strata) is unknown
c. The groundwater may not have a flow path around structures
d. The overall depth to which the piles penetrate the water table

3.3. BASELINE CONDITIONS

3.3.1. Baseline conditions including geology and hydrogeology are described in Section 10.7 of **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**).

DESIGN DETAILS

3.3.2. The following (2) bridges/piled structures have been considered in this assessment:

a. Charlton Mires Overbridge
b. Heckley Fence Overbridge

3.3.3. The general design details of the piles are as follows:

a. Pile diameter: 0.9 m
b. Pile spacing: (edge to edge): 1 m
c. Pile depth: typically, up to 15 m below existing ground level (to be confirmed at detailed design stage)

3.3.4. These numbers are general, not specific to individual piles/locations and the exact pile depth is unknown at present, therefore it has been assumed for this assessment that they penetrate to a depth of 15 m below ground level.

LOCAL GROUND CONDITIONS

3.3.5. **Table 3-1** details the local ground conditions in the vicinity of each piled structure taking into account the general design details.

Table 3-1 - Local Ground Conditions in the Vicinity of Piled Structures

Structure	Superficial deposits	Bedrock	Pile base*	Groundwater in superficial deposits	Top of bedrock	Pile penetration into superficial deposits	Pile penetration into bedrock	Pile depth below groundwater
Charleton Mires Overbridge	Predominantly Cohesive Glacial Till and cohesive alluvium	Sandstone over interbedded sandstone, limestone and coal bearing weathered mudstone.	81 mOD	94 mOD	90 mOD	Up to 7 m	8 m	13 m
Heckley Fence Overbridge	Predominantly cohesive and granular glacial till deposits, thinner bands of glaciolacustrine deposits.	Limestone	70 mOD	84 mOD	68 mOD	15 m	0 m	14 m
*based on the pile extending to 15 m below ground level								

3.4. ASSESSMENT

IMPORTANCE OF THE RECEPTOR

3.4.1. The groundwater in the cohesive glacial till, as a secondary undifferentiated aquifer is classified as a receptor of low importance.

3.4.2. The groundwater in gravels within the till and the bedrock (both of which are Secondary A Aquifers) are classified as a receptor of medium importance.

3.4.3. Therefore, for the assessments the overall importance of the receptor (shallow groundwater) is deemed to be medium.

POTENTIAL IMPACTS

3.4.4. Below ground structures such as the two proposed structures which incorporate piling into their design have the potential to create a barrier to groundwater flow causing a rise in groundwater level or changes to groundwater flow. Due to the shallow water table along much of the route, the piles terminate up to 15 m below the water table. The piles have the potential to cause changes to groundwater flow or levels due to the shallow water table across much of these sites and with the spacing of the piles reducing the cross section for groundwater flow paths by approximately 50%.

LIKELY SIGNIFICANT EFFECTS

3.4.5. Considering that the piles extend to over 1 m below the water table within a layered aquifer in all cases, in order to reduce the magnitude of the impact to minor adverse, mitigation would be implemented in the form of shallow drains either side of the foundations which feed into the local surface water or drainage systems to mitigate against groundwater rise. Such mitigation would be considered at detailed design stage. With the implementation of this mitigation, there would be a permanent minor adverse magnitude of impact upon groundwater levels and flows and the overall significance of effect would be slight adverse (not significant).

4. CONCLUSION

4.1. CONCLUSIONS

4.1.1. The updated guidance LA 113 (**Ref. 10.1**) includes a number of key changes in the assessment methodology compared to DMRB HD 45/09 (**Ref. 10.2**) which it replaces. A number of the identified changes are considered unlikely to affect the conclusions of the road drainage and the water environment assessment presented in **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**). However, the following identified changes were considered to warrant further assessment:

a. An assessment of the impacts on groundwater levels and flows, previously not required and presented within this Appendix.

4.1.2. The assessment has concluded that impacts from detention basins, bridge foundations and culverts would be mitigated. This would be through the implementation of mitigation in the form of placing higher permeability material beneath or around the detention basins; placing a granular layer beneath proposed culverts and use of shallow drains. Therefore, it is appropriate to conclude that adopting the LA 113 methodology would not change the conclusions of **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference TR010041/APP/6.3**).

4.1.3. The assessment has also concluded that impacts from below ground structures (piled foundations) would be mitigated through the implementation of mitigation in the form of shallow drains. Therefore, it is appropriate to conclude that adopting the LA 113 methodology would not change the conclusions of **Chapter 10: Road Drainage and the Water Environment, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**).

REFERENCES

Ref. 10.1 - Highways Agency (2019) Design Manual for Roads and Bridges Volume 11, Section 3, Part 10 (HD 45/09).

Ref. 10.2 - Highways England, Transport Scotland, Welsh Government, Department for Infrastructure (2020) LA 113 Road Drainage and the Water Environment. Available at: https://www.standardsforhighways.co.uk/dmrb/ [Accessed March 2020].

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