NGVL/JM/1

RAIL ENGINEER

NATIONAL GRID VIKING LINK LIMITED (VIKING LINK INTERCONNECTOR) COMPULSORY PURCHASE ORDER 2019

PROOF OF EVIDENCE

JON MCPHEE
DIRECTOR RAIL
PELL FRISCHMANN

1. QUALIFICATIONS AND EXPERIENCE

1.1 My name is Jon McPhee and I hold a BEng (Hons) degree in Civil Engineering. I am a Chartered Engineer and have been a Member of the Institution of Civil Engineers since 1995. I am also a member of the Permanent Way Institution. I have over 27 years' experience of delivering rail related projects in the UK, including metro, light rail and heavy rail.

1.2 I am Pell Frischmann's Rail Sector Director with responsibility to the executive board for the strategy of the rail business, supporting major tender submissions and client initiatives to position Pell Frischmann in target markets and projects and programmes. Alongside this role I am an active hands-on engineer. I have worked for Pell Frischmann for 22 years.

1.3 I report directly to Pell Frischmann's Managing Director.

1.4 Brief career details

1.4.1 In my working life, I have been involved with many hundreds of Civil Engineering sites of different sizes both in the operational railway environment and outside of it. For approximately half of the projects I have been involved with they have been procured on a Design and Build basis where I am employed directly by the Main Works Contractor and involved in methodology and buildability.

1.4.2 I am familiar with Network Rail operational railway having been involved in both new build projects, improvement and asset maintenance schemes for 22 years.

1.4.3 My core experience prior to achieving chartered status was in the design, inspection and assessment of bridges including new primary structures on the A41 and A14. My experience, developed in the inspection of County bridges in Norfolk, led to developing a workstream with London Underground (now a part of Transport for London) inspecting, assessing and designing repairs of bridges and retaining structures. Having developed a rail infrastructure capability, I was seconded as Resident Engineer on to the construction of Chafford Hundred Railway Station in Essex.

1.4.4 Twenty years ago, I moved employment to another small consultant which was purchased by Pell Frischmann in 2000. I undertook the design of prestressed beams for the new nine-span Sir Stephen Redgrave bridge over the Royal Albert Dock Basin in east London and a large collision protection structure to protect the Docklands Light Railway. I was subsequently appointed on site as Deputy Residential Engineer.

1.4.5 Leading a team of 12 staff, I delivered the civil design support to Marconi (now Telent) on the West Coast Main Line Train Communication System project. This consisted of the design and supervision of 176 individual trackside communication mast sites between London Euston and Manchester.

1.4.6 Other design and build projects for contractors led me to work with British Pipeline Agency (BPA) supplying general Civil Engineering capability to support their high-pressure gas pipeline design work. This included major schemes such as the Mawdesley to Warrington pipeline, Hythe CHP and Salmesbury to Helmshore pipeline.

1.4.7 The BPA schemes needed the installation of both microtunnel and directional drill crossings below major roads, rivers, canals and railways. My work required me to prepare reports to achieve Network Rail sign off and included settlement predictions, mitigation and monitoring proposals. During this time, I became a National Grid accredited GL5/G17 Approver/Appraiser of Civil Engineering design for high pressure gas projects.

1.4.8 I continued to develop the rail business within the office and led an office of circa 50 staff moving into multi-disciplinary railway designs which integrated our civils offering with track, power and signalling disciplines. I was appointed as Contractor's Engineering Manager (CEM) on many projects and given delegated authority as Civil Engineer on behalf of Network Rail for station works undertaken by the train operator LOROL.

1.4.9 For ProLogis at Daventry International Rail Freight terminal I led the design of a new multi-modal facility and rail-connected logistics buildings. This required the construction of new track, modifications to existing sidings, new bridge structures, retaining structures and highway works.

1.4.10 Connecting Pell Frischmann's building structures capability with rail knowledge led us to expand our air-rights offering to developers and landowners on over a dozen schemes. I led the design of Royal Mint Gardens through to planning over a seven-year period during which time I was employed continuously at different times by two developers, Network Rail and Docklands Light Railway to manage the design and rail assurance. I was also appointed as CEM for Solum, a developer formed from a joint venture of Network Rail and Keir Property.

1.4.11 In 2013, I was appointed as CEM and Project Manager on a £25M design for London Overground of ten new sidings extending New Cross Gate

depot, Project Director on London Underground depot extensions, station improvements and other rail infrastructure projects.

1.4.12 I have been responsible for the £6M rail turnover of Pell Frischmann since 2010 as Sector Director. I transitioned to my current role as Director Rail in 2015.

1.5 Details of Similar Experience

1.5.1 I have designed and managed the civil engineering aspects of several Transco projects to reinforce the storage and connectivity of UK gas infrastructure. For example, a 1.2m diameter high pressure gas pipeline between Mawdesley and Warrington required a similar approach to that being proposed by NGVL in that the route, obtained mainly through CPO, crossed many pieces of infrastructure such as major roads, rivers, canals and railways. I was responsible for developing individual reports of each crossing showing the predicted settlement likely to be experienced by the railway. The crossings were mostly micro-tunnel using a pipe jack system with one circa 500m long horizontal directional drill (HDD).

1.5.2 At Kensal Green, I was to challenge the basis of the design being put forward by Crossrail which resulted in the need for my Client's land to be acquired by CPO. The land in question was to be used by Network Rail as a site establishment for the construction of a new rail access into Old Oak Common depot and associated on-network modifications to the main line tracks and systems. I was commissioned as expert witness to investigate less intrusive options and present these in a report. My findings included two alternatives to Crossrail's proposal both of which used existing railway land that would be less intrusive than the CPO land and subsequently a settlement was reached between my Client and Crossrail.

1.5.3 In 2015 I was appointed on a project at Velmore, near Portsmouth, as CEM for the installation of four parallel directional drills to accommodate four new high voltage AC cable routes being installed by SSE. My role was to approve all the various designers and submit to Network Rail for acceptance prior to then signing off the design. The design assurance process achieved sign-off of design, construction phase and work package plan from Network Rail and works are now complete.

1.5.4 In 2017 I supported National Grid in their North Sea Link project where four primary cables were proposed to pass below the railway near Blyth using horizontal directional drill methods of construction similar to those proposed on the Viking Link project.

2. INTRODUCTION AND SCOPE OF EVIDENCE

2.1 This proof of evidence sets out the nature of the existing line, the methodology proposed by NGVL to cross it, the possible operational railway impacts of the proposed cable crossing and their mitigation.

2.2 My proof of evidence is set out as follows:-

2.2.1 **Section 1**- Outlines my qualifications and experience.

2.2.2 **Section 2**- Introduces my proof of evidence.

2.2.3 **Section 3**- Describes the railway to be crossed by the Viking Link Interconnector.

2.2.4 **Section 4**- Describes the works required to be carried out and potential impacts on the Railway.

2.2.5 **Section 5**- Contains my conclusions.

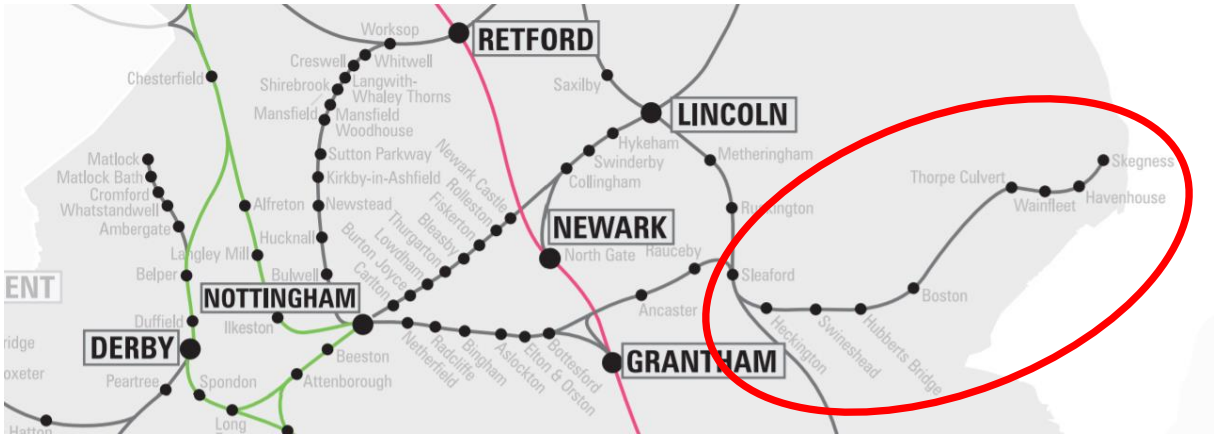
2.2.6 **Section 6**- Contains my declaration.

3. DESCRIPTION OF RAILWAY

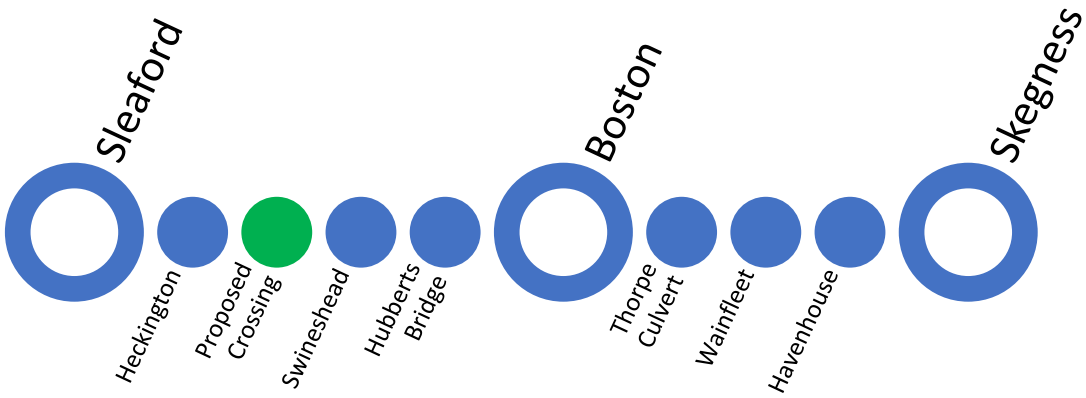
3.1 Current use of the Railway

3.1.1 Network Rail references for the line to be crossed, otherwise referred to as the 'Poacher Line', are Barkston South Junction to Skegness Line of Route LN185 and Engineers Line Reference GRS1 to GRS4.

3.1.2 The line is run as a Community Rail Partnership with passenger services operated by East Midlands Trains in partnership with Lincolnshire County Council between Sleaford and Skegness as circled in red in the figure below extracted from the Network Rail website:



3.1.3 Line LN185 connects Sleaford to Skegness through seven other stations of which Swineshead is the closest station to the proposed cable crossing point, some 2km to the east with Heckington Station 5.5km to the west indicated schematically in the figure below:



3.1.4 Patronage statistics data from the Office of Rail and Road (Appendix 1-extract) show that the key stations used along the route from Sleaford are Heckington, Boston, Wainfleet and Skegness driven by the fact that

most trains only stop at these stations. A sample of the figures are in the table below:

Station	Entries & Exits
Sleaford	309326
Heckington	66576
<<<<Crossing>>>>	
Swineshead	3406
Hubbert's Bridge	1412
Boston	218000
Thorpe Culvert	148
Wainfleet	47216
Havenhouse	172
Skegness	357428

3.1.5 Skegness is a terminus station and fifteen passenger trains arrive and fifteen leave every Monday through to Saturday and between approximately 7am and 9pm making hourly services. At one third of a million journeys taken through the station it is an important regional route to the coast for holidaymakers with two thirds of tickets being reduced ticket travellers. Very few season ticket holders use the line suggesting that commuters prefer the quicker journey by car.

3.1.6 Nine passenger trains arrive and leave on a Sunday between 10am and 9pm varying between hourly and every two hours as per the table below:

Planned Arrival	**Origin**	**Train ID**	**TOC**	**Destination**	**Planned Departure**
1007	Boston	2S03	EM	Terminates here	
	Starts here	2S10	EM	Nottingham	1014
1054	Nottingham	2S09	EM	Terminates here	
	Starts here	2S12	EM	Nottingham	1115
1150	Mansfield Woodhouse	2S11	EM	Terminates here	
	Starts here	2S14	EM	Nottingham	1227
1320	Nottingham	2S13	EM	Terminates here	
1400	Nottingham	2S15	EM	Terminates here	
	Starts here	2S18	EM	Nottingham	1410

Planned Arrival	Origin	Train ID	TOC	Destination	Planned Departure
	Starts here	2S20	EM	Nottingham	1515
1611	Nottingham	2S19	EM	Terminates here	
	Starts here	2A58	EM	Derby	1622
1708	Nottingham	2S21	EM	Terminates here	
	Starts here	2S26	EM	Mansfield Woodhouse	1807
1838	Nottingham	2S25	EM	Terminates here	
	Starts here	2S28	EM	Nottingham	1915
2026	Nottingham	2S29	EM	Terminates here	
	Starts here	2S32	EM	Nottingham	2043

3.1.7 One freight train per day is timetabled through from Sleaford to Skegness and back between Doncaster and Peterborough but is often cancelled. Short term planning of individual freight train services from Derby are also not uncommon.

3.1.8 A High-Speed train is also timetabled on a return trip from and to Derby as special event trains.

3.1.9 The consequence of this timetable is that from a little after 9pm on a Saturday evening until 7am on Monday there are only nine trains planned to move in and out along the line and all these operate from Skegness stopping at Wainfleet and Boston only before reaching Heckington.

3.2 Design of the Railway

3.2.1 Each of the two railway tracks on LN185 is constructed using conventional twin rail on timber sleepers with some areas of concrete sleepers noted. Track support is given by ballast on to the ground with little or no vertical elevation change between adjacent ground level and top of ballast.

3.2.2 Signalling of trains in the area is by traditional semaphore signals controlled from local manned signal boxes rather than the more common

two, three, and four aspect colour light signals of remotely controlled modern signalling.

3.2.3 The trains on this line are diesel powered. There is no electrification on this line.

3.2.4 Platform lengths at station vary between a length enough for 2-car trains up to 10-car passenger services.

3.2.5 Between Heckington and Swineshead stations the line speed is 60pmh for passenger services and 35mph for freight services.

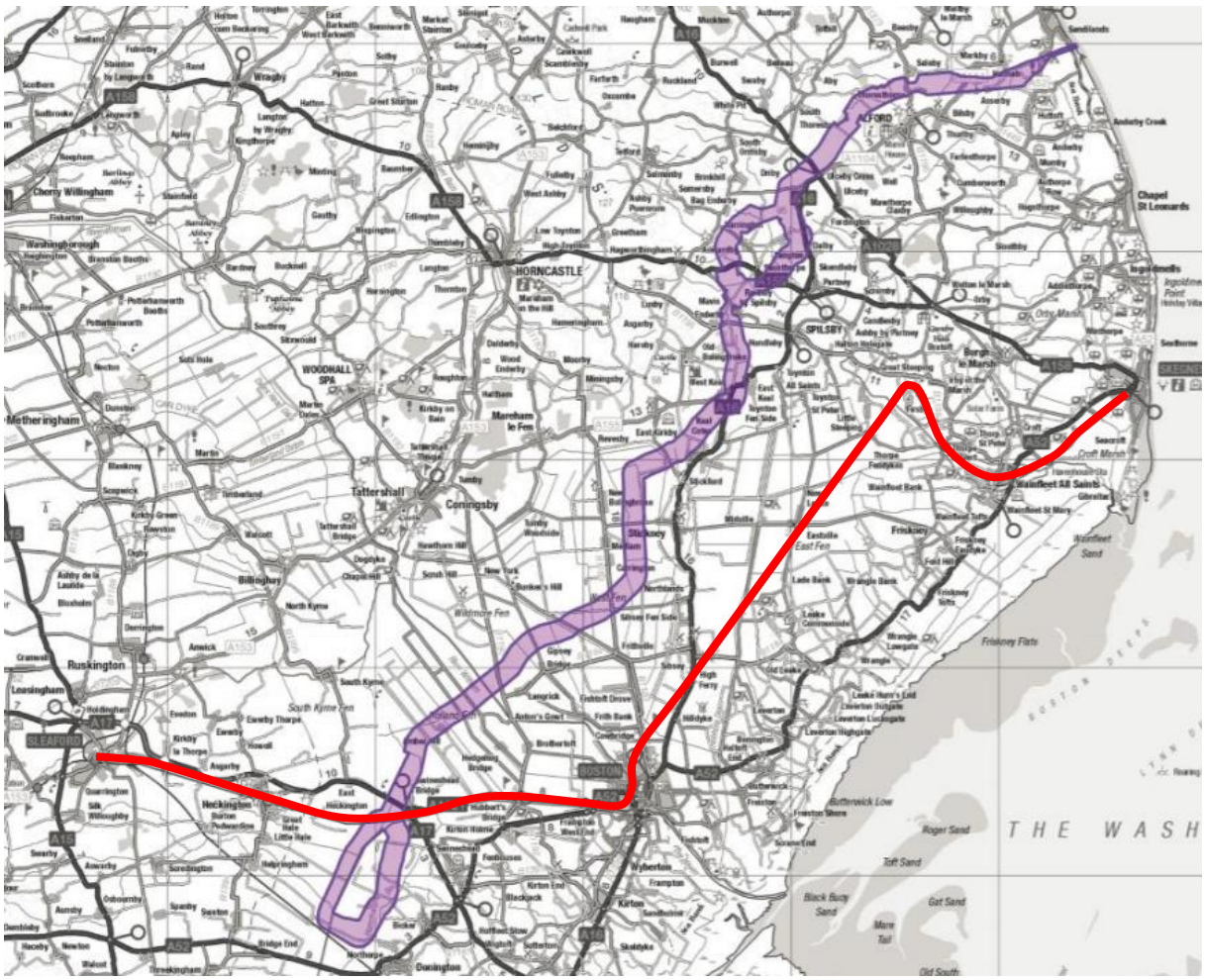
3.2.6 At the crossing point the line is twin track. To the east of Swineshead Station, beyond Hubberts Bridge, the line becomes single track limiting the capacity of the route by number of trains per hour.

3.2.7 The highway, farm accommodation and pedestrian crossings of the railway are all at-grade and a mixture of barriered and un-barriered level crossings. Near to the cable crossing point there is an un-barriered vehicle crossing for access to a drainage authority building. Swineshead Station level crossing has automatic half-barriers controlling the highway traffic on one side of each approaching lane only. To the west of the cable crossing point, Heckington Station has traditional timber manually operated gates set across the tracks and manually operated by the signaller in the immediately adjacent signal box. At Havenhouse, the level crossing surface is still formed in timbers again with half barriers.

4. PROPOSED CABLE CROSSING AND IMPACT OF WORKS ON THE RAILWAY

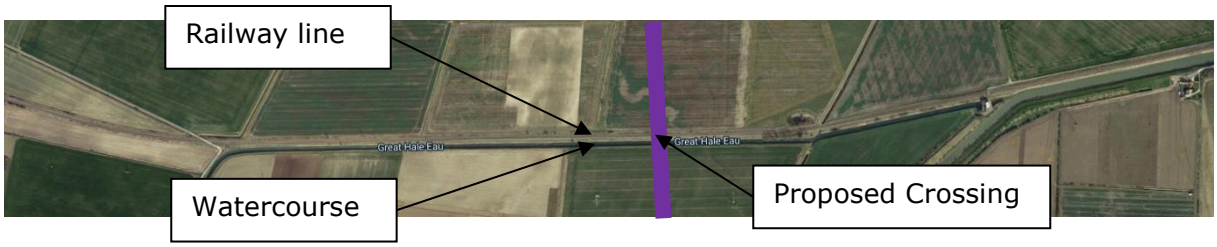
4.1 NGVL propose to install three horizontally directionally drilled (HDD) bores beneath Network Rail's line at Easting 519880 Northing 342513.5. These bores will host ducts in which high voltage cables will be drawn. Subject to final design, the depth of the bores is each expected to be in the region of 7 to 12 metres. This depth will be selected with consideration of the subsoil types in the area which have already been investigated through geotechnical investigation. These depths exceed Network Rail's own minimum requirements for under-track crossings within their own standards especially Planning, Design and Construction of Undertrack Crossings NR/L2/CIV/044 Issue 3 (Appendix 2).

4.2 As indicated in the figure below, the railway (Red) runs from the coast at Skegness inland to the main line at Sleaford and broadly east to west whereas the cable route (purple) is proposed to follow broadly a north to south alignment. It is clear to me that any cable route selected would need to pass beneath the railway at some point along LN185 to connect to the National Grid.



4.3 At the proposed cable crossing (indicated as a purple line in Figure below), route LN185 runs through a rural area parallel and immediately adjacent to a drainage watercourse referred to as the Great Hale Eau. Both the railway and watercourse

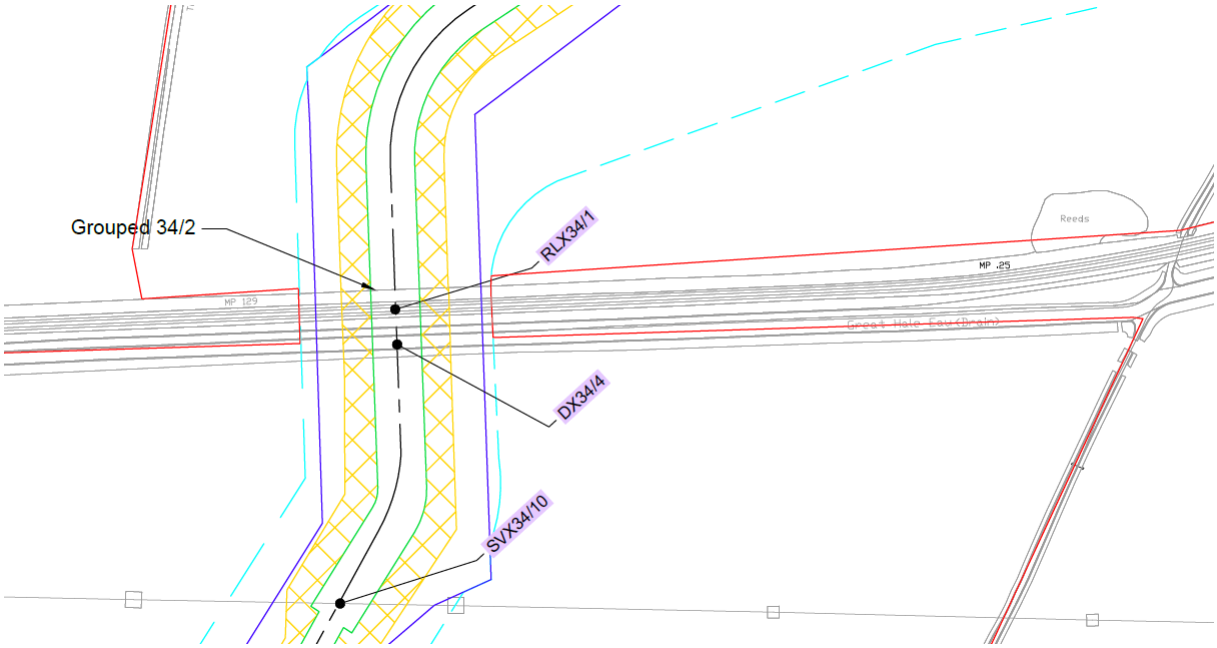
are in a near perfectly straight alignment at this point with the nearest curved track over 250m away on either side.



4.4 Reference to Network Rail's Hazard Directory for ELR GRS2 show there to be one 250mm duct carrying an electrical cable 5 metres below track at Heckington Level Crossing. In the five miles between Heckington and Swineshead there are a further two foul sewers, four gas pipes and two water mains.

4.5 As Mr Symons explains, NGVL are an expert in the cables and systems being proposed. When developing the cable crossing proposal, NGVL have engaged with a competent designer and contractor with direct similar experience of installing ducts of this nature below a railway line. I have been provided with outline proposal drawings which are competently developed.

4.6 The extract below from NGVL drawing VKL-02-07-G100-111 Revision 2 shows the cable crossing to be perpendicular to the track representing least risk to the railway and in accordance with Network Rail standards.



4.7 Again, Mr Symons is able to confirm that only demonstrably rail competent contractors and designers will be engaged on the project. Such evidence of competence will be by the relevant railway RISQS accreditation and by evidence of previous successfully completed schemes. NGVL have further confirmed to me that RISQS accredited organisations in relevant categories will be used to prepare

the submissions and act as Principal Contractor to deliver the surveys and construction. RISQS is the rail industry body supplier qualification including for quality, environment and safety.

4.8 All the above points 4.1 to 4.6 provide me with the confidence and assurance that the safe operation of the railway has been considered in the design and engineering of the Project.

4.9 To date no specific concerns over the cable crossing design or installation methodology have been received from Network Rail.

4.10 The ground conditions near to the site are shown on several publicly available borehole records from the British Geological Survey website. Three are at Swineshead Station some 2km from the proposed crossing. I have also been provided with information from three further boreholes just over 20m from the crossing point undertaken by NGVL.

4.11 All these borehole records show similar findings of sand and gravels down to at least 10 metres beyond which it meets a horizon of boulder clay. Water was encountered at a depth of around 2 to 4 metres. I note the proposed crossing will be below water table but within free draining consistent material. I see that the HDD will be kept above the boulder clay to limit the chances of refusal in that stratum. These records provide me with no concerns for the railway from the HDD crossing based upon the design proposal I have seen.

4.12 I have confirmed with the National Grid engineering designer that they have considered stray currents (Electro-Magnetic Current / EMC) from the proposed HV cables and concluded that they are not able to interfere with any railway systems, now or in the future, as the electrical fields will cancel each other out before they reach ground level.

4.13 I note from discussion with NGVL their intention that the minimum depth of 7 to 10 metres will be held over the full Network Rail corridor between existing fences. I note that the railway is already a twin track arrangement over the proposed crossing making the need to increase line capacity through the introduction of further tracks unlikely. I also see that Network Rail will have full access to their land before, during and after the proposed works. I can therefore see no physical impediment to normal track tamping, maintenance and improvement operations by Network Rail on their own land.

4.14 Should future railway improvement work through the proposed crossing site, whatever that might be, require piling for signalling or overhead line equipment (however unlikely) then the constraint represented by the width of the proposed crossing can be easily accommodated in any future design in my view.

4.15 The proposed cable crossing is to be drilled from and to at least 50 metres from the track corridor such that any temporary excavations or interventions in the ground are well outside of any zone of influence of the railway. The adverse impact on the railway can therefore only be from each of the three bores. Should a collapse or blockage occur, agreements are commonly put in place to grout and abandon the bore and install new adjacent ones. I can see from the plans given to me that there is adequate width for multiple additional bores and this would be my recommended proposal here.

4.16 One risk from directional drilling is in excess pressure being applied resulting in heave of the soil below the railway causing track movement. In this design, the large depth and small diameter of the cable ducts alongside the methodology for installation being proposed negates this risk in my view.

4.17 The main concern with tunnelling of any sort (including HDD) is overmining of the ground. Overcut is required for installation of ducts and so any volume lost on closure of the bore on to the duct migrates to the surface and causes track settlement as was the case in the Stoke Lane derailment or, worse still, track twist. Filling of the annulus between the duct and the ground with a material called Bentonite is the frequently adopted solution below settlement-sensitive features such as the railway and this would be my recommendation here.

4.18 Void migration to the surface in the sands and gravels would be rapid but, at this depth, would be well spread out in plan which I would expect to result in sub-millimetre settlements at the surface. These would combine from all three bores to form an overall peak settlement of up to a few millimetres, still well below the 5mm maximum mandated in NR/L2/CIV/044 Revision 3 (Appendix 2). These calculations would be undertaken by the expert designer and agreed with Network Rail but my formed view is that I would expect there to be no significant issue with peak settlement or differential settlement of the railway if the HDD is installed as planned.

4.19 Once installed, it is the stated objective of NGVL that the ducts should be carried sufficiently far beyond the zone of influence of railway land that future operation and maintenance activity will not require further intervention on Network Rail land. This is a sensible and commonly adopted approach which I endorse.

4.20 The NGVL declared approach to me to follow Network Rail's infrastructure protection requirements before and during construction without caveat is noted and is again a sensible approach. These rules have been developed over many years as a least-risk (ALARP) solution to reduce the effect on the railway and ensure that the effect is within acceptable bounds. Such requirements include track monitoring for settlement to Monitoring track over or adjacent to building and civil engineering works - NR/L2/CIV/177 (including pre-monitoring for benchmark movements) (Appendix 3), lift and re-tamping resources on standby

and protection staff on site throughout operations. NGVL have confirmed to me that these provisions will be a requirement of any contracts placed by them.

4.21 Each of the three HDD bores would, in my experience, traverse the railway corridor zone of influence in each direction over a two to four-hour period within a 20-hour total programme. It would in my view be easily possible to programme the works in such a way that each drill pass below the tracks will take place without any trains running overhead. I do not consider this to be essential mitigation, but it may offer Network Rail added comfort.

4.22 A further mitigation available to Network Rail is to operate a temporary speed restriction over the affected piece of track during installation as the key risk of derailment from track twist is significantly mitigated when rolling stock moves at low speed. The operational timetable on a Sunday appears to be easily able to accommodate such delays to the journey between Sleaford and Skegness.

5. SUMMARY AND CONCLUSIONS

5.1 The evidence, proposals and records I have seen of design and proposed implementation of the three cable ducts are all based upon tried and trusted techniques of a type which I have experienced on other projects and for which I had responsibility for on those projects.

5.2 To date no specific concerns over the cable crossing design or installation methodology have been received from Network Rail.

5.3 The method of installing the cable ducts is constrained by both the railway and the immediately adjacent watercourse. An open cut crossing of the railway and reinstatement is therefore not recommended in this area. Crossing both the railway and watercourse in one HDD is a reasonable risk mitigating approach.

5.4 With careful planning of the work, the current timetable provides for a 33-hour period between the end of Saturday evening planned services and start of Monday morning planned services that would allow each cable crossing duct to be installed in a single operation. Operational impact, if any, would therefore be limited to the less frequent planned Sunday services.

5.5 The availability of multiple mitigations against any threat to the railway afforded by the proposed cable crossing installation works leads me to assess the residual risk as far lower than that represented to the operational railway of the 80 existing level crossings in the area each of which allow entirely uncontrolled risk from road users and pedestrians.

5.6 In conclusion, I consider that the construction techniques and methodology used to deliver the cable crossings being proposed to be undertaken by NGVL, together with any proposed asset protection measures, will provide satisfactory protection for the Railway and that the Viking Link Interconnector will not have a detrimental impact on the operation of the railway over the short, medium and long term.

6. **DECLARATION**

Where facts and matters stated herein are within my personal knowledge, those facts and matters are true; where facts and matters stated herein are not within my personal knowledge, those facts and matters are true to the best of my knowledge, information and belief.

Mr Jon McPhee

Date: 4 June 2019