10. Geology, Soils and Groundwater

10.1. Introduction

10.1.1. This chapter presents the results of the DMRB Stage 3 Assessment of the potential impacts of the Proposed Scheme in relation to geology, soils, groundwater and contaminated land and considers potential impacts upon:

- geodiversity and economic minerals
- soils, including peat
- groundwater aquifers, and consequential impacts on groundwater dependent resources including public and private water supplies, groundwater dependent terrestrial ecosystems (GWDTEs) and surface waters (watercourses and ponds)
- existing contaminated land

10.1.2. This chapter is accompanied by the following Technical Appendices:

- Appendix A10.1 Peat Stability Assessment
- Appendix A10.2 Outline Soil and Peat Management Plan
- Appendix A10.3 Groundwater Assessment
- Appendix A10.4 Contaminated Land Assessment

10.1.3. Non groundwater related impacts on surface waters are discussed in Chapter 11. Groundwater flooding is assessed as part of the Flood Risk Assessment Technical Appendix A11.2.

10.1.4. It should be noted that consequential impacts on sites designated for their conservation value, groundwater dependent habitats and associated fauna are discussed in Chapter 12: Ecology and Nature Conservation and Technical Appendix A12.2 Vegetation and Habitats. Similarly the value of the soil resources for agriculture or other potential land uses are discussed in Chapter 8: People and Communities - Community and Private Assets.

Study Area

10.1.5. The assessment study area includes the footprint of the Proposed Scheme and a buffer of between 250m and 1.2km. This is in recognition that the potential impacts on geology, soils, contaminated land and in particular both groundwater and groundwater dependent terrestrial ecosystems (GWDTEs), may extend some distance from the Proposed Scheme itself, where a 250m buffer is used. A buffer of 850m from the Proposed Scheme footprint for private water supplies and 1.2km for public water supplies has been applied based on the requirements of the Scottish Environment Protection Agency (SEPA) Regulatory Method for Licencing Groundwater Abstractions, including dewatering[i].

10.2. Approach and Methods

10.2.1. The assessment has been carried out in accordance with the guidance contained in the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 11 Geology and Soils[ii] and DMRB Volume 11, Section 3, Part 10 HD 45/09 Road Drainage and the Water Environment[iii]. An explanation of the methods used is provided below.

Guidance

10.2.2. The following guidance documents have been used to inform the assessment:

- Scottish Natural Heritage (SNH) 'A Handbook on Environmental Impact Assessment'[iv]
- A9 Dualling Programme Strategic Environmental Assessment (SEA) Environmental Report[v]
- A9 Dualling Programme SEA Environmental Report Addendum[vi]
- The Scottish Government 'Scottish Soil Framework'[vii]
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) A Practical Guide (Version 8.2)[viii]
- Planning Advice Notice (PAN) 33: Development of Contaminated Land[ix]
- SNIFFER WFD 95: A Functional Wetland Typology for Scotland[x]
- SEPA Regulatory Position Statement – Developments on Peat[xi]
- SEPA/Scottish Renewables Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste[xii]
- SEPA Land Use Planning System (LUPS) Guidance Note 31 – Guidance on Assessing the Impacts of Development on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems[xiii]
- SEPA Regulatory Method (WAT-RM-11) Licencing Groundwater Abstractions including Dewatering (Version 5)[i]
- SEPA Regulatory Method (WAT-RM-08) Sustainable Urban Drainage systems (SuDs)[xiv]
- Pollution Prevention Guidance (PPGs) and Guidance for Pollution Prevention (GPPs)[xv]
  - PPG 1: Understanding your environmental responsibilities - good environmental practices
  - GPP 2: Above ground oil storage tanks
  - PPG 3: Use and design of oil separators in surface water drainage systems
  - PPG 4: Treatment and disposal of sewage where no foul sewer is available
  - GPP 5: Works and maintenance in or near water
  - PPG 6: Working at construction and demolition sites
  - PPG 7: Safe storage - The safe operation of refuelling facilities
  - PPG 8: Safe storage and disposal of used oils
  - GPP 13: Vehicle washing and cleaning
  - PPG 18: Managing fire water and major spillages
  - PPG 20: Dewatering underground ducts and chambers
  - PPG 21: Pollution incident response planning
  - PPG 22: Incident response - dealing with spills
  - PPG 26: Safe storage - drums and intermediate bulk containers
- Scottish Government Guidance on Developments on Peat - Site Survey[xvi]
- Scotland's Geodiversity Charter (2013)[xvii]
- British Geological Survey 'Geodiversity of the Cairngorms National Park[xviii]

- Department for Environment and Rural Affrais (DEFRA)/ Environment Agency (EA) Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination [xix]
- BS 10175:2011+A1:2013. Investigation of potentially contaminated sites. Code of practice. BSI 2011
- BS 5930:2015. Code of practice for ground investigations
- Construction Industry Research and Information Association (CIRIA) C753 – The SuDS Manual[xx]
- CIRIA report C515 Groundwater Control[xxi]
- CIRIA Contaminated Land Risk Assessment: A guide to good practice (C552)[xxii]
- Environmental Protection Act 1990: Part IIA Contaminated Land – Statutory Guidance: Edition 2[xxiii]
- Society of Chief Officers of Transportation for Scotland's (SCOTS) 2009 'SUDS for Roads' guidance document[xxiv]

Baseline Data Collection

10.2.3. Baseline conditions have been determined through consultation, desk studies and site survey.

Desk Studies

10.2.4. The desk studies included a review of the following information:

- A9 Strategic Environmental Assessment (SEA)[v]
- British Geological Survey (BGS) 1:50 000 and 1:10 000 superficial and bedrock geology mapping[xxv]
- BGS Aquifer Productivity Map of Scotland 1:100 000 scale digital version and associated user guide[xxvi]
- BGS Groundwater Vulnerability Map of Scotland 1:100 000 scale, digital version and associated user guide[xxvii]
- A9 Perth to Inverness Dualling Geotechnical Preliminary Sources Study Report (PSSR) Slochd to Moy (Rev 4) Jacobs[xxviii]
- A9 Dualling Northern Section: Tomatin to Moy Geotechnical Preliminary Sources Study Report[xxix]
- A9 Dualling Northern Section: Tomatin to Moy Preliminary Rock Cut Assessment: RC_TM_01_SB[xxx]
- A9 Dualling Northern Section: Tomatin to Moy Preliminary Rock Cut Assessment: RC_TM_02_NB[xxxi]
- Soil Engineering 'Report on a Ground Investigation for A9 Dualling: Tomatin to Moy, Tomatin (2016)[xxxii]
- Scottish Environment Protection Agency (SEPA) Groundwater Body Classification Application[xxxiii]
- SEPA Wetlands inventory (2015)
- Macaulay Institute for Soil Research Soil maps of Scotland (partial coverage) at a scale of 1:250,000[xxxiv]
- Contaminated land data from A9 Stage 1 PSSR (Jacobs) and from the Highland Council

- Review of Mining Instability in Great Britain[xxxv]
- BGS 'Non Coal Mining plans' online database[xxxvi]
- Coal Authority online interactive map data[xxxvii]
- BGS 'Geology of Britain' Viewer – Borehole Scans'
- BGS 'Directory of Mines and Quarries'[xxxviii]
- Private water supply data (The Highland Council)
- Public water supply data (Scottish Water)
- Controlled Activities Regulation list of sites (SEPA)
- Ordnance Survey (OS) raster mapping on 1:10k, 1:25k, 1:50k, 1:250k scale[xxxix]
- Scotland's Environment Water Framework Directive (WFD) Groundwater body status[xl]
- Scottish Natural Heritage (SNH) Carbon-rich soil, deep peat and priority peatlands habitats consultation map[xli]
- SNH data on designated geological sites;
- CH2M Hill/Atkins Mouchel Joint Venture (AMJV) Phase 1 habitat mapping
- AMJV NVC survey mapping Tomatin to Moy

Field Surveys

10.2.5. Geotechnical site walkovers were carried out in June 2015 to assess the site area for drilling and peat probing within the Proposed Scheme corridor.

10.2.6. General hydrological/hydrogeological walkover surveys were conducted from the 21st to the 24th July 2015, with a focus on identification and characterisation of the local water features and ground conditions within the study area, including springs, flushes and potential groundwater fed features.

10.2.7. An advanced DMRB Stage 2 Ground Investigation programme commenced in late July 2015 over a four week period, with completion of four boreholes targeted at areas of exposed rock, rock mapping, geophysical surveys and peat probing of 30 areas where the potential for peat had been identified during the desk studies. A total of 893 probing points were measured as part of the peat probing survey. Peat probing was carried out using a Van Walt peat probe to measure total peat depth, and a Macintosh probe to determine peat geotechnical properties.

10.2.8. Further peat probing was carried out in April 2016 based on the Proposed Scheme. A total of 255 probing points and four peat cores were sampled over 14 areas.

10.2.9. A preliminary DMRB Stage 3 ground investigation commenced in August 2016 over a six week period, with the completion of 43 boreholes and 92 trial pits. This also included in-situ testing, obtaining Televiewer pictures of the holes, the installation of gas and groundwater monitoring instruments, laboratory tests on samples and continued gas and groundwater monitoring for at least the following 12 months[xxxii]. At the time of writing 13 months of monitoring data has been collected and used within the relevant assessments.

10.2.10. A further round of peat probing based on the Proposed Scheme was carried out in December 2016, with a total of 90 probing points and five peat cores obtained. A further three peat cores were obtained to full depth during DMRB Stage 3 Ground Investigation work in March 2017.

10.2.11. Supplementary DMRB Stage 3 Ground Investigation work commenced in March 2017 over a four week period, with the completion of 15 boreholes and 20 trial pits. The GI

also included infiltration testing at 19 trial pit locations, groundwater and gas monitoring installations in 11 boreholes, 140 peat probes and peat coring and logging (Von Post classification) to full depth in three locations. Gas and groundwater monitoring is currently underway at these locations.

10.2.12. A Stage 3 Additional Ground Investigation is due to commence in February 2018 over an eight week period, with the completion of 85 boreholes and 112 trial pits. In addition, the installation of 69 groundwater monitoring locations for GWDTEs will be included as part of pre-construction baseline monitoring.

10.2.13. A site visit was carried out in December 2016 to collect a number of water quality samples from surface and groundwater sources around the Lynebeg area, to determine the source of water in the Lynebeg ponds. Pond surveys were carried out during summer 2016, with further information provided in Technical Appendix A12.3 Aquatic Receptors.

10.2.14. Following Phase 1 habitat surveys carried out as part of the A9 SEA, National Vegetation Classification (NVC) surveys were carried out in May 2016 and February 2017 in areas identified at DMRB Stage 2 as potential GWDTEs within a 250m distance of the Proposed Scheme.

Consultation

10.2.15. A survey of properties that are fed by private water supplies was carried out in February 2016 and February 2017 to gather further information on the type of supply, source location and number of properties served by each supply.

10.2.16. Feedback from the DMRB Stage 2 assessment was received from statutory consultees (SEPA, SNH and The Highland Council) in relation to the previous scheme options as part of the DMRB Stage 2 design process.

10.2.17. Consultation feedback from the landowners at Dalmagarry Quarry following Public Exhibitions was also reviewed as part of the mineral deposits assessment. Further information on consultation can be found in Chapter 7 Consultation and Scoping.

Assessment of Impacts

Loss of Geodiversity

10.2.18. The assessment of the potential loss of rock exposures has involved:

- identification of Geological Conservation Review (GCR) sites and Sites of Special Scientific Interest (SSSIs) designated for geological interest, identification of new and existing road cuttings and outcrops in the vicinity of the Proposed Scheme, and evaluation of the sensitivity/importance of the rock exposures
- review of the Proposed Scheme to determine where existing cuttings or outcrops will be modified, quantification of the length of each cutting modified, or outcrop intersected for the Proposed Scheme and qualitative evaluation of the potential impact on the rock exposures
- assessment of the significance of the impacts with consideration of potential mitigation

Loss of Mineral Deposits, Soils and Peat

10.2.19. The loss of mineral deposits, soils and peat have been assessed through quantification of the area or volume of each lost under the footprint of the Proposed Scheme.

10.2.20. The areas of mineral deposits were identified through review of geological mapping, searches of the Coal Authority online gazeteer[xxxvii], BGS Mining Plan Portal mapping, BGS Directory of Mines and Quarries[xxxviii], Review of Mining Instability in Great Britain[xxxv] and discussions with the Mineral Valuation Office and landowner consultation, while the

variety of soil types within the study area were determined from the Soil Survey of Scotland mapping[xxxiv].

10.2.21. The area of loss of mineral deposits is calculated based on the footprint of the Proposed Scheme in areas of superficial deposits, including area loss for existing or proposed quarries, with impacts assessed qualitatively.

10.2.22. Areas of peat, including priority peatland, were identified through comparison and collation of data from the superficial geology mapping, soils mapping, the SNH priority peatland mapping, site walkovers and Ground Investigation data including peat probing surveys.

10.2.23. As part of the Outline Soil and Peat Management Plan (see Appendix A10.2), the volume of soil and peat loss underneath the Proposed Scheme has been quantified. Peat depths gained from peat probing surveys and Ground Investigation information were compiled and analysed as part of the cut and fill assessment.

10.2.24. The Cut and Fill Assessment undertaken as part of the Engineering Assessment identified volumes of soils and peat in areas of cut, underlying infrastructure such as the widened carriageway, embankments, access tracks and SuDs ponds.

10.2.25. Soil and peat volumes were calculated for each area using an approach based on geological cross sections taken at 20m intervals using all the available Ground Investigation data and calculated using the End Area methodology.

10.2.26. The excavated volumes will be broken down into the following categories:

- Soil (including peaty soils)
- Peat – broken down further into acrotelmic, catotelmic (fibrous) and catotelmic (amorphous) peat

10.2.27. Further information is provided in Technical Appendix A10.2 Outline Soil and Peat Management Plan.

10.2.28. Impacts on indirect loss of peat as a result of hydrological changes are assessed qualitatively.

10.2.29. The sensitivity or importance of the mineral deposits, soils and peat areas has been evaluated qualitatively, as has the magnitude of impact, using the criteria set out in Tables 10.5 and 10.7 below.

Peat Stability

10.2.30. Due to the presence of areas of peat within the study area, a peat stability assessment has been undertaken. This assessment used peat probing depth data in combination with slope information to initially determine areas considered of greatest risk of slope failure, based on factor of safety slope stability calculations. These specific areas were then considered further, with a further site visit, geotechnical information and interpretation of aerial photography used to refine the initial desktop assessment for each location. Where a significant risk of peatslide was identified consideration was given to the extent and volume of any potential slide and any sensitive receptors that may be impacted.

10.2.31. Further details on the peat stability assessment method, interpretation and results are provided in Appendix A10.1.

10.2.32. The sensitivity of peat is outlined within loss of mineral deposits. The sensitivity of downstream surface water receptors is based on the sensitivity provided in Chapter 11: Road Drainage and the Water Environment, which also covers the classification of magnitude of any impact on surface water receptors.

Construction Pollution

10.2.33. Accidental spillage during construction has the potential to allow pollutants to migrate through the unsaturated zone to shallow aquifers. Excavation of the overlying material, particularly where cuttings are proposed in areas of permeable drift deposits with shallow groundwater, could increase the vulnerability of localised aquifers to contaminants.

10.2.34. The sensitivity of the groundwater has been evaluated based on the aquifer productivity classification and the magnitude of impact has been evaluated qualitatively based on a review groundwater vulnerability mapping and of areas where construction activities are proposed.

Pollution of Groundwater from Routine Runoff

10.2.35. A summary of the preliminary drainage design for the Proposed Scheme is provided in Chapter 5. All mainline drainage networks will discharge primarily to surface waters, however all networks will utilise filter drains which may be unlined and could therefore provide some infiltration to groundwater. On this basis all mainline networks have been assessed using the DMRB HD45/09 Method C assessment of pollution of groundwater from routine runoff, in addition to the assessment of impacts on surface waters detailed in Chapter 11: Road Drainage and the Water Environment.

10.2.36. The Method C assessment of potential routine runoff impacts on groundwater takes the form of a risk assessment using the Source-Pathway-Receptor (S-P-R) model utilised in contaminated land investigations. Seven parameters relating to source and pathway are considered in turn and assigned a risk category as detailed in Table 10.1.

Table 10.1: Routine Runoff Groundwater Assessment Parameters

S-P	Weighting	Parameter	Low Risk (1)	Medium Risk (2)	High Risk (3)
Source	15	Traffic density	< 50,000 AADT	50,000 to <100,000 AADT	> 100,000 AADT
	15	Annual average rainfall	< 740mm rainfall	740 – 1060 mm rainfall	> 1060 mm rainfall
Pathway	15	Soakaway geometry	Continuous linear (e.g. ditch, grassed channel)	Single point, or shallow soakaway (e.g. lagoon) serving low road area	Single point, deep serving high road area (>5,000m2)
	20	Unsaturated zone	Depth to water table >15m and unproductive strata	Depth to water table 5-15m	Depth to water table <5m
	20	Flow type	Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow)	Consolidated deposits (i.e. mixed fracture and intergranular flow)	Heavily consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)

S-P	Weighting	Parameter	Low Risk (1)	Medium Risk (2)	High Risk (3)
	7.5	Effective grain size	Fine sand and below	Coarse sand	Very coarse sand and above
	7.5	Lithology	>15% clay minerals	1-5% clay minerals	<1% clay minerals

10.2.37. The risk of adverse impact at each proposed groundwater discharge is determined by multiplying the risk factor attributed to each parameter by the weighting factor and adding the resultant scores to establish the overall risk score for each discharge. This has then been evaluated against the following risk ratings (based on DMRB 45/09 Method C method):

- Overall risk score < 150 – Low Risk of Impact
- Overall risk score 150-250 – Medium Risk of Impact
- Overall risk score > 250 – High Risk of Impact.

10.2.38. Ground investigation data available at the time of writing (namely data from the advanced Stage 2 GI, the preliminary Stage 3 GI and some data from the supplementary Stage 3 GI) has been used to determine the groundwater table and aquifer properties in the vicinity of the proposed groundwater discharges, where appropriate. However due to the widespread nature of the proposed filter drains, and the relatively limited coverage of the GI data conservative assumptions have been made in some areas, based on the available mapping data for the study area.

10.2.39. The sensitivity of groundwater aquifers have been identified and their sensitivity evaluated through review of BGS superficial geology, bedrock geology, aquifer productivity and groundwater vulnerability mapping, and review of the WFD groundwater body status[xxxiii].

10.2.40. It is also proposed that one side road drainage network will discharge entirely to groundwater via filter drains and an infiltration basin (Network 7B); all other side road and access track drainage networks will drain primarily to surface waters, however most will feature drainage features such as ditches which may be unlined and allow groundwater infiltration. Due to the low traffic volumes anticipated on these roads and tracks the Method C assessment is not appropriate; instead the impacts have been assessed qualitatively, taking into consideration site specific conditions, and with reference to the guidance provided in the CIRIA SuDS Manual[xx], SCOTS SuDS for Roads[xxiv] and SEPA WAT-RM-08[xiv].

Loss or Change to Groundwater Aquifers and Supported Water Supplies

10.2.41. The location, area and depth of each cutting has been quantified in relation to bedrock and superficial aquifers, and water supplies within close proximity. Hydraulic permeability values have been derived for each superficial geology unit based on infiltration test results from the GI or from literature values. Groundwater levels have been determined by interpolating or extrapolating local GI data, where available, and from historic borehole logs. For each cutting that is likely to intercept groundwater, a radius of drawdown influence has been determined following methods detailed in CIRIA report C515 Groundwater Control[xxi]. Detailed information is provided within Technical Appendix A10.3 Groundwater Assessment.

10.2.42. Data on public water supply groundwater sources was provided by Scottish Water, while private water supply data was provided by The Highland Council. The quality of the private water supply data provided was variable, with grid references and type of supply

(i.e. surface water or groundwater source) missing for some supplies. Additionally it was not always clear whether the grid references provided were for the source or the property supplied. This dataset was subsequently updated for the majority of the identified supplies with accurate grid references and additional information following private water supply surveys carried out in February 2016 and February 2017. The sensitivity of the water supplies has been evaluated based on current use of supply and the population supplied.

10.2.43. Controlled Activities Regulations (CAR) abstraction licences are also considered within this chapter. There is one groundwater abstraction, a groundwater source public water supply in Tomatin listed within the study area. The other CAR licences are detailed further in Chapter 11 Road Drainage and the Water Environment.

10.2.44. Following the surveys carried out in February 2016 and February 2017 within 1km of the scheme, a number of supplies were screened out from the baseline assessment based on the criteria detailed in SEPA WAT-RM-11 guidance[i]. Groundwater supplies within 850m have been considered within this assessment.

10.2.45. As part of the cutting assessment, a qualitative assessment has been undertaken of the impact on all groundwater dependent receptors, with further information detailed in Appendix A10.3. Groundwater dependent receptors include:

- Superficial and bedrock aquifers, based on groundwater vulnerability and aquifer productivity
- Public and Private water supplies from groundwater sources;
- Surface water receptors
- GWDTEs

10.2.46. The impacts on receptors identified within the cutting assessment are considered in Section 10.4.

Loss or Change to Surface Water Receptors

10.2.47. Surface water bodies such as streams, lakes and wetlands are receptors that can exchange water with groundwater bodies. Any changes to groundwater as a result of dewatering may indirectly impact surface water bodies and result in changes to surface water flow.

10.2.48. For the Proposed Scheme, the impact on surface water receptors has been assessed qualitatively based on the location and distance from each cutting as part of the cutting assessment detailed within Technical Appendix A10.3.

10.2.49. Further investigation was required into the source of the water feeding two ponds at Lynebeg (NGR NH 768 350 and NGR NH 769 340) which are in close proximity to cuttings. This included a desktop review of GI information for boreholes in the surrounding area and pond surveys. In March 2017, an additional borehole with a groundwater monitoring installation was added at the location of the proposed cutting that will intercept one of the two existing ponds at Lynebeg.

10.2.50. Further baseline information on each surface waterbody is provided in Chapter 11.

Loss or Change to Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

10.2.51. The impact of groundwater changes related to the Proposed Scheme on GWDTEs has been assessed in line with SEPA LUPS Guidance Note 31[xiii]. The assessment process has involved:

- National Vegetation Community (NVC) surveys were carried out in May 2016 and February 2017 for all areas within 250m of the Proposed Scheme. This NVC survey

information is presented in Chapter 12: Ecology and Nature Conservation, and its associated appendices and figures.

- A screening exercise was carried out to screen out NVC communities within the study area where there was a lack of hydrogeological connectivity between the NVC community and the Proposed Scheme, or where groundwater or ground condition data indicated groundwater interactions with the vegetation were highly unlikely.
- The baseline groundwater dependency of each of the remaining GWDTE habitat polygons was reviewed and revised, based on qualitative assessment of the local ecology, topography, hydrology and hydrogeology. The sensitivity of each GWDTE habitat was assigned based on the revised groundwater dependency.
- Those NVC communities considered to have a dependency on groundwater were progressed to impact assessment. The impact assessment considered direct losses under the footprint of the scheme, indirect loss due to groundwater drawdown in the vicinity of proposed road cuttings and indirect impacts to GWDTEs downslope of the Proposed Scheme due to changes in subsurface flows.
- Where significant impacts are predicted outline mitigation measures have been proposed. The residual effect on each GWDTE habitat has been evaluated taking this mitigation into consideration.
- Finally, the individual impact assessment results have been summarised and aggregated, with a qualitative assessment undertaken of the overall impact of the Proposed Scheme on GWDTEs within the study area as a whole.

10.2.52. Technical Appendix A10.3 provides further details on the assessment methodology, including screening, baseline groundwater dependency assessment and impact assessment methods.

Mobilisation of Historic Contamination

10.2.53. For contaminated land, the Scottish Government considers the 'suitable for use' approach as the most appropriate method to deal with historical land contamination. A contaminated land Phase 1 Preliminary Risk Assessment has been undertaken as part of this assessment, as reported in Technical Appendix A10.4 Contaminated Land Assessment.

10.2.54. The aims of the Preliminary Risk Assessment are to identify sites of potential historical contamination within the Proposed Scheme study area, and assess the potential risks posed to human health and the wider environment in the context of the proposed land use; in line with the requirements of PAN 33: Development of Contaminated Land[ix] and CLR11[xxii].

10.2.55. As part of DMRB Stage 2, the risk assessment methodology was used for the initial development of a Preliminary Conceptual Site Model (CSM) for the site as part of the Preliminary Risk Assessment. The CSM represents a network of relationships between potential sources of contamination and different receptors through different potential pollution pathways. The receptors can include people i.e. local residents, drivers and non-motorised users (NMUs) of the road, construction workers, the water environment, statutory designated ecological systems (SSSIs, SPAs, etc) or property such as buildings/structures, crops, livestock and domestic pets. Potential pollutant pathways may include: direct contact with contaminated soils; ingestion/inhalation of soil, dust, vapour or gas; and the leaching and migration of contaminants, including gas through the ground. The potential receptors and pathways have been compiled based on the definitions used in Part IIA of the Environmental Protection Act 1990, as provided in the Scottish Government's statutory guidance[xxiii]. Where a source, pathway and receptor combination exists this is referred to as a 'complete pollutant linkage'.

10.2.56. For the purposes of this assessment, the potentially contaminated sites under and immediately adjacent to the footprint have been investigated as part of the preliminary DMRB Stage 3 GI and some limited contamination testing was carried out. The chemical analysis undertaken focussed on soil samples rather than soil leachate, so not all the potential pollutant pathways were investigated as part of the Preliminary DMRB Stage 3 GI.

10.2.57. The GI data which was collected as part of the Preliminary DMRB Stage 3 GI has been used to refine and update the preliminary CSM as part of the Stage 3 assessment. The Technical Appendix A10.4 provides details of the risk assessment process.

10.2.58. Given the stage of the assessment and the availability of limited chemical testing data, a quantitative risk assessment has been undertaken in accordance with CIRIA C552 which updates the preliminary CSM. The risk is evaluated based on the probability or likelihood of risk being realised as shown in Table 10.2 and the consequence of risk being realised as shown in Table 10.3. The risk evaluation is then derived from the matrix shown in Table 10.4.

Table 10.2: Criteria Used to Estimate the Likelihood of Contamination

Likelihood	Description
High likelihood	There is a complete pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is a complete pollution linkage and all the elements are present and available, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over a long-term.
Low likelihood	There is a complete pollution linkage and the circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a complete pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 10.3: Criteria Used to Estimate the Consequence of an Impact of Contamination

Consequence	Description
Severe	Short-term (acute) damage to human health (significant harm). Pollution of sensitive water resources as a result of short-term exposure. Damage to a particular ecosystem as a result of acute exposure. Catastrophic damage to buildings/property/ Scheduled Ancient Monument (SAM).
Medium	Long-term (chronic) damage to human health (significant harm). Pollution of sensitive water resources as a result of chronic exposure. A significant change in a particular ecosystem, or organism forming part of such an ecosystem. Substantial damage to buildings/property/ SAM.
Mild	No appreciable impact on human health based on the potential effects on the critical human health receptor Pollution of non-sensitive water resources. Damage to ecological systems with no significant impairment. Significant damage to sensitive buildings/structures/SAM/services or the environment.

Consequence	Description
Minor	Harm (not necessarily significant), which may result in financial loss or require expenditure to resolve. Non-permanent health effects to human health. No appreciable pollution Easily repairable effects or damage to ecological systems Easily reparable damage to buildings, structures, SAM and services.

Table 10.4: Contaminated Land Potential Pollutant Linkage Risk Evaluation Matrix

Consequence	Likelihood			
	High likelihood	Likely	Low likelihood	Unlikely
Severe	Very high	High	Moderate	Moderate/Low
Medium	High	Moderate	Moderate/Low	Low
Mild	Moderate	Moderate/Low	Low	Very Low
Minor	Moderate/Low	Low	Very Low	Very low

10.2.59. The contaminated land assessment has been carried out using a consequence/likelihood risk based methodology as per accepted industry practice referenced above. This approach does not readily translate into the sensitivity/magnitude significance approach of EIA. However a methodology has been developed to assign significance to the identified levels of risk and is detailed in Table 10.11 in the section below. The assessment of impact significance will be undertaken by comparing the current baseline risks with the construction / operation (without and subsequently with mitigation) phase risks and assessing any change in risk.

Impact Assessment Criteria

10.2.60. The assessment of significance of impacts in relation to geology, soils, and groundwater has been based on the guidance provided in the DMRB, Volume 11, Section 3, Part 10, HD 45/09 Road Drainage and the Water Environment[al]. It should be noted that DMRB, Volume 11, Section 3, Part 11 Geology and Soils does not provide any specific guidance on the evaluation of sensitivity, magnitude and significance.

Value/Sensitivity

10.2.61. Application of the DMRB / EIA guidance has involved consideration of the importance/sensitivity of relevant attributes of the geology, soils, and groundwater receptors and evaluation of the magnitude of the impact. Importance/sensitivity has been evaluated taking into account quality, rarity, scale and substitutability in keeping with the principles of DMRB guidance and using the criteria shown in Table 10.5.

Table 10.5: Criteria Used to Estimate the Sensitivity of Geology and Soil Receptors

Sensitivity	Description
High	Areas containing geological or geomorphological features considered to be of a national interest such as Sites of Special Scientific Interest (SSSI), candidate SSSI or Geological Conservation Review (GCR) sites. Presence of extensive areas of economically important minerals valuable as a national resource. Presence of high quality topsoil or soils (typically indicated by Land Capability for Agriculture Class 1 and Class 2).

Sensitivity	Description
	Areas of peatland within designated sites such as SSSI, SAC or SPA with national or European importance and/ or SNH priority peatland Class 1 (nationally important carbon-rich and peaty soils, deep peat and priority peatland habitat likely to be of high conservation value) and Class 2 (nationally important carbon-rich and peaty soils, deep peat and priority peatland habitat likely to be of potentially high conservation value and restoration potential).
Medium	Areas containing geological features of designated regional importance considered worthy of protection for their educational, research, historic or aesthetic importance, such as Local Geodiversity Sites (LGS)/ Regionally Important Geological Sites (RIGS) of national/ regional importance. Presence of areas of economically important minerals of regional value. Presence of medium quality topsoil or soils (typically indicated by Land Capability for Agriculture Class 3 and Class 4). SNH priority peatland Class 3 (dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich and peaty soils, with some areas of deep peat).
Low	Sites and geological features not currently identified as SSSI, GCR or LGS/ RIGS but that may require protection in the future. Presence of mineral areas or resource of local importance only. Presence of low quality topsoil or soils (typically indicated by Land Capability for Agriculture Class 5 and Class 6). SNH priority peatland Class 5 (soil information takes precedence over vegetation data and there is no peatland habitat recorded, but all soils are carbon-rich and peaty soil and deep peat).
Negligible	Geological features not currently protected and unlikely to require protection in the future. No exploitable minerals or geological resources. Presence of very low quality topsoil or soils (typically indicated by Land Capability for Agriculture Class 7). SNH priority peatland Class 4 (areas unlikely to be associated with peatland habitats or wet and acidic type, and unlikely to include carbon-rich or peat soils), Class 0 (mineral soils where peatland habitats are not typically found), Class -1 (unknown soil types) and Class -2 (non-soil (i.e. loch, built up area, rock and scree)).

Table 10.6: Criteria Used to Estimate the Sensitivity of Groundwater Receptors

Sensitivity	Description
Very High	Groundwater aquifer(s) with very high productivity or WFD good groundwater quality and quantity status. Exploitation of groundwater resource is extensive for public, private domestic and/ or agricultural use (i.e. feeding ten or more properties) and/ or industrial supply. Important sites of nature conservation dependent on groundwater as per importance criteria attributed in Chapter 12 or groundwater is considered likely to support wetland vegetation which is highly groundwater dependent. Surface water features with hydrological importance to designated sensitive ecosystems of national/ international importance.
High	Groundwater aquifer(s) with moderate/ high productivity or WFD good groundwater quality and quantity status. Exploitation of groundwater resource is not extensive (i.e. private domestic and/ or agricultural supply feeding less than ten properties).

Sensitivity	Description
	Local areas of nature conservation dependent on groundwater as per importance criteria attributed in Chapter 12, or groundwater is considered likely to support wetland vegetation which is moderately groundwater dependent. Surface water features with hydrological importance to sensitive ecosystems of regional importance.
Medium	Groundwater aquifer(s) with low productivity or WFD variable groundwater quality and quantity status. No current known exploitation of groundwater as a resource and aquifer(s) properties make potential exploitation appear unlikely. Minor areas of nature conservation with a degree of groundwater dependency, as per importance criteria attributed in Chapter 12. Surface water features with some but limited hydrologic importance to sensitive or protected ecosystems of authority area importance.
Low	Groundwater aquifer(s) with very low productivity or WFD poor groundwater quality and quantity status. No known past or present exploitation of groundwater aquifer(s) as a resource. Areas of vegetation with no groundwater dependency. Surface water features with minimal/ insignificant hydrological importance to sensitive ecosystems of less than authority area importance.

Magnitude of Change

10.2.62. Magnitude has been determined by taking into account the extent of loss and effects on integrity of an attribute in keeping with the principles of the DMRB guidance and using the criteria shown in Tables 10.7 and 10.8.

Table 10.7: Criteria Used to Estimate the Magnitude of Change on Geology and Soil Receptors

Magnitude	Description
Major	Partial (greater than 50%) or total loss of a geological site or mineral deposit, or where there would be complete severance of a site such as to affect the value of the site/ resource. Major or total loss of topsoil, soils or peatland, or where the value of the area would be severely affected.
Moderate	Loss of part of a geological/ geodiversity site or mineral deposit, major severance, major changes to the setting, or disturbance such that the value of the site would be affected, but not to a major degree. Partial loss of topsoil, soils or peatland, or where the value of the area would be affected, but not to a major degree.
Minor	Small effect on a geological/ geodiversity site or mineral deposit (up to 15%) or a medium change on its setting, or where there would be a minor severance or disturbance such that the value of the site would not be affected. Partial loss of topsoil, soils or peatland, or where soils will be disturbed but the value of the area would not be affected.
Negligible	Very slight change from geological, mineral and soil baseline conditions.

Table 10.8: Criteria Used to Estimate the Magnitude of Change on Groundwater Receptors

Magnitude	Description
Major	Major or long term change to groundwater aquifer(s) flow, water level, quality or available yield.

Magnitude	Description
	Groundwater resource use is irreparably impacted upon, with a major or total loss of an existing supply or supplies. Changes to water table level or quality would result in a major or total change in or loss of a groundwater dependent area, where the value of a site would be severely affected. Changes to groundwater aquifer(s) flow, water level and quality would result in major changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a major shift away from baseline conditions such as change to WFD status. Dewatering changes create significant differential settlement changes on existing infrastructure and buildings. Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Method C).
Moderate	Moderate changes to groundwater aquifer(s) flow, water level, quality or available yield. Groundwater resource use is impacted slightly, but existing supplies remain sustainable. Changes to water table level or quality would result in partial change in or loss of a groundwater dependent area, where the value of the site would be affected, but not to a major degree. Changes to groundwater aquifer(s) flow, water level and quality would result in moderate changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a moderate shift from baseline conditions that may be long-term or temporary. Dewatering changes create moderate differential settlement changes on existing infrastructure and buildings. Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250.
Minor	Minor changes to groundwater aquifer(s) flow, water level, quality or available yield. Changes to water table level, quality and yield result in little discernible change to existing resource use. Changes to water table level or quality would result in minor change to groundwater dependent areas, but where the value of the site would not be affected. Changes to groundwater aquifer(s) flow, water level and quality would result in minor changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a minor shift from baseline conditions (equivalent to minor but measurable change within WFD status). Dewatering changes create minor differential settlement changes on existing infrastructure and buildings. Potential low risk of pollution to groundwater from routine runoff – risk score <150. Minor effects on groundwater supported wetlands
Negligible	Very slight change from groundwater baseline conditions, approximating to ‘no change’ conditions. Dewatering changes create no or no noticeable differential settlement changes on existing infrastructure and buildings. No measurable impact upon an aquifer from pollution.

Significance of effect

10.2.63. The evaluation of significance has been derived by combining the sensitivity of the affected attributes and the magnitude of the impacts using the matrix recommended in the DMRB HD 45/09 guidance, which is replicated in Tables 10.9 and 10.10. Where the

significance is shown as being one of two alternatives, a single description is provided based on reasoned judgement.

Table 10.9: Significance Criteria for Geology and Soil Impacts

Value or Sensitivity	Magnitude			
	Major	Moderate	Minor	Negligible
High	Large	Moderate / Large	Moderate	Slight
Medium	Moderate / Large	Moderate	Slight / Moderate	Neutral / Slight
Low	Moderate	Slight / Moderate	Neutral / Slight	Neutral
Negligible	Slight	Neutral / Slight	Neutral	Neutral

Table 10.10: Significance Criteria for Groundwater Impacts

Value or Sensitivity	Magnitude			
	Major	Moderate	Minor	Negligible
Very High	Very Large	Large / Very Large	Moderate / Large	Neutral
High	Large / Very Large	Moderate / Large	Slight / Moderate	Neutral
Medium	Large	Moderate	Slight	Neutral
Low	Slight / Moderate	Slight	Neutral	Neutral

10.2.64. As noted above, the contaminated land assessment does not readily translate into the sensitivity / magnitude / significance approach of EIA. Table 10.11 provides details of the criteria that have been derived to assign significance to the identified levels of risk associated with contaminated land.

Table 10.11: Significance Criteria for Contamination Impacts

Significance Criteria	Definition
Major adverse effect	An increase in contamination risk from the existing baseline conditions of 4 or 5 risk levels in the risk matrix e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Moderate adverse effect	An increase in contamination risk from the existing baseline conditions of 2 or 3 risk levels in the risk matrix e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Minor adverse effect	Limited risk of pollution to an aquifer. An increase in contamination risk from the existing baseline conditions of 1 risk level in the risk matrix e.g. land that has a low contamination risk in the baseline becoming a moderate / low risk.
Neutral effect	No measureable risk of pollution to an aquifer. No change in contaminated land risks.
Minor beneficial effect	Reduction in existing risks to an aquifer and increased water quality. A reduction in contamination risk from the existing baseline conditions of 1 risk level in the risk matrix e.g. land that has a moderate / low contamination risk in the baseline becomes a low risk.

Significance Criteria	Definition
Moderate beneficial effect	Reduction in existing risks to an aquifer and increased water quality. A reduction in contamination risk from the existing baseline conditions of 2 or 3 risk levels in the risk matrix e.g. land that has a high contamination risk in the baseline becomes a moderate / low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.
Major beneficial effect	Recharge of an aquifer and significant reduction of impact to groundwater quality. A reduction in contamination risk from the existing baseline conditions of 4 or 5 risk levels in the risk matrix e.g. land that has a very high contamination risk in the baseline becomes low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.

Limitations of the Assessment

10.2.65. The assessment has relied on available historic GI data, supplemented by other desk based information in addition to DMRB Stage 2 and Stage 3 GI works.

10.2.66. As a result, there is limited site specific information available on the groundwater table and aquifer properties in the vicinity of many of the proposed road cuttings. Conservative assumptions of hydraulic conductivity values have therefore been made for the majority of the cuttings, based on the available mapping data for the study area. The groundwater monitoring data used for the assessment was collected between August 2016 and September 2017, from approximately 60 locations distributed across the Proposed Scheme extents. There are concentrations of monitoring locations in the vicinity of the Tomatin Grade Separated Junction (GSJ) and Lynebeg Left-in/Left-out (LILO) junction, however there are several areas where there is a notable absence of monitoring locations. This sparsity of data does not allow for a reliable interpolation of the recorded groundwater levels in some areas. As a result it has been necessary to include Digital Terrain Model (DTM) elevations of surface water features in the interpolation of groundwater levels, resulting in an inexact estimate of the groundwater level at some cuttings.

10.2.67. There are additional limitations surrounding the cuttings assessment methodology itself. The direction of each cutting relative to the groundwater flow direction is not considered during the assessment. The calculations also utilise an empirical constant which may overestimate the radius of influence, as detailed in Technical Appendix A10.3.

10.2.68. This assessment has relied upon the accuracy and level of detail of the documented data sources. For instance, identification of potential contaminated land and historical quarry sites have been through desk study review of historical maps. It is possible that potentially contaminating land use or quarry excavation and backfilling could have taken place between recorded years of mapping and have therefore not been identified. It is also possible given the rural nature of the Proposed Scheme that unrecorded farmers' tips may be present along the scheme.

10.2.69. The scale of various mapping datasets, such as groundwater vulnerability and soils mapping, is such that only broad characterisation of these attributes and high level assessment of potential impacts has been possible where there is no GI data available. Both the aquifer productivity and groundwater vulnerability data only provide a guide to aquifer conditions at a 1:100,000 scale.

10.2.70. In relation to private water supplies, whilst full landowner consultation has been carried out, the location of some sources remains unknown where landowners were unable to

provide this information. The exact location of associated pipework has not been determined as part of this assessment.

10.2.71. In relation to the peat investigations the probing surveys carried out provide total soil depths at a specified location, but do not detail the extent of different soil layers (e.g. peat, clay, gravel), which is available from the preliminary DMRB Stage 3 GI. Any estimates of peat depths between probe locations have been extrapolated from surrounding data points and topography.

10.2.72. The contaminated land assessment has been based on desk study data as well as the limited ground investigation data taken from the preliminary and supplementary Stage 3 GI. At the time of writing the groundwater monitoring undertaken to date has not been within the areas of potential contamination, while the gas monitoring undertaken is of limited use as the relevant boreholes were fully screened and the results cannot be relied upon. The full Stage 3 GI, scheduled to commence in February 2018, will address these limitations. The potential pollution pathway linkages have been identified and risk assessed based on the available data, where there are information gaps a conservative approach has been taken. It should be noted that not all potential sources of contamination have undergone ground investigation (i.e. risk to Water Environment) therefore, the presence, nature, extent and severity of all potential pollutant linkages cannot be confirmed at this stage.

10.2.73. The limitations discussed above are typical of a DMRB Stage 3 Assessment, and the assessment detailed herein is considered to be robust and of an appropriate level of detail to inform assessment of the Proposed Scheme.

10.3. Baseline Conditions

Geology

10.3.1. The information below is summarised from the Geotechnical Preliminary Sources Study Report, desktop information and Ground Investigation works.

Bedrock Geology

10.3.2. BGS mapping indicates the study area is dominated by metasedimentary bedrock of the Moine Supergroup, with a large igneous intrusion in the Tomatin area, as shown in Figure 10.1a-c.

10.3.3. Between the current Tomatin South junction and Findhorn Bridge there is a complex sequence of psammite and semipelite formations, namely: gneissose-micaceous psammites of the Beinn Bhreac Psammite Formation; quartzose-gneissose-migmatitic psammites of the Slochd Psammite Formation; gneissose semipelites of the Creag Buidhe Semipelite Formation; psammite, semipelite and calc-silicate rock of the Dalradian Supergroup; and the Glen Banchor Subgroup featuring micaceous psammites.

10.3.4. The southern section of the Proposed Scheme between Soilshan and Invereen, and much of Tomatin village, is underlain by igneous intrusive granodiorite of the Findhorn Pluton of Silurian age. The granodiorite is separated from geological units north of this area by a northeast-southwest trending fault near Invereen (NGR NH 794 314).

10.3.5. The northern part of the Proposed Scheme is underlain by the Dava Succession of the Moine Supergroup comprising of metasedimentary gneissose psammite and gneissose semipelite bedrock of Dalradian age. There is a minor intrusion of quartz/feldspar/porphyry (Scottish Highland Siluro-Devonian Calc-alkaline Minor Intrusion) present close to the northern extent of the Proposed Scheme (NGR NH 734 347). To the north of the study area granitic rock of the Moy Pluton can be found.

10.3.6. Historic exploratory boreholes generally confirm the BGS mapping, indicating that in the southern part of the study area the granodiorite is between 13m to 26m below ground level (mbgl), and is described as being faintly to moderately weathered, but was also encountered as strong. The majority of exploratory holes in the northern part of the study area did not encounter bedrock as they were mostly to a depth of less than 5m. However, just to the southwest of Loch Moy bedrock was encountered at or within 30cm of the ground surface, and was encountered at between 3.50mbgl and 6.2mbgl in a further 5 boreholes. The bedrock in these holes was described a slightly weathered gneiss, the weathered horizon being between 30cm and 5m thick. Further north bedrock was encountered at 2.4 and 6.3mbgl to the north of the scheme, and is described as strong to very strong gneiss.

10.3.7. Ground Investigation works in 2016 indicated gneiss was encountered between 1.8mbgl and 26.7mbgl, described as medium strong to very strong. The gneiss was encountered in six boreholes, between the existing Moy junction and Lynebeg. Microdiorite was encountered east of Lynebeg at 17mbgl. Schist was encountered at between 0.4 and 3.2mbgl at the northern end of the Proposed Scheme, and at a second location just over half way along the Proposed Scheme respectively.

10.3.8. Two areas of hard rock cutting are present on the existing A9, one to the north of the Moy Rail Bridge (NGR NH 777 333) and the other at the northern extent of the Proposed Scheme (NGR NH 736 347). Preliminary rock cut assessments indicate these have little geodiversity interest[xxx].

10.3.9. The sensitivity of each bedrock unit is listed in Table 10.12 below. All of the formations have a sensitivity of Negligible as they are not protected, occur widely throughout the region, and would be exploited on a local scale only. These are grouped together in the remainder of this assessment as igneous bedrock and metasedimentary bedrock.

Table 10.12: Sensitivity of Each Bedrock Geological Formation within the Study Area

BGS Geological Unit	Sensitivity
Igneous Geological Units: Findhorn Pluton - granodiorite Moy Pluton – granitic rock Scottish Highland Siluro-Devonian Calc-Alkaline Minor Intrusion Suite	Negligible
Metasedimentary Geological Units: Beinn Bhreac Psammite Formation – psammite, gneissose-micaceous Dalradian Supergroup psammite, semipelite and calcsilicate rock Dava Subgroup – psammite, gneissose Dava Subgroup – semipelite, gneissose Glen Banchor Subgroup – psammite, micaceous Creag Buidhe Semipelite Formation – semipelite, gneissose Slochd Psammite Formation – psammite, quartzose-gneissose-migmatitic	Negligible

Superficial Geology

10.3.10. BGS mapping indicates the most prevalent superficial deposits underlying the study area comprise glacial deposits including poorly sorted Devensian Till and better sorted Glaciofluvial deposits comprising sand and gravel with lenses of silt and clay. Localised areas of Alluvium and River Terrace deposits correspond to minor watercourses within the study area. The superficial geological units are displayed in Figure 10.2a-c.

10.3.11. Devensian Till (diamicton), variously described as firm-stiff sandy silty gravelly clay and very compact clay silty gravelly sand, is present on site most extensively in the northern half of the study area, at NGR NH 761 351, as well as from NGR NH 780 321, north of

the Dalmagarry Burn, to NGR NH 751 345 west of Moy. In the south of the study area Devensian Till is less extensive but is most prevalent west of the Allt na Frithe between NGR NH 800 296 and NGR NH 807 291, as well as south of Tomatin at NGR NH 810 271. Across the study area the till was found to vary in depth between 0.3m to 15m. Around NGR NH 794 309, between Tomatin and Invereen, the geological map indicates Pleistocene Hummocky (Moundy) Glacial Deposits consisting of diamicton, sand and gravel to the west of the Proposed Scheme. Hummocky (Moundy) Glacial Deposits are also located at the north end of the scheme at NGR NH 728 347.

10.3.12. Glaciofluvial Sheet and Contact Deposits, comprising gravel, sand and silts with cobbles and boulders, underlie the majority of the existing A9 and are particularly prevalent between NGR NH 799 296 and NGR NH 794 314, from Invereen to Dalmagarry as well as at the existing Tomatin South Junction. The thickness of these deposits are anticipated to be up to 15m.

10.3.13. Alluvium deposits, typically described as silty sands and gravels with cobbles and boulders, are indicated on the geological map where the Allt Dubhag crosses the study area just to the north of Tomatin. Extensive alluvial deposits are associated with the River Findhorn and the Funtack Burn, to the east of the study area, and where the Dalmagarry Burn crosses the Proposed Scheme. Alluvial fan deposits, comprising gravel, sand, silt and clay are also encountered fairly extensively in the vicinity of Dalmagarry. Further north there are alluvial deposits beneath the study area at NGR NH 766 341 associated with an unnamed stream near Lynebeg, on the Alt na Loinne Moire downstream of the existing A9, and around the Allt Creag Bheithin and Allt na Slanaich watercourses at NGR NH 749 347 and NGR NH 750 347 respectively. The depth of alluvium found across the site cannot be confirmed at present as the historic drill logs do not differentiate these deposits from other granular superficial deposits. However historic boreholes in the vicinity of the River Findhorn viaduct found Alluvium up to 25m in depth.

10.3.14. Undifferentiated River Terrace deposits (gravel, sand, silt and clay) are indicated on the geological map where the Allt na Frithe crosses the study area at Tomatin, and adjacent to the Proposed Scheme between Tomatin and Invereen. Further north, there is a small area of river terrace deposits along the valley of Allt na Loinne Moire, near Lynemore.

10.3.15. A small area of Lacustrine deposits comprising clay, sand and silt are indicated to the west of the study area, at NGR NH 793 302, north of the existing Tomatin junction.

10.3.16. The superficial deposits encountered in the exploratory holes across the Proposed Scheme and surrounding study area predominantly represented both sorted and unsorted fluvial and glacial deposits. The deposits were predominantly described as gravelly fine to coarse sand, silty, gravelly fine-coarse sand or silty fine-coarse sand and gravel with some clayey sandy silt or clayey silt. Frequently, angular-rounded cobbles and boulders of mixed lithology were present.

10.3.17. Geological mapping also indicates a number of peat deposits along the Proposed Scheme, which are discussed within the Soils section below. The sensitivity of each superficial formation is listed below.

Table 10.13: Sensitivity of Bedrock Formation

BGS Geological Unit	Sensitivity
Peat	n/a – refer to Peat Baseline section
Glaciofluvial Sheet Deposits	Low
Glaciofluvial Ice Contact Deposits	
Alluvial Fan Deposits	Negligible
Alluvium	

BGS Geological Unit	Sensitivity
Undifferentiated River Terrace Deposits	
Devensian Till	
Hummocky (Moundy) Glacial Deposits	

Designated Geological Sites

10.3.18. There are no Geological SSSIs, candidate SSSIs or GCRs identified within the study area. The nearest designated site is Slochd GCR, located 880m south-east of the Proposed Scheme.

Economic Minerals

10.3.19. A search of the Review of Mining Instability in Great Britain, data from the Mineral Valuation Unit and the BGS Mining Plan Portal mapping information confirmed that Tomatin and Moy are in areas which are not affected by present or past underground mining activities.

10.3.20. The BGS Directory of Mines and Quarries[xxxviii] and Geoindex online mapping indicates there are no active mines or quarries within the study area. However Dalmagarry sand and gravel quarry, located immediately east of the A9 at NGR NH 794 316, has recently been given planning permission to re-open (Planning Ref: 14/03270/FUL), with the potential for material to be used as part of the A9 construction. The planning permission relates to an area of approximately 11Ha.

10.3.21. Historical maps indicate 5 disused pits, 4 disused quarries and 1 disused mineral site within the study area (shown and labelled on Figure 10.8a-c):

- small former quarry close to Findhornbridge (NGR NH 808 277 – site 10, Figure 10.8a)
- small former quarry close to Findhorn Viaduct (NGR NH 808 286 – site 8, Figure 10.8a)
- small former quarry close to Raigbeg adjacent to the existing A9 (NGR NH 808 289 – site 4, Figure 10.8a)
- disused pit located approx. 230m southwest of the A9 at Tomatin (NGR NH 798 295 – site 6, Figure 10.8b)
- disused mineral site approximately 225m southwest of the A9 at Tomatin (NGR NH 798 295 – site 9, Figure 10.8b)
- disused Moy School gravel pit, located close to the western shore of Loch Moy (NGR NH 776 338 – site 11, Figure 10.8c)
- two disused pits located either side of the track between Moy and Lynebeg, immediately to the east of the A9 (NGR NH 769 341 – site 2, Figure 10.8c)
- disused pit located under the existing A9 mainline west of Moy (NGR NH 755 346 – site 1, Figure 10.8c)
- disused quarry located immediately adjacent to the B9154, north of Moy (NGR NH 758 351 – site 12, Figure 10.8c)

10.3.22. Given their location and the underlying geology it is assumed that each of these sites was worked for sand and gravel.

10.3.23. Dalmagarry Quarry (location shown on Figure 10.8b) is considered a regionally important site for sand and gravel and has therefore been assigned a Medium sensitivity. Given the widespread occurrence of sands and gravel deposits in the wider

area, and the limited number of active workings within the study area, the sensitivity of the remaining sand and gravel resources are considered Low.

Soils

10.3.24. The soil units present on site are summarised from the 1:250,000 Soil Map of Scotland by the James Hutton Institute[xxxiv].

10.3.25. The distribution of soils within the study area is dependent on the geology, topography and drainage regime of the area. The study area soils consist of various soil units belonging to the Arkaig, Corby and Aberlour Associations, derived from: Moine Series metamorphic rocks; granites and fluvioglacial sands and gravels; and acid granites and schists respectively. The main soil types within the study area are:

- Gleys: naturally poorly drained soils that develop under conditions of intermittent or permanent waterlogging. Soils are typically greyish or blue-grey with orange mottling. Peaty gleys have a peat-rich surface horizon; non-calcareous gleys have a low lime content; humic gleys include a humus-rich surface layer.
- Podzols: typically free-draining acid soils developed under aerobic conditions. Podzols are generally nutrient-deficient and heavily leached in the upper horizons, with an accumulation of iron/aluminium oxides ('ironpan') or organic material at lower levels within the soil profile. Peaty podzols have a peat-rich surface horizon; humus-iron podzols have a more humus-rich surface layer and a higher concentration of iron oxides within the soil profile. In areas with low slope angles, waterlogging may occur above the ironpan; this can produce a soil intermediate between a podzol and a gley.
- Rankers: predominant in mountain or hilly terrain or on glacially eroded rocky terrain with underlying solid or fragmented non-calcareous rocks within 30cm depth. An organic or organo-mineral surface horizon present but generally lacks subsoil.
- Peat: accumulations of organic material that have remained wet to the surface; often dominated by Sphagnum mosses.

10.3.26. Eight soil units are found within the study area, summarised in order of site dominance in Table 10.14, and shown in Figure 10.3a-c. Each soil unit consists of varying proportions of the soil types discussed above, with the proportion of each soil type within a soil unit dictated by the local climatic, topographical and drainage conditions.

Table 10.14: Soils within the Study Area

Soil Association	Soil Unit	Component Soils	Landforms	Typical Associated Vegetation	Study Area Presence
Corby	101	Peaty podzols, some humus-iron podzols and peat	Mounds, ridges and terraces with gentle to steep slopes	Atlantic and Boreal heather moor, blanket bog, Oak and Birchwood	Northeast area of the Proposed Scheme, south of Loch Moy and along Funtack Burn
	98	Humus-iron podzols, some gleys	Valley floors, terraces and mounds with gentle and strong slopes	Arable and permanent pastures, oak and birchwood, rush pastures and sedge mires	Southeast area of the Proposed Scheme, east of Tomatin extending north to Dalmagarry
Arkaig	23	Peat, peaty gleys and peaty podzols	Undulating lowlands and uplands with gentle and strong slopes, non-rocky	Blanket and upland blanket bog, Bog Heather Moor, Moist Boreal Heather moor	Northern section of Proposed scheme, south of the Proposed Scheme between Lynebeg and Allt Creag Bheithin
	22	Peaty podzols, peat, some peaty gleys and humus-iron podzols	Hills and valley sides with strong slopes, non-rocky	Moist boreal heather moor, blanket and upland blanket bog, bog heather moor	Central section west of the Proposed Scheme, south of Moy
	20	Peaty podzols, peat, some peaty gleys and humus-iron podzols	Undulating lowlands and valley sides with gentle and strong slopes, non-rocky	Arable and permanent pastures, rush pastures and sedge mires, dry Atlantic heather moor	South of Tomatin adjacent to Drumbain Cottage
	30	Rankers, peaty podzols; some humus-ironpodzols and peaty gleys	Rugged hills with strong and steep slopes; very rocky	Dry and moist boreal heather moor, bog heather moor, blueberry heath	Northern extent of the study area
Alluvial Soils	1	Alluvial soils	Flood plains, river terraces and former lake beds	Arable and permanent pastures, rush pastures and sedge mires, broadleaved woodland	North of Moy Hall
Aberlour	7	Peaty podzols	Hills and valley sides with strong and steep slopes; non rocky	Moist Boreal heather moor; blanket and upland blanket bog; Bog heather moor	Small area north of Raigmore
Organic Soils	606	Eroded blanket peats	Uplands and northern lowlands with gentle and strong slopes	Blanket and flying bent bog, upland and mountain blanket bog, deer grass bog, sedge mires.	Upper hillslopes in the northern section of the study area, northern slopes of Carn na h-Easgainn

Table Source: Soils Scotland.

10.3.27. Information on the potential use and quality of the soils has been derived from the Land Capability for Agriculture mapping, also produced by The James Hutton Institute[xxxiv]. This information is also used for the Agricultural Land assessment detailed in Chapter 8 People and Communities - Community and Private Assets, and is shown in Figure 8.3a-f. The land capability classes present within the study area are listed in order of prevalence within Table 10.15 below.

Table 10.15: Land Capability for Agriculture Classes within the Study Area

Class	Description	Study Area Presence
5_2	Land capable of use as improved grassland. Sward establishment presents no difficulties but moderate to low trafficability, patterned land and/or strong slopes cause maintenance problems. Growth rates are high and despite some problems of poaching satisfactory stocking rates are achievable	Valley slopes west of Tomatin and Invereen. North of Slochd Summit. Underlies existing A9 from north of Dalmagarry to northwest of Moy, including valley floors of upper Funtack Burn and lower Allt Creag Bheithin. Correlates broadly with soil units 22 and 101
4_1	Land capable of producing a narrow range of crops. Suited to crop rotations which, although primarily based on ley grassland, include forage crops and cereals for stock feed. Yields of grass are high but difficulties of utilisation and conservation may be encountered. Other crop yields are very variable and usually below the national average.	Valley bottoms of the River Findhorn at Tomatin, settlement of Drumbain, and the Lower Funtack and Dalmagarry burns. Broadly correlates to soil unit 98.
6_3	Land capable of use only for rough grazing. The vegetation is dominated by plant communities with low grazing values, particularly heather moor, bog heather moor and blanket bog.	Area around Tomatin South Junction. Moorland hillside to the west of the study area from north of Dalmagarry to the northern extent of the Proposed Scheme. Correlates broadly with soil units 3 and 23
4_2	Land capable of producing a narrow range of crops. Primarily grassland with some limited potential for other crops. Grass yields can be high but difficulties of conservation or utilisation may be severe, especially in areas of poor climate or on very wet soils.	Valley bottom of the Moy Burn, upstream of Loch Moy. Far northwest of the study area, separated from the existing A9 by the railway. Broadly correlates to soil unit 101.
5_3	Land capable of use as improved grassland. Land in this division has properties leading to trafficability and poaching issues, patterns of soil, slope and wetness may interfere with establishment and/or maintenance. Land cannot support high stock densities without damage.	Small area around Soilshan west of the existing dualled section of A9.
7	Land of very limited agricultural value. Severe limitations such as extremely severe wetness, very steep gradients, severe erosion including intensively hagged peatlands and extremely severe climates (exposed situations, protracted snow cover and short growing seasons) restrict use to very poor rough grazing.	Upper hill slopes in the northern section of the study area, upper northern slopes of Carn na h-Easgainn. Correlates broadly with soil unit 4e.

Table Source: Soils Scotland.

10.3.28. Given the distribution of the soils the vast majority of the Proposed Scheme is underlain by land capability class 5 and 6 soils, where the soils are of low quality and therefore of Low sensitivity.

10.3.29. There are small areas of land capability class 4 soils, which are of medium quality and therefore of Medium sensitivity.

10.3.30. The outlying areas of the Proposed Scheme are generally on higher ground with poorer quality soils (land capability class 7) where the soils are of very low quality and therefore are considered to be of Negligible sensitivity.

Peat

10.3.31. Peat is a soft to very soft, highly compressible, highly porous organic material which can consist of up to 90% water by volume. Unmodified blanket peat typically has two layers, a surface layer or acrotelm which is usually 0.1 to 0.3 m thick, highly permeable and receptive to rainfall. The acrotelm layer generally has a high proportion of fibrous material and often forms a crust under dry conditions. The second layer, or catotelm, lies beneath the acrotelm and forms a stable colloidal substance which is generally impermeable. As a result, the catotelm usually remains saturated with little groundwater flow. Peat is thixotrophic, meaning that its viscosity decreases under applied stress. This property may be considered less important where the peat has been modified through artificial drainage and is drier, but will be significant when the peat body is saturated.

10.3.32. A variety of desk study data sources provide information on the presence of peat deposits within the study area, in particular the superficial geology mapping and the soils mapping. However there are conflicts between the datasets, partly due to the different scales of mapping, but also due to differences in the definition of what constitutes peat and the criteria used in mapping it.

10.3.33. SNH published a national map of 'carbon-rich soil, deep peat and priority peatland' in July 2016[xii]. This map draws on a number of national datasets (including those mentioned above) to identify peat and peat soils and classify them by 'importance'. This mapping is presented in Figure 10.4a-k. A summary description of the Carbon and Peatland 'importance' classes present within the study area is provided in Table 10.16, listed in order of prevalence within the study area.

Table 10.16: Summary of Carbon and Peatland Classes Present within Study Area

Class	Description	Study Area Presence	Area within Study Area (ha)
Class 4	Area unlikely to be associated with peatland habitats or wet and acidic soils Area unlikely to include carbon-rich soils	Present around Dalmagarry, Moy, west of Moy along the Allt Creag Bheithin and south of Daviot.	299.23
Class 5	Soil information takes precedence over vegetation data No peatland habitat recorded. May also show bare soil. All soils are carbon-rich and deep peat	Conifer forestry areas across the scheme including around Moy and west of Lynebeg south of existing A9. Also at Slochd Summit by Tomatin South Junction.	324.22
Class 0	Mineral soils Peatland habitats are not typically found on such soils	Present around Tomatin area and in River Findhorn Valley.	237.25

Class	Description	Study Area Presence	Area within Study Area (ha)
Class 3	Vegetation cover does not indicate priority peatland habitat, but associated with wet and acidic soils Most of the soils are carbon-rich soil, with some areas of deep peat	Small areas along south extent, with larger areas located along central and northern section west of Moy.	86.61
Class 1	All vegetation cover indicates priority peatland habitats All soils are carbon-rich soils and deep peat	Confined pockets west of Lynebeg, south of Tomatin South Junction and north of Dalmagarry.	32.11
Class - 2	Non-soil e.g. loch, built up area	Lochs and larger watercourses throughout the study area.	2.46

Table Source: SNH (2016).

10.3.34. The SNH priority peatland mapping has been supplemented with data from historical boreholes, the results of the DMRB Stage 2 Advanced GI and Preliminary DMRB Stage 3 GI and three peat probing surveys. The first survey assisted in defining the extent and depth of the peat within the study area. The following two surveys provided further data in areas of peat for the Proposed Scheme. Nine peat cores were collected to determine the physical properties of peat deposits. The results of the peat probing surveys and peat contours based on these results are presented in Figure 10.4a-k.

10.3.35. The vast majority of the study area was found to have peaty soils of less than 0.5m depth, however peat or peaty soils greater than 0.5m in depth have been identified in a number of discrete areas immediately adjacent to or under the footprint of the Proposed Scheme. For the purposes of the engineering cut and fill calculations, materials calculations and peat management plan calculations the Proposed Scheme has been subdivided into 20 earthworks areas. A summary of the peat present in each of these 20 areas are presented in Table 10.17 below and displayed on Figure 10.4a-k, with full details provided in Appendix A10.2.

10.3.36. Based on the information presented here the sensitivity of the Class 1 peat within the study area is considered high, while the Class 3 peat is considered medium. The Class 5 areas are considered low sensitivity, and Class 4 and Class 0 areas are considered Negligible. Whilst there is no Class 1 peat under the excavation areas identified in Table 10.17, it is present within the study area.

Table 10.17: Areas of Peat Under or Immediately Adjacent to the Proposed Scheme

Area	Max peat depth (m) SNH Peatland Class	Associated Peat Core Von Post Class	Description
Tomatin South Junction	0 Class 5	n/a	Small area of gently sloping ground, featuring both conifer woodland and semi natural mixed woodland. No peat encountered in this area
C1121 Tomatin Village Road	0 Class 0	n/a	Area of largely agricultural land, with some conifer plantation, no peat encountered in this area

Area	Max peat depth (m) SNH Peatland Class	Associated Peat Core Von Post Class	Description
Mainline Ch 400 - 1200	1.2 Class 0	n/a	Area of grassland, and existing road featuring humus-iron podzols, with a small well defined area of deeper peat in the north associated with marshy grassland
Tomatin GSJ	2.0 Class 0	TM-PC-15 H5 Moderately Decomposed	Mix of blanket bog and wet woodland habitats at base of existing embankment, flat area, wet underfoot. Features pockets of deeper peat.
Mainline Ch 1200 - 2700	0.7 Class 0, 5 and 3	n/a	Unimproved grassland, woodland and conifer forestry adjacent to the existing carriageway. Small well defined area of shallow peat
Ruthven Tomatin Link Road	1.89 Classes 0, 3 and 5	n/a	A mix of blanket bog and wet woodland featuring deep peat in the south, with thinner soils in grassland and woodland areas in the north.
Mainline Ch 2700 - 3620	2.2 Classes 5, 3 and 0	TM-PC-02 H3 Very Weakly Decomposed	Area of woodland, conifer plantation and grassland along the existing A9. Underlain by humus-iron podzols and peaty podzols. Pocket of deeper peat located within woodland adjacent to the Dalmagarry Burn.
NCN7	0.6 Classes 5,4, 3 and 0	n/a	Features areas of marshy grassland and conifer forestry, with a smaller defined area of peat in the south. Underlain primarily by thin peaty podzols.
Dalmagarry Access Tracks	0.6 Classes 4 and 0	n/a	Area on the western side of the HML within semi improved acid grassland and wet heath adjacent to the Dalmagarry Burn, where shallow soils are anticipated. Isolated pocket of shallow peat to the north of the farmhouse.
Ruthven Moy Link Road	2.2 Class 3, 4 and 0	TM-PC-02 H3 Very Weakly Decomposed	Area features deep peat within blanket bog and boggy woodland located in isolated hollow at the toe of a steep slope adjacent to the Dalmagarry Burn. Remainder of area features shallow soils within semi improved grassland
Mainline Ch 3620 - 4100	0.2 Class 4	n/a	Area is relatively flat and features marshy grassland and thin soils.
Moy South LILO	4.0 Class 3	TM-PC-10 TM-PC-16 H8 Very Strongly Decomposed	Flat area featuring blanket bog and poor semi-improved grassland. Peat cores show deep peat in the centre of this area, which is strongly decomposed at depth. Remaining area features shallow soils and grassland. Area features small drains.
Mainline Ch 4100 - 4780	1.1 Class 0	n/a	This small area is adjacent to the railway at the bottom of the existing embankment and features wet bog and broad leaved semi-natural woodland. Steeper slopes located west of the A9. This area is similar in nature to Class 3 soils, with smaller defined areas of deeper peat.

Area	Max peat depth (m) SNH Peatland Class	Associated Peat Core Von Post Class	Description
Mainline Ch 4780 - 6600	2.6 Class 5	n/a	This area features a mix of conifer and broad-leaved semi-natural woodland, with shallow slopes and peaty soils found in this area, with a small defined area of deeper peat.
Lynebeg Access Tracks	0.94 Classes 4 and 5	n/a	Area features a mix of heath, woodland and conifer plantation, with moderate and shallow slopes and underlain by thin peaty podzols. Generally shallow soils with pockets of shallow peat
Lynebeg LILO	0.60 Classes 5 and 4	n/a	Area features a mix of woodland, grassland, heath and a standing waterbody. Underlain by thin peaty podzols, featuring shallow to moderate slopes. Generally shallow soils with pockets of shallow peat
Mainline Ch 6600 - 9600	1.65 Classes 3 and 4	TM-PC-04 H4 Weakly Decomposed TM-PC-06 H4 Weakly Decomposed	This area features shallow acidic soils across a large area which features very shallow slopes and comprises of wet heath and conifer plantation, with several small discrete areas of deeper peat.
Moy Access Tracks	1.50 Class 3	TM-PC-14 H5 Moderately Decomposed	Area features a mix of grassland, flushes, mires and blanket bog across a relatively flat area. Features peaty podzols soils, with a small defined area of deeper peat of 1.5m depth.
Forestry Access Tracks	2.82 Class 5	TM-PC-17 H5 Moderately Decomposed	This area features the existing road along the valley with shallow slopes and flat ledges, with areas of recently felled woodland, conifer plantation, marshy grassland and bog. Peaty soils and wet habitats are common with smaller defined areas of deep peat.

Peat Stability

10.3.37. Due to the presence of areas of peat in the study area, a peat stability assessment has been undertaken. This assessment used peat depth data in combination with slope information to initially determine areas considered of greatest risk of slope failure, based on factor of safety slope stability calculations. These specific areas were then considered further, with further information collected and interpretation of aerial photography used to refine the initial desktop assessment for each location.

10.3.38. No evidence of peat instability was recorded during the site visits, with deeper peat deposits confined to well defined basins, and other exposures providing evidence of glacial till and peaty soils. Based on the initial Peat Stability Assessment, a number of peat cores were collected at identified areas of peat across the scheme. The peat characteristics are subsequently used to provide more accurate information in Factor of Safety (FoS) slope calculations.

10.3.39. The results of the peat cores are detailed in Technical Appendix A10.1. The Peat Stability Assessment initially highlighted 12 areas of initial concern (5 high and 7 moderate). The results of the assessment show that following detailed assessment, all of the areas are considered to have a low peat stability risk. Therefore this has been scoped out of the impact assessment.

Groundwater

Hydrogeology

10.3.40. Both the intrusive igneous bedrock in the south of the study area, and the metasedimentary bedrock in the north, are described on the BGS Bedrock Aquifer Productivity mapping[xxvi] as being very low productivity aquifers, as shown in Figure 10.5a-k. Within these very low permeability rocks groundwater storage and flow is limited to the near surface weathered zone and secondary features such as fractures. Sustainable yields of less than 0.1 litres per second (l/s) are typical in suitably sited boreholes. Rare springs may occur in the igneous granodiorite, with small yields except where tectonic influences have increased the secondary porosity. Only seven out of the 47 exploratory boreholes drilled in the 2016 GI reached bedrock. Out of these seven, two have shown bedrock to be outcropping at the surface, and both indicated the presence of shallow groundwater. Based on the findings of the GI (detailed in Appendix A10.3) is assumed that the recharge is occurring in the outcrop zone and that the groundwater flow is within the weathered and fractured zones near the surface, flowing towards the closest surface water feature.

10.3.41. The BGS Superficial Aquifer Productivity mapping[xxvi] , Figure 10.5a-k indicates that the glaciofluvial sheet and ice contact deposits comprising gravel, sand and silt are considered to be high productivity intergranular flow aquifers. Typical sustainable borehole yields of the superficial aquifers are expected to be greater than 10l/s. The river terrace and alluvial deposits within the study area are described as intergranular flow aquifers with moderate to high productivity i.e. sustainable yields of between 1 and 10l/s are typical. The Devensian Till, Hummocky (Moundy) Glacial Deposits and Peat are characterised by typical sustainable yields (if any) of less than 0.1l/s. The glaciofluvial sheet and ice contact deposits, as well as the river terrace and alluvial deposits are all considered to be in hydraulic continuity when they are in direct contact with each other. However, along the scheme itself there are areas on the BGS mapping where these layers are separated by areas of Devensian Till and Peat, or exposed metamorphic bedrock

- from chainage (Ch.) 1665 to 2150
- from Ch. 4385 to 5735
- from Ch. 7100 to 7700
- from Ch. 8470 onwards

10.3.42. Any hydraulic continuity between sand and gravel aquifers is expected to be reduced significantly along these stretches, which effectively splits the sand and gravels aquifer into four separate aquifers along the Proposed Scheme[xxx]. However, it should be noted that the results of the 2016 GI indicate the presence of sand and gravel at some locations mapped as Devensian Till and therefore hydraulic continuity may still be significant.

10.3.43. Groundwater monitoring rounds have been taken on an approximately monthly basis, beginning in August 2016 and the most recent round being undertaken in September 2017. This monitoring has recorded groundwater levels at depths varying from 0.3mbgl to 13.1mbgl, therefore the water table can be said to be shallow in all of the areas that have been monitored.

10.3.44. Historic borehole logs along the existing Tomatin to Moy route indicate that groundwater can be encountered at different depths at different locations - between 0.1mbgl and 19.2mbgl. Historic monitoring of groundwater levels in the Moy area of the A9, undertaken in spring/summer 2005, indicated water levels were relatively stable within individual boreholes, with highest water levels recorded at depths between 1.8m and 7.8mbgl.

Groundwater Vulnerability

10.3.45. Groundwater vulnerability is defined as 'the tendency and likelihood for general contaminants to reach the water table within the uppermost aquifer after introduction at the ground surface'[xxvii]. The groundwater vulnerability classifications are derived from datasets from a number of parameters, including the flow type, presence of clay deposits, permeability and thickness of superficial and bedrock deposits, groundwater depth and Hydrology of Soil Type (HOST) class.

10.3.46. The variation of groundwater vulnerability classification is important in identification of the risk posed to groundwater receptors from pollutants, and is considered when assessing potential pollution impacts from construction activities and operational routine runoff and accidental spillages on groundwater bodies.

10.3.47. Table 10.18 provides information on the groundwater vulnerability classifications[xxvii]. Groundwater vulnerability mapping is presented in Figure 10.6a-c.

Table 10.18: Groundwater Vulnerability Classifications

Vulnerability Class	Description		Frequency of activity	Travel time	Site Presence
5	Vulnerable to most pollutants, with rapid impact in many scenarios		Vulnerable to individual events	Rapid	South of Meall Mór, and eastern slopes of Tom na h-Ulaidh east of Invereen. Also, small areas identified west of Moy and adjacent to Midlairgs Burn. Generally corresponds to areas where bedrock is at or near surface.
4	Vulnerable to those pollutants not readily absorbed or transformed	4a May have low permeability soil; less likely to have clay present in superficial deposits			Most of The Proposed Scheme area falls under this class, including areas around Moy, west of Slochd Summit, Soilshan, Tomatin, Dalmagarry, Milton of Moy, and around the Midlairgs Burn along Stairsneach nan Gaidheal,. Broadly corresponds to the glaciofluvial and alluvial deposits, and some till deposits.
		4b More likely to have clay present in superficial deposits			Small areas along the valley of Allt Creag Bheithin south of Meall Mór, west of Slochd Summit, north of Dalmagarry Farm, west of Inverbrough on the eastern slopes of Carn Móraig and along the Allt Creag Bheithin. Generally corresponds to peat deposits at higher elevations
3	Vulnerable to some pollutants; many others significantly attenuated				Small areas north of Tomatin, west of Invereen, eastern slopes of Carn na Loinne and small areas north of Lynemore and Moy. Broadly corresponds to some till deposits within the study area
2	Vulnerable to some pollutants; but only when they are continuously discharged/leached				Small areas including south of Loch Moy, areas around Lower Inverbrough and north of Raigbeg. Can correspond to some till deposits or valley peat deposits.
1	Only vulnerable to conservative pollutants in the long term when continuously and widely discharged/leached		Vulnerable only to persistent activity	Very Slow	Small areas limited to south of Raigbeg, south of Invereen, and west of Moy. Largely corresponds to areas of valley peat.
0	Not sufficient data to classify vulnerability e.g. below lochs, in urban areas where geological and/or soil data is missing, where superficial deposits are mapped but not classified; or in mined (including opencast) and quarried areas.				Areas including the existing A9 footprint at Tomatin South Junction, west of Lower Inverbrough, Tomatin Distillery and Loch Moy.

Table Source: BGS (2016)

10.3.48. The groundwater vulnerability mapping (Figure 10.6a-c) indicates that the majority of the study area falls under Class 4a, featuring low permeability soils and a relatively high groundwater vulnerability.

Water Quality & Water Framework Directive (WFD) Status

10.3.49. The bedrock aquifer of the study area is classified under the WFD as part of the Strathnairn, Speyside and Cairngorms Groundwater Body (WFD ID 150709). The superficial aquifers of the study area are classified under the WFD as part of the Findhorn and Muckle Burn Sand and Gravel Groundwater Body (WFD ID 150812)[xxxiii].

10.3.50. As of 2015 these water bodies are classified as having an overall status of Good with Medium confidence, with a Good status for both chemistry and quantitative factors. There are currently no pressures identified on these water bodies. Both waterbodies are also designated as Drinking Water Protected Areas (DWPA) under the Drinking Water Directive, with a current condition parameter (DWPA status) of Pass.

10.3.51. The bedrock aquifers are classified as part of the Precambrian North bedrock aquifer unit, which feature weakly mineralised groundwater conditions with variable redox conditions. The superficial aquifers are classified as Quaternary superficial aquifers which also feature variable redox conditions which may be weakly to moderately mineralised[xliii].

10.3.52. Information from SEPA identified a number of domestic septic tank soakaways and sheep dips on agricultural land within the scheme area. The SEPA dataset indicates that all the identified septic tanks are located within the land boundary of the associated domestic properties and are not located within the Proposed Scheme footprint. It is therefore assumed that septic tanks will be unaffected by the scheme. However consultation with the property owners should be carried out at detailed design to confirm this. There are three sheep dips located at Dalmagarry Farm which are also not located under the Proposed Scheme footprint. Surface water sources and discharges are discussed in Chapter 11.

10.3.53. Based on the information presented above all of the groundwater bodies of the study area are considered to be of High sensitivity in relation to groundwater quality.

10.3.54. Table 10.19 shows the SEPA and BGS classifications and implied sensitivity of water quality and also as a resource supply of each of the identified aquifers (including non-aquifers). The two types of bedrock identified have been listed as separate aquifers as little is known with regards to the extent of the hydraulic continuity between these strata (the Moine Supergroup and Findhorn Pluton Bedrocks). The superficial aquifers with High Productivity (according to BGS Superficial Aquifer Productivity mapping[xxvi]) have been grouped and treated as a single aquifer, listed as part of the Findhorn and Muckle Burn Sand and Gravel. The superficial aquifers with Moderate to High Productivity have also been grouped. It is reasonable to assume that there is significant hydraulic continuity between these layers due to the predominance of sands and gravels.

Table 10.19: Sensitivity of Groundwater Aquifers

Geological Unit	Attribute	Classification	Sensitivity
Moine Supergroup Bedrock – Psammites & Semipelites	Water Quality	WFD Good status - Strathnairn, Speyside and Cairngorms Groundwater Body	High
	Water Supply, Groundwater Flow	Very Low Productivity	Low

Geological Unit	Attribute	Classification	Sensitivity
Findhorn Pluton Bedrock – Graniodiorite, biotite	Water Quality	WFD Good status - Strathnairn, Speyside and Cairngorms Groundwater Body	High
	Water Supply, Groundwater Flow	Very Low Productivity	Low
Devensian Till Hummocky (Moundy) Glacial Deposits Peat	Water Quality	N/A	Low
	Water Supply, Groundwater Flow	Non-aquifer	Low
Glaciofluvial Sheet Deposits Glaciofluvial Ice Contact Deposits	Water Quality	WFD Good status - Findhorn and Muckle Burn Sand and Gravel	High
	Water Supply, Groundwater Flow	High Productivity	High
Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits	Water Quality	Moderate to High Productivity WFD Good status - Findhorn and Muckle Burn Sand and Gravel	High
	Water Supply, Groundwater Flow	Moderate to High Productivity	High

Public Water Supplies

10.3.55. Public water supply information was provided by Scottish Water. A groundwater source and water treatment works were identified in the Tomatin area. The precise location of the borehole is confidential and has been excluded from Figure 10.6a-c. Due to the inclusion of the bus turning area south of Tomatin this source is located within 900m of the Proposed Scheme, within the 1.2km survey radius buffer.

10.3.56. Borehole logs provided by Scottish Water confirm the public supply boreholes are abstracting from the Findhorn and Muckle Burn Sand and Gravels deposits between depths of 8 to 20mbgl. The sensitivity of the Tomatin groundwater source boreholes is considered Very High.

Private Water Supplies

10.3.57. Private water supplies identified to date within 850m of the study area are shown on Figure 10.6a-c and presented in Table 10.19 below. Where private abstractions have been identified within the study area, but are unlikely to have any hydrogeological connectivity with the scheme, these supplies are screened out of the impact assessment.

10.3.58. Six of the private water supply sources have been eliminated from this assessment, due to their distance from the Proposed Scheme and the intervening topography, or because they are confirmed surface water sources and are dealt with within Chapter 11: Road Drainage and the Water Environment. The sensitivity of the private water supply sources has been based on the number of properties served, as determined from data provided by The Highland Council and landowner interviews.

Table 10.20: Private Water Supplies Located Within 850m of the Proposed Scheme

Source name and grid reference	Source Type	Properties Supplied and Estimated no. of properties served	Property Grid Reference	Comment and screening decision	Screening result	Sensitivity
PWS Riverside Exact location unconfirmed	Spring	Riverside Dell Cottage Bridgend Cottage 3 properties	NH 803 277	The three properties are listed as being fed by a spring supply with no details on source location, with this area located 600m west of the existing A9. Landowner consultation confirmed the spring source is located uphill of these properties to the west of the River Findhorn. Given the intervening topography, as these are located across the Findhorn Valley, it is very unlikely these supplies would be impacted.	Screened out	Not applicable
PWS Corrybrough NH 820 292	Spring	Keepers Cottage Rose Cottage White Cottage Gardeners Cottage Corrybrough Lodge The Granary 6 properties	NH 817 294	The supply for the PWS Corrybrough estate is located 1.8km south-east of the Proposed Scheme, with the River Findhorn in between and serves a number of properties on the estate. The nearest property, White Cottage, is located 840m north-east of the Proposed Scheme. Given the distance of the source from the scheme and intervening topography it is unlikely the scheme will impact on this source.	Screened out	Not applicable
PWS Tomatin House NH 810 299	Spring	Tomatin House, Butlers Cottage, Gardeners Cottage 3 properties	NH 811 297	This property is not listed within the Highland Council dataset, however landowner consultation has confirmed the presence of two wells which are no longer in use and the properties are fed by public supply. One source was located during site visit, approx. 870m east of scheme adjacent to River Findhorn. Given the downstream location and topography of area, this supply may be impacted.	Screened in	Medium
PWS Old Manse Exact location unconfirmed	Spring	The Old Manse, Avondale, Glenkirk &The Cottage of Free 4 properties	NH 789 297	These properties are all served from a single supply, from a spring source located on the hillside above and to the west of the properties. The supply is over 400m west and upgradient of the existing A9.	Screened out	Not applicable

Source name and grid reference	Source Type	Properties Supplied and Estimated no. of properties served	Property Grid Reference	Comment and screening decision	Screening result	Sensitivity
				Given their distance and the intervening topography, including the railway and unclassified road at Tomatin, they will be unaffected by the Proposed Scheme.		
PWS Invereen NH 798 315	Well	Invereen Farm 1 property	NH 797 315	Well located close to farmhouse, 300m east and downgradient from the existing A9, likely taking water from shallow sand and gravel aquifer. Landowner consultation has confirmed the well is not currently used and property is fed by public water supply.	Screened in	Medium
PWS Corrie Beg NH 797 326	Spring	Corrie Beg Corrie Beg, Lubrachan & Milton of Moy 3 properties	NH 801 323	These properties are all served from a spring located on the hillside above and north west of the properties, located 500m north-east of the existing A9. Given the distance and the intervening topography, including the Funtack Burn and located uphill of any infrastructure, this source will be unaffected by the Proposed Scheme	Screened out	Not applicable
PWS Dalmagarry NH 792 327	Spring	Dalmagarry Farm, The Cottage, The Farmhouse & The Shieling 3 properties	NH 787 323	The supply for Dalmagarry Farm is fed from a spring source in woodland east of the Funtack Burn, 700m north-east of the Proposed Scheme. There is also an old well at Dalmagarry Farm that is not in use. Given the intervening topography and the Funtack burn located between the scheme and the supply, both the supply and water mains will not be impacted.	Screened out	Not applicable
PWS Moy Estate Exact location unconfirmed	Spring	1 & 2 Forestry Cottages Gardeners Cottage 3 properties	NH 768 350 769 353	The properties on the Moy Estate are located approx. 860m north-east of the Proposed Scheme, with the source location unknown and the Moy Burn, Highland Mainline and B9154 road in between. The spring-fed source is confirmed located up-hill and to the east of the estate, however the source location is currently unknown. Given the distance of the source from the scheme and intervening topography it is unlikely the scheme will impact on this source.	Screened out	Not applicable

Source name and grid reference	Source Type	Properties Supplied and Estimated no. of properties served	Property Grid Reference	Comment and screening decision	Screening result	Sensitivity
PWS Invermoy Exact location unconfirmed	Spring	None	n/a	The old supply network for the properties west of Moy was originally fed by a supply located on the hillside south of the A9 near the Lynebeg and Lynemore supplies, with the exact location unknown. It is currently blocked off at Moy Halt where public mains is installed, with no properties currently using this private supply. It should be noted however that several properties retain the right to use this supply	Screened in	Medium

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

10.3.59. GWDTEs are types of wetland which are specifically protected under the Water Framework Directive (WFD) and can include: fens, springs, flushes, seepages, quaking bog, wet woodland, marshy grassland and some types of wet heath, reedbed and swamp.

10.3.60. NVC surveys were carried out in May 2016, February and July 2017. Further information on the survey method, baseline information and results are presented in Chapter 11: Ecology and Nature Conservation and Technical Appendix A12.2 Vegetation and Habitats.

10.3.61. The NVC map was reviewed for GWDTEs using SEPA guidance which indicates which NVC habitats could be potentially groundwater dependent. Areas which were not likely to be groundwater fed or were not hydrogeologically linked to the Proposed Scheme based on the methodology described in Section 10.2 were screened out from the assessment. The groundwater dependency of the remaining NVC habitats has been reviewed and revised as described in Section 10.2. Full descriptions of each habitat and their resulting groundwater dependencies are provided in Technical Appendix A10.3. The resulting GWDTE map is presented in Figure 10.7a-k and summarised in Table 10.21 below.

Table 10.21: GWDTE Baseline Assessment Summary

Groundwater Dependency	Sensitivity	Area (ha)	No of polygons
High	Very High	13.1	25
Moderate	High	54.2	132
Low	Medium	58.8	128
None	Low	15.3	26
Total		141.4	311

10.3.62. From an original list of 452 potential GWDTE areas, approximately 37% of the NVC habitats initially identified using the SEPA criteria are not considered as GWDTEs following review of local characteristics, with the remaining 285 locations considered of potential High, Moderate or Low groundwater dependence, representing 13% of the total study area, based on a 250m buffer zone.

10.3.63. For the purpose of this assessment, NVC communities which are defined as highly dependent are considered to be genuinely groundwater dependent and are considered to be of Very High sensitivity. Areas with potential moderate groundwater dependency are likely to feature a combination of surface and groundwater dependency and are considered of High sensitivity. Low groundwater dependency areas are likely to be predominantly fed by surface runoff and direct rainfall, but groundwater input may contribute and are considered of Medium sensitivity.

10.3.64. The limited coverage of monitoring wells across the scheme does not provide enough information to determine whether these areas are solely groundwater fed at the present time. It is proposed that further groundwater monitoring is carried out at a representative sample of these areas during the detailed design phase to determine whether they are true GWDTEs; this has been included as a mitigation commitment in Section 10.5. This uncertainty has led to a precautionary approach when defining groundwater dependency status for individual areas.

10.3.65. Areas assessed as having no groundwater dependency, while assessed as having a Low sensitivity, have not been progressed to the impact assessment.

Surface Water Receptors

10.3.66. The study area features a number of watercourses including the River Findhorn and its tributaries, the Funtack Burn and its tributaries and the Moy Burn and its tributaries, all of which are expected to be in continuity with groundwater to a greater or lesser extent. The sensitivity of these watercourses range from Low to High. Further information on surface water receptors is provided in Chapter 11: Road Drainage and the Water Environment.

10.3.67. There are two ponds at Lynebeg, identified during pond surveys as Pond 4 (NGR NH 768 340) and Pond 5 (NGR NH 769 340), which are located north-east of the existing A9 carriageway (refer to Figure 12.13h for pond locations). The ponds are of good water quality, surrounded by conifer woodland, the land of which is primarily dry underfoot in the vicinity of the ponds. These ponds were surveyed using the National Pond Survey methodology, as detailed in Chapter 12. The findings of these surveys found that in general the water quality of the ponds was good and that a mixed hydrological dependence was likely (i.e. fed by a combination of direct rainfall, surface water and groundwater) and their conservation value was considered to be of 'Local' importance. On this basis the ponds are considered to be of Medium sensitivity.

10.3.68. There are no obvious inflows or natural outflows from either pond, and the surface water catchments for each appear to be too small to sustain the ponds, therefore some dependence on groundwater was suspected. However the GI and groundwater monitoring data collected to date suggest that the ponds are not connected to groundwater. The results indicate there is a confined aquifer within the glacial sands and gravels below the ponds, but that the ponds themselves are isolated from this aquifer and are perched on near-surface low permeability layers (i.e. glacial till, silt and peat). On this basis it is assumed that neither pond is groundwater dependent, with each relying solely on direct rainfall and surface water inflows. Further details of the analysis of the GI and groundwater monitoring data are provided in Appendix A10.3.

Contaminated Land

Sites of Potential Contamination

10.3.69. Potentially significant sources of contamination within the study area have been identified. These sites of potential contamination are discussed in detail within these reports, are shown in Figure 10.8a-c and are summarised in Table 10.22 below, listed in order of increasing distance from the Proposed Scheme.

Table 10.22: Contaminated Land Sites Located Within the Study Area

Site Description	NGR Location (Map Reference Number)	Location relative to the Proposed Scheme Footprint
The Highland Mainline railway line generally follows the route of the A9 until the railway turns northwards at Moy.	Throughout the study area (Labelled on Figure 10.8a-c)	Generally located within 50m of the route, except at three locations where the railway line and the proposed route intersect -

Site Description	NGR Location (Map Reference Number)	Location relative to the Proposed Scheme Footprint
		Dalmagarry, A9/B9154 junction and in the vicinity of Moy Rail Bridge.
Disused pit located underneath existing A9 beyond the proposed Moy junction	NH 755 346 (map ref 1, Figure 10.8c)	Under footprint
Disused pits (2 No.) beneath the proposed Moy junction – infilled but no details on what was extracted or used in backfilling process	NH 769 341 (map ref 2, Figure 10.8c)	Partially under footprint of Moy junction
Agricultural buildings. Given the largely agricultural nature of the study area there are likely to be several farms and associated buildings where potential contamination sources could exist as a result of the use of pesticides and fertilisers.	Throughout the study area	Within the study area
Former timber treatment yard located off B9154	NH 779 332 (map ref 3, Figure 10.8c)	Immediately adjacent to proposed footprint. Proposed access road encroaches onto associated land parcel
Small former quarry close to Raigbeg – no detail on what was extracted or what was used in the backfilling process	NH 808 289 (map ref 4, Figure 10.8a)	Adjacent to existing A9.
Former Freeburn Hotel, fuel station and Little Chef restaurant. Underground fuel tanks from the original fuel station are believed to have been removed during redevelopment works in 1995. Subsequently the site has ceased to operate with the hotel, restaurant and fuel station being demolished. The fuel tanks from the redeveloped site are thought to have been filled with concrete but no details of decommissioning works are available. No validation report has been made available to confirm that all materials impacted by spills and leaks have been removed, nor are de-gas certificates for the fuel tanks available. Stockpiles of material remain on site following the demolition of the buildings. A biological filtration system was present to deal with sewage wastes arising from the site. Discharge consents relating to this system indicate that treated waste water was discharged into the adjacent Allt na Frithe burn which is located 50m to the south of the site.	NH 795 300 (map ref 5, Figure 10.8b)	34m west
Disused pit located approx. 230m southwest of the A9 at Tomatin - no details on what was extracted, whether it is infilled and what was used in the backfilling process	NH 798 295 (map ref 6, Figure 10.8b)	40m south

Site Description	NGR Location (Map Reference Number)	Location relative to the Proposed Scheme Footprint
Potentially contaminated site 94m northeast of the A9. No other details are provided.	NH 796 314 (map ref 7, Figure 10.8b)	67m northeast
Small former quarry close to Findhorn viaduct – no detail on what was extracted or what was used in the backfilling process	NH 808 286 (map ref 8, Figure 10.8a)	68m west
Disused mineral site approximately 225m southwest of the A9 at Tomatin – no details available. Located close to the disused pit at NGR NH 798 295.	NH 798 295 (map ref 9, Figure 10.8b)	78m south
Small former quarry close to Findhornbridge – no detail on what was extracted or what was used in the backfilling process.	NH 808 277 (map ref 10, Figure 10.8a)	132m west
Gravel pit – located 175m northwest of the A9 adjacent to Loch Moy, relating to Moy School gravel pit where sand and gravel from the Glaciofluvial Ice Contact deposits were extracted.	NH 776 338 (map ref 11, Figure 10.8b)	145m northeast
Small disused quarry located immediately adjacent to the B9154, north of Moy - no details on what was extracted and what was used in the backfilling process	NH 758 351 (map ref 12, Figure 10.8c)	155m east
Former railway station at Moy	NH 763 845 (map ref 13, Figure 10.8c)	160m northeast

10.3.70. The CSM has been developed for the baseline conditions and comprises a summary of the ground model, potential sources, pathways and receptors as well as an evaluation of the risk associated with plausible pollutant linkages.

Ground Model

10.3.71. Land use within the study area is largely estate/ agricultural / forestry land, with the exception of the settlements at Tomatin, Moy and Lynebeg.

10.3.72. Several sites of potentially contaminated ground have been identified as discussed in Table 10.22. Made Ground is likely to be present in these areas as well as being associated with the existing A9. The Made Ground has the potential to contain contaminants as well as to generate ground gas / vapours. In addition, spills and leaks at several of the areas may have introduced contaminants to the ground.

10.3.73. No significant contamination was identified following the assessment of the contamination testing results taken as part of the Preliminary DMRB Stage 3 GI. The assessment is reported in Technical Appendix A10.4 Contaminated Land Assessment. Due to the limited nature of this preliminary investigation in terms of contamination risks, not all sources and pathways were investigated during the ground investigation.

10.3.74. A large proportion of the superficial deposits within the study area have been classified as highly productive aquifers. These include the glaciofluvial sheet deposits, glaciofluvial ice contact deposits, river terrace deposits and alluvial deposits. These deposits form a patchwork across the study area along with very low productivity

aquifers comprising peat and till. The bedrock is considered to be very low productivity, and has therefore been ruled out of any further contamination assessment.

10.3.75. There are several surface water bodies within the study area, with a number of watercourses crossing beneath the existing A9, or flowing in the general vicinity. These include the River Findhorn, Allt na Frithe, Dalmagarry Burn, Allt na Loinne Moire, Allt na Slanaich and Allt Creag Bheithin. The waterbodies within the study area which have been designated under the WFD are all considered to have 'Good' overall status.

10.3.76. No designated ecological systems have been identified within the study area. There are also no scheduled ancient monuments under the Proposed Scheme footprint.

10.3.77. Residential properties are concentrated in the settlements of Tomatin, Moy and Lynebeg. There are also individual properties scattered throughout the study area. There are several agricultural properties scattered throughout the study area. Farming within the study area is largely limited to livestock (sheep) farming, with very limited arable farming.

10.3.78. It should also be noted that parts of the A9 alignment are within designated Radon Affected Areas. The presence of radon is noted as a diffuse source/regional constraint to the A9 dualling corridor. However, as there are no buildings within the Proposed Scheme, there is unlikely to be an impact from radon.

Potential Sources

10.3.79. Sites of potential contamination within the study area are identified in Table 10.22 above. Table 10.23 below provides details of the likely contaminants associated with these potential sources and their expected distribution.

Table 10.23: Potential Sources of Contamination

Ref	Primary Source	Expected Distribution	Likely Contaminants
S1	Potentially Contaminated Ground / Waters located within Proposed Footprint – Railway, infilled pits / quarries, agricultural use, former timber treatment yard	Across all areas where potentially contaminative uses have been identified	Heavy metals, asbestos, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), acidic / alkali pH.
		Additional contaminants associated with farms	Pesticides, herbicides, insecticides, phenols
		Additional contaminants associated with railways	Herbicides, polychlorinated biphenyls (PCBs)
		Additional contaminants associated with infilled quarries / pits	Phenols, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs)
S2	Potentially Contaminated Ground / Waters located within 250m of Proposed Footprint (including within the CPO boundary – Railway, infilled pits / quarries, agricultural use, former fuel station	As detailed above	As detailed above

Potential Receptors

10.3.80. The identified potential receptors are detailed in Table 10.24 below.

Table 10.24: Potential Receptors

Ref	Receptor	Description
R1	Aquifer – Superficial Deposits	The following underlying superficial deposits are classified as moderate to high productivity intergranular flow aquifers (glaciofluvial sheet deposits, glaciofluvial ice contact deposits, river terrace deposits and alluvial deposits) and are likely to be in hydraulic continuity with the surrounding burns and rivers.
R2	Surface Water – Loch Moy, rivers, burns	There are several watercourses present adjacent to and that flow under the A9 as well as Loch Moy to the north of the A9. All these surface waters are considered to have Good Status under the WFD.
R3	Vehicle Travellers & NMUs	Drivers of vehicles using the existing/proposed route, pedestrians and NMU using the existing/proposed footpaths and cycle paths
R4	Local Residents	Residents located in properties present at isolated off-site locations along the route corridor
R5	Property (buildings and crops)	There are several residential properties and agricultural buildings and limited agricultural fields for arable farming present at isolated locations within the study area
R6	Property (livestock, Pets, wildlife)	Sheep farming is prevalent throughout the study area. There are likely to be pets associated within various residential properties and wildlife subject to shooting and fishing rights in the study area.
R7	Site Infrastructure	There will be buried services, culverts and structure foundations associated with the Proposed Scheme

10.3.81. Construction and maintenance workers are potential receptors to contamination but are not considered in this CSM. The UK framework for contaminated land assessment is based on potential adverse health effects resulting from long-term exposure to soil contamination. This is because, in the majority of cases, chronic exposure to contamination is more significant than acute exposure, and because the occupational risks are already required to be addressed by the Health and Safety at Work Act 1974 and related legislation.

Potential Pathways

10.3.82. The potential pathways which could expose the potential receptors to the potential sources of contamination are summarised in Table 10.25 below.

Table 10.25: Potential Pathways

Reference	Pathway	Description
P1	Direct contact with soil / soil dust	Soil contaminants could come into direct contact with the site users, property (including crops via plant uptake) and site infrastructure.
P2	Ingestion of soil / soil dust / fibres	Soil derived contaminants could be ingested by site users and livestock / pets / wildlife.
P3	Inhalation of fugitive soil dust	During dry, dusty conditions, contaminated soil dust could be inhaled by site users and livestock / pets / wildlife.
P4	Inhalation of vapour / soil gas	Site users and livestock / pets / wildlife may inhale vapours and / or soil gas that may be present.

Reference	Pathway	Description
P5	Leaching and vertical / lateral migration of contaminants	Contaminants could leach and migrate into the underlying superficial aquifer and adjacent watercourses / bodies, affecting dependant water supplies, ecosystems and livestock. Contaminated surface and groundwater could come into contact with property foundations and site infrastructure. Contaminated groundwater could discharge into surface waters. Contaminants present in offsite sources could migrate onto the proposed footprint. Contaminated surface water could run off into adjacent watercourses. There could also be migration via preferential pathways such as soakaways and underground services.
P6	Vertical and lateral migration of soil gas	There is the potential that made ground present in the study area could generate soil gas. This gas could potentially migrate into buildings and site infrastructure.

Risk Evaluation – Baseline Conditions

10.3.83. Each plausible pollutant linkage at baseline is identified in Table 10.26. An evaluation of the risk that each pollutant linkage poses, based on the current desk based and ground investigation data, has been undertaken in general accordance with CIRIA guidance document C552, 2001. Risk classification matrices are presented in the methodology for the assessment detailed section 10.2.

10.3.84. The evaluations are based on the available information presented within this report, Technical Appendix A10.4 and the data presented within the preliminary DMRB Stage 3 Ground Investigation Report.

Table 10.26: Risk Evaluation of Plausible Pollutant Linkages – Baseline

Hazard identification	Hazard assessment		Risk estimation		Risk evaluation	Comments
Contaminant source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Classification	
S1 Potentially contaminated ground / waters located within Proposed Footprint – Railway, infilled pits / quarries, agricultural use, former timber treatment yard	P1 – Direct Contact with soil / soil dust	R3 - Drivers & NMUs	Medium	Unlikely	Low	It is unlikely that these receptors would come into direct contact with soil / soil dust during baseline conditions due to the lack of exposed soil.
		R4 – Local Residents	Medium	Unlikely	Low	
		R5 – Buildings & Crops	Mild	Unlikely	Very Low	
		R6 – Livestock, Pets & Wildlife	Mild	Unlikely	Very Low	
		R7 – Site Infrastructure	Mild	Low	Low	It is possible that site infrastructure could come into direct contact with contaminated soil during baseline conditions.
	P2 – Ingestion of soil / soil dust	R3 – Drivers & NMUs	Medium	Unlikely	Low	It is unlikely that these receptors would ingest soil / soil dust, inhale fugitive soil dust or inhale vapours / soil gas during baseline conditions due to the lack of exposed soil and the lack of enclosed spaces in the immediate vicinity of the scheme.
		R4 – Local Residents	Medium	Unlikely	Low	
		R6 – Livestock, Pets & Wildlife	Mild	Unlikely	Very Low	
	P3 – Inhalation of fugitive soil dust	R3 – Drivers & NMUs	Medium	Unlikely	Low	
		R4 – Local Residents	Medium	Unlikely	Low	
		R6 – Livestock, Pets & Wildlife	Mild	Unlikely	Very Low	
	P4 – Inhalation of vapours / soil gas	R3 – Drivers & NMUs	Medium	Unlikely	Low	
		R4 – Local Residents	Medium	Unlikely	Low	
		R6 – Livestock, Pets & Wildlife	Mild	Unlikely	Very Low	

Hazard identification	Hazard assessment		Risk estimation		Risk evaluation	Comments
Contaminant source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Classification	
	P5 – Leaching and vertical / lateral migration of contaminants	R1 - Aquifer	Medium	Low	Moderate / Low	It is possible that contaminants present in sources within the proposed footprint could leach and migrate into the underlying aquifer and into adjacent surface waters
		R2 – Surface Water	Medium	Low	Moderate / Low	
	P6 – Vertical and lateral migration of soil gas	R4 – Local Residents	Severe	Unlikely	Moderate / Low	It is unlikely that soil gas from sources present within the proposed footprint would migrate to affect these receptors.
		R5 – Buildings & Crops	Severe	Unlikely	Moderate / Low	
		R7 – Site Infrastructure	Severe	Unlikely	Moderate / Low	
S2 Potentially Contaminated Ground / waters located within 250m of Proposed Footprint (including within the indicative LMA boundary – Railway, infilled pits / quarries, agricultural use, former fuel station	P5 – Leaching and vertical / lateral migration of contaminants	R1 - Aquifer	Medium	Low	Moderate / Low	Contaminants located in sources outside the proposed footprint could migrate into the aquifer and surface waters located within the footprint of scheme.
		R2 – Surface Water	Medium	Low	Moderate / Low	
	P6 – Vertical and lateral migration of soil gas	R4 – Local Residents	Severe	Unlikely	Moderate / Low	Soil gas from sources outside the proposed footprint could migrate into the scheme area and affect local residents and site infrastructure.
		R8 – Site Infrastructure	Severe	Unlikely	Moderate / Low	

Summary of Baseline Receptor Sensitivity

10.3.85. A summary of the sensitivity of each baseline receptor is listed in the table below.

Table 10.27: Sensitivity of Receptors

Sub-topic	Receptor	Attribute	Sensitivity
Bedrock Geology	Igneous bedrock Metasedimentary bedrock	Geodiversity Mineral value	Negligible
Superficial Geology	Devensian Till Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits	Geodiversity Mineral value	Negligible
	Glaciofluvial Sheet Deposits Glaciofluvial Ice Contact Deposits		Low
	Dalmagarry Quarry	Mineral Value	Medium
Soils	LCA Class 4	Soil value	Medium
	LCA Class 5 & 6		Low
	LCA Class 7		Negligible
	SNH Peat Class 3	Biodiversity	Medium
	SNH Peat Class 5	Biodiversity	Low
	SNH Peat Classes 0 and 4	Biodiversity	Negligible
Groundwater	Dava Bedrock – Psammite, Gneissose	Water Quality	High
		Water Supply, Groundwater Flow	Low
	Findhorn Pluton Bedrock – Granodiorite, biotite	Water Quality	High
		Water Supply, Groundwater Flow	Low
	Devensian Till Hummocky (Moundy) Glacial Deposits Peat	Water Quality	Low
		Water Supply, Groundwater Flow	Low
	Glaciofluvial Sheet Deposits Glaciofluvial Ice Contact Deposits	Water Quality	High
		Water Supply, Groundwater Flow	High
	Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits	Water Quality	High
		Water Supply, Groundwater Flow	High
Public Water Supplies	Tomatin GWPS	Water Supply, Groundwater Flow, Water Quality	Very High
	PWS Tomatin House		Medium

Sub-topic	Receptor	Attribute	Sensitivity
Private Water Supplies	PWS Invereen	Water Supply, Groundwater Flow, Water Quality	Medium
	PWS Invermoy		Medium
GWDTEs	GWDTEs with High Groundwater Dependency	Biodiversity	Very High
	GWDTEs with Moderate Groundwater Dependency	Biodiversity	High
	GWDTEs with Low Groundwater Dependency	Biodiversity	Medium
	GWDTEs with No Groundwater Dependency	Biodiversity	Low
	Surface Water Receptors	Surface Water Flow	High - Low
Contaminated Land	Historically Contaminated Land	n/a	n/a – Moderate to Very Low Risk Evaluation

10.4. Potential Impacts

10.4.1. The potential impacts of the Proposed Scheme discussed in this section are subdivided into construction and operational impacts. For the purposes of this assessment construction impacts are generally considered to be short-term impacts which occur during the construction phase only. Operational impacts are considered to be long-term or permanent impacts affecting receptors after the construction phase is complete. It is recognised that many operational impacts are initiated by construction activities, e.g. excavation of cuttings, however, the full effect of the impact may only manifest itself in the long-term.

10.4.2. The potential significant impacts from the Proposed Scheme which are considered within this section are:

- pollution of groundwater aquifers, private and public water supplies during construction due to increased generation and release of sediments and suspended solids, and increased risk of accidental spillage of pollutants such as oil, fuel and concrete associated with construction activities and site storage requirements
- disturbance of existing contaminated land during construction, resulting in the establishment of potential pollutant linkages or an increase in the risk associated with existing pollutant linkages with consequential impacts on local receptors
- loss of geodiversity, particularly within sites of conservation importance, where existing road cuttings are widened/deepened, or new cuttings created
- loss or sterilisation of economic mineral deposits, soils and peat, below the footprint of the Proposed Scheme
- pollution of groundwater aquifers, private and public water supplies during road operation due to contaminants within routine road runoff - a broad range of potential pollutants, such as hydrocarbons i.e. fuel and lubricants, fuel additives, metal from corrosion of vehicles, de-icer and gritting material, can accumulate on road surfaces; these can subsequently be washed off the road surface during rainfall events, polluting the receiving groundwater bodies

- direct loss or changes to groundwater aquifers and groundwater supported public and private water supplies, either below the footprint of the Proposed Scheme, or as a result of changes to groundwater flows and levels associated with the dewatering of deep cuttings and foundation excavations
- indirect loss of surface water as a result of changes to groundwater aquifers, due to dewatering activities where surface waterbodies are connected to groundwater aquifers
- loss or changes to Groundwater Dependent Terrestrial Ecosystems (GWDTEs), including peatland habitats, either below the footprint of the Proposed Scheme, as a result of severance of habitat or as a result of changes to groundwater flows and levels associated with dewatering activities
- disturbance of existing contaminated land during operation, resulting in the establishment of potential pollutant linkages or an increase in the risk associated with existing pollutant linkages with consequential impacts on local receptors

10.4.3. Each impact is assessed using the methods outlined in Section 10.2. All magnitude and significance ratings are adverse unless otherwise stated.

10.4.4. Much of the potential 'mitigation' of geology, soils and groundwater impacts has been realised through the iterative design of the scheme and as such is embedded within the design. The potential impacts have been assessed with the embedded mitigation listed below, but without additional standard or project specific environmental mitigation and therefore consider a worst case scenario.

10.4.5. Embedded mitigation included in the design of the Proposed Scheme comprises:

- the avoidance of Class 1 Priority peatland and areas of deep peat under the Proposed Scheme footprint
- optimisation of road alignment through Dalmagarry Quarry to reduce land take
- all proposed SuDs ponds will be lined to prevent groundwater infiltration and pollution (note filter drains within the proposed mainline networks may be unlined, dependant on ground conditions)
- sections of the Forestry Access track and Moy Access Track will be constructed as 'floating' track where peat greater than 1m is encountered, thereby reducing the volume of peat to be excavated
- the inclusion of a Compact Grade Separated Junction (CGSJ) at Tomatin to reduce the land-take required, therefore reducing impact on direct loss of GWDTEs and soil and peat loss
- horizontal and vertical alignments designed to be as close to the existing A9 as possible to minimise resultant earthwork embankments/cuttings and land take

10.4.6. Standard good practice and specific mitigation measures are detailed in Section 10.5. Residual effects, post mitigation, are summarised in Section 10.6.

Construction Impacts

Construction Pollution

10.4.7. Accidental spillage during construction has the potential to allow pollutants to migrate through the unsaturated zone to shallow aquifers. Excavation of the overlying material, particularly where cuttings are proposed in areas of permeable drift deposits with shallow groundwater, could increase the vulnerability of localised aquifers to contaminants.

10.4.8. Potential impacts on groundwater quality during construction relate to the removal of surface cover, including soils and superficial deposits, during the creation of cuttings and

potential excavation close to or below the groundwater table. Spillages in these areas could introduce pollutants directly into the groundwater aquifers resulting in changes to water quality. These impacts are temporary in nature but may result in long-term changes to water quality.

Groundwater aquifers

10.4.9. The Proposed Scheme includes 149 proposed cuttings (area of excavation of material), of which 30 are likely to intercept groundwater with a subsequent potential for direct introduction of pollutants. The assessment is detailed in Technical Appendix A10.3. Of these cuttings, those that are very likely to intercept bedrock are the cuttings at Mainline Ch. 4985 to 5250, Mainline Ch. 5370 to 5395, Mainline Ch. 6830 to 7325, Mainline Ch. 9520 to 9615, Mainline Ch. 10845 to 10870 and Forestry/Windfarm Access Track Spur Ch. 0 to 35 and 95 to 150.

10.4.10. There are also risks to bedrock and superficial aquifers throughout the Proposed Scheme footprint outside of cuttings. Areas of high groundwater vulnerability are most at risk where there is a shorter pathway to groundwater, particularly in Class 5 areas where bedrock is at or near surface. Also, as there are no septic tanks identified within the Proposed Scheme footprint there are unlikely to be any pollution impacts to groundwater arising from septic tanks.

10.4.11. The impact of potential construction pollution incident on bedrock aquifers is considered to be of Moderate magnitude, with a significance of **Moderate**.

10.4.12. It is considered that the potential impact from construction pollution on high and moderate to high productivity superficial aquifers (High sensitivity) for the Proposed Scheme would be of Moderate magnitude, with an associated significance of **Moderate**.

10.4.13. The impact of potential construction pollution incident on the non-significant superficial aquifers (Devensian Till, Alluvium, Peat, Lacustrine deposits) is of Moderate magnitude, with a significance of **Slight**.

Public Water Supplies

10.4.14. The nearest element of the Proposed Scheme to the Tomatin public water supply borehole is the proposed bus turning circle, located at NH 8100 2716, over 800m away and on the opposite side of the River Findhorn. The nature of the construction required at the bus turning area features no deep excavations or cuttings and therefore it is considered unlikely that dewatering activities will be required. There is still a possibility of the contamination of groundwater as a result of construction activities (oil, fuel or other fluids leaking from machinery for example). However, given that the River Findhorn represents a hydraulic boundary between the abstraction borehole and the bus turning area any risk to the abstraction borehole is considered negligible. Any spillages of contaminants arising from the construction works would reach the River Findhorn before reaching the public abstraction borehole. Additionally, any cone of depression generated by the abstraction borehole would also not affect the turning circle due to the presence of the River Findhorn.

10.4.15. Based on the information provided above it is unlikely that any construction pollution spillages entering the ground will be connected to the zone of influence of the public water supply in Tomatin. Therefore, the impact of potential construction pollution incident on the public water supply is of Negligible magnitude, with a significance of **Neutral**.

Private Water Supplies

10.4.16. The well supply at Tomatin House is located 800m north and down gradient of the Proposed Scheme mainline carriageway. The supply is located within River Terrace deposits near to the River Findhorn at approximately 278mAOD. There is a small section of cutting along the northbound side along the existing dualled section at

approximately 318mAOD within Devensian Till deposits. Given the distance and difference in elevation, it is unlikely any pollutants resulting from cutting activities will impact the quality of supply at PWS Tomatin House.

10.4.17. The impact of construction pollution at PWS Tomatin House is considered to be of Minor magnitude with a significance of **Slight**.

10.4.18. The well supply at Invereen is located 300m east and down gradient of the Proposed Scheme. The well is likely to be abstracting from either glaciofluvial or alluvial fan deposits. Construction activities in this area include the construction of the new Ruthven Tomatin Link Road, with areas of cutting required on the southbound side. The cuttings assessment shows that Cutting no. 43 (chainage 1970 to 2150 on the Ruthven Tomatin Link Road) intercepts groundwater, with an estimated drawdown of 3.6m and an estimated radius of influence of 72m. This radius of influence is on the upslope side of the cutting to the west, however, and the horizontal distance between Cutting no. 43 and the well supply at Invereen is approximately 380m, and so is outside the predicted radius of influence by a significant distance. However there is still potential for pollutants to be introduced to the aquifer upstream of the supply source.

10.4.19. The impact of construction pollution at PWS Invereen is considered to be of Moderate magnitude with a significance of **Moderate**.

10.4.20. The supply source for Invermoy is located south of the existing A9 in the Lynemore area, with the supply pipework understood to cross under the existing A9 in the vicinity of the Allt Loinne Moire. However, the exact location of the source and pipework could not be confirmed during landowner consultation. As the source is located up gradient of the Proposed Scheme it will be unaffected by the construction works, however the supply pipework will be affected, which may result in disruption to supply. It is anticipated that the impact on the supply during construction will be of Minor magnitude, resulting in a significance of **Slight**.

Mobilisation of Historic Contamination

10.4.21. Potential impacts with regard to historic contamination during construction relate to the disturbance / exposure of sources of potential historical contamination within the Proposed Scheme footprint. This disturbance could result in an increase in the risk associated with certain pollutant linkages or could potentially create new pollutant linkages due to new pathways being created.

10.4.22. The potential pollutant linkages identified at baseline have been reassessed for the construction phase, without mitigation, and a comparison of the risk outcomes at each stage has been made to give an indication of the effect significance as shown in Table 10.28 below.

Table 10.28: Risk Evaluation of Plausible Pollutant Linkages – Construction without Mitigation Measures

Hazard identification	Hazard assessment		Baseline Risk Evaluation	Construction Risk Estimation (without mitigation)		Construction Risk Evaluation (without mitigation)	Impact Significance
Contaminant source	Pathway	Receptor		Consequence of risk being realised	Probability of risk being realised		
S1 Potentially contaminated ground / waters located within Proposed Footprint – Railway, infilled pits / quarries, agricultural use, former timber treatment yard.	P1 – Direct Contact with soil / soil dust	R3 - Drivers & NMUs	Low	Medium	Unlikely	Low	Neutral
		R4 – Local Residents	Low	Medium	Low	Moderate / Low	Minor adverse
		R5 – Buildings & Crops	Very Low	Mild	Low	Low	Minor adverse
		R6 – Livestock, Pets & Wildlife	Very Low	Mild	Low	Low	Minor adverse
		R7 – Site Infrastructure	Low	Mild	Low	Low	Neutral
	P2 – Ingestion of soil / soil dust	R3 – Drivers & NMUs	Low	Medium	Low	Moderate / Low	Minor adverse
		R4 – Local Residents	Low	Medium	Low	Moderate / Low	Minor adverse
		R6 – Livestock, Pets & Wildlife	Very Low	Mild	Low	Low	Minor adverse
	P3 – Inhalation of fugitive soil dust	R3 – Drivers & NMUs	Low	Medium	Low	Moderate / Low	Minor adverse
		R4 – Local Residents	Low	Medium	Low	Moderate / Low	Minor adverse
		R6 – Livestock, Pets & Wildlife	Very Low	Mild	Low	Low	Minor adverse
	P4 – Inhalation of vapours / soil gas	R3 – Drivers & NMUs	Low	Medium	Unlikely	Low	Neutral
		R4 – Local Residents	Low	Medium	Low	Moderate / Low	Minor adverse
		R6 – Livestock, Pets & Wildlife	Very Low	Mild	Low	Low	Minor adverse
	P5 – Leaching and vertical / lateral migration of contaminants	R1 - Aquifer	Moderate / Low	Medium	Low	Moderate / Low	Neutral
		R2 – Surface Water	Moderate / Low	Medium	Low	Moderate / Low	Neutral

Hazard identification	Hazard assessment		Baseline Risk Evaluation	Construction Risk Estimation (without mitigation)		Construction Risk Evaluation (without mitigation)	Impact Significance
Contaminant source	Pathway	Receptor		Consequence of risk being realised	Probability of risk being realised		
	P6 – Vertical and lateral migration of soil gas	R4 – Local Residents	Moderate / Low	Severe	Low	Moderate	Minor adverse
		R5 – Buildings & Crops	Moderate / Low	Severe	Low	Moderate	Minor adverse
		R7 – Site Infrastructure	Moderate / Low	Severe	Low	Moderate	Minor adverse
S2 Potentially Contaminated Ground / waters located within 250m of Proposed Footprint (including within the indicative LMA Boundary) – Railway, infilled pits / quarries, agricultural use, former fuel station	P5 – Leaching and vertical / lateral migration of contaminants	R1 - Aquifer	Moderate / Low	Medium	Low	Moderate / Low	Neutral
		R2 – Surface Water	Moderate / Low	Medium	Low	Moderate / Low	Neutral
	P6 – Vertical and lateral migration of soil gas	R4 – Local Residents	Moderate / Low	Severe	Low	Moderate	Minor adverse
		R8 – Site Infrastructure	Moderate / Low	Severe	Low	Moderate	Minor adverse

10.4.23. With regard to the significance of the potential impacts during construction, this is considered to be **Minor** adverse.

Operational Impacts

Loss of Geodiversity

10.4.24. Rock exposures and other geological and geomorphological features can provide an important foundation upon which ecosystems thrive and can provide an important educational and scientific resource. Road construction, in particular excavation of cuttings, can result in the loss of these features both through direct removal and from the obscuring effects of slope stabilisation methods. Where blasting is required the rock structure may be impacted, with potential to generate new fractures and extend existing fractures. This may also have indirect impacts on groundwater.

10.4.25. The Proposed Scheme involves the modification of existing cuttings and excavation of several new cuttings, the majority of which will be excavated into superficial deposits (impacts to aquifers from cuttings are discussed below). However cuttings at the following locations are considered likely or very likely to cut into bedrock:

- Ch.4985 to 5250 (mainline carriageway A9)
- Ch. 5370 to 5395 (mainline carriageway A9)
- Ch. 6830 to 7325 (mainline carriageway A9)
- Ch. 9520 to 9615 (mainline carriageway A9)
- Ch. 10845 to 10870 (mainline carriageway A9)
- Ch.0 to 35 (forestry/windfarm access track spur)
- Ch. 95 to 150 (forestry/windfarm access track spur)

10.4.26. These rock cuts are considered to have little geodiversity interest and although they will be excavated further for the widening of the road the extent and quality of the exposures is unlikely to change. The use of blasting at these locations cannot be ruled out at this stage, however the impact on the bedrock is expected to be minimal.

10.4.27. It is considered unlikely that the proposed introduction of new cuttings, or widening of existing cuttings, will have any material adverse effect on the quality or value of the existing rock exposures or geological features of the study area. There is also the possibility that the new cuttings proposed may expose geological features of some scientific value.

Table 10.29: Impacts of Excavation on Bedrock and Superficial Geology

Sub-topic	Receptor	Magnitude	Significance
Bedrock Geology	Igneous bedrock Metasedimentary bedrock	Negligible	Neutral
Superficial Geology	Devensian Till Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits	Negligible	Neutral
	Glaciofluvial Sheet Deposits Glaciofluvial Ice Contact Deposits		

10.4.28. Overall it is considered that the impact across the entire Proposed Scheme will be of Negligible magnitude, and therefore of **Neutral** significance.

Loss of Economic Mineral Deposits

10.4.29. Construction of the Proposed Scheme has the potential to reduce the area available for future quarrying. Impacts at Dalmagarry Quarry are also assessed in Chapter 8 Communities and Private Assets.

10.4.30. The Proposed Scheme will result in a new side road impinging on the site of Dalmagarry Quarry, which is currently operational. Approximately 2.6ha of the quarry site will lie under the footprint of the Proposed Scheme, this equates to 26% of the area which currently has planning permission for extraction. However through consultation with the quarry operator the alignment of the side road has been optimised, with the majority of the alignment lying within an area that has already been worked for sand and gravel. Any remaining workable deposits under the footprint of the Proposed Scheme will be used in the scheme construction. Furthermore the alignment of the side road has been designed to minimise any other disruption to the quarry operations. With this embedded mitigation in place the impact on this Medium sensitivity site is considered to be of negligible magnitude, and therefore of **Neutral** significance.

10.4.31. A significant proportion of the Proposed Scheme also crosses unworked glaciofluvial sand and gravel deposits. Although it is possible that these areas have the potential to be worked, these deposits are common in the wider area and the loss of the deposits under the footprint of the Proposed Scheme constitutes a minor loss of resource. Therefore the impact is considered to be of Minor magnitude resulting in a significance of **Neutral**.

Loss of Soils

10.4.32. Construction of the Proposed Scheme will result in the disturbance of soils and impact on soil quality. Although it is anticipated that much of the topsoil will be reused as part of the Proposed Scheme, for landscape mitigation and to dress the earthworks slopes for instance, there is the potential for the quality and value of the soils to be affected if improperly handled.

10.4.33. The area of soils lost or disturbed under the footprint of the Proposed Scheme, subdivided by LCA class is presented in Table 10.30 below.

Table 10.30: Soil Loss

LCA Class	Sensitivity	Area Loss (ha)	Loss of LCA Class within study area (%)	Magnitude	Significance
Class 4	Medium	44.22	15.1	Minor	Slight
Class 5 & 6	Low	94.58	14.0	Minor	Neutral
Class 7	Negligible	0	0	Negligible	Neutral

10.4.34. As can be seen above the area of Class 4, 5 and 6 soils is less than 15% each, which is considered an impact of Minor magnitude, particularly in light of the fact that much, if not all, of the soil will be reused on site for slope dressing and landscape mitigation.

Loss of Peat

Direct Loss

10.4.35. Construction of the Proposed Scheme will result in the disturbance of peat and peaty soils. Although it is anticipated that much of the peaty soil will be reused as part of the Proposed Scheme, for landscape mitigation and to dress the earthworks slopes, there is

the potential for the quality and value of the materials to be affected if improperly handled.

10.4.36. Due to its poor engineering characteristics any peat present under the footprint of the Proposed Scheme is likely to be excavated out and replaced with suitable engineering fill, with the exception of low trafficked access tracks crossing deep peat areas which will be constructed using floating road techniques. Where peat has been identified under the footprint of the Proposed Scheme, it has been assumed that the full depth of peat will to be removed regardless of the nature of construction required (cutting, embankment etc) as the engineering design requires competent ground to be reached.

10.4.37. Large volumes of excavated peat can present an additional management issue as storage can be difficult and opportunities for successful reuse on site can be limited, due to the lack of suitable sites where the hydrological regime of the peat can be maintained.

10.4.38. The volumes of soil and peat to be excavated from under the permanent footprint of the Proposed Scheme have been determined as shown in Table 10.31, subdivided into the previously defined earthworks areas, and further subdivided by topsoil, peaty soils, acrotelmic, catotelmic (fibrous) and catotelmic (amorphous) peat. Full results and further information can be found in the Outline Soil and Peat Management Plan (Technical Appendix A10.2).

Table 10.31: Peat and Peaty Soil Excavation Volumes

Earthworks Area	Topsoil Volume (m^3)	Peaty Soil (m^3)	Peat Acrotelm (m^3)	Peat Catotelm (Fibrous) (m^3)	Peat Catotelm (Amorphous) (m^3)	Total Peat Volume (m^3)
Tomatin South Junction	1,218	0	0	0	0	**0**
C1121*	0	0	0	0	0	**0**
Mainline CH300-CH380	400	0	0	0	0	**0**
Tomatin GSJ	14,200	1,255	3,812	8,893	2,868	**16,828**
Mainline CH400-CH1200	1,600	0	1,949	4,548	1,486	**7,983**
Ruthven Link Road	27,580	3,650	2,244	5,234	0	**11,128**
Mainline CH1200-CH2700	14,300	121	447	1,044	0	**1,612**
NCN7	1,300	0	38	89	28	**155**
Mainline CH2700-CH3620	9,800	0	164	383	15	**562**
Ruthven Moy Link Road	27,660	913	1,699	3,966	502	**7,080**
Dalmagarry Access Tracks	5,960	0	329	768	125	**1,222**
Mainline CH3620-CH4100	5,200	0	240	560	1,600	**2,400**
Moy South LILO	3,600	0	2,552	5,954	9,306	**17,812**

Earthworks Area	Topsoil Volume (m^3)	Peaty Soil (m^3)	Peat Acrotelm (m^3)	Peat Catotelm (Fibrous) (m^3)	Peat Catotelm (Amorphous) (m^3)	Total Peat Volume (m^3)
Mainline CH4100-CH4780	10,100	2,724	3,194	7,453	1,716	**15,087**
Mainline CH4780-CH6600	15,200	7,900	738	1,721	658	**11,017**
Lynebeg Access Tracks	4,900	363	179	418	96	**1,056**
Lynebeg LILO	5,800	0	1,325	3,093	0	**4,418**
Moy Access Tracks*	3,000	0	0	0	0	**0**
Mainline CH6600-CH9600	26,600	5,220	5,750	13,417	3,729	**28,116**
Forestry Access Tracks	400	0	202	472	2,023	**2,697**
Totals	**178,818**	**22,146**	**24,862**	**58,013**	**24,152**	**129,173^**

* - Only Class 1/2 material due to be excavated

^ - This volume has been rounded to 129,200m^3 within the earthworks calculations

10.4.39. As can be seen above the material to be excavated consist predominantly of topsoil, although overall there is also a significant proportion of mostly shallow peat to be excavated. There are several notable areas where discrete pockets of deeper peat will be excavated, namely Tomatin GSJ and the Moy South LILO. It should be noted that although it is proposed that the Forestry Access Tracks will be 'floated' over areas of deeper peat the excavation volume calculations have assumed that all this material will be removed, as a worst case scenario. Should the track be floated as proposed it is anticipated that the total excavated peat volume will be reduced by up to 2,697m^3.

10.4.40. As detailed in the Appendix A10.2 Outline Soil and Peat Management Plan it is proposed that all topsoil and peat material will be reused in the dressing of earthwork slopes and in the landscaping of the Proposed Scheme. However in order to be used for this purpose the amorphous catotelm will require drying, and all peat will be mixed with the topsoils and/or peaty soils. In this instance although the material will be retained on site, minimising the waste to be disposed of off-site, the structure and function of the original peat material will be largely lost. It should be noted however that the resulting soil/peat mix used for landscaping will result in a poorer draining planting material that will promote the establishment of wet loving vegetation, akin to the natural vegetation in the surrounding areas.

10.4.41. The loss of peat as a proportion of the SNH Priority Peatland Classes within the study area is listed below in Table 10.32. The avoidance of peat, in particular Class 1 peat, has been used as a key constraint in the development of the Proposed Scheme.

Table 10.32: Peat Loss in Relation to SNH Priority Peatland Class

SNH Peat Class	Sensitivity	Area within Study Area (m^2)	Excavated Peat Depth (m)		Area Loss (ha)	Loss of SNH Peat Class within study area (%)	Magnitude	Significance
			Ave	Max				
1	High	305,388	0.05	0.10	0.08	0.2	Negligible	Neutral
3	Medium	703,825	0.55	3.71	13.2	15	Minor	Slight
4	Negligible	2,960,721	0.34	2.75	45.0	15	Minor	Neutral
5	Low	2,883,009	0.32	1.89	40.8	13	Minor	Neutral
0	Negligible	2,769,406	0.31	2.18	39.7	16	Moderate	Neutral

10.4.42. As shown in Figure 10.4a-k and Table 10.32 there is a negligible loss of material within the Class 1 area under the Proposed Scheme. Peat probing surveys within the area of Class 1 Peatland north of the Moy South LILO, where a stream realignment is proposed, recorded thin peaty soils up to 0.1m in depth. Organic soils with depths less than 0.5m are not classified as peat (as discussed in Technical Appendix 10.2), therefore, no impacts to Class 1 peatland are anticipated.

10.4.43. The defined areas of deep peat which will be excavated are generally located as discrete isolated pockets, or as outliers from larger areas of deep peat within the study area. As such they are a small proportion of the peat present within the study area, as shown in Table 10.32. Excavation of these isolated areas of deep peat is unlikely to affect the value or integrity of the peat within the study area. Subsequently the magnitude of the impact is considered to be Minor, with a resulting significance of **Slight** for the Class 3 peat, and **Neutral** for all other peat classes.

Indirect Loss

10.4.44. The construction of cuttings and embankments, the introduction of pre-earthworks cut-off drainage and the direct excavation of peat can alter the groundwater and surface water flow paths through the peat lying adjacent to the Proposed Scheme. This can result in drying out of the peat in some areas and surcharging in others. The effects of this can sometimes be seen extending some distance from the footprint of the Proposed Scheme. This can subsequently cause erosion and/or instability of the peat, resulting in the release of organic carbon to the atmosphere and local watercourses, or potentially catastrophic peat landslides.

10.4.45. Areas of peatland may be impacted by changes to groundwater levels caused by dewatering of cuttings, where the peat is located within the likely groundwater drawdown zone of influence, or where the scheme footprint may act as a barrier to subsurface flow.

10.4.46. There is an extensive area of deep Class 1 and Class 3 peat located to the north and east of the Moy South LILO. The LILO junction will primarily be built on embankment, with no impact from changes in groundwater as a result. The material used within the embankment at the new junction will comprise of permeable fill but may result in slight changes to subsurface flow to the peatland to the east. This impact on the Class 3 peatland will be limited in extent due to the small area of catchment impacted, the low hydraulic conductivity of the peat itself, and the mixed hydrological dependence of the peat, which is fed by rainfall and both surface and groundwater. The Class 1 peat will be unaffected, being located over 100m from the proposed works in this area.

10.4.47. With regards to changes in hydrological flow, as the A9 is an existing barrier to flow where peat deposits are located downslope of the existing road, the dualling of the

existing mainline, or where side roads are running parallel and adjacent to the mainline, will not result in significant changes to hydrological flow. Only very localised areas will be impacted, for example, at the Tomatin GSJ and Moy South LILO where a larger landtake is required.

10.4.48. This is unlikely to impact the Class 1 peatland located between Moy and Dalmagarry, 53m to the north of the Moy LILO, as this area is not located downstream of the junction. The Class 1 peatland west of Lynebeg will also not be impacted as this area is upslope of the Proposed Scheme. Areas of Class 5 peatland and peaty soils in the valley of the Allt Creag Bheithin are largely unaffected.

10.4.49. The impact of changes to hydrological regime resulting in indirect loss of peat is of Minor magnitude, resulting in a significance of **Slight**.

Pollution from Routine Runoff

Mainline

10.4.50. As discussed in Section 10.2 all of the mainline road drainage networks have been designed to discharge primarily to surface waters, via lined SuDs ponds. However each network will include filter drains, which if unlined may allow a proportion of runoff to infiltrate to groundwater.

10.4.51. As a result DMRB Method C calculations have been carried out for each mainline network to assess the potential impact on groundwater. A summary of the overall risk from routine runoff associated with each network is presented in Table 10.33, based on the criteria and weightings detailed in Section 10.2 and Table 10.1.

Table 10.33: Results of DMRB Method C Assessment for Routine Runoff to Groundwater

Parameter	Weighting	Network Risk Scores													
		E-A	1-A	2-A	3-A	4-A	4-B	5-A	6-A	7-A	8-A	9-A	X-A	Y-A	Z-A
Traffic Density	15	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Annual Average Rainfall	15	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Soakaway Geometry	15	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Depth to water table	20	3	3	3	2	3	3	3	3	3	3	3	3	3	3
Flow Type	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Effective Grain Size	7.5	1	1	1	1	1	1	1	2	2	2	2	1	1	1
Lithology	7.5	2	3	3	2	2	2	3	3	3	3	3	3	3	2
Overall Risk Score		**178**	**170**	**170**	**143**	**163**	**163**	**170**	**178**	**178**	**178**	**178**	**170**	**170**	**178**

10.4.52. The majority of the networks have been identified as a Medium Risk, primarily due to the shallow groundwater levels and lithology. However it is considered that the assessment is likely to be over estimating the risk to groundwaters, due to a number of reasons:

traffic volumes associated with the networks are at the lower end of the parameter class, only a small proportion of the runoff will infiltrate to groundwaters and the assessment method does not take into consideration the treatment afforded by the filter drains before the runoff infiltrates the underlying geology. These factors mean that the pollutant load being discharged to groundwater is likely to be overestimated. With this in mind the overall risk is considered to be Low.

10.4.53. The impact of routine run-off on all bedrock and superficial aquifers (High sensitivity) is of Minor magnitude, with a significance of **Slight**.

Side Roads and Access Tracks

10.4.54. All side roads and access tracks are designed to drain primarily to surface waters, with the exception of the Lynebeg underpass, which will drain to an infiltration basin. However, as with the mainline each network will include features such as filter drains or vegetated ditches which are likely to be unlined and may allow a small proportion of runoff to infiltrate to groundwater.

10.4.55. Traffic volumes on these roads are expected to be very low and therefore pollutant loads will be very low. Additionally the runoff will been subject to some treatment from the filter drains and vegetated ditches prior to infiltration.

10.4.56. The magnitude of impact of routine runoff from side roads into medium and high productivity superficial aquifers is Negligible, with a significance of **Neutral**.

10.4.57. The magnitude of impact of routine runoff from side roads into low productivity and non-significant superficial aquifers is Negligible, with a significance of **Neutral**.

Loss or Change to Groundwater Aquifers

10.4.58. Road cuttings excavated to below the groundwater table, and associated drainage, have the potential to permanently lower groundwater levels in the aquifer adjacent to the cutting and alter groundwater flowpaths. This could also potentially affect nearby groundwater dependent receptors, such as wetlands, surface water bodies or groundwater abstractions.

10.4.59. There are 149 cuttings associated with the Proposed Scheme, 30 of which have been identified as intercepting the groundwater table. The estimated groundwater drawdown and radius of influence of these 30 cuttings, and the subsequent assessment of impact on the affected aquifers is summarised in Table 10.34 below.

10.4.60. At the Tomatin South Junction there are a number of small cuttings with a maximum 1.0m excavation depth. The surface water drain approximately 30-35m to the south (at NGR NH 826 262) is lower than the base elevation of the proposed cutting. Additionally, given that the slope immediately to the south of the proposed cutting (NGR NH 828 261) (deepest cut point) is relatively steep, with no springs emerging from the slope, it is considered that the groundwater level is likely to be deeper than 1mbgl. The drain closest to the cutting (NGR NH 827 262) is at a lower elevation, indicating groundwater levels are at a lower level in this area. Given all of the above, there are unlikely to be any indirect impacts on groundwater levels from these cuttings, and therefore not considered as part of the assessment.

10.4.61. The assessment of impact magnitude at each cutting has been determined using professional judgement, and has been influenced by the geographical setting of the cutting and affected aquifer, the extent of the affected aquifer and the length of cutting, in addition to the estimated drawdown and zone of influence. The complete methodology describing in detail how this groundwater assessment was undertaken can be found in Appendix A10.3: Groundwater Assessment. Cuttings which will not intercept groundwater are considered to have a Negligible impact magnitude, and subsequent **Neutral** significance.

Table 10.34: Impact of Cuttings on Aquifers

Cutting no.	Road Description / NGR	Approx. Chainage		NGR	Estimated Drawdown(m)	Calculated ROI (m)	Groundwater body impacted*	Sensitivity **	Magnitude	Significance
		From	To							
7	Tomatin junction- N/B sliproad	35	50	NH 79769 29853	2.1	71.9	UFSG	H	Moderate	Moderate
	Tomatin junction- S/B sliproad	0	170							
	Main A9	750	890							
8	River Findhorn Access	15	30	NH 79802 29963	1.2	0.7	Non-aquifer UFSG	L	Negligible	Neutral
	Ruthven Tomatin Link Road	60	105							
	Main A9	810	855							
10	Ruthven Tomatin Link Road	0	50	NH 79849 29948	2.2	1.4	Non-aquifer UFSG	L	Negligible	Neutral
	Tomatin Junction S/B sliproad	270	280							
	Main A9	750	790							
29	Ruthven Tomatin Link Road	982	1000	NH 79418 30745	0.1	0.1	Non-aquifer	L	Negligible	Neutral
31	Ruthven Tomatin Link Road	1185	1215	NH 79456 30950	1.1	22.0	UFSG	H	Minor	Slight
	A9	1970	2000							
43	Ruthven Tomatin Link Road	1970	2150	NH 79255 31880	3.6	72.0	UFSG	H	Moderate	Moderate
	A9	2630	3070							
50	Dalmagarry Farm Access 2	245	515	NH 78988 32119	0.7	14.0	UFSG	H	Negligible	Neutral
51	Dalmagarry Farm Access 2	565	605	NH 79149 32022	0.5	10.8	UFSG	H	Negligible	Neutral

Cutting no.	Road Description / NGR	Approx. Chainage		NGR	Estimated Drawdown(m)	Calculated ROI (m)	Groundwater body impacted*	Sensitivity **	Magnitude	Significance
		From	To							
55	Main A9	4925	5250	NH 77686 33378	2.2	1.4	Non-aquifer FBLSGA	L	Negligible	Neutral
64	Pond 6-A/B Access 1	5	115	NH 77013 34020	1.1	22.0	UFSG	H	Minor	Moderate
69	Main A9	6830	7325	NH 76127 34390	2.6	36.8	FBLSGA	H	Minor	Moderate
81	Windfarm Access Road 1	540	607	NH 72863 34803	0.7	14.1	FBLSGA	H	Negligible	Neutral
82	Windfarm Access Road 1	325	530	NH 72796 34846	1.9	38.0	FBLSGA	H	Minor	Slight
	A9	104000	104800							
86	Windfarm Access Road 1	65	75	NH 72511 35143	0.3	0.2	Non-aquifer	L	Negligible	Neutral
	Windfarm Access Road 2	95	120							
	A9	10800	10840							
87	Windfarm Access Road 2	10	60	NH 72492 35223	1.3	25.3	Non-aquifer	L	Minor	Neutral
88	Windfarm Access Road 1	0	65	NH 72509 35154	0.4	0.7	Non-aquifer	L	Negligible	Neutral
	Windfarm Access Road 2	88	120							
	A9	10815	10868							
95	Main A9	750	910	NH 79798 29925	5.1	125.2	UFSG Non-aquifer	H	Major	Large

Cutting no.	Road Description / NGR	Approx. Chainage		NGR	Estimated Drawdown(m)	Calculated ROI (m)	Groundwater body impacted*	Sensitivity **	Magnitude	Significance
		From	To							
104	Pond P6-A/B Access 1	1080	1120	NH 77788 33390	0.4	0.3	Non-aquifer	L	Negligible	Neutral
106	Pond P6-A/B Access 1	1040	1070	NH 77768 33422	0.3	6.0	Non-aquifer	L	Negligible	Neutral
124	A9	2835	2900	NH 79343 31820	1.9	37.7	UFSG	H	Minor	Slight
135	MCA1 / Dalmagarry Farm Access 3	1585	1630	NH 78452 32122	0.0	0.5	FBLSGA	H	Negligible	Neutral
136	MCMC / Dalmagarry Burn Realignment	17	23	NH 78657 32203	0.1	2.4	FBLSGA	H	Negligible	Neutral
137	MCMC / Dalmagarry Burn Realignment	145	162	NH 78777 32215	0.0	0.2	UFSG	H	Negligible	Neutral
143	A9	5375	5430	NH 77532 33572	0.1	2.6	Non-aquifer FBLSGA	H	Negligible	Neutral
147	MCX2	235	272	NH 75706 35325	0.4	7.0	UFSG	H	Negligible	Neutral
148	MCX2	205	222	NH 75689 35343	0.5	10.0	UFSG	H	Negligible	Neutral
153	MCR0 / Windfarm Access Road 1	320	440	NH 72701 34944	0.9	0.5	Non-aquifer	L	Negligible	Neutral
154	MCR0 / Windfarm Access Road 1	320	355	NH 72675 34948	0.6	0.3	Non-aquifer	L	Negligible	Neutral
156	MCR0 / Windfarm Access Road 1	35	50	NH 72549 35135	0.4	0.2	Non-aquifer	L	Negligible	Neutral

Cutting no.	Road Description / NGR	Approx. Chainage		NGR	Estimated Drawdown(m)	Calculated ROI (m)	Groundwater body impacted*	Sensitivity **	Magnitude	Significance
		From	To							
161	A9	240	330	NH 77899 33240	2.7	1.7	Non-aquifer	L	Negligible	Neutral
	* Groundwater bodies: UFSG: Upper Findhorn Sand and Gravel (WFD ID 150328) FBLSGA: Findhorn Bedrock and Localised Sand and Gravel Aquifers (WFD ID 150333) **DMRB Sensitivity Abbreviations: L = Low , M = Medium, H = High, VH = Very High									

10.4.62. The majority of the cuttings which intercept groundwater will have very little impact on the surrounding groundwater levels or flows, due to relatively small radii of influence. However Cutting 95, located at Ch. 750 to 890, will result in an impact of **Large** significance due to the large drawdown (over 5m) and calculated radius of influence, which is over 125m from the upslope edge of the cutting. A further 4 cuttings were found to have an impact of **Moderate** significance on the surrounding high productivity aquifers.

Loss or Change to Public Water Supplies

10.4.63. As discussed previously the nearest element of the Proposed Scheme to the Tomatin public water supply borehole is a bus turning circle within Tomatin village, located over 800m from the abstraction. The nature of the construction required at the bus turning area features no deep excavations or cuttings and therefore it is considered unlikely that dewatering activities will be required or that groundwater levels will be affected.

10.4.64. With regard to water quality, it is considered that there would be no risk to the abstraction during the operational phase as the area of the turning circle is to be discharged to the Allt Cosach to the east via surface water drainage systems.

10.4.65. The impact of changes to groundwater flow and quality to the public water supply is of Negligible magnitude with a resulting significance of **Neutral**.

Loss or Change to Private Water Supplies

10.4.66. As discussed above, impacts on the groundwater aquifers of the study area could also impact on groundwater dependent abstractions, resulting in a loss of yield and failure of the supply.

10.4.67. Nine groundwater fed private water supplies have been identified in the vicinity of the Proposed Scheme. Of these supplies, six have been screened out from further assessment, following SEPA WAT-RM-11 guidance, as there is a lack of hydrogeological connection to the Proposed Scheme because of intervening topography or large watercourses.

10.4.68. The well at Tomatin House is located downslope of the mainline carriageway, with the nearest cutting located 800m south and uphill of the source. None of the cuttings within

850m intercept groundwater and as a result no groundwater changes are predicted. It is anticipated that the impact on supply will be of Negligible magnitude, resulting in a significance of **Neutral**.

10.4.69. The supply at Invereen has been identified as a well located close to the farmhouse, which lies approximately 275m east and downhill of the southbound side of the Proposed Scheme. In this area the Proposed Scheme features northbound widening of the mainline and construction the new Ruthven Tomatin Link Road, with cuttings proposed along the southbound side of the access road. The cuttings are not likely to intercept groundwater at this location. It is anticipated that the impact on this source is of Negligible magnitude, resulting in a significance of **Neutral**.

10.4.70. The supply source for Invermoy is located south of the existing A9 in the Lynemore area, up gradient of the Proposed Scheme and will therefore be unaffected during the operational phase. As a result, the impact on supply is considered to be of Negligible magnitude, resulting in a significance of **Neutral**.

10.4.71. With regards to the impact of routine runoff on the water quality of the private water supplies, the assessment in the 'Pollution from Routine Runoff' section described a Minor magnitude impact on the aquifers due to the nature of the proposed drainage systems. The nearest private water supply, the well at Invereen 275m east and downstream of the Proposed Scheme, is unlikely to be impacted due to the distance and anticipated low pollutant load within the runoff. Therefore, the magnitude of impact on all groundwater private water supply sources is considered to be Negligible, with a significance of **Neutral**.

Loss or change to GWDTEs

10.4.72. GWDTEs within the study area may be impacted through direct loss of habitat under the footprint of the Proposed Scheme, through severance of habitat and through changes to the groundwater regime supporting the habitat. This could result in altered vegetation in corridors close to infrastructure.

10.4.73. The direct and indirect loss of GWDTEs falls under SEPA LUPS-GU 31 guidance Option 4, which features "infrastructure involving development on a sensitive receptor and/or excavations deeper than 1m within 250m of sensitive receptors" which requires a bespoke risk assessment. Each of the 452 GWDTE areas (polygons) identified within the study area has undergone assessment, as detailed in Technical Appendix A10.3.

10.4.74. Following this assessment, a total of 140 habitats (51.7 Ha) will not be impacted. These habitats are located outside of the Proposed Scheme footprint, either upslope of the scheme, where there is no hydrological or topographical connection between the habitat and the Proposed Scheme, or where the distance between the two is such that there is no impact anticipated.

10.4.75. A total of 145 habitats (21.9 Ha) will be partially or completely lost under the footprint of the Proposed Scheme (Land Made Available (LMA) boundary). This includes 48 habitats (7.7 Ha) where there is a loss of over 95% of the habitat, 30 habitats (4.7 Ha) where 50%-95% of the habitat is lost, 40 habitats (7.6 Ha) where there is a loss of 15%-50% and 27 habitats (1.9 Ha) which feature less than 15% loss of habitat.

10.4.76. The loss of habitat calculated is within the LMA boundary. This includes the permanent earthworks of the Proposed Scheme, as well as temporary construction areas which may be used for temporary haul routes, construction SuDs, storage areas etc. The GWDTEs located within temporary works areas will be cleared for construction works, but the majority of these areas will not be impacted by long term changes to groundwater flows (with the exception of those which also lie within the drawdown zones of the permanent cuttings, as discussed below). The groundwater table is likely to remain unchanged over the long term, therefore although the GWDTE habitat will be lost in the short term, the ground conditions conducive to GWDTE formation will remain, with

the possibility of some form of GWDTE habitat re-establishing in the long term. Therefore the total area of GWDTEs lost under the footprint is a conservative estimate, given some of these areas could return in the long term.

10.4.77. Also, the area of GWDTE loss includes both dominant and sub-dominant habitats. A number of these mosaics will feature non-groundwater dependent habitats, which may result in an over-estimate of true GWDTE loss.

10.4.78. A number of cuttings are required as part of the Proposed Scheme design, some of which intercept groundwater. Dewatering within cuttings can alter the groundwater flow in the surrounding area (zone of influence) with long term changes to groundwater levels.

10.4.79. Of the 149 cuttings associated with the Proposed Scheme 30 have been identified as intercepting the groundwater table, primarily at the deeper cutting locations. These include new cuttings required at Tomatin GSJ, Dalmagarry Quarry, north of the Moy Rail Bridge, the Lynebeg underpass, along the B9154 west of Moy, the northbound carriageway west of Lynebeg and the forestry windfarm access track upgrade. The depth of these cuttings vary from approximately 0.3m to 14.1m depth (at Dalmagarry Quarry).

10.4.80. A total of 25 habitats (9.6 Ha) are located within the zone of influence of cuttings 7, 43, 51, 69, 81, 87, 95 and 101, all of which intercept groundwater. However, the majority of these GWDTEs will be lost directly within the LMA boundary. As the changes to groundwater levels in these areas are likely to be permanent, any habitats that are located within these areas which may be used for temporary works are not likely to be re-established as they could not be supported by groundwater in the long term.

10.4.81. Of the 25 habitats, eight (A250, A252, A061, C183, C184, C185 and C186) are located within groundwater drawdown zones of influence which extend outside of the LMA, resulting in an additional permanent loss of 0.42 Ha. The zones of influence relate to cuttings 7, 69 and 95. This results in a very small percentage of GWDTEs (0.3%) impacted solely by groundwater changes.

10.4.82. A total of 75 habitats are located downslope of the Proposed Scheme and may be impacted indirectly by changes to subsurface flows. Many of these habitats also lie within the LMA and partially under the permanent earthworks footprint, and so will suffer from direct loss in the both the short and long term. Given the combined effects of these impacts it is not possible to quantify the areas associated solely with indirect loss. However the impacts have been assessed qualitatively, and the potential area impacted can conservatively be assumed to be the GWDTE area downslope of the permanent earthworks.

10.4.83. An overall impact magnitude and significance has been determined for each GWDTE habitat assessed, taking into consideration each of the impact types discussed above.

10.4.84. A summary of the potential GWDTE impacts before any mitigation is provided in Table 10.35 below, with significant impacts highlighted in red.

Table 10.35: Summary of Potential Impacts on GWDTEs

Groundwater Dependency	Sensitivity	Number of polygons	Area Loss (ha)	% of Total Area of Baseline GWDTE	% of Overall Study Area, 250m Buffer	Potential Impact Magnitude	Potential Significance on Individual GWDTE
High	Very High	6	1.33	0.94%	0.13%	Major	Very Large
		6	1.58	1.12%	0.16%	Moderate	Large
		3	0.16	0.11%	0.02%	Minor	Moderate
		10	0.00	-	-	Negligible	Neutral
	Subtotal	25	3.07	2.17%	0.31%	-	-
Moderate	High	1	0.10	0.07%	0.01%	Major	Very Large
		31	5.61	3.97%	0.57%	Major	Large
		9	1.11	0.78%	0.11%	Moderate	Large
		20	1.77	1.25%	0.18%	Moderate	Moderate
		1	0.00	-	-	Minor	Moderate
		12	0.30	0.21%	0.03%	Minor	Slight
		58	0.00	-	-	Negligible	Neutral
	Subtotal	132	8.89	6.28%	0.90%	-	-
Low	Medium	30	3.83	2.71%	0.39%	Major	Large
		38	6.13	4.33%	0.62%	Moderate	Moderate
		11	0.34	0.24%	0.03%	Minor	Slight
		49	0.00	-	-	Negligible	Neutral
	Subtotal	128	10.30	7.28%	1.04%	-	-
Various	Various	145	21.62	15.28%	2.19%	Various	Individual GWDTE Areas with Significance Values of Very Large / Large / Moderate

10.4.85. The baseline conditions and potential effects of the Proposed Scheme on individual GWDTE polygons are provided in Technical Appendix A10.3, with significance values for individual polygons, following review, summarised in Table 10.35. Table 10.35 identifies that there are 145 GWDTE polygons, with an aggregated area of 21.62 hectares, with direct and indirect losses that each have a potentially significant effect (i.e. Very Large, Large or Moderate significance values). This equates to 15.3% of the total area of baseline GWDTE identified and 2.2% of the overall study area.

10.4.86. Individual GWDTE locations have been assessed and, due to local characteristics, wide-ranging outcomes have been collated, with sensitivity values ranging from Medium to Very High, magnitude values ranging from Negligible to Major and significance outcomes ranging from Neutral to Very Large.

10.4.87. The allocation of sensitivity and importance of GWDTEs has been a key consideration, with individual polygons evaluated on the basis of potential groundwater dependency, enabling design input and monitoring and mitigation to target appropriate locations.

When considering the overall GWDTE effect in an EIA context, it would not be appropriate to consider an undesignated GWDTE area, which may represent a widespread vegetation community in Scotland, to hold equivalent importance to a receptor with an international designation, such as a SAC, as there are is a clear differential in status, leading to design influence and degree of protection that should be applied. Medium and high sensitivity locations represent 18.55 hectares of the 21.62 hectares identified as potentially significant, overall GWDTE at the Proposed Scheme are therefore considered of High sensitivity.

10.4.88. The outcomes for individual GWDTE polygons were evaluated using a purposefully precautionary approach, in order to establish constraints during the design process, propose specific mitigation measures to limit adverse effect on groundwater conditions and identify groundwater monitoring locations. This approach is likely to have led to an overestimate in the total number of habitats that are truly groundwater dependent, which further monitoring during detailed design will help to refine. It is also reasonable to anticipate that a substantial proportion of the identified habitats could re-establish within temporary construction areas in the longer term.

10.4.89. Notwithstanding the individual GWDTE area outcomes recorded in Table 10.35 (i.e. ranging from Medium to Very High sensitivity/importance, Negligible to Major magnitude and Neutral to Very Large significance) in order to determine a proportionate assessment outcome an overall High sensitivity has been applied to GWDTE receptors and with a Moderate magnitude, this results in a **Moderate** significance outcome. This approach takes into account the relatively small areas of GWDTE where significant effects are anticipated, with further rationale for the overall evaluation provided in Appendix A10.3.

Groundwater Impacts on Surface Water Receptors

10.4.90. Surface water features such as rivers and burns which rely on groundwater for base flow may be impacted by changes in groundwater levels as a result of cutting dewatering. Out of the 30 cuttings which are expected to have an impact on groundwater, eight have surface water features, five watercourses and two ponds, within their calculated radii of influence which may be impacted by reduced base flows.

10.4.91. The affected watercourses include the River Findhorn, Allt na Frithe, and Dalmagarry Burn. The hydrological sensitivity of these watercourses is High. In each case the magnitude of the impact is anticipated to be Negligible due to the small proportion of base flow that may be lost. The subsequent impact significance will be **Neutral**.

10.4.92. There are two ponds at Lynebeg, identified during pond surveys as Pond 4 (NGR NH 768 340) and Pond 5 (NGR NH 769 340), which are located north east of the existing A9. Pond 4 lies in close proximity to the proposed cuttings associated with the Lynebeg underpass and link road, and which are expected to intersect groundwater.

10.4.93. Pond 5 lies partially under the footprint of one of the cuttings, and will be drained as a consequence. The impact on Pond 5 is related to direct loss under the footprint, rather than the indirect impact of groundwater drawdown and is therefore assessed within Chapter 11: Road Drainage and the Water Environment.

10.4.94. GI data and groundwater monitoring collected to date in this area indicates that both ponds are perched above the main confined aquifer and are not directly dependent on the groundwater within the main aquifer, as discussed in Technical Appendix A10.3. With this being the case it is unlikely that the Lynebeg underpass cuttings could indirectly affect Pond 4 through the release of hydraulic pressure from the confined levels of the glacial deposits.

10.4.95. Based on the current understanding of the groundwater regime in this area it is considered that the potential impact on Pond 4 would be of Minor magnitude, and therefore of **Slight** significance.

10.4.96. It should be noted that the analysis of the available GI and groundwater monitoring data has highlighted that the groundwater regime in the Lynebeg area appears to be quite complex, with groundwater interactions likely within the proposed cuttings and at the site of the proposed replacement pond. Further investigation and assessment is required at detailed design to inform the engineering design of these elements of the Proposed Scheme.

Mobilisation of Historic Contamination

10.4.97. The impacts related to the mobilisation of historic contamination are mainly considered to be construction phase impacts, as most interaction with any potential contamination sources will occur at this stage.

10.4.98. It is likely that during operation the contamination risks will be similar to the baseline conditions. As such, significance is considered to be a **Neutral** during operation.

10.5. Mitigation

10.5.1. Embedded mitigation has been included within the Proposed Scheme design as detailed in Section 10.4. In addition to this there is a need for further environmental mitigation, both standard and project specific.

10.5.2. A list of standard mitigation measures has been developed for all projects within the A9 Dualling Programme; those related to geology, soil, contaminated land and groundwater impacts are detailed below in Table 10.36. In addition to these, scheme specific mitigation measures have also been developed as detailed in Table 10.37. These mitigation measures are also set out in Chapter 21 Schedule of Environmental Commitments, with further details on location, timing and responsibilities detailed there.

Table 10.36: Geology, Soils, Contaminated Land and Groundwater Standard A9 Mitigation

Mitigation Item	Description
SMC-G1	To reduce impacts from contaminated land sources: Prior to construction, consultation will be undertaken with the relevant local authorities and SEPA regarding works in relation to land affected by contamination to support the obligations set out in 'Planning Advice Note 33: Development of Contaminated Land' (Scottish Government, 2000). Any remedial action undertaken in relation to land affected by contamination will be carried out under the appropriate remediation licencing.
SMC-G2	To determine the extent and type of contaminants present and to inform identification of appropriate construction methods and any additional mitigation: Prior to construction and where potential contamination has been identified, further site investigations sufficient to determine the extent and type of contaminants present will be undertaken, as necessary, to inform identification of appropriate construction methods and any additional mitigation.
SMC-G3	To ensure appropriate health and safety and waste management procedures for working with potentially contaminated soils are followed: Prior to construction, appropriate health and safety and waste management procedures for working with potentially contaminated soils will be established. Waste management procedures will include, but are not limited to: Waste Management Licence Regulations 1994 (as amended by Waste management licensing Amendment (Scotland) Regulations 2003), HSE Guideline Note MS13 Asbestos 1988 and the Health and Safety Commission Approved Code of Practice and Guidance Note. These procedures will be implemented as appropriate during construction.
SMC-G4	To reduce impacts from contaminated land sources and confirm the safety of construction and maintenance staff: Risks to construction and maintenance staff working with/near contaminated land will be mitigated by the implementation of **Mitigation Item G3** in combination with the adoption of appropriate systems of work, including personal protective equipment (PPE) as a last resort. In the event that unrecorded contamination is encountered, works should be stopped and the working procedures reassessed to confirm the working methods remain appropriate.
SMC-G5	To identify potential presence of previously unidentified contamination: Appropriate training of personnel involved in earthworks activities to implement a watching brief to identify potential presence of previously unidentified contamination.
SMC-G6	To mitigate the loss/disturbance of any septic tanks: Where required, landowner consultation and site visits will be undertaken to confirm the location and network of septic tanks. Where septic tanks are located within the LMA they will be relocated and/or rebuilt subject to discussion and agreement with the affected landowner(s).
SMC-G7	To prevent cross contamination and pollution from piling works undertaken in areas of land affected by contamination, the Contractor will adhere to appropriate guidance including the 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, National Groundwater and Contaminated Land Centre Report NC/99/77'.
SMC-G8	Prior to disposal, soils will be assessed in line with the 'Waste Classification: Guidance on the Classification and Assessment of Waste' (Technical Guidance WM3) (Natural Resources Wales, SEPA, Northern Ireland Environment Agency, Environment Agency, May 2015) to determine whether they are hazardous or non-hazardous.
SMC-G9	To maximise the reuse of site-won materials on-site (and minimise the need for disposal of waste in line with the principles of the "Waste Hierarchy" through re-use of excavation arisings (refer to Mitigation Item M3)) whilst ensuring that no risks are posed to human health nor the water environment a soil reuse assessment will be undertaken prior to construction. The soil reuse assessment will identify any potential risks posed to both human health and the water environment from potentially contaminated soils reused throughout the Proposed Scheme.
SMC-G10	If peat is encountered during construction, it will be extracted, excavated, stored, with any off-site removal undertaken with cognisance of 'Development on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste' (Scottish Renewables and

Mitigation Item	Description
	SEPA, 2012) and will comply with relevant waste management practices under The Waste Management Licensing (Scotland) Regulations 2011.
SMC-G11	Where concrete materials are proposed to be used, appropriate guidance such as 'Building Research Establishment (BRE) SD1:2005' and 'British Standard (BS) BS8500' should be followed to ensure that ground conditions are appropriate for the use of concrete at each given location.
SMC-G12	To mitigate against potential impacts on human health during construction and Off Site Receptors (Local residents, transient traffic (foot, road and rail traffic) in the surrounding area) due to ground gas: Where potential pollutant pathways for ground gas have been identified, a ground gas monitoring program will be developed prior to construction in adherence to 'CIRIA 665 Assessing Risks Posed by Hazardous Ground Gases to Buildings'. This will include an assessment of gassing issues following receipt of additional ground gas monitoring results at selected boreholes. Appropriate working methods will be developed and adopted during below ground site construction works (including piling works and excavations). This should include as a minimum, gas monitoring undertaken prior to any entry into excavations, confined spaces or below ground structures and use of PPE as a last resort. If significant ground gas issues are identified during construction, further post construction monitoring will be undertaken and/or appropriate gas protection measures will be incorporated into the final design.
SMC-G13	To mitigate against potential impacts on water quality due to leaching from SuDS features: Unless it can be demonstrated by the Contractor via a Quantitative Risk Assessment that no water quality impacts will occur due to leaching from SuDS features, operational SuDS features should be lined. Any potential water quality impacts due to leaching from SuDS features will be addressed through the CAR process.
SMC-G14	To ensure that no polluted water percolates into the ground or contaminated run-off is generated: Where required, storage of excavated soils and made ground will be minimised on site (spatially and in duration) and all storage areas will be appropriately lined, with adequate drainage management in place.
SMC-G15	To minimise or control the impact of blasting on bedrock geology - risk assessments will be required before explosives can be used on site.
n/a (note)	*Further to the above, the implementation of Mitigation Items detailed in Chapter 11 (Road Drainage and the Water Environment) and the measures detailed in Chapter 16 (Air Quality).*

Table 10.37: Geology, Soils, Contaminated Land and Groundwater Project Specific Mitigation

Mitigation Item	Description
P12-G16	To monitor potential construction pollution at Tomatin House & Invereen groundwater abstractions: A programme of monitoring (water quality sampling) will be undertaken. The frequency and duration of sampling and the water quality parameters to be tested will be agreed with the landowners/users, SEPA and The Highland Council.
P12-G17	To minimise disruption to the private water supplies at Invermoy the Contractor will: - accurately locate and map supply lines prior to construction; - take measures to prevent damage to supply lines and to avoid pollution during supply line diversions, excavations and groundworks; - provide an alternative water supply if supply lines are to be temporarily disrupted by the works; and - consult with the owners/users of the affected private water supplies to ensure the effects of any disruption are minimised.
P12-G18	To avoid impacts on groundwater quality from operational routine runoff the contractor will: - revisit the Method C assessment for the proposed filter drains as more detailed GI and groundwater level data becomes available at detailed design; - should the Method C assessment indicate there is a Medium to High Risk to groundwater, further site specific assessment will be carried out; and - if it is concluded that groundwater quality impacts are likely, the proposed filter drains will be lined or alternative appropriate mitigations implemented. Any potential water quality impacts due to leaching from SuDS features will be addressed through the CAR process.
P12-G19	To avoid impacts to groundwater flows and levels: Further ground investigations, groundwater monitoring and assessment will be carried out pre-construction for those cuttings assessed as having a significant impact on groundwater levels and flows, namely Cuttings 7, 43, 64, 69 and 95. If the impacts are confirmed as significant, additional mitigation measures may be required, such as containing, channelling and directing groundwater to the down gradient side of the cutting, allowing the discharge to infiltrate back to ground. The potential volume of groundwater seeping into the above cuttings will also be considered in relation to the design of the cutting drainage and potential groundwater abstraction CAR licensing. Further investigations will also be carried out in the vicinity of the Lynebeg ponds to fully understand the groundwater regime in this area, and to inform the engineering design of the cuttings and proposed replacement pond.
P12-G20	To mitigate any effects on GWDTEs: Land clearance and soil stripping should be minimised within the temporary construction areas of the LMA, to minimise loss of GWDTE habitat. Where temporary construction areas are cleared the restoration and landscaping of these areas should reflect the original topography and vegetation as far as is practical to encourage the re-establishment of GWDTE habitats. Pre-construction groundwater monitoring will be carried out at a representative sample of high and moderate groundwater dependency GWDTEs to determine whether they are true GWDTEs. This will comprise a minimum of ten samples over a 6 month period, with at least five taken during the summer period. As a minimum monitoring should be carried out in relation to the following GWDTE habitat polygons: A381, A323, A319, B090, B093, B100, B107, C148, C147, C144, C188, C140, C017, C033, C163, C179, BH05, BH06, BH15, BH22, BH24, BH25, DB_B085, BH15e, JM001, JM011, JM025, JM024, JJ017, JM026, JM027, CC038, CC037, CC034, CC030. Where GWDTEs will be affected by groundwater drawdown in the vicinity of cuttings, any groundwater entering cuttings will be directed to the down gradient side and allowed to infiltrate. Where possible the location and frequency of these discharges will be designed to replicate the natural groundwater flow as closely as possible. This mitigation shall apply to the following polygons as a minimum: A066, C183, C184 (two polygons), C185. Where GWDTES are located downslope of proposed road embankments, permeable fill material will be used in the embankment construction wherever possible, to maintain groundwater flows. Cross

Mitigation Item	Description
	formation drains will be used where practicable to facilitate groundwater through flow. This mitigation shall apply to the following polygons as a minimum: CC034, CC037, CC038. Should a spring issue within the footprint of the scheme this will be dealt with using standard construction practice, however the outflow will be located where it is able to feed the same downslope GWDTE habitat wherever possible. Details of the individual GWDTE habitats where the above outline mitigations are proposed are detailed in Technical Appendix A10.3. The precise design mitigation for each GWDTE will be devised during the detailed design stage. Monitoring during construction to be determined in consultation with SEPA. Post-construction monitoring will be carried out (a minimum of ten measurements over a twelve month period, for a minimum of three years) until it is demonstrated that receptors are not impacted. Should post-construction monitoring reveal residual impacts, consultation with SEPA will be carried out to determine feasible mitigation measures.
P12-G21	To reduce impacts on soil and peat loss through peat re-use: The Peat Management Plan will be revised and refined during detailed design. At present it is proposed that all soil and peat excavated as part of the Proposed Scheme will be re-used for on-site landscaping purposes, with no excess peat identified. This should continue to be the preferred reuse option. Should the refined design identify an excess of peat consideration should be given to additional reuse options, both onsite and offsite in preference to disposal. Consultation with landowners and statutory stakeholders will continue to confirm where peat will be stored and re-used as part of the pre-construction phase. Information on WML requirements should be provided by the contractor at detailed design stage as part of the detailed Soil and Peat Management Plan to ensure compliance for any temporary storage, transportation and re-use of soil and peat on-site.
P12-G22	To prevent pollution impacts on the water environment from the temporary storage and handling of soil and peat: Where soil and peat needs to be temporarily stored and/or naturally dried within the scheme area, pollution prevention requirements have be considered to avoid impacts to surface and groundwater bodies and to comply with 'Development on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste' (Scottish Renewables and SEPA, 2012) and relevant waste management practices under The Waste Management Licensing (Scotland) Regulations 2011. This includes the **standard and specific mitigation items** included within this chapter and Chapter 11, including: - **SMC-G10** To comply with relevant waste management practices under The Waste Management Licensing (Scotland) Regulations 2011 and reduce impacts on peatlands:; - **SMC-G14** To ensure that no polluted water percolates into the ground or contaminated run-off is generated; - **SMC-W4** In relation to construction site runoff and sedimentation, the Contractor will adhere to GPPs/PGGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1); and - **P12-W18** Prior to construction the Contractor shall produce a Surface Water Management Plan (SWMP) (or similar such document) that will be submitted to SEPA for approval as part of the CAR authorisation process for site discharges.

10.6. Residual Effects

10.6.1. A summary of the impact assessment for the Proposed Scheme is provided in Table 10.38 below. It should be noted that the impact significance stated in the table represents the residual impact, taking into account the mitigation discussed above. As such there may be differences in the significance ratings listed compared with those discussed in the Section 10.4 Potential Impacts.

Table 10.38: Summary of Residual Impacts

Sub-topic	Receptor	Potential Impact	Residual Significance
Construction Impacts			
Construction Pollution	Dava Bedrock – Psammite, Gneissose	Reduction in water quality	Slight
	Findhorn Pluton Bedrock – Granodiorite, biotite		
	Devensian Till Peat		Neutral
	Glaciofluvial Sheet deposits Glaciofluvial Ice Contact Deposits		Slight
	Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits		
	Tomatin Public Water Supply		Neutral
	PWS Invereen		Slight
	PWS Tomatin House		Neutral
	PWS Invermoy		
Mobilisation of historic contamination	Groundwater / Surface Water	Mobilisation of pollutants into groundwater / surface water	Neutral / Minor beneficial
	Drivers & NMUs, local residents, livestock, pets & wildlife	Direct contact with / ingestion of / inhalation of soil / soil dust / vapours / ground gas	Neutral
	Buildings & crops, site infrastructure	Direct contact with contaminants	Neutral
	Local Residents, buildings & crops, site infrastructure	Migration of soil gas	Neutral
Operational Impacts			
Geodiversity	Geological deposits (general)	Loss of geodiversity sites	Neutral
Economic minerals	Superficial deposits	Loss of economic minerals	Neutral
	Dalmagarry Quarry		Neutral
Soils & Peat	LCA Class 4	Loss of soils	Slight
	LCA Class 5 & 6		Neutral
	SNH Peat Class 3	Loss of peat	Slight
	SNH Peat Class 5		Neutral
	SNH Peat Class 0 and 4		Neutral
Groundwater	Dava Bedrock – Psammite, Gneissose		Slight

Sub-topic	Receptor	Potential Impact	Residual Significance
	Findhorn Pluton Bedrock – Granodiorite, biotite	Changes to water quality from routine runoff	
	Devensian Till Hummocky (Moundy) Glacial Deposits Peat		
	Glaciofluvial Sheet deposits Glaciofluvial Ice Contact Deposits		
	Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits		
	Tomatin Public Water Supply		
	PWS Invereen		
	PWS Tomatin House		
	PWS Invermoy		
	Dava Bedrock – Psammite, Gneissose	Loss or change to groundwater flow	Neutral
	Findhorn Pluton Bedrock – Granodiorite, biotite		
	Devensian Till Hummocky (Moundy) Glacial Deposits Peat		
	Glaciofluvial Sheet deposits Glaciofluvial Ice Contact Deposits		Slight
	Alluvial Fan Deposits Alluvium Undifferentiated River Terrace Deposits		Neutral
	Tomatin Public Water Supply	Loss or change to supply	Neutral
	PWS Dalmagarry		
	PWS Invereen		
	PWS Tomatin House		
	PWS Invermoy		
	Funtack Burn Tributary 4, Moy Burn Tributary 2	Loss or change to baseflow	Neutral
	Allt na Frithe, Dalmagarry Burn, River Findhorn		

Sub-topic	Receptor	Potential Impact	Residual Significance
	GWDTEs (overall)	Loss of GWDTEs / Loss of Biodiversity	Slight
Mobilisation of historic contamination	Groundwater / Surface Water	Mobilisation of pollutants into groundwater / surface water	Neutral
	Drivers & NMUs, local residents, livestock, pets & wildlife	Direct contact with / ingestion of / inhalation of soil / soil dust / vapours / ground gas	Neutral
	Buildings & crops, site infrastructure	Direct contact with contaminants	Neutral
	Local Residents, buildings & crops, site infrastructure	Migration of soil gas	Neutral

10.6.2. There is recognition that a number of individual GWDTE locations may have a localised significant impact (approximating 2% of the overall study area), ranging up to Very Large significance, however, taking into context DMRB guidance, the scale of the Proposed Scheme and mitigation/monitoring commitments, the overall effect on GWDTE receptors across the Proposed Scheme has been evaluated as **Slight** adverse. Further GWDTE information is provided in Technical Appendix A10.3.

10.6.3. The assessment concludes that there are no residual significant impacts, with the largest residual significance predicted as being **Slight** adverse.

10.7. References

[i] SEPA. (2013). Regulator Method (WAT-RM-11) Licencing Groundwater Abstractions including Dewatering. Version v5 June 2013.
[ii] The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department Regional Development Northern Ireland. (1993). Design Manual for Roads and Bridges, Volume 11, Section 3, Part 11, Geology and Soils.
[iii] The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department Regional Development Northern Ireland (2009); Design Manual for Roads and Bridges, Volume 11, Section 3, Part 10 Road Drainage and the Water Environment HD45/09.
[iv] Scottish Natural Heritage (2013). 'A Handbook on Environmental Impact Assessment' Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland. 4th edition.
[v] Transport Scotland. (2013). A9 Dualling Programme Strategic Environmental Assessment (SEA).
[vi] Transport Scotland. (2014). A9 Dualling Programme Strategic Environmental Assessment (SEA) Environmental Report Addendum. Document TSSEA9/ER/02.
[vii] The Scottish Government. (2009). The Scottish Soil Framework.
[viii] SEPA. (2018). The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) - A Practical Guide (Version 8.2).
[ix] The Scottish Government. (2003). Planning Advice Notice (PAN) 33: Development of Contaminated Land.
[x] Scotland and Northern Ireland Forum for Environmental Research (SNIFFER). (2009). WFD 95: A Functional Wetland Typology for Scotland.
[xi] SEPA. (2010). Regulatory Position Statement 'Developments on Peat'.
[xii] SEPA, Scottish Renewables (2012). Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste.
[xiii] SEPA. (2017). Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Land Use Planning System, SEPA Guidance Note 31.
[xiv] SEPA (2014); Regulatory Method (WAT-RM-08) Sustainable Urban Drainage systems (SUDS or SUD Systems).
[xv] Netregs. (2017). Environmental Guidance for your Business in Northern Ireland and Scotland. Guidance for Pollution Prevention (GPPs). http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/
[xvi] Scottish Government. (2014). Guidance on Developments on Peat - Site Survey.
[xvii] Scottish Geodiveristy Forum. (2013). Scotland's Geodiversity Charter.
[xviii] H F Barron, M R Gillespie and J W Merritt. (2011). Geodiversity of the Cairngorms National Park. British Geological Survey. Open Report OR/10/019.
[xix] Department for Environment, Food and Rural Affairs (DEFRA)/Environment Agency (EA). (2004). Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination.

[xx] CIRIA (2015); C753 – The SuDS Manual.
[xxi] CIRIA C515, Groundwater Control – design and practise. Construction Industry Research and Information Association, CIRIA Publication C515, 2000.
[xxii] CIRIA. (2001). Contaminated Land Risk Assessment: A guide to good practice (C552).
[xxiii] Scottish Executive. (2006) Environmental Protection Act 1990: Part IIA Contaminated Land. Statutory Guidance: Edition 2. Paper SE/2006/44.
[xxiv] Society of Chief Officers of Transportation for Scotland (SCOTS) (2009); SUDS for Roads guidance.
[xxv] British Geological Survey (BGS). (2015). Superficial and Bedrock Geology mapping 1:50,000 scale.
[xxvi] Ó Dochartaigh B É, Doce D, Rutter H K and Macdonald AM. (2015). User Guide: Aquifer Productivity (Scotland) GIS datasets, Version 2. Revised Report. British Geological Survey Open Report, OR/15/003.
[xxvii] Ó Dochartaigh B É, Doce D, Rutter H K and Macdonald AM. (2015). User Guide: Groundwater Vulnerability (Scotland) GIS dataset, Version 2. Revised Report. British Geological Survey Open Report, OR/15/002.
[xxviii] Jacobs. (2014). A9 Dualling: Preliminary Engineering Support Services Appendix E PSSR 11 Slochd to Moy. Transport Scotland.
[xxix] Atkins Mouchel Joint Venture (AMJV). (2015). A9 Dualling Northern Section: Tomatin to Moy Geotechnical Preliminary Sources Study Report.
[xxx] Atkins Mouchel Joint Venture (AMJV). (2015). A9 Dualling Northern Section: Tomatin to Moy Preliminary Rock Cut Assessment: RC_TM_01_SB.
[xxxi] Atkins Mouchel Joint Venture (AMJV). (2015). A9 Dualling Northern Section: Tomatin to Moy Preliminary Rock Cut Assessment: RC_TM_02_NB.
[xxxii] Atkins Mouchel Joint Venture. (2016). Report on a Ground Investigation for A9 Dualling: Tomatin to Moy, Tomatin.
[xxxiii] SEPA. (2014). Scotland's Environment Groundwater Body Classification. Available at http://www.environment.scotland.gov.uk/get-interactive/data/groundwater/ (accessed 5th April 2016).
[xxxiv] Soil Survey of Scotland Staff. (1970-1987). Soil maps of Scotland (partial coverage) at a scale of 1:25 000. Macaulay Institute for Soil Research, Aberdeen. Available at http://www.soils-scotland.gov.uk/data/soil-survey (accessed 1st December 2015).
[xxxv] Arup Geotechnics. (1991). Review of mining instability in Great Britain. Report to Department of the Environment, Newcastle-upon-Tyne, 25 vols.
[xxxvi] British Geological Survey (BGS). (2015). Non Coal Mining Plans online database. Available at http://www.bgs.ac.uk/data/miningplans/ (accessed 15th March 2017).
[xxxvii] The Coal Authority (2015) online interactive map. Available at http://mapapps2.bgs.ac.uk/coalauthority/home.html (accessed 15th March 2017).
[xxxviii] British Geological Survey (BGS). (2014). Directory of Mines and Quarries, Tenth Addition. Compiled by D G Cameron, T Bide, S F Parry, A S Parker and J M Mankelow.
[xxxix] Ordnance Survey (OS). (2015). Raster mapping on 1:10k, 1:25k, 1:50k, 1:250k scale.
[xl] SEPA. (2013). Scotland's Environment Water Framework Directive (WFD) Groundwater Body Status. Available at http://www.environment.scotland.gov.uk/ (accessed 1st December 2015).

[xlii] Scottish Natural Heritage (SNH). (2016). Carbon-rich soil, deep peat and priority peatland habitats map.
[xliii] O Dochartaigh, B.E.; MacDonald, A.M.; Fitzsimons, V.; Ward, R. 2015. Scotland's aquifers and groundwater bodies. Nottingham, UK, British Geological Survey, 63pp. (OR/15/028) (Unpublished)