13 Road Drainage and the Water Environment

This chapter assesses the impacts of the proposed scheme on the surface water environment, specifically considering the attributes of hydrology and flood risk, fluvial geomorphology and water quality.

The proposed scheme is located within the catchment areas of the Scretan Burn (SWF04) and Cairnlaw Burn (SWF08). Within a 500m study area, nine surface water features were identified to be affected by the proposed scheme. All surface water features are located in a low lying, near coastal environment bordered by the Moray Firth estuary including five designated sites. The Moray Firth is a Special Area of Conservation (SAC) and a proposed Special Protection Area (pSPA); the Inner Moray Firth (an area extending approximately 500m into estuary from the shoreline) is a Special Protection Area (SPA) and Wetland of International Importance (Ramsar); as well as Longman and Castle Bays which is a Site of Special Scientific Interest (SSSI). The water features within the study area are generally heavily modified, featuring multiple culverts through urban areas and straightened (drainage) channels where crossing agricultural land.

The largest watercourse within the study area is the Scretan Burn (SWF04) (catchment area approximately 7.2km^2 up to the A96 crossing near Seafield). As part of the proposed scheme, eight new watercourse crossings are planned, two over the Cairnlaw Burn (SWF08), three over the Scretan Burn (SWF04), one over the Beechwood Burn (SWF03) and two crossing a tributary of Scretan Burn (SWF05).

Land uses within the Scretan Burn (SWF04) and Cairnlaw Burn (SWF08) catchments are forestry plantation and managed moorland in the upper reaches. The lower reaches are dominated by mixed agriculture and built development. Potential pollution sources are generally limited to agricultural runoff, urban runoff and forestry operations.

The impact assessment was informed by consultation, desk-based assessments, site walkovers and surveys. Hydraulic modelling of the two largest watercourses within the study area (Cairnlaw Burn and Scretan Burn) and several other minor watercourses was undertaken to assess potential impacts on flood risk.

Significant potential impacts from the proposed scheme in the absence of mitigation include increases in fluvial flood risk, alterations to flows and sediment processes within watercourses, and deterioration in water quality within receiving watercourses from construction and operational runoff.

Mitigation during construction would be delivered through a Construction Environmental Management Plan (CEMP), which would include measures for flood risk, fluvial geomorphology and water quality. Good practice guidance during construction will be adhered to, including Scottish Environment Protection Agency (SEPA) Guidance for Pollution Prevention (GPPs). Specific management plans to manage drainage and minimise the generation of suspended sediment are included as measures to mitigate construction impacts.

With the implementation of mitigation measures during construction, residual impacts on all watercourses in relation to fluvial geomorphology, flood risk and water quality would be reduced to either Neutral or Slight significance.

During the operational phase, mitigation measures include the use of Sustainable Drainage Systems (SuDS), flood relief culverts, flood storage areas, topographical adjustment, morphological improvements and scour protection to protect affected watercourses.

For Hydrology and Flood Risk adverse impacts of Large to Very Large significance are reported during the operation phase for Beechwood Burn (SWF03), Scretan Burn (SWF04), Tributary of Scretan Burn (SWF05) and Cairnlaw Burn (SWF08). This is due to localised increases in flood depths occurring within the area of the draft Compulsory Purchase Order (CPO) for the proposed scheme. These increases occur as a result of flood mitigation measures aimed at removing increases in flood risk outwith the CPO. A neutral impact on flood risk is reported on land and receptors outwith the CPO for the proposed scheme.

13.1 Introduction

13.1.1 This chapter presents the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment Report (EIAR) of the proposed scheme in terms of the following aspects of the surface water environment: hydrology and flood risk, fluvial geomorphology and water quality.

13.1.2 The chapter is supported by the following appendices, which are cross-referenced where relevant:

- Appendix A13.1: Flood Risk Assessment;
- Appendix A13.2: Surface Water Hydrology;
- Appendix A13.3: Sustainable Drainage Systems (SuDS) and Water Quality;
- Appendix A13.4: Fluvial Geomorphology;
- Appendix A13.5: Watercourse Crossing Report;
- Appendix A13.6: Water Framework Directive (WFD) and River Basin Management Planning (RBMP); and
- Appendix A13.7: Hydraulic Modelling Report.

13.1.3 The chapter is further supported by the following figures, which are cross-referenced where relevant:

- Figure 13.1: Surface Water Features;
- Figure 13.2: Modelled Baseline Flood Risk;
- Figure 13.3: Modelled Residual Flood Risk (with Mitigation); and
- Figure 13.4: Drainage Catchment.

13.2 Methodology

Structure of Assessment

13.2.1 The assessment of potential impacts on elements of the surface water environment includes:

- Hydrology and Flood Risk: the potential impacts on the flow of water above ground and the risk of flooding from all sources;
- Fluvial Geomorphology: the potential impacts on fluvial landforms associated with river systems and the flow and sediment transport processes which create and sustain them;
- Water Quality: the quality of the water in terms of potential impacts to key elements such as chemistry, biodiversity and dilution capacity (dilution and removal of waste products); and
- Water Supply: the potential impacts on any surface water fed Public or Private Water Supply.

13.2.2 The surface water environment is intrinsically linked to groundwater and ecological receptors, considered in Chapter 12 (Geology, Soils, Contaminated Land and Groundwater) and Chapter 11 (Ecology and Nature Conservation) respectively.

Legislative and Policy Context

13.2.3 The assessment has considered relevant guidance, legislation, policy and regulations including those listed in Table 13.1.

Table 13.1: Legislation, Policy, Regulations and Guidance

Topic	Name
Key Legislation	Directive 2007/60/EC on the assessment and management of flood risk (Floods Directive); Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Water Framework Directive);

Topic	Name
	Flood Risk Management (Scotland) Act 2009 (FRM Act) (Scottish Government 2009a); The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) (Scottish Government 2011); The Water Environment (Miscellaneous) (Scotland) Regulations 2017; and Water Environment Water Services (WEWS Act) (Scotland) Act 2003 (Scottish Government 2003a).
Other Legislation	Control of Pollution Act 1974; Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (Drinking Water Directive); Environmental Protection Act 1990; Environmental Liability (Scotland) Regulations 2009 (Scottish Government 2009b); Pollution Prevention and Control (Scotland) Regulations 2012 (PPC) (Scottish Government 2012); Surface Waters (Fishlife) (Classification) (Scotland) Amendment Regulations 2003; The Climate Change (Scotland) Act 2009 (Scottish Government 2009c); The Environment Act 1995; The Private Water Supplies (Scotland) Regulations 2006 (Scottish Government 2006a); The Public Water Supplies (Scotland) Regulations 2014 (Scottish Government 2014a); and The Scotland River Basin District (Standards) Directions 2014 (Scottish Government 2014b).
Policy	Water Framework Directive (WFD) policy guidance 'The Future for Scotland's Waters: Guiding Principles on the Technical Requirements of the Water Framework Directive' (SEPA 2002); Scottish Planning Policy (SPP), A Natural, Resilient Place, Managing Flood Risk and Drainage (Scottish Government 2014c); and SEPA - Planning Authority Protocol (Policy 41) Development at Risk of Flooding: Advice and Consultations (SEPA 2016a).
General Guidance	British Standards BS 6031:2009 Code of Practice for Earthworks (British Standards 2009); Construction Industry Research and Information Association (CIRIA) C689: Culvert Design and Operation Guide (CIRIA 2010); CIRIA C741: Environmental Good Practice on Site (fourth edition) (CIRIA 2015a); CIRIA C768: Guidance on the construction of SuDS (CIRIA 2017); DMRB Volume 4, Section 2, Part 3 (HD33/16) Design of Highway Drainage Systems (Highways England, Transport Scotland, Welsh Government and Department for Infrastructure 2016), hereby referred to as HD 33/16; DMRB Volume 4, Section 2, Part 7 (HA107/04): Design of Outfall and Culvert Details (Highways Agency, Scottish Executive, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2004), hereby referred to as DMRB HA107/04; DMRB Volume 11, Section 3, Part 10 (HD45/09): Road Drainage and the Water Environment (Highways Agency, Transport Scotland, Welsh Government and The Department for Regional Development Northern Ireland 2009a), hereby referred to as DMRB HD45/09; Interim Advice Note (IAN) 125/15: Supplementary Guidance for Users of DMRB Volume 11 Environmental Assessment (Highways Agency, Transport Scotland, Welsh Assembly Government and Department for Regional Development Northern Ireland 2015); River Crossings and Migratory Fish: Design Guidance (Scottish Executive 2012); SEPA (WAT-PS-06). Position Statement to Support the Implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (SEPA 2015); SEPA (WAT-RM-08) Regulatory Method. Sustainable Urban Drainage Systems (SUDS or SUD Systems) (SEPA 2019b); SEPA (WAT-SG-23). Engineering in the Water Environment: Good Practice Guide: Bank Protection: Rivers and Lochs (SEPA 2008a); SEPA (WAT-SG-25). Engineering in the Water Environment: Good Practice Guide: River Crossings (SEPA 2010a);

Topic	Name
	SEPA (WAT-SG-28). Engineering in the Water Environment: Good Practice Guide: Intakes and Outfalls (SEPA 2008b); SEPA (WAT-SG-29) Engineering in the Water Environment: Good Practice Guide: Temporary Construction Methods (SEPA 2009a); SEPA (WAT-SG-93) Guidance for Transport Infrastructure Projects (SEPA, 2018a); and SEPA The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) A Practical Guide (SEPA 2018b).
Flood Risk Guidance	Flood Risk and Drainage Impact, Supplementary Guidance (The Highland Council 2013); Highland and Argyll Local Plan District Local Flood Risk Management Plan 2016-2022 (The Highland Council 2015); Scottish Government's Flood Risk: Planning Advice (Scottish Government 2015b); and Technical Flood Risk Guidance for Stakeholders, SEPA requirements for undertaking a Flood Risk Assessment, Version 12 (SEPA 2019a).
Fluvial Geomorphology Guidance	SEPA (WAT-SG-21) Environmental Standards for River Morphology (SEPA 2012a); SEPA (WAT-PS-07-02) Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011: Bank Protection (SEPA 2012b); Guidebook of Applied Fluvial Geomorphology (Sear et al. 2004); SEPA (WAT-SG-26) Engineering in the Water Environment: Good Practice Guide: Sediment Management (SEPA 2010b); SEPA (WAT-SG-86) Registration Rules for Exposed Sediment Removal, Version 3 (SEPA 2016d); Manual of River Restoration Techniques (RRC 2013); Environment Agency (1999). Waterway Bank Protection: a guide to erosion assessment and management (Environment Agency); Environment Agency (2010). The Fluvial Design Guide; Applied Fluvial Geomorphology for River Engineering and Management (Thorne et al. 1997); and, The Scottish Rivers Handbook (CREW 2013).
Water Quality Guidance	CIRIA C532: Control of water pollution from construction sites (CIRIA 2001); CIRIA C609: Sustainable drainage systems: Hydraulic, structural and water quality advice (CIRIA, 2004); CIRIA C648: Control of water pollution from linear construction projects: Technical Guidance (CIRIA, 2006a); CIRIA C649: Control of water pollution from linear construction projects: Site Guide (CIRIA, 2006b); CIRIA C698: Site handbook for construction of SuDS (CIRIA 2007); CIRIA C753: The SuDS Manual (CIRIA 2015b); CIRIA C768: Guidance on the construction of SuDS (CIRIA 2017); CIRIA R142: Control of pollution from highway drainage discharge (CIRIA 1994); SEPA Code of Practice for installers, owners and operators of underground storage tanks and pipelines (SEPA 2006); and SEPA Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs) (SEPA 2006 to 2018).

13.2.4 The following paragraphs discuss the key legislation of relevance to this chapter.

Water Environment Water Services (WEWS) Act 2003

13.2.5 The Water Framework Directive (WFD) (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy [2000]) was transposed into Scottish law under the WEWS Act (Scottish Government 2003a). Under the WFD, new activities within or near to the water environment must not cause deterioration (of Overall ecology or Overall chemistry status of surface and groundwater bodies) or prevent the achievement of Good Status

or Good Ecological Potential (for artificial or heavily modified water bodies). However, such activities may be permitted, where:

- the benefits to human health, human safety, or sustainable development outweigh their costs to environment and to society;
- there are no significantly better alternative means of providing the benefits; and
- all practicable mitigation measures are taken to minimise their adverse effects on the water environment.

13.2.6 The aims of the WEWS Act are to:

- provide a sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use;
- significantly reduce groundwater pollution;
- protect territorial and other marine waters; and
- achieve the objectives of international agreements.

13.2.7 The WEWS Act is delivered through the production of River Basin Management Plans (RBMP), which detail the current condition of water bodies in the Plan area and set objectives for improvement. The RBMP of relevance to water bodies in the proposed scheme area is the river basin management plan for the Scotland river basin district: 2015 – 2027 (SEPA 2015). The objectives were published in the second RBMP cycle in December 2014. These objectives outline how SEPA intends on achieving good status for all water bodies to meet the objectives of WFD. Further detail on RBMP is provided in Appendix A13.6 (WFD and RBMP).

The Water Environment (Controlled Activities Regulations) (Scotland) Regulations 2011 (as amended) (CAR) and The Water Environment (Miscellaneous) (Scotland) Regulations 2017

13.2.8 The WEWS Act (Scottish Government 2003a) gives Scottish Ministers the power to regulate activities in or near to the water environment (both surface waters and groundwater). This is achieved under CAR (Scottish Government 2011) and The Water Environment (Miscellaneous) (Scotland) Regulations 2017 (Scottish Government 2017). This legislation is intended to control impacts on the water environment, including mitigating the effects on other water users. There are four separate regulatory regimes, namely engineering, pollution control, abstractions and impoundments. Without going through a derogation process, CAR will not permit a downgrade of status on any classified water body or permit activities that will prevent good status being achieved by 2027.

13.2.9 There are three different levels of authorisation under CAR: General Binding Rules (GBRs), Registration, and Licence (either Simple or Complex). The level of authorisation required for an activity relates to the risk associated with the activity and is determined from the criteria set out within the CAR: A Practical Guide (SEPA 2018b). The level of authorisation under CAR for the proposed scheme is likely to range from GBRs covering discharges from short road drainage catchments, to Simple Licences for new culverts and Complex Licences for channel realignments.

13.2.10 The Water Environment (Miscellaneous) (Scotland) Regulations 2017 provides further updates to the CAR process whereby discharges to the water environment from construction sites will require a CAR Licence. These regulations also formally revoke The Water Environment (Oil Storage) Regulations 2006 (Scottish Government 2006b).

13.2.11 In line with SEPA's Guidance for Transport Infrastructure Projects (WAT-SG-93) (SEPA 2018a), the proposed scheme design assessed at DMRB Stage 3 has been developed with consideration of the RBMP targets for each water body and the requirements of CAR. Although consultation with SEPA regarding the proposed scheme design at DMRB Stage 3 has been undertaken, further consultation will be required following the publication of DMRB Stage 3 EIAR. This additional consultation with SEPA will relate to further development of the design, preparation of a CAR scoping report and drafting of CAR licence applications.

Flood Risk Management (Scotland) Act

13.2.12 The EU Floods Directive (2007/60/EC) is transposed into Scottish law through the Flood Risk Management (Scotland) Act (Scottish Government 2009a), hereafter referred to as 'the FRM Act'. The FRM Act sets in place a statutory framework for delivering a sustainable and risk-based approach to the management of flooding, including the preparation of assessments of the likelihood and impact of flooding and associated catchment focussed plans.

13.2.13 The FRM Act places a duty on the responsible authorities (Scottish Ministers, SEPA, Scottish Water and local authorities) to manage and reduce flood risk and promote sustainable flood management. The main elements of the FRM Act, which are relevant to the planning system, are the assessment of flood risk and undertaking structural and non-structural flood management measures.

Scottish Planning Policy (SPP)

13.2.14 Through the FRM Act, SPP (Scottish Government 2014c) requires planning authorities to consider all sources of flooding (coastal, fluvial, pluvial, groundwater, sewers and blocked culverts) and their associated risks when preparing development plans and reviewing planning applications.

13.2.15 The aims of SPP in relation to flooding are:

- to prevent developments that would be at significant risk of being affected by flooding;
- to prevent developments that would increase the probability of flooding elsewhere; and
- to provide a risk framework from which to identify a site's flood risk category and the appropriate planning response.

13.2.16 The approach places planning in the wider context of Scottish Government aims and policies. SPP does not reinstate policy and guidance used elsewhere but should take into account the wider policy framework, including the National Planning Framework, in decision making.

Highland and Argyll Local Flood Risk Management Plan (2016-2022) / Flood Risk Drainage Impact Assessment Supplementary Guidance (The Highland Council 2015)

13.2.17 The Highland and Argyll Local Flood Risk Management Plan (LPD01) (The Highland Council 2015) identifies a list of constraints to development in the Highlands, one of which is proposed development in areas at medium to high risk of flooding. Flood risk and drainage impacts are highlighted as material considerations for any new application and new developments are required to follow guidance presented in The Flood Risk and Drainage Impact Assessment Supplementary Guidance (The Highland Council 2013).

13.2.18 This guidance highlights that the Council is committed to ensuring developments are free from unacceptable flood risk and not likely to exacerbate flood risk elsewhere. The guidance further emphasises that developments proposed within, or bordering medium to high flood risk areas, will need to demonstrate compliance with SPP. This includes the criteria in SPP that all new developments should be free from unacceptable flood risk for all flood events up to and including the 0.5% Annual Exceedance Probability (AEP) (200-year return period) event plus an allowance for climate change. Where flood management measures are required, natural techniques (e.g. restoration of floodplains, wetlands and water bodies) should be incorporated into the design, or sufficient justification provided as to why they were not included. All proposed new developments are also required to be drained by SuDS in order to attenuate flows and reduce pollution to the receiving watercourse.

Study Area

13.2.19 Generally, the baseline study area for this assessment extends up to 500m from the footprint of the proposed scheme as shown on Figure 13.1, and includes identified watercourses (including natural, modified and artificial rivers, streams and drainage channels), existing watercourse crossing points and flood inundation extents. Ecological designations are shown on Figure 11.1 (which accompanies Chapter 11: Ecology and Nature Conservation).

13.2.20 For hydrology and flood risk, the study area principally comprises the land adjacent to the proposed scheme; however, the impacts of the proposed scheme on flooding may occur a significant distance away. Consequently, the study area extends to include all areas where flood risk would be altered as a result of the proposed scheme. This includes any watercourse, surface water and groundwater catchments that may be impacted by the proposed scheme.

13.2.21 The study area for fluvial geomorphology extends to a reach length of at least 500m centred on the proposed watercourse crossing locations. However, the reach may be extended to incorporate understanding of the wider catchment-scale processes, and to identify and assess locations of sediment sources, storage and deposition. In this way, more accurate baseline stability analyses can be undertaken.

13.2.22 The study area for water quality extends to a radius of at least 500m around the entire proposed scheme; however, for some categories of data, the search may extend to significantly greater distances, depending on the location of features such as water quality sampling stations or protected areas.

13.2.23 The study area for water supply extends to a radius of at least 500m around the entire proposed scheme. Due to the location of the proposed scheme, this includes the discharge point of all watercourses into the Inner Moray Firth as there may be downstream uses of surface waters for water supply, which could be affected by the proposed scheme.

Baseline Conditions

13.2.24 Baseline conditions were identified through a combination of consultation with relevant stakeholders, desk-based assessment, site walkovers, topographic surveys of the channel cross sections and details of cross drainage structures and hydraulic modelling (for the Scretan Burn, Cairnlaw Burn and their tributaries within the modelling extent).

Desk-based Assessment

13.2.25 The desk-based assessment considered relevant guidance (including DMRB Volume 11, Section 3, Part 10 (HD 45/09): Road Drainage and the Water Environment (Highways Agency, Transport Scotland, Welsh Government and The Department for Regional Development Northern Ireland 2009a), hereby referred to as DMRB HD45/09) legislation and regulations, as provided in

13.2.26 In addition, data sources detailed in Table 13.2 and Section 13.8 (References), have also informed the assessment.

Table 13.2: Data Sources

Topic	Sources of Information
Mapping and Spatial Data	Aerial Photography (BLOM 2017); Ordnance Survey (OS) 1:25,000 mapping and 1:1,250 to 1:10,000 MasterMap Data; LiDAR topographical survey data (available on https://remotesensingdata.gov.scot/); Historical maps (National Library of Scotland 2015); and British Geological Survey (BGS) Geology of Britain viewer (BGS 2018).
Hydrological data	Flood Estimation Handbook (FEH) CD-ROM v3, Centre for Ecology and Hydrology (Centre for Ecology and Hydrology (CEH) 2018); Flood Estimation Handbook Web Service (CEH 2018); SEPA Flood Map (2018d); Low Flows Enterprise (LFE) flow duration curve percentiles supplied by Wallingford Hydro Solutions; National River Flow Archive (CEH 2018); and Flood incidents / extent data from Jacobs Stakeholder Consultation records (SEPA and The Highland Council).

Topic	Sources of Information
WFD Data	Jacobs Consultation with SEPA; SEPA RBMP data and classification results available on the SEPA Water Environment Hub (SEPA 2016b) and the SEPA Water Classification Hub (SEPA 2018c); and The river basin management plan for the Scotland river basin district: 2015 – 2027 (SEPA 2015).
Previous assessments	A96 Dualling Inverness to Nairn: DMRB Stage 3 Environmental Statement (Jacobs 2016); and A9/A96 Inshes to Smithton: DMRB Stage 2 Scheme Assessment Report, Volume 1 – Main Report, Part 3 – Environmental Assessment (Jacobs 2017).

13.2.27 The Smithton and Culloden Flood Alleviation Scheme (SCFAS) has been constructed to the east of the proposed scheme. The SCFAS was therefore reviewed as part of the baseline assessment to assess its proximity to the proposed development corridor and to ascertain whether it was likely to be impacted by the proposed scheme. The baseline assessment concluded that any impacts due to the proposed scheme and associated works would either be to the south of the Smithton area, or would not impact watercourses/surface water flow in the vicinity of the flood alleviation scheme. This is due to the land in the vicinity of the proposed scheme draining to the north/north-west. Therefore, the flood alleviation scheme is not included in this assessment.

Site Walkover and Surveys

13.2.28 The site walkover and surveys undertaken in support of the assessments are detailed in Table 13.3.

Table 13.3: Site Walkovers and Surveys

Stage	Date	Discipline	Survey Details
DMRB Stage 2	April 2016	Fluvial Geomorphology	Visual inspection of watercourses and other surface water features and the adjacent area to provide an understanding of the local topography and floodplain and channel geomorphology.
DMRB Stage 3	January 2018	All	More detailed walkover surveys and visual inspection of watercourses and the adjacent area to provide an understanding of the hydrological regime and to enable catchment boundaries to be checked where there was uncertainty based on the desk-based assessment. The surveys also included assessment of the local topography to ensure the hydraulic regime is represented correctly in the hydraulic model. The surveys also informed the assessments for Fluvial Geomorphology, Water Quality and Water Supply. Information relevant to the CAR application process, which will follow the DMRB Stage 3 assessment, was also gathered.
DMRB Stage 3	June 2018	Water Quality and Hydrology and Flood Risk	Visual inspection of all watercourses within the project area, assessing their suitability for potential SuDS outfalls and better understanding of existing drainage around the A9 Perth - Inverness Trunk Road.

Consultation

13.2.29 Details of the full consultation process for the proposed scheme are provided in Chapter 6 (Consultation and Scoping) and Appendix A6.1 (Summary of Consultation Responses). Consultation of relevance to the assessment of Road Drainage and the Water Environment was undertaken with regulatory bodies and key stakeholders, including SEPA, Scottish Natural Heritage (SNH), The Highland Council, Scottish Water, Network Rail and the Ness and Beauly Fisheries Trust (NBFT). Specific consultation undertaken during the DMRB Stage 3 assessment and of relevance to this chapter is summarised in Table 13.4.

Table 13.4: Consultation Undertaken for DMRB Stage 3

Consultee	Date(s)	Aspect	Comments
NBFT	March 2018	Fish species	NBFT was requested to supply details of known fish passage sites, species present in watercourses within the proposed scheme area and fish population records.

Consultee	Date(s)	Aspect	Comments
Network Rail	May 2018	Flood Histories	Consultation with Network Rail was undertaken requesting any flood histories within the area of the proposed Scheme. At the time of writing no information has been received from Network Rail.
The Highland Council	March/April 2018	Flood Histories	Consultation was undertaken with The Highland Council requesting any relevant flood histories within the area of the proposed scheme. The Highland Council provided flood histories for the area of the proposed scheme and confirmed that no Strategic Flood Risk Assessment has been undertaken in this area.
Scottish Water	May 2018	Flood Histories	Consultation was undertaken with Scottish Water to check if there is any known flood risk from sewer/water mains within the area of the proposed scheme. Scottish Water noted that they were not aware of the availability of such information.
SEPA	June/July 2018	General	Consultation undertaken to discuss the scope, approach and methods to be undertaken for the assessment.
	2018/2019	Minor watercourses and Flood Risk	Consultation undertaken to discuss the proposed approach to the assessment methods for all minor watercourses potentially impacted by the proposed scheme. SEPA were also requested to provide (and have provided) flood histories for the area of the proposed scheme.
		FRA methodology, results and proposed mitigation	Consultation has been undertaken to discuss the FRA methodology and baseline results.
	March 2018	Fluvial Geomorphology	SEPA have supplied WFD morphological impact assessment data for Cairnlaw Burn and Scretan Burn to inform the fluvial geomorphology assessment and CAR requirements (following DMRB Stage 3).
		Water Quality	SEPA have supplied WFD water quality data, water quality monitoring data (including rainfall), abstractions and discharges licenced under CAR.
		Flood Risk	SEPA confirmed the SEPA Flood data from March 2016 was the most recent available.

13.2.30 Flooding issues raised by members of the public during consultations have also been included in the baseline assessment where relevant.

Planning Applications under Construction

13.2.31 Planning applications under construction are detailed in Chapter 5 (Overview of Assessment) and shown on Figure 15.4 which accompanies Chapter 15 (People and Communities – Community and Private Assets).

13.2.32 Phase 1A of the Stratton Development (PA18 to PA21), which includes the construction of approximately 400 houses to the east of the lower reaches of the proposed scheme, has been taken into consideration for the assessment of Hydrology and Flood Risk as the development is currently under construction. For Water Quality, this development is a consented scheme and it is therefore assumed that the SuDS proposals included in Phase 1A provide adequate treatment of polluted runoff from the development area.

13.2.33 Construction of a life sciences building (PA13) and a pedestrian bridge (PA12) (under LA03 and LA06) have also been considered. However, given these developments have been consented, they are

therefore required to satisfy relevant treatment and attenuation standards for runoff. Because of this the proposed developments are unlikely to have an effect on flooding in the vicinity of the proposed scheme.

13.2.34 The extant planning permissions outside of development land allocations and where construction has commenced, including PA07 (Demolition of Steading and Erection of Dwelling at Inshes), PA10 (Erection of Care Home at Cradlehall) and PA25 (Erection of Dwelling and Garage at Resaurie) have been considered, however, no impacts to these or from these are anticipated.

Impact Assessment Methodology

Introduction

13.2.35 The impact assessment reported in this chapter was undertaken in accordance with the guidance provided in DMRB HD45/09 (Highways Agency et al. 2009a), whereby the level of significance of a potential impact on the existing baseline condition of the surface water environment is determined by the importance of the surface water feature, combined with the magnitude of impact. This assessment takes account of the impacts from construction and/or operational activities, both before and after the application of mitigation measures i.e. potential and residual impacts respectively.

Hydrology and Flood Risk

13.2.36 Assessment of the potential impacts on hydrology and flood risk considered changes to the flow of water above the ground surface and within associated watercourses. In particular, the likelihood of flooding was assessed against the design 0.5% AEP (1 in 200-year) plus a 20% allowance for climate change (CC) flood event, in line with SEPA's Technical Flood Risk Guidance for Stakeholders (SEPA 2019a); hereafter referred to as the 0.5% AEP (200-year) plus CC event.

13.2.37 AEP refers to the chance that a flood of a particular size is experienced or exceeded during any year. This chapter refers to a probability value expressed as a percentage to quantify this. For example, a 50% AEP equates to a 1 in 2 chance of the flood being experienced or exceeded in any given year, and a 0.5% AEP equates to a 1 in 200 chance of the flood being experienced or exceeded in any given year. The potential effects of CC were allowed for in flood flow calculations by adding 20% to the 0.5% AEP (200-year) flood flows, in accordance with guidance (SEPA 2018c). For simplicity, the terms 0.5% AEP (200-year) plus CC or the '*design flood event'* are used to describe the flood event used in the assessment of flood risk.

Fluvial Geomorphology

13.2.38 Assessment of potential impacts on fluvial geomorphology considered changes in upstream and downstream bed substrate, and any disruption to fluvial and geomorphological processes within the channel and the adjacent floodplain.

13.2.39 Assessment of fluvial geomorphology impacts was undertaken using standard good practice and guidance notes from SEPA.

Water Quality

13.2.40 The assessment of potential impacts on water quality included the sub-attributes of quality, dilution and removal of waste products and biodiversity, as specified in DMRB HD45/09.

Water Supply

13.2.41 The assessment of potential impacts on water supply considered any disruption, pollution or severance of any surface water public or private water supplies or water supply infrastructure.

Importance

13.2.42 The importance of surface water features is assigned in Section 13.3 (Baseline Conditions) and was categorised on a scale of 'low' to 'very high' using various sources of information described below, as well as professional judgement, in accordance with the criteria provided in Table 13.5. In some cases,

surface water features were categorised with a higher importance if there is sufficient justification. Where applicable, supporting information is provided within the relevant technical appendices (Appendix A13.1 to A13.7).

13.2.43 For hydrology and flood risk, the importance was based on the number and type of potential flood receptors.

13.2.44 For fluvial geomorphology, the importance was based upon the watercourses' sediment regime, the diversity of the channel morphology and the existence of natural fluvial processes.

13.2.45 The importance for water quality was informed by the WFD water body condition status published by SEPA (to meet WEWS Act requirements) on its Water Environment Hub (SEPA 2016b) and Water Classification Hub (SEPA 2018c) websites. Where no data exist for smaller/minor watercourses, assumptions were made based on the status of the nearest classified watercourse of a similar character (Mustow, S. E., Burgess, P. F. and Walker, N. 2005). In addition, any field observations that would likely affect the status of the watercourse, if it were to be classified, were also taken into consideration.

Table 13.5: Importance Criteria - Surface Water Features

Importance	Criteria
very high	**Attribute has a high quality and/or rarity on an international scale.**
	Hydrology and Flood Risk
	Water feature with direct flood risk to the adjacent populated areas, with greater than 100 residential properties and/or critical social infrastructure units (such as the A9 Perth – Inverness Trunk Road (A9), A96 Aberdeen – Inverness Trunk Road (A96) and the Highland Main Line / Aberdeen to Inverness Railway Line), hospitals, schools, safe shelters or other land use of great value at risk during the design 0.5% AEP (200-year) plus CC event. Water feature with hydrological importance to: (i) sensitive and protected ecosystems of international status; and/or (ii) critical economic and social uses (e.g. water supply, navigation, recreation, and amenity).
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides a diverse mosaic of habitat types suitable for species sensitive to changes in sediment concentration and turbidity, such as migratory salmon and/or freshwater pearl mussel (FWPM). Water feature appears to be in dynamic equilibrium with minimal erosion, transport and depositional processes. The water feature has sediment processes reflecting the nature of the catchment and fluvial system. **Channel Morphology** Water feature includes varied morphological features (e.g. pools, riffles, bars, natural bank profiles) with no sign of artificial modification. **Natural Fluvial Processes** Water feature displays natural fluvial processes and natural flow regime, which would be highly vulnerable to change as a result of modification.
	Water Quality
	Water Quality 'High' Physico-Chemical status, 'Pass' for specific pollutants, and/or considered to exhibit 'High' water quality based on site observations and professional judgement, which may include no or very limited anthropogenic pressures on water quality from surrounding land-use with no impact on Environmental Quality Standards (EQS). **Dilution and Removal of Waste Products** Multiple CAR complex licensed discharges to or within 50m of water feature (with potential hydraulic connectivity to the watercourse) relative to flow. E.g. multiple discharges of effluent (organic, inorganic or sewage) >100 population equivalent (pe) and/or multiple medium/high significance Combined Sewer Overflow (as defined in SEPA 2018c) and/or Emergency Overflow discharges. **Biodiversity** 'High' Overall ecology status or potential; or for non-classified water features, high ecosystem quality, based on site observations and professional judgement, and/or Protected/designated under EC legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site), and/or No existing pressures to biodiversity.
	Water Supply
	Water resource extensively exploited for public, private domestic and/or agricultural and/or industrial use, feeding ten or more properties.
high	**Attribute has a high quality and/or rarity on national scale.**

Importance	Criteria
	Hydrology and Flood Risk
	Water feature with direct flood risk to adjacent populated areas, with between 1 and 100 residential properties and/or 10 or more industrial premises at risk from flooding during the 0.5% AEP (200-year) plus CC design flood event. Minor watercourses with an indirect and localised flood risk to critical infrastructure (including the A9, A96 and the Highland Main Line Railway / Aberdeen to Inverness Railway Line), during 0.5 % AEP plus CC event, due to undersized culverts. Water feature with hydrological importance to: (i) national designation sensitive and protected ecosystems; and/or (ii) locally important economic and social uses (e.g. water supply, navigation, recreation, and amenity).
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides habitats suitable for species sensitive to changes in sediment concentration and turbidity, such as migratory salmon and/or FWPM. Water feature appears largely in dynamic equilibrium with areas of localised accelerated erosion and/or deposition caused by land use and/or modifications. Primarily the sediment regime reflects the nature of the natural catchment and fluvial system. **Channel Morphology** Water feature exhibiting a natural range of morphological features (e.g. pools, riffles, bars, varied natural river bank profiles), with limited signs of artificial modifications or morphological pressures. **Natural Fluvial Processes** Predominantly natural water feature with a diverse range of fluvial processes that is highly vulnerable to change as a result of modification.
	Water Quality
	Water Quality 'Good' Physico-Chemical status, 'Pass' for specific pollutants and/or considered to exhibit 'Good' water quality based on site observations and professional judgement. May have a small number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are not considered likely to affect compliance with EQS. This includes potentially contaminated land sites (as identified in Chapter 12: Geology, Soils and Groundwater) present 25 to 50m from water feature with potential hydraulic connection to the water feature and/or pollutant inputs that do not significantly affect WFD aims. **Dilution and Removal of Waste Products** One CAR complex and/or multiple CAR simple licensed discharges to or within 50m of watercourse relative to flow. E.g. multiple discharges of effluent (organic, inorganic or sewage) >15 to 100pe and/or low significance Combined Sewer Overflows (CSO), a single discharge >100pe and/or medium/high significance CSO. **Biodiversity** 'Good' Overall ecology status or potential; or for non-classified water features, good ecosystem quality, based on site observations and professional judgement and/or Few existing pressures to biodiversity.
	Water Supply
	Valuable water supply resource due to exploitation for public, private domestic and/or agricultural and/or industrial use, feeding fewer than 10 properties.
medium	**Attribute has a medium quality and/or rarity on regional/local scale**
	Hydrology and Flood Risk
	A water feature with a possibility of direct flood risk to less populated areas (no residential properties or critical infrastructure units at risk) with <10 industrial premises and/or utilisable agricultural fields. A water feature with some but limited hydrological importance to: sensitive or protected ecosystems; and/or economic and social uses.
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides some habitat suitable for species sensitive to change in suspended sediment concentrations or turbidity. A water feature with natural processes occurring but modified, which causes notable alteration to the natural sediment transport pathways, sediment sources and areas of deposition. **Channel Morphology** Water feature exhibiting some morphological diversity (e.g. pools, riffles and depositional bars). The channel cross-section is partially modified in places, with indications of modification to the channel morphology. Natural recovery of channel form may be apparent (e.g. eroding cliffs, depositional bars). **Natural Fluvial Processes** Water feature with some natural fluvial processes, including varied flow types. Modifications and anthropogenic influences having an overt impact on natural flow regime, flow pathways and fluvial processes.
	Water Quality
	Water Quality

Importance	Criteria
	'Moderate' Physico-Chemical status, 'Pass' for specific pollutants, and/or considered to exhibit 'Moderate' water quality based on site observations and professional judgement. May have a number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are considered likely to be affecting compliance with EQS for one or more parameters. This includes potentially contaminated land sites (as identified in Chapter 12: Geology, Soils, Contaminated Land and Groundwater) present 10 to 25m from water feature with potential hydraulic connection to the water feature. **Dilution and removal of waste products** One CAR simple licensed discharge and/or multiple CAR registrations for discharges to or within 50m of watercourse relative to flow. E.g. one discharge of effluent (organic, inorganic or sewage) >15 to100pe and/or low significance CSO and/or multiple discharges of effluent <15pe. **Biodiversity** 'Moderate' Overall ecology status or potential; or for non-classified water features, moderate ecosystem quality, based on site observations and professional judgement, and/or Existing pressures which are likely to be adversely affecting biodiversity.
	Water Supply
	N/A
low	**Attribute has a low quality and/or rarity on a local scale**
	Hydrology and Flood Risk
	A water feature passing through uncultivated agricultural land. A water feature which is assessed as not being a flood risk to critical infrastructure for the 0.5% AEP (200-year) plus CC design flood event. A water feature with minimal hydrological importance to: (i) sensitive or protected ecosystems; and/or (ii) economic and social uses.
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime which provides very limited physical habitat for species sensitive to changes in suspended solids concentration or turbidity. Highly modified sediment regime with limited/no capacity for natural recovery. **Channel Morphology** Water feature that has been extensively modified (e.g. by culverting, addition of bank protection or impoundments) and exhibits limited to no morphological diversity. The water feature is likely to have uniform flow, uniform banks and absence of bars. Insufficient energy for morphological change. **Natural Fluvial Processes** Water feature which shows no or limited evidence of active fluvial processes with an unnatural flow regime or/and uniform flow types and minimal secondary currents.
	Water Quality
	Water Quality 'Poor' or 'Bad' Physico-Chemical status; 'Fail' for specific pollutants, and/or considered to exhibit 'Poor' or 'Bad' water quality based on site observations and professional judgement. May have a large number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are considered likely to be affecting the compliance of EQS for the majority of parameters. This includes potentially contaminated land sites (as identified in Chapter 10: Geology, Soils and Groundwater) present within 10m of water feature with potential hydraulic connection to the water feature**.** **Dilution and removal of waste products** Limited (one or two CAR registrations for discharges) or no existing licensed discharges to or within 50m of the water feature. **Biodiversity** 'Poor' or 'Bad' Overall ecology status or for non-classified water features, poor or bad ecosystem quality, based on site observations and professional judgement, and/or Many existing pressures which are considered to be adversely affecting biodiversity.
	Water Supply
	N/A

Impact Magnitude

13.2.46 The magnitude of potential impacts was assessed on a scale of 'major' to 'negligible' for both adverse and beneficial impacts based on the likely effect of the proposed activities, guided by the criteria and examples provided in Table 13.6 and using professional judgement where necessary. The assessment of magnitude was influenced by the timing, scale, size and duration of changes to the baseline conditions, as well as the likelihood or probability of occurrence.

13.2.47 The highest magnitude of impact is applied when any one of the criteria are met from the adverse categories presented in Table 13.6.

13.2.48 The classification of magnitude of impact on hydrology and flood risk in Table 13.6 follows the guidance set out in DMRB HD45/09. However, it should be noted that DMRB HD45/09 classifies the magnitude of potential impacts on flood level using the 1% AEP (100-year) design flood event. In Scotland, the design standard is the 0.5% AEP (200-year) event (taken from guidance Scottish Government 2014b and SEPA 2018c). Therefore, the magnitude of impacts has been assessed using the 200-year design flood event rather 100-year quoted in DMRB guidance.

13.2.49 To meet the requirements of the WEWS Act, the magnitude of impact assessment on fluvial geomorphology considers the potential impacts on the condition status of the WFD water bodies and the supporting hydromorphological quality elements, as published on the SEPA Water Environment Hub and Water Classification Hub websites (SEPA 2016b and SEPA 2018c).

13.2.50 Impacts to water supply are only considered to be moderate adverse or major adverse, therefore only appear in those sections in Table 13.6.

Table 13.6: Magnitude Criteria - Surface Water Features

Magnitude	Criteria
Major adverse	**Results in loss of surface water feature and/or quality and integrity of the water feature**
	Hydrology and Flood Risk
	Increase in peak flood water level for the 0.5% AEP (200-year) plus CC event of > 100mm.
	Fluvial Geomorphology
	Sediment Regime Extensive impacts on the water feature bed, banks and vegetated riparian corridor resulting in changes to sediment characteristics, transport processes, sediment load and turbidity. This includes extensive input of sediment from the wider catchment due to modifications. Impacts would be at the water body scale. **Channel Morphology** Extensive alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. This could include: significant channel realignment (negative); extensive loss of lateral connectivity due to new/extended embankments; and/or, significant modifications to channel morphology due to installation of culverts or outfalls. Impacts would be at the water body scale. **Natural Fluvial Processes** Major shift away from baseline conditions with potential to alter processes at the catchment scale. **Condition Status** Adverse impacts causing loss or damage to habitats. Impacts have the potential to cause deterioration in hydromorphology quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone) preventing the achievement of water body objectives for Good Ecological Status (GES) or Good Ecological Potential (GEP).
	Water Quality
	Major shift away from baseline conditions. Likely to result in a downgrade of Physico-Chemical, Specific pollutants and/or Overall ecology (e.g. a change from 'Pass' to 'Fail') status. A downgrade of status could be caused by either: • a measurable deterioration in EQS for greater than one month (construction); and/or • failure of both soluble and sediment-bound pollutants in the Highways Agency Water Risk Assessment Tool (HAWRAT) assessment, and compliance failure against EQS values (operation). • indication of 'additional TSS, Metals and Hydrocarbon mitigation required' when CIRIA's Simple Index Approach Tool is used to assess runoff drainage (when HAWRAT is not applicable, i.e. roads with traffic flows of <10,000 vehicles per day (vpd)) as this indicates insufficient SuDS treatment for the proposed land use. Total removal of the water feature's capacity to dilute existing licenced discharges under CAR. Long term loss or change to designated site. Calculated risk of pollution from a spillage >2% annually during operation.
	Water Supply
	Long term loss or change to water supply.
	Results in effect on integrity of attribute, or loss of part of the surface water feature
	Hydrology and Flood Risk

Magnitude	Criteria
Moderate adverse	Increase in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of > 50mm and < 100mm.
	Fluvial Geomorphology
	Sediment Regime Some changes and impacts on the water feature bed, banks and vegetated riparian corridor resulting in some changes to sediment characteristics, transport processes, sediment load and turbidity. Impacts would extend beyond reach scale. **Channel Morphology** Some alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. Activities could include: channel realignment, new/extended embankments, modified bed and/bank profiles, replacement of bed and/or banks with artificial material and/or installation of culverts. Impacts would extend beyond reach scale. **Natural Fluvial Processes** A shift away from baseline conditions with potential to alter processes at the reach or general scale. **Condition Status** Moderate adverse impacts at the reach or multiple reach scale, which causes some loss or damage to habitats. Impacts have the potential to cause failure or deterioration in one or more of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone). May prevent the achievement of water body objectives for GES or GEP.
	Water Quality
	A moderate shift away from baseline conditions that may be long-term or temporary. Likely to result in a decline in water quality but not a downgrade in overall water quality status from either: • a measurable deterioration in EQS for less than one month (construction); and/or • failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values (operation). Reduction in the water feature's capacity to dilute existing discharges under CAR. May result in temporary impacts on designated species/habitats. Calculated risk of pollution from a spillage >1% and <2% annually during operation.
	Water Supply
	Temporary disruption or deterioration in a water supply.
Minor Adverse	**Results in some measurable change in quality or vulnerability of attribute of the surface water feature**
	Hydrology and Flood Risk
	Increase in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of > 10mm and < 50mm.
	Fluvial Geomorphology
	Sediment Regime Limited impacts on the water feature bed, banks and vegetated riparian corridor resulting in local (but notable) changes to sediment characteristics, transport processes, sediment load and turbidity at the reach scale. **Channel Morphology** A small change or modification in the channel planform and/or cross section. Includes upgrade to and/or extension of existing watercourse crossing and/or structure with associated minor channel realignments with localised impacts. **Natural Fluvial Processes** Minimal shift away from baseline conditions with typically localised impacts up to the reach scale. **Condition Status** Impacts which may cause partial loss or damage to habitats. Impacts have the potential to cause failure or deterioration in one of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone).
	Water Quality
	Minor shift away from baseline conditions. Likely to result in a slight decline in water quality with no associated impacts on designated species/habitats or water supply, which is characterised by: • a temporary decline in Physico-Chemical or Specific pollutants statuses during construction; and/or • failure of either soluble or sediment-bound pollutants in HAWRAT during operation. Slight reduction in the water feature's capacity to dilute existing discharges under CAR. Calculated risk of pollution from a spillage >0.5% and <1% annually during operation.
Negligible	**Results in effect on attribute of the water feature, but of insufficient magnitude to affect the use or integrity**
	Hydrology and Flood Risk

Magnitude	Criteria
	Negligible change in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of up to <+/- 10mm.
	Fluvial Geomorphology
	Minimal or no measurable change from baseline conditions in terms of sediment transport, channel morphology and natural fluvial processes. Any impacts are likely to be highly localised and not have an effect at the reach scale.
	Water Quality
	No perceptible changes to baseline conditions. No measurable change in water quality at any time during construction. No change in the water feature's capacity to dilute existing discharges under CAR. No risk identified by HAWRAT (Pass for both soluble and sediment-bound pollutants) during operation. Risk of pollution from a spillage <0.5% during operation.
Minor beneficial	**Results in some beneficial effect on attribute of the water feature or a reduced risk of negative effect occurring to the water feature**
	Hydrology and Flood Risk
	Reduction in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event > 10mm and < 50mm.
	Fluvial Geomorphology
	Sediment Regime Partial improvement to sediment processes at the reach scale, including reduction in siltation and localised recovery of sediment transport processes. **Channel Morphology** Partial improvements include enhancements to in-channel habitat, riparian zone and morphological diversity of the bed and/or banks. **Natural Fluvial Processes** Slight improvement on baseline conditions with potential to improve flow processes at the reach scale. **Condition Status** Slight beneficial impacts at the reach scale, which may cause partial habitat enhancement. Impacts have the potential to improve one of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone).
	Water Quality
	Minor improvement over baseline conditions. HAWRAT assessment of either soluble or sediment-bound pollutants becomes 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
Moderate beneficial	**Results in moderate improvement of the quality of the attribute of the water feature**
	Hydrology and Flood Risk
	Reduction in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event > 50mm and < 100mm.
	Fluvial Geomorphology
	Sediment Regime Reduction in siltation and recovery of sediment transport processes at the reach or multiple reach scale. **Channel Morphology** Partial creation of both in-channel and vegetated riparian habitat. Improvement in morphological diversity of the bed and/or banks at the reach or multiple reach scale. Includes partial or complete removal of structures and/or artificial materials. **Natural Fluvial Processes** Notable improvements on baseline conditions and recovery of fluvial processes at the reach or across multiple reaches. **Condition Status** Notable beneficial impacts at the reach to multiple reach scale. Impacts have the potential to improve one or more of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone) and/or assist in achieving the water body objectives for GES or GEP.
	Water Quality
	A moderate improvement over baseline conditions. A Highways Agency Water Risk Assessment Tool (HAWRAT) assessment of both soluble and sediment-bound pollutants becomes 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).
	Results in major improvement of attribute quality

Magnitude	Criteria
Major beneficial	**Hydrology and Flood Risk**
	Reduction in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event > 100mm.
	Fluvial Geomorphology
	Sediment Regime Improvement to sediment processes at the catchment scale, including recovery of sediment supply and transport processes. **Channel Morphology** Extensive creation of both in-channel habitat and riparian zone. Morphological diversity of the bed and/or banks is restored, such as natural planform, varied natural cross-sectional profiles, recovery of fluvial features (e.g. cascades, pools, riffles, and bars) expected for river type. Removal of modifications, structures, and artificial materials. **Natural Fluvial Processes** Substantial improvement on baseline conditions at catchment scale. Recovery of flow and sediment regime. **Condition Status** Substantial beneficial impacts at the catchment scale, which result in recovery/restoration of natural habitats suitable for supporting sensitive species. Potential improvement of Overall status condition, which could lead to achievement of water body objectives for GES or GEP.
	Water Quality
	Major improvement over baseline conditions and upgrading of Physico-Chemical, Specific pollutants or Overall ecological status. The removal or likelihood of removal of existing pressures, resulting in a water body achieving its objectives for GES or GEP.

Impact Significance

13.2.51 The significance of impacts (either with or without mitigation measures) was determined as a function of the importance of the surface water feature and the magnitude of the predicted impact. The matrix for the determination of significance, provided in the DMRB HD45/09 guidance, is shown in Table 13.7.

13.2.52 Where the matrix indicates two alternative options (e.g. Slight / Moderate), the significance rating was selected using professional judgement, in accordance with the DMRB HD45/09 guidance. The selection of a higher significance is chosen where a greater number of high risk activities are proposed, or where the impact on one attribute is intrinsically linked to another attribute (e.g. quality and biodiversity) that has a higher importance.

Table 13.7: Matrix for Determination of Significance

Magnitude / Importance	Negligible	Minor	Moderate	Major
Very High	Neutral	Moderate / Large	Large / Very Large	Very Large
High	Neutral	Slight / Moderate	Moderate / Large	Large / Very Large
Medium	Neutral	Slight	Moderate	Large
Low	Neutral	Neutral	Slight	Slight / Moderate

13.2.53 For the purposes of this assessment, impact significance of 'Moderate' or higher are considered significant in the context of the EIA Regulations and, therefore, is the focus for mitigation where practicable. However, it should be noted, for flood risk (guided by discussions with SEPA and to ensure consistency with SPP (Scottish Government 2014b) on flood risk), the aim has been to avoid any increased flood risk where feasible as part of the DMRB Stage 3 design. This avoidance of any increased flood risk is therefore considered irrespective of the significance classification as set out in this chapter.

13.2.54 Only those surface water features considered to potentially be significantly impacted (i.e. impacts of Moderate or greater significance) are presented within Section 13.4 (Potential Impacts).

Specific Methodologies

13.2.55 Throughout the DMRB Stage 3 assessments there was discussion with statutory consultees such as SEPA regarding the development of the proposed scheme design as well as the environmental assessment methods.

Hydrology and Flood Risk

13.2.56 A Flood Risk Assessment (FRA) was undertaken following SEPA's Technical Flood Risk Guidance for Stakeholders (SEPA 2019a), as well as considering guidance within DMRB HD45/09. As part of the FRA, numerical hydraulic modelling was undertaken to assess the existing flood risk from the Cairnlaw Burn (SWF08) and Scretan Burn (SWF04) (and their associated tributaries within the model extent); these watercourses are assessed as having a high sensitivity to flood risk and will be crossed by the proposed scheme.

13.2.57 Full detailed methodologies are provided in three separate appendices, namely, Appendix A13.1 (Flood Risk Assessment), Appendix A13.2 (Surface Water Hydrology) and Appendix A13.7 (Hydraulic Modelling).

Fluvial Geomorphology

13.2.58 An assessment of potential impacts on the fluvial geomorphology of the surface water features affected by the proposed scheme was carried out following SEPA Best Practice Guidelines and referring to the Supporting Guidance (WAT-SG-21): Environmental Standards for River Morphology (SEPA 2012a).

13.2.59 Full details of the geomorphological baseline surveys and geomorphological assessments are provided in Appendix A13.4 (Fluvial Geomorphology).

Water Quality

13.2.60 Specific water quality assessments were carried out to assess the impacts on the water environment from the proposed scheme.

13.2.61 The operational impact magnitudes (Table 13.6) for the attributes of water quality have been informed by water quality assessments using CIRIA's Simple Index Approach Tool and Highways Agency Water Risk Assessment Tool (HAWRAT) (as detailed within DMRB HD45/09) Method A (Routine Runoff) and Method D (Spillage Risk). Full detail on the water quality assessments undertaken is provided within Appendix A13.3 (SuDS and Water Quality).

Limitations to DMRB Stage 3 Assessment

13.2.62 Baseline conditions described in Section 13.3 (Baseline Conditions) were informed by site walkover observations and surveys of watercourses and other surface water features made at specific times and water levels. However, it is recognised that seasonal variables (such as flow levels, vegetation growth and land use) can affect the visibility of in-channel features; as well as the overall morphology and fluvial processes observed at the time of survey, representing a limitation in recorded data sets, common to all aquatic field studies. In addition, some of the data received during consultation may have been updated since the time of undertaking this assessment.

13.2.63 Consultation with SEPA undertaken in March 2018 noted that there is currently an error with the SEPA water body line for Cairnlaw Burn (SWF08) (as used in this assessment, see Figure 13.1). This means that the reach currently shown on SEPA's Water Environment Hub (SEPA 2016) and Water Classification Hub (SEPA 2018c) within the study area and crossed by the proposed scheme may be subject to change. Therefore, in subsequent design stages (including Specimen and Detailed design, which will inform CAR) the proposed works on Cairnlaw Burn may be assessed as being on a tributary, as opposed to on a baseline WFD water body. However, at the time of writing, the water body line remains the same, therefore the assessment has been completed on this basis.

Hydrology and Flood Risk

13.2.64 Flood risk related to groundwater sources has not been specifically addressed within this chapter; it is considered in Appendix A13.1 (Flood Risk Assessment).

13.2.65 Limitations relating to the flood risk assessment, flow estimation methods and hydraulic modelling are also provided in Appendix A13.1 (Flood Risk Assessment), Appendix A13.2 (Surface Water Hydrology) and A13.7 (Hydraulic Modelling).

Fluvial Geomorphology

13.2.66 The quality and quantity of baseline geomorphological data were affected by accessibility, and seasonal variations in flow and vegetation cover. For the purposes of this study, sediment dynamics and flow processes were interpreted from combined field survey data and desk-study information and supported by topographic survey data and hydraulic models.

13.2.67 Limitations relating to the surveys and assessments undertaken for fluvial geomorphology are provided in Appendix A13.4 (Fluvial Geomorphology).

13.3 Baseline Conditions

13.3.1 This section provides a description of all watercourses potentially affected by the proposed scheme. This includes the baseline conditions for all water environment attributes covered within this chapter. As part of the baseline assessment for all surface water features, an importance rating was determined for each water environment attribute.

13.3.2 Within 1km of the proposed scheme, 12 surface water features were identified, seven of these are considered to be watercourses and five of these are considered to be minor tributaries and drainage channels. The surface water features have been numbered from SWF01 (Mill Burn) to SWF12 (Kenneth's Black Well). The locations of the surface water features, with corresponding identification references, proposed scheme crossing locations and flood inundation extents are shown on Figures 13.1 and 13.2.

13.3.3 Due to their relative distance from the proposed scheme extents, SWF01 (Mill Burn), SWF11 (Tributary of Cairnlaw Burn) and SWF12 (Kenneth's Black Well) are not considered to be affected by the proposed scheme and are therefore scoped out of the assessment.

WFD Classified Watercourses

13.3.4 The majority of the surface water features in the study area are too small (in terms of catchment area) to be classified as main stem water bodies by SEPA under WFD. Cairnlaw Burn (SWF08) is the only WFD classified main stem water body.

Licenced Abstractions and Discharges

13.3.5 As advised by SEPA in a response to consultation received 5 June 2018 (refer to Appendix A6.1: Summary of Consultation Responses), there are discharges, abstractions and impoundments licenced under CAR, along watercourses identified to be within the study area. Licenced activities and their locations, along the entire length of the watercourse, are detailed in Table 13.8.

Table 13.8: Licenced Activities (Abstractions, Discharges and Impoundments).

Watercourse	No. of Licenced Activities	Type and Location
SWF02 (Inshes Burn)	5	• A **Complex** CAR Licence exists for discharge from a combined sewer outfall (CSO) at Stoneyfield House commercial estate. • Four **Registration** CAR Licences for discharge of septic tank effluent to land/soakaways within 50m of Inshes Burn at Inshbeg, West Park (3 properties), Dell of Inshes and Ardachy.

Watercourse	No. of Licenced Activities	Type and Location
SWF03 (Beechwood Burn)	1	• A **Simple** CAR Licence is associated with an outfall from a SuDS Management Train treating runoff from Inverness College (University of Highlands and Islands (UHI) Campus). The Surface Water Management Plan for Inverness Campus outlines runoff from development is first treated by filter drains, vegetated strips or swales before being conveyed into detention basins/retention ponds (Fairhurst 2010).
SWF04 (Scretan Burn)	5	• Four **Registration** CAR Licences for discharges related to sewage effluent are present within 50m of the Scretan Burn. Three of these are Sewage Treatment Effluent (STE) to land / soakaways (Bogbain Farmhouse, Upper Muckovie and Killearnan Cottage) and two discharges to Scretan Burn (New Dwelling north-east of Milton Croft as well as Milton Croft itself). These Registration CAR Licences are located out with the 500m buffer zone of the proposed scheme, but are within a 2km radius.
SWF08 (Cairnlaw Burn)	2	• In the upper catchment, a **Registration** CAR Licence relating to a STE to a soakaway exists at Upper Muckovie Farmhouse. • In the lower catchment, a (**Non-Granted Site**) CAR Licence is recorded on Ashton Farm associated with runoff from sheep dip related activities.
SWF10 (Tower Burn)	2	• In the upper reaches of the catchment two **Registration** CAR licences, relating to STE to land/soakaway, exist at Upper Muckovie Castle Cottage and Easter Bogbain.

Water Supply

13.3.6 The exact abstraction locations of private water supplies (PWS) are not currently known within a 500m buffer zone of the study area therefore the assessment of any PWS are absent from this report. Please refer to Chapter 12 (Geology, Soils, Contaminated Land and Groundwater) for more detailed information related to PWS within the proposed scheme.

13.3.7 Several Scottish Water main pipelines (public water supply) are present throughout the study area (refer to Figure 13.1). To the west of the Highland Main Line Railway, the network of water mains present creates a near circular arrangement around the Inverness Campus. Starting on the west side of the Inshes Overbridge, the pipeline follows Inshes Burn (SWF02) through Beechwood Business Park and then, after doubling back to the Inshes roundabout, it follows the A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive) east before it is culverted under the A9 Perth – Inverness Trunk Road onto the Inverness Campus. A branch of the pipeline runs parallel to the western side of Highland Main Line Railway until it reaches properties in the Cradlehall area and turns south-west towards B9006 Culloden Road, eventually running parallel (north) to Beechwood Burn (SWF03). Additionally, from Beechwood Business Park a pipeline runs near parallel to Inshes Burn (SWF02) continuing until it reaches the (western side) of A9 carriageway where it stops.

13.3.8 To the north and east of the Highland Main Line Railway, a pipe network exists within Inverness Retail and Business Park, one of which runs parallel to Beechwood Burn (SWF03) and Scretan Burn (SWF04) from the Highland Main Line Railway until Scretan Burn is culverted under the A96 Aberdeen - Inverness Trunk Road. From here a branch of the pipeline continues south along the access road to Ashton Farm, firstly parallel to the un-named drain (SWF07) and then Cairnlaw Burn (SWF08) at Ashton Farm Cottages continuing south, terminating approximately 180m east of U1058 Caulfield Road North. A further branch of this pipeline extends east and then north towards Stratton and C1032 Barn Church Road at the northern extent of the study area.

13.3.9 All public water supplies are considered to be of very high importance.

Existing Road Drainage Network

13.3.10 Treatment of road runoff from the A9 between Inshes and the Raigmore Junction, A96 from the Raigmore Junction to the junction with the C1032 Barn Church Road and the local road network (including the A8082 Sir Walter Scott Drive and B9006 Culloden Road) is generally limited, consisting predominantly of kerbs and gullies which discharge untreated road runoff to the nearest watercourse. There are some limited sections of filter drains within the roadside verges, which will provide an initial level of treatment for road runoff. Road runoff from the car parks and road network of Inverness Campus is treated by two levels of SuDS treatment (filter drains/vegetated strips/swales and then retention ponds/detention basins).

Watercourses

13.3.11 This section presents the baseline for watercourses potentially affected by the proposed scheme, which have a catchment area of greater than 0.5km^2.

Inshes Burn (SWF02)

13.3.12 Inshes Burn (SWF02) is a relatively small watercourse with a catchment area of approximately 1.9km^2 up to the confluence with the Scretan Burn (SWF04). It is sourced south of Balvonie Wood at approximately 190m above ordnance datum (AOD) and flows in a north-easterly direction towards Inverness. Prior to the construction of the existing A9, the main channel of Inshes Burn joined Beechwood Burn (SWF03), however it was diverted into a separate watercourse in the vicinity of Beechwood Business Park. The diverted watercourse flows in an easterly direction south of the Raigmore Junction where it is culverted under the A9 and Highland Main Line Railway. Inshes Burn discharges into Scretan Burn (SWF 04) downstream of the Inverness Retail and Business Park and approximately 165m upstream of the culvert under the A96 carriageway. The watercourse has been extensively realigned with a trapezoidal cross section and reinforced banks. Land use surrounding the watercourse consists of urban residential and commercial properties, the A9 and local road network as well as forestry in the upper reaches. Inshes Burn is not classified by SEPA under the WFD. There are two tributaries which join the Inshes Burn:

- a small tributary joining at Dell of Inshes; and
- a small tributary joining at Beechwood Business Park.

Photograph 1: Upstream view of Inshes Burn, before it is culverted under Inverness Retail and Business Park.

Photograph 2: Downstream view of Inshes Burn after it is culverted under Inverness Retail and Business Park, just before its confluence with Scretan Burn (SWF04) upstream of the Ashton Farm access track.

Hydrology and Flood Risk

13.3.13 The flood extent of Inshes Burn is not assessed by the SEPA Flood Map (SEPA 2018d) as its catchment area is less than 3km^2 (therefore smaller than the significance threshold for inclusion in the SEPA Flood Map). However, as the Inshes Burn flows in very close proximity to residential areas, commercial areas, Raigmore Hospital, crosses the Highland Main Line Railway and the local road network, it is assessed as likely to pose a flood risk to local receptors during higher return period flood events.

13.3.14 Consultation with The Highland Council and SEPA has identified that Inshes Burn upstream and in the vicinity of the Inshes Retail Park, has the potential to pose a flood risk to local receptors including local residences. Flooding incidents for Inshes Burn have been reported in 2002 and 2014 which resulted in flooding to roads (including the A9 slip road), gardens, houses and commercial premises (including a petrol station and the Thistle Hotel).

13.3.15 Inshes Burn has therefore been assessed as having very high importance in terms of hydrology and flood risk.

Fluvial Geomorphology

13.3.1 Inshes Burn has a sinuous planform in the upstream reaches from Balvonie Wood to Dell of Inshes, and a straightened planform through Inverness Retail and Business Park to its confluence with Scretan Burn (SWF04). With the exception of a 350m section of the channel north of Inshes, which has a scattered tree coverage, the channel has an approximately 40m wide riparian zone consisting of mature deciduous trees and a shrub understory within the upstream section. The channel was observed to have no vegetated riparian corridor downstream of Inshes.

13.3.2 The watercourse was observed to display plane-riffle bedforms and non-laminar flow types. The channel substrate consisted of poorly sorted fine gravels to coarse gravels and cobbles with lateral bars composed of well sorted fine gravels and sands.

13.3.3 Dell of Inshes marks the location of the confluence with a tributary to Inshes Burn which, similarly, has its source to the south-west of Balvonie Wood. The tributary was straightened with an over-wide trapezoidal cross-section and has a narrow, uniform riparian corridor.

13.3.4 As the channel has been observed to be modified, artificially straightened and lacked morphological diversity, Inshes Burn is considered to have a low sensitivity to disturbance and is therefore assessed as having low importance in relation to the fluvial geomorphology assessment.

Water Quality

13.3.5 Land use within the Inshes Burn catchment comprises planted forestry (~29%), cleared forestry (~16%), farmland (~19%) and urban development (road infrastructure, residential and commercial properties ~28%). Potential pollutants from forestry could include sediment, dissolved organic carbon and nutrients, pollutants from the remaining sources include: suspended solids and contaminants bound to them (such as heavy metals and phosphorus); diffuse sources with high levels of nutrients (nitrogen and phosphorus); de-icing salt (chloride); and oil and related compounds.

13.3.6 There are five CAR Pollution Control licences within 50m of the watercourse. Four of the licences (Registrations) are associated with septic tank effluent to land / soakaways, two of these are within, and two of these are out with a 500m radius from the study area respectively. A combined sewer overflow (CSO) discharges into the watercourse (Complex Licence) on the Stoneyfield House commercial estate (see Table 13.8). Two Scottish Water Surface Water Sewer outfalls from Beechwood Business Park also discharge into Inshes Burn (not CAR licenced).

13.3.7 Inshes Burn is not anticipated to support healthy populations of designated aquatic species due to unsuitable habitat conditions with exception of European eel (see Chapter 11: Ecology and Nature Conservation). However, Inshes Burn is a tributary of Scretan Burn (SWF04), which discharges into the Inner Moray Firth (designations include; Wetland of International Importance (Ramsar), Site of Special Scientific Interest (SSSI) and Special Protected Area (SPA) (mostly regarding bird species)).

13.3.8 Given the anthropogenic pressures on water quality, the number of discharges (particularly the presence of a CAR Complex Licence) (for dilution and removal of waste products) and habitat suitability for biodiversity, the overall importance of Inshes Burn for water quality is considered to be high.

<u>Beechwood Burn (SWF03)</u>

13.3.9 Beechwood Burn is a small watercourse, with a catchment area of approximately 1.2km^2. The source is located between the A9 and B9006 Culloden Road, south of Inshes Smallholdings at approximately 65m AOD. From its source the watercourse flows approximately 1km north-west, where it is met by the historic channel of Inshes Burn (SWF02). The confluence with the historic channel of Inshes Burn (SWF02) is located south-west of Inverness Campus. Flows into the historic channel of Inshes Burn (SWF02) are now predominantly from road runoff from the existing A9. The watercourse then flows approximately 1km north-east to its confluence with the Scretan Burn (SWF04).

13.3.10 Catchment land use of Beechwood Burn is predominantly agricultural with some urban areas. The channel has a uniform trapezoidal cross section.

Photograph 3: Upstream view of Beechwood Burn downstream of bridge access to Inverness Retail and Business Park.

Photograph 4: Upstream view of Beechwood Burn prior to confluence with Scretan Burn (SWF04).

Hydrology and Flood Risk

13.3.11 Beechwood Burn does not feature on the SEPA Flood Map (SEPA 2018d) due to its small catchment (less than 3km^2). There are a number of properties located in very close proximity to the watercourse, as well as buildings for Inverness Campus and Inverness Retail and Business Park (as well as a proposed prison) which could be at flood risk during higher return period events. An FRA was undertaken for Inverness College University of Highlands and Islands (UHI) which noted that the development would be located outwith inundation areas in the indicative 0.5% AEP and 0.1% AEP events (Fairhurst 2010).

13.3.12 The lower reaches of Beechwood Burn have been subject to hydraulic modelling and are included within the Scretan Burn (SWF04) hydraulic model. Beechwood Burn has been modelled from just south of the Highland Main Line Railway to its confluence with Scretan Burn (SWF04). The hydraulic modelling indicates that fluvial flooding occurs downstream of the Highland Main Line Railway to the watercourse's confluence with Scretan Burn (SWF04) for the design 0.5% AEP (200-year) plus CC event, predominantly on the east side of Beechwood Burn. The flooding is simulated to occur in an area of agricultural land. The results of the hydraulic modelling do not show the Highland Main Line Railway to be at fluvial flood risk, but the SEPA Surface Water Flood Maps (SEPA 2018d) indicate potential pluvial flood risk to the Highland Main Line Railway.

13.3.13 Beechwood Burn flows past the Inshes Smallholdings in its upper reaches, and consultation with The Highland Council has identified the watercourse as a potential source of flood risk in this vicinity. In 2014 properties were noted as being affected by flooding due to flow overtopping Beechwood Burn. The Inshes Smallholdings area has also been identified by both The Highland Council and SEPA as having past pluvial flooding issues causing flooding to properties / roads. A local resident has further indicated flooding occurs to his land in the vicinity of Beechwood Burn which is reported by the resident as occurring due to runoff from the garden centre and other properties / businesses (pluvial flooding).

13.3.14 Beechwood Burn has therefore been assessed as having a very high importance in terms of hydrology and flood risk.

Fluvial Geomorphology

13.3.15 Upstream of the Highland Main Line Railway, Beechwood Burn was observed to flow within a straightened ditch within which a sinuous low flow channel has recovered due to the formation of vegetated berms. Downstream, the channel has a uniform, trapezoidal cross section and a modified straight planform and laminar flow. The channel substrate consisted of silt with some gravels. Gravels were not noted to be consolidated and were poorly sorted. There was no evidence of erosion within the reach. The channel appears to currently be exhibiting a plane-riffle typology in this reach.

13.3.16 The channel banks have a 20˚ to 35˚ profile, consist of soil, and have a continuous riparian corridor comprising shrubs and unimproved grasses along the right bank and a narrow line of mature trees along the left bank. Downstream of the Highland Main Line Railway the left bank was observed to be vegetated by large deciduous trees and bushes. Adjacent land use consisted or unimproved grassland and mixed urban use.

13.3.17 Due to the modified nature of the channel, general absence of morphological features and lack of diversity of processes and flow types, Beechwood Burn has been assessed to have a low sensitivity to disturbance and therefore low importance.

Water Quality

13.3.18 Beechwood Burn is not classified by SEPA under the WFD. Land use within the Beechwood Burn catchment (~2.5km^2) comprises planted forestry (~19%), cleared forestry (~15%), farmland (~41%) and urban (road infrastructure, residential and commercial properties equals ~17%). Potential pollutants from farmland affecting water quality could include diffuse sources with high levels of nutrients (nitrogen and phosphorus). Potential pollutants from urban areas could include de-icing salt (chloride); suspended solids and contaminants bound to them (such as heavy metals and phosphorus); and oil and related compounds. Potential pollutants from forestry could include sediment and dissolved organic carbon and nutrients.

13.3.19 The watercourse receives input of treated runoff from a (Simple) CAR licenced outfall from the SuDS management train serving Inverness Campus.

13.3.20 Beechwood Burn is not anticipated to support healthy populations of designated aquatic species due to unsuitable habitat conditions with the exception of European eel (see Chapter 11: Ecology and Nature Conservation). Consequently, Beechwood Burn is considered to have a medium quality / rarity on a local scale.

13.3.21 Given the anthropogenic pressures on quality, discharge consent (for dilution and removal of waste products) and habitat suitability for biodiversity, the overall importance of Beechwood Burn for water quality is considered to be medium.

<u>Scretan Burn (SWF04)</u>

13.3.22 Scretan Burn is a medium sized watercourse and has a catchment area of approximately 7.2km^2 up to its crossing of the A96 near Seafield. The source of Scretan Burn is east of Milton of Leys (a suburb of Inverness) and the existing A9 (outside of the study area, to the south) at approximately 190m AOD. The watercourse then flows in a northerly direction through the area of the proposed scheme, before joining the Inshes Burn (SWF02) to the north-west of the Inverness Retail and Business Park, and then flowing under the existing A96, beneath the Aberdeen to Inverness Railway Line and onto towards the Inner Moray Firth. The watercourse outfalls into the Inner Moray Firth and has three notable tributaries:

- Inshes Burn (SWF02) with a confluence near the north side of Inverness Retail and Business Park;
- Beechwood Burn (SWF03) with a confluence near the southern end of Inverness Retail and Business Park; and
- SWF05 and SWF06, (field drainage ditches (which form both direct and indirect tributaries)), with confluences at the Inverness Retail and Business Park, downstream of where Beechwood Burn (SWF03) joins the Scretan Burn (SWF04).

13.3.23 The watercourse has been extensively realigned with a trapezoidal cross section and reinforced banks. Land use surrounding the watercourse consists of agricultural, urban, residential and commercial properties as well as pockets of forestry in the upper reaches. Scretan Burn is not classified by SEPA under WFD.

Photograph 5: Upstream view of Scretan Burn prior to confluence with Beechwood Burn (SWF03)

Photograph 6: Upstream view of Scretan Burn adjacent to Inverness Retail and Business Park

Hydrology and Flood Risk

13.3.24 Scretan Burn together with the lower reaches of its tributaries (Inshes Burn (SWF02), Beechwood Burn SWF03), Tributary of Scretan Burn (SWF05) and Indirect tributary of Scretan Burn (SWF06)) have been subject to hydraulic modelling as part of this assessment. The results of hydraulic modelling indicate widespread shallow flooding for the 0.5% AEP (200-year) plus CC event. The hydraulic modelling results also show that during the 0.5% AEP (200-year) plus CC event, the flood water from Cairnlaw Burn (SWF08) flows across land to the south of the Highland Main Line Railway and enters SWF05 (Tributary of Scretan Burn). The left bank of SWF05 (Tributary of Scretan Burn) is simulated to overtop due to this lateral overland flow from Cairnlaw Burn (SWF08) and flood water is simulated to flow to the west adjacent to the Highland Main Line Railway before joining SWF04 (Scretan Burn).

13.3.25 The hydraulic model predicts extensive flooding to occur from Scretan Burn inundating properties in the Cradlehall area (with approximately 20 houses in Cradlehall Meadows and Cradlehall Farm Drive residential area potentially being flooded). The model results also indicate that Cradlehall Business Park is likely to be inundated from flood water spilling from Scretan Burn and the flood water further travelling overland towards the Inverness Campus, inundating sections of two local roads. The average flood depth for the 0.5% AEP (200-year) plus CC event for the Cradlehall Meadows and Cradlehall Farm Drive residential area is simulated as 0.052m, which is likely to be below the floor level of the properties in the area. Existing drainage in this area is not included within the model, which will likely reduce the chance of flooding occurring to these properties. Approximately 50% of the baseline flood extent within the Cradlehall / Inverness Campus areas occurs in residential areas, business premises and on the local road network and these are likely to have drainage infrastructure.

13.3.26 During a 0.5% AEP (200-year) plus CC event, results of hydraulic modelling also indicates the Scretan Burn west of Cradlehall, overtops both its banks and flood water is simulated to travel parallel to the watercourse, along the floodplain. The hydraulic model simulations suggests the flood water would then re-enter the Scretan Burn immediately upstream of the culvert under the Highland Main Line Railway.

13.3.27 The results of the hydraulic model also indicate some overland flooding at the Scretan Burn confluence with Beechwood Burn (SWF03) and the Tributary of Scretan Burn (SWF05). Some flooding is also simulated upstream and downstream of the Aberdeen to Inverness Railway Line culvert as well as at some locations in the vicinity of the Inverness Retail and Business Park.

13.3.28 Areas of pluvial flooding are also shown by the SEPA Surface Water Flood Maps (SEPA 2018d) on both the Highland Main Line and Aberdeen to Inverness Railway Line tracks.

13.3.29 Flood histories received from The Highland Council report that flooding has occurred from the Scretan Burn just south / south-east of the proposed scheme with properties / gardens and roads noted as being flooded. Many of the flood incidents are attributed to culvert blockage issues which caused the watercourse to backup and spill into neighbouring land.

13.3.30 Scretan Burn has been assessed as having very high importance in terms of hydrology and flood risk.

Fluvial Geomorphology

13.3.31 The majority of Scretan Burn within the study area flows in a channel adjacent to improved pasture. A 500m section of flow is through deciduous woodland from B9006 Culloden Road to U1058 Caulfield Road North and downstream of the A96.

13.3.32 At Inshes Wood, south of B9006 Culloden Road, the channel was observed to have low sinuosity and exhibited the characteristics of a step-pool channel. The channel substrate primarily consisted of partially sorted cobbles and gravels with small boulders scattered throughout its length. The channel immediately upstream and downstream of U1124 Caulfield Road was modified, with a concrete lined bed at the culvert inlet upstream, and an overwide channel lined with gabion baskets downstream of the culvert. Downstream of the artificial reinforcements the channel narrowed between near-vertical soil banks to a width of approximately 1m with a gravel and fine-cobble bed. Two weirs were observed between U1124 Caulfield Road and U1058 Caulfield Road North.

13.3.33 North of Cradlehall Business Park the channel was observed to be straight, lacking any morphological features as characteristic of a plane bed channel, with a uniform, trapezoidal cross-section and steep soil banks. Downstream of the Highland Main Line Railway, the watercourse has a sinuous planform with small vegetated berms within a 10m wide riparian corridor. The substrate was observed to consist of poorly sorted cobbles and the bed morphology was a relatively featureless plane-bed. The channel has a narrow riparian corridor consisting of shrubs upstream of the railway and improved grasses downstream.

13.3.34 After the confluence with Beechwood Burn (SWF03) adjacent to Inverness Retail and Business Park the channel widened. Several small berms have formed providing some flow diversity within homogenous low flow channel, with erosion occasionally present on the opposing bank. Morphology appeared to consist of glide-riffle sequences. The characteristics of the channel suggest it is currently exhibiting a plane-riffle typology with infrequent deposits in this reach. The left bank consisted of soil with bank angles less than 45° and was vegetated by mature trees adjacent to Inverness Retail and Business Park. Gabion basket reinforced banks extended from the Ashton Farm access road culvert down to the A96 culvert.

13.3.35 An area of artificial bed and bank material was present immediately downstream of the culvert under the A96. Downstream of the A96 the channel was observed to be sinuous with evidence of erosion on the right bank. The height and steep gradient (75˚ to 90˚) of the right bank appeared to have resulted in geotechnical failure. Bank material within this section consists of bare earth and sand with steep or undercut bank profiles. Gravel point bars and alternating sand side bars were observed at this section deflecting the flow and causing the opposing bank to erode. The dominant flow type at this section was characteristic of a plane-riffle watercourse. Areas of ponded water from back-water effects were also observed upstream of wood debris dams and fallen trees. These characteristics suggest it is currently restoring a meandering typology in this reach.

13.3.36 Scretan Burn has a modified channel planform and modified cross section upstream of B9006 Culloden Road and adjacent to Inverness Retail and Business Park. However, where the channel is unmodified the characteristics of the water feature suggest it currently has a sinuous, plane-riffle typology evolving towards a meandering typology. It also exhibits a suitable substrate for aquatic ecology, morphological features and evidence of natural processes, such as bank scour, bank failure and deposition within a modified channel. Consequently, Scretan Burn has been assessed as having a medium sensitivity to disturbance and therefore medium importance.

Water Quality

13.3.37 Scretan Burn is not classified by SEPA under the WFD. Land use within the Scretan Burn catchment comprises planted forestry (~21%), farmland (~47%) and urban (road infrastructure, residential and commercial properties equals ~22%). Potential pollutants from forestry could include sediment, dissolved organic carbon and nutrients. Potential pollutants from farmland could include diffuse sources with high levels of (agricultural) nutrients (nitrogen and phosphorus). Potential pollutants from urban sources could include suspended solids and contaminants bound to them (such as heavy metals and

phosphorus); diffuse sources with high levels of (agricultural) nutrients (nitrogen and phosphorus); de-icing salt (chloride); and oil and related compounds.

13.3.38 There are no CAR licenced abstractions from the watercourse within the 500m study area. Outwith the 500m study area, there are five Pollution Control (Registration) CAR Licences within 100m of the Scretan Burn. Additionally, three outfalls from Scottish Water Surface Water Sewers have been identified as discharging into the Scretan Burn. These are located at approximately NGR NH70266 44423 (from Cradlehall Park residential properties), NH 69974 44710 (from Cradlehall Business Park) and NH 69693 45711 (Inverness Retail and Business Park).

13.3.39 Scretan Burn is not anticipated to support healthy populations of designated aquatic species due to unsuitable habitat conditions with the exception of the European eel (see Chapter 11: Ecology and Nature Conservation). Scretan Burn discharges into Longman Bay, which is part of the Inner Moray Firth. This area has many designations including; Ramsar, SSSI and SPA. Scretan Burn is not considered to be of high quality on a national or international scale, however it discharges into a nationally and internationally designated protected area.

13.3.40 Therefore, given the anthropogenic pressures on quality, the number of discharges (for dilution and removal of waste products) and downstream designations (for biodiversity), the overall importance of Scretan Burn for water quality is considered to be high.

Cairnlaw Burn (SWF08)

13.3.41 Cairnlaw Burn is a medium sized watercourse and has a catchment area of approximately 6km^2 (upstream of the A96 crossing). Its source appears to lie to the south of Upper Muckovie (outside of the study area) at approximately 190m AOD. From here the watercourse flows in a north-westerly direction before flowing under the Highland Main Line Railway. The watercourse then flows in a north-easterly direction through the study area, under the A96, beneath the Aberdeen to Inverness Railway Line and onto towards the Inner Moray Firth, north east of Cairnlaw. Cairnlaw Burn has three direct tributaries which are in the area of the proposed scheme:

- Un-named Drain (SWF07) - confluence at approximate NGR NH 70063 45848;
- Tower Burn (SWF10) – confluence at approximate NGR NH 69957 45675; and
- Tributary of Cairnlaw Burn (SWF11) confluence at approximate NGR NH 70673 46620

Photograph 7: Upstream View of Straightened Section of Cairnlaw Burn.

Photograph 8: Upstream View of Cairnlaw Burn in the Vicinity of Ashton Farm.

Hydrology and Flood Risk

13.3.42 Cairnlaw Burn has been subject to hydraulic modelling as part of this assessment. The results of the hydraulic modelling indicate water from Cairnlaw Burn (SWF08) is likely to overtop its left bank upstream of the Highland Main Line Railway culvert, inundating a large area of the floodplain just south of the Highland Main Line Railway. The model simulates transfer of flood flow from Cairnlaw Burn to the

tributary of Scretan Burn (SWF05) at this location during the 3.33% AEP (30-year) and larger events. The left bank of the tributary of Cairnlaw Burn (SWF05) is also simulated to overtop due to the overland flow from Cairnlaw Burn and the combined flood water is simulated to flow to the west adjacent to the Highland Main Line Railway before joining Scretan Burn (SWF04). The modelling results also indicate that flows from the watercourse overtop the right bank and the flood water is likely to cross the Highland Main Line Railway during the 0.5% AEP (200-year) plus CC event.

13.3.43 North of the Highland Main Line Railway the hydraulic model predicts that during the 0.5% AEP (200-year) plus CC event, the left bank of the Cairnlaw Burn is overtopped and a large area of the agricultural land adjacent to the Cairnlaw Burn is inundated. Land to the east of the Cairnlaw Burn is also inundated by water spilling from Cairnlaw Burn / Indirect tributary of Cairnlaw Burn (SWF09) flooding agricultural land and an access track. Between the Cairnlaw Burn confluence with Tributary of Cairnlaw Burn (SWF07) and its confluence with Tower Burn (SWF10), hydraulic modelling simulates that a large area of Cairnlaw Burn floodplain is inundated during the 0.5% AEP (200-year) plus CC event. Phase 1A of the Stratton New Town development is currently under construction to the east of the Cairnlaw Burn in the lower reaches and the SEPA Flood Map (surface water flooding for 0.5% AEP event) (SEPA 2018d) show that there may be small areas of this development that may be at flood risk.

13.3.44 The SEPA Flood Map (SEPA 2018d) indicate this watercourse is within PVA 01/20. This suggests that the area has been identified by SEPA as being particularly susceptible to flooding.

13.3.45 Cairnlaw Burn has therefore been assessed as having very high importance in terms of hydrology and flood risk.

Fluvial Geomorphology

13.3.46 Cairnlaw Burn flows in a channel adjacent to mixed use agricultural land along a straightened planform and modified trapezoidal cross section, particularly upstream of the confluence with an un-named drain (SWF07). The channel upstream of Ashton Farm was over-deep and appeared to have very limited connectivity with the floodplain due to the over-deep cross section and vertical soil banks. Channel substrate predominately consisted of poorly sorted sand, fine gravel and coarse gravels. Morphology through this length consisted of plane-riffle flow types with few notable depositional or erosional features.

13.3.47 Downstream of Ashton Farm the bank slope reduced and the floodplain widened. The channel bed was featureless, currently reflecting a plane-bed typology. Much of the riparian zone was vegetated by unimproved grassland with short lengths of shrub vegetation.

13.3.48 Downstream of the confluence with an un-named drain (SWF07) the channel was partially shaded by deciduous trees. The channel has low sinuosity and has variable dimensions due to the presence of side bars, and berms. The right bank profile was steeper than the left and has an undercut profile. A wire fence crossing the channel has caused a back-water affect and upstream aggradation.

13.3.49 East of C1032 Barn Church Road the channel passes through a short artificially straightened reach prior to a sinuous section with small gravel point bars, vegetated berms and erosion on the opposing bank. The morphology through the reach suggests a transition from plane-riffle to active meandering. The channel has a consolidated gravel and cobble bed with very little sorting evident. Banks were steep but the channel was not over-deep and was likely connected to its floodplain.

13.3.50 Upstream of the confluence with a tributary of Cairnlaw Burn (SWF11) the cross section, planform and morphology were uniform and straight with occasional side bars in a channel that would otherwise be characterised as a plane-bed channel.

13.3.51 Downstream of the A96 and Aberdeen to Inverness Railway Line, the channel of Cairnlaw Burn has been modified and was constrained by artificial reinforcement. Downstream of the reinforced reach the channel has a sinuous planform with a varied cross section, pool-riffle sequences and fine gravel and pebble substrate. The features present suggest the channel has a meandering planform. The channel passes under U1144 Milton of Culloden road through a brick arch bridge and flows through straight, uniform length of channel with a sandy substrate for approximately 150m. The channel passed down a small bedrock cascade, approximately 1m high and 2m long, to the Inner Moray Firth. The riparian zone was complex and consisted of large mature deciduous trees and shrubs.

13.3.52 With the exception of the reach 160m upstream from the A96 culvert and downstream of the A96 culvert the Cairnlaw Burn would be considered to be a plane-riffle channel showing evidence of restoration to an active meandering channel.

13.3.53 Cairnlaw Burn is designated as a WFD water body and consultation undertaken with SEPA in June 2018 indicated that it is currently achieving 'Bad' physical condition (however this status change has not yet been reflected on the SEPA's Water Classification Hub). However, based on the diversity and frequency of depositional and erosional features present within the water feature that would suggest adjustment, it has been assessed as having a medium sensitivity to disturbance and therefore medium importance.

Water Quality

13.3.54 Cairnlaw Burn is classified by SEPA (river ID 20241) under the WFD. In the latest 2017 classification its Overall status and Overall ecology were classified as 'Moderate' with a Physio-Chemical status of 'High' (SEPA 2018d).

13.3.55 Within the study area the catchment of Cairnlaw Burn is approximately 3.2km^2. Plantation woodland and forestry in the upper reaches of the watercourse (near Drummosie Muir) covers approximately 46% and may input potential pollutants including sediment, dissolved organic carbon and nutrients into the watercourse. The watercourse flows through the settlements of Cradlehall and Westhill and urban land use covers approximately 12% of the catchment, with farmland/agricultural fields comprising the greatest other proportion of land uses, equating to approximately 34%. Potential pollutants from the urban and agricultural land uses could include suspended solids and contaminants bound to them (such as heavy metals and phosphorus); diffuse sources with high levels of (agricultural) nutrients (nitrogen and phosphorus); de-icing salt (chloride); and oil and related compounds.

13.3.56 There are no CAR licenced abstractions from the Cairnlaw Burn within 50m of the watercourse or outwith the study area of the proposed scheme. However, there are two sewage discharges as reported within Table 13.8.

13.3.57 In 2017, Cairnlaw Burn has been assigned 'Good' status for 'Biological Elements' (SEPA 2018c). There is some potential for Cairnlaw Burn to support populations of designated aquatic species due to the presence of suitable habitat conditions and accessible fish passage along its course. Cairnlaw Burn is also known to support European eel, which is a critically endangered species (see Chapter 11: Ecology and Nature Conservation). Cairnlaw Burn discharges into Longman Bay and the Inner Moray Firth which has multiple designations including; Ramsar, SSSI and SPA.

13.3.58 Considering anthropogenic pressures on water quality, the number of discharges (for dilution and removal of waste products), downstream designations and endangered species, the overall importance of Cairnlaw Burn for water quality is considered to be very high.

Tower Burn (SWF10)

13.3.59 Tower Burn is a relatively small watercourse with a catchment area of approximately 2.89km^2. The source of the Tower Burn is located immediately north of Easter Bogbain at approximately 180m AOD and flows north along a straightened length of channel through Smithton to a wooded area with a sinuous channel where it meets the confluence with Cairnlaw Burn (SWF08) immediately south of the A96. The watercourse has one major tributary, the Indirect tributary of Cairnlaw Burn (SWF09).

13.3.60 Land use surrounding the watercourse consists of urban residential and commercial areas, rough grassland and small woodlands. Tower Burn is not classified under the WFD.

Photograph 9: Upstream View of Tower Burn in Incised Section.

Photograph 10: Downstream View of Tower Burn Towards Confluence with Cairnlaw Burn (SWF08).

Hydrology and Flood Risk

13.3.61 Tower Burn has been included in the Cairnlaw Burn (SWF08) hydraulic model up to its confluence with the indirect tributary of Cairnlaw Burn (SWF09). Results of hydraulic modelling indicate that the watercourse overtops its bank on both the right and left-hand bank over stretches of the watercourse between its confluence with the indirect tributary of Cairnlaw Burn (SWF09) and Cairnlaw Burn (SWF08) but only a small volume of flood floodwater spills out of bank. Phase 1A of the Stratton New Town development is currently under construction to the east of Tower Burn and there is likely to be a potential of flood risk (surface water flooding for 0.5% AEP event as shown by SEPA Flood Map (SEPA 2018d)) to small areas of the development. The flood extents, however, appear to be in close proximity to the watercourse and therefore the flood risk is likely to be minimal.

13.3.62 The SEPA Flood Map (SEPA 2018d) show this watercourse is within PVA 01/20. This indicates that the general area has been identified by SEPA as being particularly susceptible to flooding.

13.3.63 The watercourse is shown by mapping data to flow in close proximity to approximately 50 residential properties in its upper reaches as well as the local road network and crosses the Highland Main Line Railway.

13.3.64 Information received from The Highland Council reports water flowing down the embankment and damaging the roadside drainage on C1032 Barn Church Road just downstream of the Tower Burn confluence with Cairnlaw Burn (SWF08). Flooding incidents have also been reported by The Highland Council in the upper reaches of Tower Burn (SEPA 2019c). Acceleration of erosion on the river banks has been highlighted as an issue leading to loss of gardens and risk to houses. Severe flooding from Tower Burn, which resulted in the evacuation of three council houses for 12 months, was also reported as occurring in 2002; a culvert blockage due to gravel from bed and bank erosion resulted in silt being washed into gardens in close proximity to the watercourse.

13.3.65 Tower Burn has been assessed as having high importance in terms of hydrology and flood risk.

Fluvial Geomorphology

13.3.66 Tower Burn has undergone high impact realignment upstream of B9006 Culloden Road, presumably to accommodate drainage for the agricultural and forestry land. The channel has also been culverted at several locations. The planform of the surveyed reach upstream of the confluence with Cairnlaw Burn (SWF08) was unmodified.

13.3.67 Upstream of the confluence with Cairnlaw Burn (SWF08)), Tower Burn has a narrow channel with a low sinuosity planform and vertical soil banks, approximately 0.3m high, within a woodland valley. Within the upstream length of the woodland banks were higher, vertical and bare suggesting incision. There was limited evidence to suggest geotechnical failures had taken place. Channel substrates became finer

closer to the confluence with Cairnlaw Burn (SWF08), grading from cobbles to fine gravels. Gravels and sands were deposited as lateral bars and mid-channel bars naturally and behind obstructions (e.g. pipes and woody material). Small woodland ponds were present in the floodplain. Plane-riffle flow sequences were observed through the reach. The characteristics of the reach suggest it has a plane-riffle typology with infrequent bar deposits.

13.3.68 Riparian vegetation consisted of large deciduous trees with an understory of simple grasses. The riparian corridor elsewhere within the catchment appeared to consist of agricultural grassland with shrubs and small clusters of trees. A cover of mature broadleaf trees was present on both bank tops for a distance of 1.1km through Smithton.

13.3.69 The baseline conditions of Tower Burn have identified morphological features which suggest some minor morphological activity within an otherwise 'unmodified' reach of the water feature. Therefore, it is assessed to have a medium sensitivity to disturbance and therefore medium importance.

Water Quality

13.3.70 Tower Burn is not classified by SEPA under the WFD. Plantation woodland in the upper reaches covers approximately 13% of catchment land use, but farmland comprises the largest at approximately 48%. As the watercourse flows north towards the Inner Moray Firth, it passes through the settlements of Westhill and Smithton with urban areas covering approximately 30% of total catchment land use. Tower Burn is joined by various small tributaries in the upper reaches of the catchment and has a confluence with the Indirect tributary of Cairnlaw Burn (SWF09) in the lower catchment, approximately 300m before it confluences with Cairnlaw Burn (SWF08) at Stratton. The potential pollutants influencing water quality are very similar to those stated for Cairnlaw Burn (SWF08) (above) albeit there is a greater percentage coverage of urban and farmland areas compared to forestry.

13.3.71 There are no CAR Licenced abstractions for Tower Burn, however there are CAR Pollution Control Licences (Registration) within 50m of the watercourse at Upper Muckovie Castle Cottage and Easter Bogbain relating to sewage effluent, as reported within Table 13.8.

13.3.72 Tower Burn is not anticipated to support healthy populations of designated aquatic species due to unsuitable habitat conditions with exception of European eel (see Chapter 11: Ecology and Nature Conservation). However, Tower Burn is a tributary of Cairnlaw Burn (SWF08), which discharges into the Inner Moray Firth (designations include; Ramsar, SSSI and SPA (mostly regarding bird species)).

13.3.73 Given the anthropogenic pressures on quality, the number of discharges (for dilution and removal of waste products) and that it is a tributary to a watercourse discharging to a Ramsar, SSSI and SPA site (for biodiversity), Tower Burn has been assessed as having a high importance.

<u>The Inner Moray Firth</u>

Water Quality

13.3.74 The Inner Moray Firth is a designated Ramsar and SPA and is included within the Moray Firth transitional water body as classified by SEPA (ID: 200440) under the WFD. The Longman and Castle Stuart Bay SSSI also covers the same area as the Ramsar and SPA. The Moray Firth WFD transitional water body has an area of 61.7 km^2. In 2017, SEPA classified the water body as having an Overall status of 'Good', with 'High' Physico-Chemical status, 'Good' Overall ecology status, and 'Good' status for Biological elements. The designations are particularly related to the importance for wading bird species (further detail is provided in Chapter 11: Ecology and Nature Conservation). The Moray Firth WFD water body is shown on Figure 13.1 and the Inner Moray Firth Ramsar / SPA and Longman and Castle Stuart Bay SSSI are shown on Figure 11.1 (accompanies Chapter 11: Ecology and Nature Conservation).

13.3.75 All watercourses within the study area discharge (either directly or indirectly) to the Inner Moray Firth.

13.3.76 Potential pollutants from surrounding land uses could include; sediment, dissolved organic carbon, suspended solids and contaminants bound to them (such as heavy metals and phosphorus); diffuse sources with high levels of (agricultural) nutrients (nitrogen and phosphorus); de-icing salt (chloride); and oil and related compounds.

13.3.77 The Inner Moray Firth has internationally recognised designations (Ramsar, SSSI and SPA) and is therefore considered to be very high importance for water quality.

Minor Tributaries and Drainage Channels

13.3.78 Table 13.9 describes the baseline conditions for the minor tributaries and drainage channels potentially affected by the proposed scheme, which have a catchment area of less than 0.5km^2.

Table 13.9: Baseline Conditions - Minor Tributaries and Drainage Channels

Surface Water Feature	Photograph	Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality
Tributary of Scretan Burn (SWF05) **Catchment area: 0.3km²**		Watercourse has been subject to hydraulic modelling as it is part of Scretan Burn (SWF04) catchment. The results of hydraulic modelling indicate flooding occurs for the 0.5% AEP (200-year) plus CC event to both the east and west of the watercourse on the south side of the Highland Main Line Railway, where the tributary flows in close proximity to several houses. Flooding is exacerbated by water overflowing from Cairnlaw Burn (SWF08) and flowing overland into the watercourse at 3.3% AEP (30-year) and larger event. Flood water from the watercourse then spills on the left-hand bank and flows overland into Scretan Burn (SWF04). Flooding to properties in Cradlehall is predicted to occur at the design flood event to the east of the watercourse. This is predominantly due to flooding from Scretan Burn (SWF04), but this is exacerbated due to the transferred flood flow from Cairnlaw Burn (SWF08) through this watercourse. Flooding is also predicted at the 0.5% AEP (200-year) plus CC event downstream of the Highland Main Line Railway and also at its confluence with Scretan Burn (SWF04) in the vicinity of the Inverness Retail and Business Park (flooding agricultural land). Watercourse is considered to be high importance in relation to flood risk.	A small plane-bed water feature with a straight planform and trapezoidal cross section. The riparian zone consisted of shrubs and unimproved grasses on the right bank only. Flow was laminar and the substrate consisted of silt, gravel and cobbles with a uniform bed. Assessed as having a low sensitivity and therefore low Importance.	Land uses consist predominately of agricultural fields. Potential pollutants could include suspended solids and nutrients (nitrogen and phosphorous) from agricultural sources including fertilisers. A Scottish Water Surface Water Sewer outfall discharges from Cradlehall Meadows, approximate NGR NH 70008 44950. It is a field drainage channel and is considered to be low quality on a local scale. Not anticipated to support designated aquatic species. Assessed as having low importance for water quality.

Surface Water Feature	Photograph	Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality
Indirect Tributary of Scretan Burn (SWF06) **Catchment area: 0.06km²**		Not on SEPA Flood Map (catchment area <3km²). The tributary / drainage channel has been subject to hydraulic modelling within Scretan Burn (SWF04) model. The results of hydraulic modelling indicate that flow is maintained within bank at the 0.5% AEP (200-year) plus CC event. No sensitive receptors in close proximity to watercourse. Watercourse has been assessed as having a low importance for flood risk.	A straight trapezoidal plane-bed water feature. The watercourse has a discontinuous fence line on the banks, and a natural grass and tree lined riparian zone. Channel substrate was observed to be silt. The downstream reaches are un-fenced and substrate consisted of gravels and small cobbles. Where flow was perceivable it was typically laminar and tranquil. Assessed as having a low sensitivity and therefore low importance.	With the exception of the Scottish Water Surface Water Sewer outfall, baseline is the same as for Tributary of Scretan Burn (SWF05). Assessed as having low importance for water quality.
Un-named Drain (SWF07) **Catchment area: 0.04km²**		Not on SEPA Flood Map (catchment area <3km²). Flows along the side of a local road before flowing across a field and into Cairnlaw Burn (SWF08). This drain has been included in the hydraulic model as part of Cairnlaw Burn (SWF08) model. At the 0.5% AEP (200-year) plus CC event, the hydraulic model predicts flooding on the left-hand bank of the drain near its confluence with the Cairnlaw Burn. The flood extents are likely to be due to flooding from Cairnlaw Burn (SWF08). SEPA Flood Map (SEPA 2018d) show that this watercourse is on the outskirts of PVA 01/20 (area sensitive to flood risk). Considered to be medium importance in relation to flood risk.	The watercourse was observed to be a road drainage channel in the upstream section and a straightened field drain downstream, the characteristics of which typically conform to those of a plane-bed channel. The downstream section has a continuous tree lining on the right bank and an intermittent fence on the left bank. Water within the channel was not perceived to be flowing and channel substrate consisted of silt at the time of survey. Assessed to have a low sensitivity and therefore low importance.	With the exception of the Scottish Water Surface Water Sewer outfall, baseline is the same as for Tributary of Scretan Burn (SWF05). Assessed as having low importance for water quality.

Surface Water Feature	Photograph	Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality
Indirect Tributary of Cairnlaw Burn (SWF09) **Catchment area: 0.44km²**		This watercourse has been subject to hydraulic modelling as it is part of Cairnlaw Burn (SWF08) model. The results of hydraulic model indicate that this watercourse receives flood water from Cairnlaw Burn (SWF08) just north of the Highland Main Line Railway during the 0.5% AEP (200-year) plus CC event. The results of hydraulic model also indicate that flooding occurs on both the left and right-hand banks of the watercourse, inundating the agricultural land and the access road to Resaurie. Flooding is predicted to occur over most of the reach of the watercourse up to its confluence with Tower Burn (SWF10). The watercourse is on the edge of Phase 1A of the Stratton New Town development at its confluence with Tower Burn (SWF10) and SEPA Flood Map (SEPA 2018d) indicate that the watercourse has the potential to pose a flood risk (surface water flooding from 0.5% AEP event (SEPA 2018d)) to the development. The watercourse also flows close to residential properties upstream and downstream of the Highland Main Line Railway. Flood histories from The Highland Council indicate fluvial flooding occurred in 1999 due to a burn overflowing south of the Highland Main Line Railway. SEPA Flood Map (SEPA 2018d) show this watercourse is within PVA 01/20 (area sensitive to flood risk). Watercourse considered to be of high importance in relation to flood risk.	A small straightened channel, that shares characteristics with a plane-bed channel, with shrub vegetation within the riparian zone. The watercourse was observed to flow between small alternating berms within the channel bounds. Assessed to have a low sensitivity to disturbance and therefore low importance.	With the exception of the Scottish Water Surface Water Sewer outfall, baseline the same as Tributary of Scretan Burn (SWF05). Assessed as having low importance for water quality.

Summary of Watercourses

13.3.79 Table 13.10 summarises the importance, according to criteria outlined in Table 13.5, of watercourses within the proposed scheme 500m study area.

Table 13.10: Summary of Surface Water Importance

Surface Water Feature	Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality
Inshes Burn (SWF02)	very high	low	high
Beechwood Burn (SWF03)	very high	low	medium
Scretan Burn (SWF04)	very high	medium	high
Tributary of Scretan Burn (SWF05)	high	low	low
Indirect tributary of Scretan Burn (SWF06)	low	low	low
Un-named drain (SWF07)	medium	low	low
Cairnlaw Burn (SWF08)	very high	very high	very high
Indirect tributary of Cairnlaw Burn (SWF09)	high	low	low
Tower Burn (SWF10)	high	medium	high
Inner Moray Firth	N/A	N/A	very high
Public Water Supply	N/A	N/A	very high

13.4 Potential Impacts

Introduction

13.4.1 This section describes the assessment of potential impacts of the proposed scheme on the surface water environment, that could arise in the absence of mitigation measures (i.e. those not already embedded within the proposed scheme designs).

13.4.2 The potential impacts reported in this section are assessed in the context of the existing land use as defined in Chapter 5 (Overview of Assessment). It is acknowledged that land use in the area will evolve overtime with cognisance of the aspirations of the local development plan, and in the future the proposed scheme would be located within a landscape which has undergone substantial change; the existing land (mainly agricultural land) becoming urbanised as a result of a series of proposed mixed-use developments.

13.4.3 The potential cumulative impacts of the proposed scheme in-combination with other committed / reasonably foreseeable developments are assessed in Chapter 19 (Assessment of Cumulative Effects). However, as the proposed scheme results in impacts on the same watercourse catchments as the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, potential impacts from these schemes in combination are considered in this section.

13.4.4 Associated potential impacts affecting groundwater and ecological receptors are addressed in Chapter 12 (Geology, Soils, Contaminated Land and Groundwater) and Chapter 11 (Ecology and Nature Conservation) respectively.

13.4.5 Potential impacts are presented for each watercourse and are attributed to the specific activities that may impact on each of them. All potential impacts reported are adverse, unless otherwise stated.

Construction

13.4.6 This section presents the potential impacts likely to occur during construction in the absence of mitigation. Potential impacts arising from construction activities are typically considered to be short-term, although in some cases they can have longer term effects. For instance, short-term, acute impacts on water quality could have longer term chronic effects on aquatic ecology (see Chapter 11: Ecology and Nature Conservation). The potential impacts during construction are described in Table 13.11 for Hydrology and Flood Risk, Fluvial Geomorphology and Water Quality / Water Supply.

Table 13.11: Impact Assessment – Construction

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
Hydrology and Flood Risk						
Inshes Burn (SWF02)	Construction of road / infrastructure in close proximity.	Increase in runoff rates/ flood risk	Potential for increase in hardstanding area and / or soil compaction during construction resulting in temporary increase in runoff rates.	very high	negligible adverse	Neutral
Beechwood Burn (SWF03) **Scretan Burn (SWF04)**	Construction of mainline / side road / A9 widening (SWF03 only) in close proximity.	Increase in runoff rates/ flood risk	Potential for increase in hardstanding area and / or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	very high	major adverse	Very Large
	SWF03: Construction of one new culvert, one culvert replacement and one culvert extension. **SWF04:** Construction of three new culverts.	Increase in flood risk / impacts on flow pathways	Culvert construction /replacement /extension, in-channel works and temporary construction structures placed within the floodplain may cause; restriction in flood flows, temporary increase in flood risk locally and may be susceptible to flood damage. Temporary channel diversions may also increase flood risk and cause disruption / blockage of existing natural flow pathways.			
	Construction of road drainage outfalls. Two outfalls on each watercourse, are proposed to be constructed discharging into SWF03 and SWF04.	Increase in flood risk / potential impact on flow characteristics.	Potential increases in peak flow rates going into water feature due to temporary construction works for SuDS within catchments. Changes to flow characteristics due, for example, to disturbance or unintentional changes to channel dimensions and / or sedimentation associated with outfall construction works which may impact on the hydraulic flow characteristics of a water feature.			
	SWF03: Construction of two swales (with associated wetland/filter drain). **SWF04:** Construction of one enhanced swale (with filter drain) and one wetland (with filter drain).	Increase in flood risk	Temporary increase in flood risk due to increased runoff rates into the watercourse due to increased soil compaction and hardstanding during construction of the swales / wetlands/filter drains. Potential loss of floodplain storage due to works in the floodplain.			
Tributary of Scretan Burn (SWF05)	Construction of mainline / side road in close proximity.	Increase in runoff rates / flood risk	Potential for increase in hardstanding area and / or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	high	moderate adverse	Moderate

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
	Construction of two new culverts	Increase in flood risk / impacts on flow pathways	Culvert construction, in-channel works and temporary construction structures placed within the floodplain may cause; restriction in flood flows, temporary increase in flood risk locally and may be susceptible to flood damage. Temporary channel diversions may also increase flood risk and cause disruption / blockage of existing natural flow pathways.			
Indirect tributary of Scretan Burn (SWF06)	Construction of mainline / side road in close proximity.	Increase in runoff rates/ flood risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	low	minor adverse	Neutral
Un-named Drain (SWF07)	Construction of mainline / local road in the locality.	Increase in runoff rates/ flood risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	medium	negligible adverse	Neutral
Cairnlaw Burn (SWF08)	Construction of mainline / side road in close proximity.	Increase in runoff rates/ flood risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	very high	major adverse	Very Large
	Construction of three swales (with associated wetlands / retention pond).	Increase in flood risk	Temporary increase in flood risk due to increased runoff rates into the watercourse due to increased soil compaction and hardstanding during construction on the swales / wetlands / retention pond. Potential loss of floodplain storage due to works in the floodplain.			
	Construction of two new culverts	Increase in flood risk / impacts on flow pathways	Culvert construction, in-channel works and temporary construction structures placed within the floodplain may cause; restriction in flood flows, temporary increase in flood risk locally and may be susceptible to flood damage. Temporary channel diversions may also increase flood risk and cause disruption / blockage of existing natural flow pathways.			
	Construction of two road drainage outfalls.	Increase in flood risk / potential impact on flow characteristics.	Potential increases in peak flow rates going into water feature due to temporary construction works for SuDS within catchments. Changes to flow characteristics due, for example, to disturbance or unintentional changes to channel dimensions and/or sedimentation associated with outfall construction works which may impact on the hydraulic flow characteristics of a water feature.			
Indirect tributary of Cairnlaw Burn (SWF09) **Tower Burn (SWF10)**	Construction of mainline in close proximity to SWF.	Increase in runoff rates / flood risk	Potential for increase in hardstanding area and / or soil compaction during construction resulting in temporary increase in runoff rates. Potential for reduced natural floodplain conveyance due to construction materials / plant / works within the floodplain.	high	negligible adverse	Neutral

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
Fluvial Geomorphology						
Beechwood Burn (SWF03)	Earthworks/ construction in vicinity to watercourse and in channel working Construction of roads, new culvert, culvert extension, culvert replacement and outfalls.	Increased sediment delivery into the channel and/or downstream.	Bare earth, excavation (including the channel bank/bed), construction of earthworks, culverts and outfall installation and use of plant in and around the channel, could increase sediment delivery. This could cause aggradation or channel narrowing, smothering and damage to valuable morphological features in and around the channel and coarse substrate.	low	moderate adverse	Slight
		Damage to morphological features, channel bed and bank	Disturbance and direct damage to bars, berms, and channel substrate. In-channel works (including tracking of plant through the channel) and works on and near the bank could overload the bank and/or reduce bank stability, which could increase bank erosion and the possibility of failure damaging the channel bed and bank and delivering fine sediment downstream. Natural lengths of channel bed and banks as well as important geomorphological features such as berms and bars would be excavated to enable the construction of outfalls. Construction of culvert C05, replacement of culvert C09 and extension of culvert C10 will require the removal of gravel/pebble substrate and marginal berms where present, reducing the morphological diversity of the channel. Tracking plant through the watercourse and riparian vegetation clearance during the construction of this culvert could release fine sediments which could smother coarse substrate downstream and cause the compaction of mobile gravel substrate where present.			
		Altered flow pathways	Storage and compaction of the earth could alter flow paths. This could cause increase sediment delivery and alter volumes and velocities of flow subsequently altering morphological processes in channel.			
		Release of construction material	Release and delivery of fine construction material including concrete and cement materials to the watercourse. This could result in smothering and damage to morphological features and substrate.			
	Temporary watercourse diversions/ pumping	Increased erosion/ deposition	Increase in sediment deposition as water collects upstream of impoundment. Increase in erosion as water is released downstream of work area.			
	Removal of riparian vegetation	Increased sediment delivery	Removal of riparian vegetation may destabilise channel banks leading to future erosion/bank failure. Release of fine sediment during vegetation removal.			
Scretan Burn (SWF04) **Cairnlaw Burn (SWF08)**	Earthworks/ construction in vicinity of watercourse and in channel working Construction of roads, culverts and outfalls.	Increased sediment delivery	Refer to impact assessment for SWF03 for impacts.	medium	major adverse	Large
		Damage to morphological features, channel bed and banks	Impacts to SWF04 and SWF08 are largely similar to those reported for SWF03, with the following differences: **SWF04:** Increased runoff of sediment laden flows, increased sediment delivery and in channel and bankside works could lead to the smothering of valuable morphological features in the channel and coarse substrate.			

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
			Construction of culvert C04 would require the removal of natural channel bed and banks along a length of sinuous channel with a low flow channel and gravel substrate. This would reduce the morphological diversity and would likely have a significant effect on the downstream length of the watercourse, burying sediment and altering existing morphological processes. Tracking of plant and riparian vegetation clearance during construction both at this crossing and at culvert C01 and culvert C08 (culvert associated with non-motorised users (NMU) link) could release fine sediments which could smother coarse substrate downstream and cause the compaction of mobile gravel substrate. **SWF08**: The construction of Cairnlaw Burn Culvert No. 1 (C06), the tracking of plant through the water feature and riparian vegetation clearance during the construction both at this crossing and the upstream crossing could release fine sediments which could smother coarse substrate downstream and cause the compaction of mobile gravel substrate. Construction of the Cairnlaw Burn Culvert No.2 (C07) would require the excavation and replacement of natural channel banks, berms and gravel bars which are present in the lower course of the channel. These would be replaced with hard surfaces and fixed channel dimensions. This would reduce the morphological diversity of the water feature and would likely have a significant effect on the downstream length of the water feature.			
		Altered flow pathways	Refer to impact assessment for SWF03 for impacts.			
		Release of construction material	Refer to impact assessment for SWF03 for impacts.			
	Temporary watercourse diversions/ pumping	Increased erosion/ deposition	Increase in sediment deposition as water collects upstream of impoundment. Increase in erosion as water is released downstream of work area. This could potentially mobilise and erode gravel bars and vegetated berms present downstream of both SWF04 and SWF08.			
	Removal of riparian vegetation	Damage to bank and morphological features	Reduced bank stability due to removal of root structures which could lead to increased erosion. Release of fine materials during vegetation clearance and removal, subsequently leading to smothering of gravel substrate and morphological features downstream. A reduction in in riparian diversity and associated damage to the channel bank and morphological features could occur during the process of removal and from increased fine sediment supply from vegetation clearance, notably to coarse deposits and steep banks present on both SWF04 and SWF08.			
		Increased sediment delivery	Removal of riparian vegetation may destabilise channel banks leading to future erosion/bank failure releasing fine sediment during vegetation removal which could bury coarse substrate, gravel bars and cause the channel to aggrade.			
Tributary of Scretan Burn SWF05	Refer to impact assessment for SWF03 for activities and impacts.			low	minor adverse	Neutral

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
Water Quality						
Beechwood Burn (SWF03)	Widening of current mainline (A9) Site clearance activities Construction of mainline and side road, culverts (new, replacement and extension), SuDS and drainage/SuDS outfalls	Increased input of sediment-laden runoff Accidental spillage of fuels, oils, cementitious material or other polluting substances.	A temporary measurable decrease in water quality (including EQS) for more than one month. Decline in pollutant removal capacity resulting from increased risk of chemical pollution. A decline in river ecosystem health and loss of aquatic species due to the decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). Exposed soil/earthworks and inadequate construction drainage systems could induce smothering of the riverbed within the watercourse channel from increased sediment-laden runoff. Sewage inputs from uncontrolled release from damaged pipeline (a CSO runs parallel to SWF03 after it is culverted under Highland Main Railway Line).	medium	major adverse	Large
Scretan Burn (SWF04)	Site clearance activities Construction of mainline and side road (including Cradlehall Railway Bridge), five culverts, SuDS and drainage/SuDS outfalls.	Increased input of sediment-laden runoff Accidental spillage of fuels, oils, cementitious material or other polluting substances.	A temporary measurable decrease in water quality (including EQS) for more than one month. Decline in pollutant removal capacity resulting from increased risk of chemical pollution. A decline in river ecosystem health and loss of aquatic species due to the decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). Exposed soil/earthworks and inadequate construction drainage systems could induce smothering of the riverbed within the watercourse channel from increased sediment-laden runoff.	high	major adverse	Very Large
Tributary of Scretan Burn (SWF05)				low	major adverse	Moderate
Indirect tributary of Scretan Burn (SWF06)			A temporary measurable decrease in water quality (including EQS) for less than one month. Decline in pollutant removal capacity resulting from increased risk of chemical pollution. A decline in river ecosystem health and loss of aquatic species due to the decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). Exposed soil/earthworks and inadequate construction drainage systems could induce smothering of the riverbed within the watercourse channel from increased sediment-laden runoff.	low	moderate adverse	Slight
Cairnlaw Burn (SWF08)	Site clearance activities Construction of mainline and side road (including Cradlehall Railway Bridge), two culverts, SuDS and drainage/ SuDS outfalls.	Increased input of sediment-laden runoff Accidental spillage of fuels, oils, cementitious material or other polluting substances.	A temporary measurable decrease in water quality (including EQS) for more than one month. If this impact is prolonged it could lead to downgrade of physio-chemical status. Decline in pollutant removal capacity resulting from increased risk of chemical pollution. A decline in river ecosystem health and loss of aquatic species due to the decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). If this impact is prolonged it could lead to downgrade of overall ecological status.	very high	major adverse	Very Large

Surface Water Feature	Activities	Type of Impact	Description – Construction Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
			Sewage inputs from uncontrolled release from damaged pipelines (a CSO crosses and runs parallel to proposed scheme from approximately chainage 850 to 1100). Exposed soil/earthworks and inadequate construction drainage systems could induce smothering of the riverbed within the watercourse channel from increased sediment-laden runoff.			
Inner Moray Firth	Works on tributaries of the Inner Moray Firth	Increased input of sediment-laden runoff Increased pollutant loading due to accidental spillage of fuels, oils, cementitious material or other polluting substances from tributaries (SWF04 and SWF08 (direct) and all other watercourses (indirect))	A temporary measurable decrease in water quality for more than one month. The pathways for this runoff entering estuary would be tributaries SWF04 and SWF08. Subsequent consequences could be a decline in foreshore and intertidal ecosystem health and loss of protected aquatic species due to the decline in water quality (e.g. chemical release or excessive sediment loading). If construction impact were prolonged it could lead to downgrade of Physio-chemical and/or overall ecological status.	very high	moderate adverse	Large
Water Supply						
Scottish Water Main Pipeline	Site clearance activities Construction of the mainline and side roads Widening of existing roads	Potential to cause severance or damage of water mains and/or a decline in water quality either during or after construction has ceased.	Potential impacts apply to all locations where the proposed scheme intersects Scottish Water Main pipelines, as highlighted in Section 13.3 (Baseline Conditions).	very high	major adverse	Very Large

Operation

13.4.7 This section presents the potential impacts likely to occur during operation in the absence of mitigation. Operational impacts are generally longer-term or permanent effects that would influence watercourses after the proposed scheme is constructed. The potential operational impacts are described in Table 13.12 for Hydrology and Flood Risk, Fluvial Geomorphology and Water Quality.

Table 13.12: Impact Assessment - Operation

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
Hydrology and Flood Risk						
For hydrology and flood risk it has been estimated that the proposed scheme (unmitigated) would result in the loss of approximately 725m^3 of flood storage due to the construction of the proposed scheme in the functional floodplain. This would result in an increase in flood depth upstream of the proposed scheme but no increase in flood risk to sensitive receptors.						
Inshes Burn (SWF02)	Operation of A9 additional lane.	Increased runoff rates	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates.	very high	negligible adverse	Neutral
Beechwood Burn (SWF03)	Operation of mainline and side road	Increased runoff rates / increased flood risk	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates. Loss of a small volume of floodplain storage (94m^3) due to construction of the proposed scheme. The construction of the new culvert (CO5) and carriageway results in increased peak flooding depths immediately upstream of the culvert with a peak depth increase of 0.128m (major adverse). The increased flood depths occur in an area of current agricultural land (in close proximity to the Inverness Retail and Business Park). A footpath is also likely to be inundated. Downstream of the culvert (C05) a minor to major beneficial impact on flood depths is simulated on the right bank.	very high	major adverse	Very Large
	Operation of one new culvert, one culvert replacement and one culvert extension.	Increase in flood risk	Alterations to flood risk due to construction of a new culvert / replacement culvert / culvert extension.			
	Operation of two new road drainage outfalls		Potential impact to flood risk due to alteration to area draining to the catchment due to road drainage and due to two road drainage outfalls discharging to watercourse.			
	Operation of new swales (with associated wetland / filter drain)		Potential alterations to flood risk due to operation of two new swales (and associated wetland / filter drain) in close proximity to watercourse.			
Scretan Burn (SWF04)	Operation of mainline and side road	Changes to runoff and flow characteristics. Increased flood risk.	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates. Loss of a small volume-of floodplain storage (340m^3) due to construction of the proposed scheme. Hydraulic modelling simulates that the proposed scheme has a major adverse impact on flood depths (with a peak flood depth increase of 1.916m) immediately upstream of culvert C01 with a minor adverse impact on flood depths downstream of the culvert on the right bank. The receptor immediately upstream and downstream of culvert C01 is agricultural land. The left bank of the watercourse has a decrease in flood depths and the flood depths simulated to flow overland to the Inverness Campus are greatly reduced (assessed from major beneficial impact to negligible impact).	very high	major adverse	Very Large

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
			Minor beneficial impacts on flood depths are also simulated over small areas in the vicinity of the Inverness Retail and Business Park.			
	Operation of three new culverts	Increase in flood risk	Alterations to flood risk due to construction of three new culverts.			
	Operation of two new road drainage outfalls		Potential impact to flood risk due to alteration to area draining to the catchment due to road drainage and due to two road drainage outfall discharging to this watercourse.			
	Operation of new swale and wetland (with associated filter drains)		Loss of floodplain storage (40m^3) and alterations to flood risk due to operation of a new swale and wetland (with associated filter drain) in close proximity to watercourse.			
Tributary of Scretan Burn (SWF05)	Operation of mainline and side road	Increased runoff rates / increased flood risk	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates. Loss of a small volume of floodplain storage (116m^3) due to construction of the proposed scheme. Hydraulic modelling simulates moderate adverse increases in flood depths upstream of the Highland Main Line Railway (with increased peak flood depths of 0.075m being simulated in the left floodplain). Major adverse increases in flood depths are simulated downstream of the Highland Main Line Railway for the combined 'worst case' model run simulations (with increased peak flood depths of 0.578m being simulated in the left bank floodplain). Flooding is simulated in areas of current agricultural land. Small areas of minor adverse increases in flood depths (increased peak flood depths of 0.012m) are also simulated upstream of the confluence with Scretan Burn (SWF04), also in areas of current agricultural land. Small areas of minor beneficial where decreases in flood depths are also simulated. For the design flood event duration run to culverts C02 and C03 no change in flood depths are simulated upstream of culverts C02 and C03 (Run 2c). This run does not include the design flood event duration to the proposed scheme for Scretan Burn (SWF04) (which SWF05 is a tributary) or Cairnlaw Burn (SWF08) (which is simulated to transfer flood water into SWF05 during flood events from the 3.33% AEP (30-year) and larger events (incorporated in design Runs 2a and 2b respectively)). The larger impact of all design runs is reported in the magnitude column.	high	major adverse	Large
	Operation of two new culverts	Increase in flood risk	Alterations to flood risk due to construction of two new culverts.			
Indirect tributary of Scretan Burn (SWF06)	Operation of mainline and side road	Increased runoff rates	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates.	low	minor adverse	Neutral
Un-named drain (SWF07)	Operation of mainline / local road	Increased runoff rates	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates.	medium	negligible adverse	Neutral

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
			The hydraulic model simulates the proposed scheme has a negligible impact on flooding from this watercourse.			
Cairnlaw Burn (SWF08)	Operation of mainline and side road	Increased runoff rates / increased flood risk	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates. Loss of a small area of floodplain (132m^3) due to construction of the proposed scheme. Hydraulic modelling simulates that the proposed scheme has a major adverse impact on flood depths immediately upstream of culvert C06 with an increase in peak flood depth in the floodplain of 0.808m. This flooding occurs in an area of current agricultural land. Major / moderate beneficial impacts are simulated to occur downstream of the culvert. The model further simulates that the proposed scheme results in moderate adverse increases in flood depths upstream of culvert C07 with an increase in peak flood depth in the floodplain upstream of the culvert of 0.091m (in an area of current agricultural land). Negligible to major beneficial reductions in flood depths are simulated downstream of culvert C07.	very high	major adverse	Very Large
	Operation of two new culverts	Increase in flood risk	Alterations to flood risk due to construction of two new culverts.			
	Operation of two new road drainage outfalls	Increase in flood risk	Potential impact to flood risk due to alteration to area draining to the catchment due to road drainage and due to two road drainage outfalls discharging to this watercourse.			
	Operation of three new swales (with associated retention pond / wetlands)		Loss of floodplain storage (3m^3) and alterations to flood risk due to operation of new swales (and associated retention pond / wetland) in close proximity to watercourse.			
Indirect tributary of Cairnlaw Burn (SWF09) **Tower Burn (SWF10)**	Operation of mainline	Increased runoff rates	Increased impervious surfaces due to carriageway near watercourse resulting in increased runoff rates. The hydraulic model simulates that the proposed scheme results in negligible impacts to flood risk upstream of Tower Burn's confluence with Cairnlaw Burn (SWF08).	high	negligible adverse	Neutral
Fluvial Geomorphology						
Beechwood Burn (SWF03)	Increase in impermeable surfaces in watercourse vicinity Operation of a new, extended and replacement culvert.	Changes to sediment regime	The culvert design is currently an overwide twin box culvert to mitigate flood risk), the culvert and possible associated changes to flow processes could cause an increase in deposition in the vicinity of the crossing location. Additional sediment delivered to the channel by road drainage discharged by new outfalls. This could result in the smothering of substrates and the channel aggrading, reducing the morphological diversity.	low	moderate adverse	Slight
	Operation of two new outfalls draining an increase in	Changes to flow regime	Additional flows delivered to the channel by road drainage discharged by new outfalls and the increase in overland flow due to a greater area of impermeable surfaces.			

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
	impermeable surfaces in watercourse vicinity		Subsequently, this could lead to the transportation of coarse substrates away from the reach and increased bed and bank erosion. Overland flow paths may also be permanently altered resulting in changes to flow velocities and volumes.			
		Changes to bed substrate and bank material, dimensions	Replacement of natural bed substrate and bank material with artificial material due to the construction of outfalls, new culvert, replacement culvert and culvert extension. This could lead to a change in flow and sediment processes and could increase incision or scour, especially around the culvert inlets. Burial of coarse substrate by fine sediment delivered from upstream bank erosion or discharge from outfalls			
		Loss of riparian vegetation	Loss of riparian vegetation coverage at new outfalls, culvert extensions and new culvert lengths could lead to a change in flow dynamics and reduced bank stability, resulting in increased bank erosion and increased fine sediment delivery, potentially burying coarse substrate and morphologically valuable features.			
		Loss of morphological diversity	Removal of morphological features such as the low flow channel, berms and coarse substrate during the construction of the outfalls and culverts would result in a loss of morphological diversity locally during operation.			
		Reduced connectivity	Reduced lateral connectivity of the floodplain due to road embankments and the presence of headwalls and wingwalls for new outfalls and culvert extensions would increase channel capacity and could contribute to increased downstream erosion during high flows.			
Scretan Burn (SWF04) **Cairnlaw Burn (SWF08)**	**SWF04:** Operation of three new culverts Operation of two new outfalls draining an increased impermeable area in watercourse vicinity. **SWF08:** Operation of two new culverts Operation of two new outfalls draining an increased impermeable area in watercourse vicinity.	Changes to sediment regime	Additional sediment delivered to the channel by road drainage discharged by new outfalls. This could result in the smothering of substrates and the channel aggrading reducing the morphological diversity.	medium	major adverse	Large
		Changes to flow regime	Additional flows delivered to the channel by road drainage discharged by new outfalls and the increase in overland flow due to a greater area of impermeable surfaces. Subsequently, this could lead to the transportation of substrates away from the reach and increased bed and bank erosion.			
		Changes to bed substrate and bank material, dimensions	**SWF04:** The three new culverts and outfalls would require the removal of a length of earth bed and banks. This could potentially lead to scour around the inlet of the culverts. **SWF08:** The two new culverts would require the removal of a length of natural bed and banks, including the sinuous planform, low flow berms, pool-riffle morphology and gravel bed. This could potentially lead to scour around the banks and inlet of the culvert.			
		Loss of riparian vegetation	**SWF04:** Loss of riparian vegetation. Notably mature trees found north of U1058 Caulfield Road North. This could potentially lead to an increase in bank erosion. Consequently, increased volumes of sediment would be delivered downstream potentially smothering coarse substrates. **SWF08:** The new culverts and outfalls would require the removal of a length of riparian vegetation, notably mature trees. This could potentially lead to an increase in erosion.			

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
			Consequently, increased volumes of sediment would be delivered downstream potentially burying substrates and gravel bars downstream.			
		Loss of morphological diversity	**SWF04:** Replacement of bed and bank material with new culverts and outfalls would result in a loss of gravel cobble substrate, low flow channel dimensions and small berms. Additionally, altered flow volumes and velocities may erode downstream features e.g. gravel and sand bars. **SWF08:** The new culverts and outfalls would require the removal of channel bed and banks and thus the removal of bed and flow diversity, most notably at the northern culvert. Additionally, altered flow volumes and velocities may erode downstream features e.g. bars, berms.			
		Reduced connectivity	**SWF04:** Culverts and outfall wingwalls/headwalls will obstruct lateral connectivity preventing flows from accessing the floodplain. **SWF08:** New culverts and outfalls and the associated wingwalls and banks would result in a reduction in connectivity. This would lead to increased depths and increased flow volumes/velocities. Subsequently, the channel may begin to incise or erode.			
		Cumulative impacts on wider catchment	**SWF04:** A low impact, low sinuosity channel realignment with steps and pools is included in the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme for SWF04. This realignment improves the morphology of the watercourse relative to its pre-existing condition (e.g. prior to the completion of the A96 Dualling Inverness to Nairn (including Nairn Bypass scheme)). The proposed scheme has the potential to offset these benefits through the introduction of additional upstream morphological pressures. **SWF08:** A low impact, sinuous two-stage (bench within an over-wide and over-deep channel that acts as a floodplain and dissipates energy) channel realignment is included in the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme for SWF08. These realignments improve the morphology of the watercourse relative to its pre-existing condition (e.g. prior to the completion of the A96 Dualling Inverness to Nairn (including Nairn Bypass scheme)). The proposed scheme has the potential to offset these benefits through the introduction of additional upstream morphological pressures.			
Tributary of Scretan Burn (SWF05)	Operation of two new culverts	Changes to bed substrate and bank material, dimensions	The two new culverts would require the removal of a length of earth bed and banks. This could potentially lead to scour around the banks and inlet of the culverts.	low	minor adverse	Neutral
		Loss of riparian vegetation	The new culverts would require the removal of a length of riparian vegetation. This could potentially lead to an increase in erosion. Consequently, increased volumes of sediment could potentially bury substrate or be delivered downstream to receiving water features.			
		Loss of morphological diversity	Replacement of silt bed and earth banks with new culverts and an outfall would reduce the morphological value of the watercourse			

Surface Water Feature	Activities	Type of Impact	Description – Operation Impacts – Hydrology and Flood Risk / Fluvial Geomorphology / Water Quality / Water Supply	Importance	Magnitude	Significance
		Reduced connectivity	Reduced lateral connectivity due to the presence of outfall wingwalls and culvert walls. This could subsequently result in altered flow processes downstream.			
Water Quality						
Beechwood Burn (SWF03)	Routine road run-off discharging into watercourses without any prior SuDS treatment	Decline in water quality as calculated by HAWRAT routine run-off assessments/as indicated by Simple Index Approach	Operational discharges of routine runoff from drainage catchments F and G. Simple Index Approach results for selected runoff area land use, i.e. 'Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways)' indicate without any SuDS treatment 'Additional mitigation required' for Suspended Solids, Metals and Hydrocarbons.	medium	major adverse	Large
Scretan Burn (SWF04)			Operational discharges of routine runoff from drainage catchments D and E. HAWRAT single outfall assessment for catchment D and E indicate pass results for all relevant parameters. HAWRAT combined outfall assessment for D and E (cumulative) indicates 'Fail' for dissolved zinc. No exceedance of AA-EQS thresholds for dissolved Cu and dissolved Zn.	high	minor adverse	Moderate
Cairnlaw Burn (SWF08)			Operational discharges of routine runoff from drainage catchment A, B and C. HAWRAT single outfall assessment indicates 'Fail' for dissolved zinc only. HAWRAT cumulative assessment for catchments A and B, and in combination assessment with the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme indicate a 'Fail' for both dissolved copper and dissolved zinc. No exceedance of AA-EQS thresholds for dissolved copper and dissolved zinc. HAWRAT cumulative assessment for catchments B and C indicate a 'Fail' of dissolved copper and dissolved zinc as well as an exceedance of AA-EQS threshold for dissolved copper.	very high	major adverse	Very Large
Inner Moray Firth (Estuary)			Operational routine runoff from drainage catchment H. The proposals involve an additional 0.28ha of impermeable area into an existing drainage catchment with 2.822ha of impermeable area. SuDS treatment will be retrofitted in to the existing network, which currently discharges into the Inner Moray Firth. Due to the limited additional discharge associated with the proposed scheme and the improvement in SuDS treatment and dilution that will occur within the estuary, the magnitude of impact is expected to be negligible.	very high	negligible adverse	Neutral

Summary of Impacts

13.4.8 For the purposes of this assessment, impact significance of 'Moderate' or higher is considered significant in the context of the EIA regulations and, therefore, is the focus for mitigation where practicable. Table 13.13 summarises the significance of impacts (pre-mitigation) detailed in Table 13.11 and Table 13.12.

Table 13.13: Summary of Potential Impact Significance (Pre-Mitigation)

Surface Water Feature	Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality
Construction			
Inshes Burn (SWF02)	Neutral	Not Applicable	Not Applicable
Beechwood Burn (SWF03)	Very Large	Neutral	Large
Scretan Burn (SWF04)	Very Large	Large	Very Large
Tributary of Scretan Burn (SWF05)	Moderate	Neutral	Moderate
Indirect tributary of Scretan Burn (SWF06)	Neutral	Not Applicable	Slight
Un-named drain (SWF07)	Neutral	Not Applicable	Not Applicable
Cairnlaw Burn (SWF08)	Very Large	Large	Very Large
Indirect tributary of Cairnlaw Burn (SWF09)	Neutral	Not Applicable	Not Applicable
Tower Burn (SWF10)	Neutral	Not Applicable	Not Applicable
Inner Moray Firth	Not Applicable	Not Applicable	Large
Public Water Supply	Not Applicable	Not Applicable	Very Large
Operation			
Inshes Burn (SWF02)	Neutral	Not Applicable	Not Applicable
Beechwood Burn (SWF03)	Very Large	Neutral	Large
Scretan Burn (SWF04)	Very Large	Large	Moderate
Tributary of Scretan Burn (SWF05)	Large	Neutral	Not Applicable
Indirect tributary of Scretan Burn (SWF06)	Neutral	Not Applicable	Not Applicable
Un-named drain (SWF07)	Neutral	Not Applicable	Not Applicable
Cairnlaw Burn (SWF08)	Very Large	Large	Very Large
Indirect tributary of Cairnlaw Burn (SWF09)	Neutral	Not Applicable	Not Applicable
Tower Burn (SWF10)	Neutral	Not Applicable	Not Applicable
Inner Moray Firth	Not Applicable	Not Applicable	Neutral
Public Water Supply	Not Applicable	Not Applicable	Not Applicable

13.5 Mitigation

Introduction

13.5.1 The objective of this section is the identification of mitigation measures to avoid, prevent, reduce or offset potential significant impacts, described in Section 13.4 (Potential Impacts), taking into account best practice, legislation and guidance during both construction and operation.

Embedded Mitigation

13.5.2 Substantial environmental input has contributed to the design process to help inform the most sustainable alignment options, watercourse crossing design and drainage solutions (referred to as embedded mitigation). This iterative approach has included discussion of proposed engineering options

and their associated potential environmental impacts, as well as the recommendation of measures that limit the impacts on the water environment.

13.5.3 The embedded mitigation measures considered for hydrology and flood risk were:

- moving the proposed scheme outside of the functional floodplain (but this was considered impracticable across the whole of the proposed scheme);
- reducing the extent of the proposed scheme within the functional floodplain; and
- removing all SuDS wetlands and swales from the functional floodplain.

13.5.4 Further information on the embedded mitigation measures considered for hydrology and flood risk and those taken forward for the proposed scheme are presented in Table 9 of Appendix A13.1: Flood Risk Assessment. The embedded mitigation measures considered for fluvial geomorphology were:

- geomorphology design input to the positioning of outfall locations; and
- geomorphology input to the positioning of the scheme alignment to minimise the length of new culverts on watercourses and ensure appropriate channel gradients and continuity (upstream and downstream); and
- flood risk input to the sizing of culverts.

13.5.5 An engineering solution has been developed at each watercourse crossing, which, subject to further development of the DMRB Stage 3 design (during the Specimen and Detailed design stages), is anticipated to gain consent under CAR. (refer to Appendix A13.5: Watercourse Crossings). Works on Cairnlaw Burn (SWF08) have been screened for potential impacts on WFD and RBMP objectives, (refer to Appendix A13.6: Water Framework Directive and River Basin Management Plan). Further design detail will be developed (during Specimen and Detailed design stages), in consultation with SEPA, to support the CAR authorisation process following the completion of the DMRB Stage 3 assessment.

Land Made Available for Construction

13.5.6 A preliminary review of construction drainage requirements has been undertaken to inform the land required to provide adequate surface water management during construction.

13.5.7 This review assessed the land required to accommodate the 10% AEP (10-year) return period rainfall event, as would reasonably be expected to occur during the period of construction, for each construction drainage catchment within each construction phase.

13.5.8 The results of the review have been used in the planning of the draft Compulsory Purchase Order (CPO) and will form a baseline for the contractor to develop a construction drainage strategy (CDS) within a site-specific Pollution Prevention Plan (PPP). This PPP will be submitted to SEPA for approval prior to construction as part of the CAR Construction Site Licence authorisation process.

Mainline, Junctions and Side Roads

13.5.9 The proposed scheme has been designed to be above the 0.5% AEP (200-year) plus CC flood level with an additional 600mm of freeboard at all culvert crossings where reasonably practicable.

SuDS

13.5.10 SuDS are a legal requirement in Scotland under WEWS and CAR, and SuDS features are included within the DMRB Stage 3 design. The proposed scheme includes seven SuDS outfalls discharging to four water features (SWF03 (Beechwood Burn), SWF04 (Scretan Burn), SWF08 (Cairnlaw Burn) and Inner Moray Firth Estuary). In addition, drainage catchment A will tie-in with an outfall to Cairnlaw Burn (SWF08) constructed as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. SuDS are designed to treat pollutants and attenuate runoff to acceptable levels before discharge to watercourses. SuDS features have been located outside the 0.5% AEP (200-year) functional floodplain.

They are designed to attenuate the 0.5% AEP (200-year) plus CC rainfall event with appropriate freeboard and discharge at the 50% AEP (2-year) 'greenfield' runoff rate.

13.5.11 Engineering and environmental factors were considered to confirm the drainage design and the types and locations of SuDS features. The results from the HAWRAT assessment also contributed to this process and the outcomes are reported in Table 13.16 and Section 13.6 (Residual Impacts). For the purposes of the water quality assessments, discharges are reported for both before and after proposed SuDS treatment in Appendix A13.3 (SuDS and Water Quality).

Culverts

13.5.12 All new culverts are designed wherever practicable to freely pass the 0.5% AEP (200-year) plus climate change design event (with appropriate freeboard within the culvert barrel). This was achieved across the proposed scheme with the exception of culvert C05 on SWF03 (Beechwood Burn) which freely passes the design event but with a reduced freeboard within the culvert barrels of 190mm. Freeboard was limited in this case by the low road levels of the proposed scheme which were required to tie in to the existing road network close to the proposed culvert.

Pre-earthworks Drainage

13.5.13 Pre-earthworks drainage may take the form of filter drains or ditches and will be constructed at the top of cuttings and the base of embankments where surface water and sub-surface pathways from adjoining land will flow towards the proposed scheme or other receptors, thus intercepting the flow. Pre-earthwork drainage design will be finalised through further development of the DMRB Stage 3 design during the Specimen and Detailed design stages. The purpose of the pre-earthworks drainage is to collect runoff from the natural catchments surrounding the proposed scheme and convey overland flow to the nearest watercourse, maintaining the existing hydrological regime of the natural catchment, where possible.

13.5.14 Pre-earthworks drainage will be sized to convey the 1.3% AEP (75-year) rainfall runoff event. Additional outfalls to the watercourses crossed by the proposed scheme may be required for discharges from pre-earthworks drainage; however, as these are likely to be located at low points adjacent to the proposed scheme and new watercourse crossings (e.g. in areas where multiple construction activities are proposed), no additional impacts are anticipated from the construction of these outfalls. However, mitigation for water quality is required during construction, which is detailed in Table 13.14. Once operational, this system does not require any formal treatment or attenuation prior to discharge, beyond the treatment and attenuation that is provided by the drain itself, as it is draining the natural catchment and kept separate from any polluted carriageway runoff. However, mitigation during construction is required, which is detailed in Table 13.14.

Construction Mitigation

13.5.15 Mitigation commitments during construction are detailed in Table 13.14. Mitigation measures can be applicable at two different scales, either scheme wide or to a specific receptor.

13.5.16 It should be noted that the flood risk mitigation measures presented below have been derived by first considering embedded mitigation within the proposed scheme design. If it was not practicable to prevent the proposed scheme impacting on the functional floodplain, then the provision of compensatory storage was investigated. The provision of compensatory storage has been implemented with consideration of SEPA guidance (SEPA 2019b), and taking into account topographical, ecological, environmental and land constraints. Two locations were investigated for flood storage, but due to the proposed scheme embankment impeding flood flows paths, it was considered impractical to provide compensatory flood storage close to the point of the lost floodplain storage area as recommended by SEPA. This is due to this option requiring an extensive engineering solution comprising significant lengths of embankment retaining water immediately adjacent to the proposed scheme. Providing attenuation storage areas was therefore assessed as the most practical solution. For further details of the mitigation measures considered refer to Appendix A13.1: Flood Risk Assessment (Mitigation Measures within Section 3: Fluvial Flooding).

Table 13.14: Mitigation During Construction

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WC-01	Construction Method Statements (CMS) will be prepared for each construction activity which will provide clear linkage to the proposed methods and mitigation measures as set out within this Chapter. The CMS will form part of the CEMP (refer to **Mitigation Item SM-01**).	Scheme Wide	Hydrology and Flood Risk Fluvial Geomorphology Water Quality
WC-02	In relation to flood risk, the contractor will implement the following mitigation measures during construction: • develop a flood response plan for any activities to be located within the functional floodplain (defined here as the 0.5% AEP (200-year) flood extent); • any temporary works within the functional floodplain will be made resistant or resilient to flood impacts; • storing plant and materials outside of the functional floodplain; if reasonably impracticable plant and material will be stored outwith the 10% AEP (10-year) flood extent; • temporary construction SuDS will be provided at the outset of construction and will provide attenuation up to the 10% (10-year) AEP rainfall event during construction; • regular maintenance of construction SuDS and associated outfalls will be undertaken to ensure the basins are not susceptible to flood damage, and that flood risk is not increased locally during construction; and • in advance of extreme flood events (e.g. 0.5% AEP (200-year), in stream working areas will be evacuated and allowed to flood to prevent any increases in flood levels from constriction of flows.	Scheme Wide	Hydrology and Flood Risk
WC-03	In relation to construction site runoff and sedimentation, the contractor will adhere to GPPs/PPGs (SEPA 2006 to 2018) and other good practice guidance (refer to Table 13.1), and implement appropriate measures which will include, but may not be limited to: • avoid unnecessary stockpiling of materials and exposure of bare surfaces, limiting topsoil stripping and phasing stripping to areas where bulk earthworks are immediately programmed; • installation of temporary construction SuDS (or equivalent) including pre-earthworks drainage prior to any earthworks activities to allow settlement and treatment of any pollutants contained in site runoff and to control the rate of flow before water is discharged into a receiving watercourse; • adoption of silt fences, check dams, settlement lagoons, soakaways and other sediment trap structures as appropriate; • use of an appropriate grade of material on temporary haul routes that will be clean and will be durable under heavy trafficking; • maintenance and regrading of haulage route surfaces where issues are encountered with the breakdown of the existing surface and generation of fine sediment; • provision of wheel washes at appropriate locations (in terms of proposed construction activities) and >10m from water features where practicable; • protocols will be developed for ceasing or reducing construction activities during periods of high rainfall to reduce the risks of erosion, sedimentation and pollution; • protection of soil stockpiles using bunds, silt fencing and peripheral cut-off ditches, and location of stockpiles at distances of >10m from water features where practicable; and • restoration of bare surfaces (seeding and planting) throughout the construction period as soon as possible after the work has been completed.	Scheme Wide	Hydrology and Flood Risk Water Quality

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
	The measures will form a construction drainage strategy set out within a site-specific Pollution Prevention Plan. This Plan will form part of the CEMP (refer to **Mitigation Item SM-01**) and will be submitted to SEPA for approval prior to construction as part of the CAR Construction Site Licence authorisation process.		
WC-04	In relation to the construction of watercourse crossings, the contractor will adhere to GPPs/PPGs (SEPA 2006 to 2018) and other good practice guidance (Table 13.1), and implement appropriate measures which will include, but may not be limited to: • a suitably qualified geomorphologist will be present during key stages of construction; • undertaking in-channel works during low flow periods (i.e. when flows are at or below the mean average) as far as reasonably practicable to reduce the potential for sediment release and scour; • no in-channel working during the salmonid spawning seasons unless permitted within any CAR licence; • minimise the length of channel disturbed and size of working corridor, with the use of silt fences or bunds where appropriate to prevent sediment being washed into the watercourse; • limit the removal of vegetation from the riparian corridor and retain trees on banks and bank top as far as practicable during construction. Retain fallen trees and large wood on banks and in channel margins where practicable; • limit the amount of tracking adjacent to watercourses and avoid creation of new flow paths between exposed areas and new or existing channels; and • where bank stabilisation is required, green bank protection (willow spiling or similar) will be considered in preference to grey bank protection (e.g. rip-rap).	SWF03 SWF04 SWF05 SWF08	Hydrology and Flood Risk Fluvial Geomorphology
WC-05	Where improvements are proposed to the morphology of watercourses to offset degradation resulting from the proposed scheme the contractor will adhere to good practice guidance (Table 13.1) and implement appropriate measures which will include, but may not be limited to: • if any offline sections are required, once a new section of channel is constructed, the flow should, where practicable, be diverted from the existing section of channel to the new course with a steady release of water and under normal/low flow conditions to avoid entrainment of fine sediment or erosion of the new channel; • diverting flow to a new section of channel should be timed to avoid forecast heavy rainfall events at the location and higher up in the catchment (the optimum time will be the spring and early summer months to allow vegetation establishment to help stabilise the new channel banks); and • any proposed morphological improvement works will be supervised by a suitably qualified geomorphologist.	SWF03 SWF04 SWF05 SWF08	Hydrology and Flood Risk Fluvial Geomorphology
WC-06	In relation to refuelling and storage of fuels the contractor will adhere to GPPs/PPGs (SEPA, 2006 to 2018) and other good practice guidance (Table 13.1), and implement appropriate measures which will include, but may not be limited to: • only designated trained and competent operatives will be authorised to refuel plant; • refuelling will be undertaken at designated refuelling areas (e.g. on hardstanding, with spill kits available, and >10m from water features) where practicable; • appropriate measures will be adopted to avoid spillages (refer to **Mitigation Item WC-07**); and • compliance with the Pollution Prevention Plan (approved by SEPA as part of the CAR Construction Site Licence authorisation process), refer to **Mitigation Items WC-03**).	Scheme Wide	Water Quality

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WC-07	In relation to oil/fuel leaks and spillages, the contractor will adhere to GPPs/PPGs (SEPA 2006 to 2018) and other good practice guidance (Table 13.1), and implement appropriate measures which will include, but may not be limited to: • stationary plant will be fitted with drip trays and emptied regularly; • plant machinery will be regularly inspected for leaks with maintenance as required; • spillage kits will be stored at key locations on-site and detailed within the CEMP (refer to **Mitigation Item SM01**); and • construction activities will comply with the Pollution Prevention Plan (approved by SEPA as part of the CAR Construction Site Licence authorisation process), refer to **Mitigation Item WC-03**).	Scheme Wide	Water Quality
WC-08	In relation to chemical storage, handling and reuse the contractor will adhere to GPPs/PPGs (SEPA, 2006 to 2018) and other good practice guidance (Table 13.1), and implement appropriate measures which will include, but may not be limited to: • chemical, fuel and oil storage will be undertaken within a site compound, which will be located on stable ground at a low risk of flooding and >10m from any watercourse, where practicable; • chemical, fuel and oil stores will be locked and sited on an impervious base within a secured bund with 110% of the storage capacity; • pesticides, including herbicides, will only be used if there are no alternative practicable measures, and will be used in accordance with CAR requirements (where applicable), the manufacturer's instructions and application rates; and • construction activities will comply with the Pollution Prevention Plan (approved by SEPA as part of the CAR Construction Site Licence authorisation process), refer to **Mitigation Item WC-03**).	Scheme Wide	Water Quality
WC-09	In relation to concrete, cement and grout the contractor will adhere to GPPs/PPGs (SEPA 2006 to 2018) and other good practice guidance (Table 13.1), and implement appropriate measures which will include, but may not be limited to: • concrete mixing and washing areas will be located > 10m from water features (where practicable), have settlement and re-circulation systems for water reuse; and have a contained area for washing out and cleaning of concrete batching plant or ready-mix lorries; • wash-water will not be discharged to the water environment and will be disposed of appropriately to the foul sewer (with permission from Scottish Water) or through containment and disposal to an authorised site; • where concrete pouring is required within a channel, a dry working area will be created; • where concrete pouring is required within 10m of a water feature or over a water feature, appropriate protection will be put in place to prevent spills entering the channel (e.g. Isolation of working area, protective sheeting); and • quick setting products (cement, concrete and grout) will be used for structures that are in or near to watercourses.	Scheme Wide	Water Quality
WC-10	Sewage from site facilities will be disposed appropriately either to a foul sewer (with the permission of Scottish Water) or via appropriate treatment and discharge as agreed with SEPA in advance of construction and in accordance with PPG04 Treatment and Disposal of Sewage (SEPA 2009b).	Scheme Wide	Water Quality
WC-11	In relation to service diversions and to avoid damage to existing services from excavations and ground penetration, including temporary severance of public and private water supplies through potential damage to infrastructure, the contractor will: • locate and map all private or public water supply assets and other service infrastructure prior to construction; • take measures to prevent damage to services and to avoid pollution during service diversions, excavations and ground works; and • provide a temporary alternative water supply (e.g. bottled or tankered) if services are to be disrupted or diverted by the works.	Scheme Wide	Water Supply

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WC-12	For works within areas identified as potentially containing contaminated land and sediment the contractor will reduce the risk of surface water pollution to an acceptably low level through: • further site investigation to determine the level of contamination prior to start of construction; • the installation of temporary treatment facilities to enable removal of pollutants from surface waters; and • adoption of mitigation measures relating to contaminated land as outlined in Chapter 12 (Geology, Soils, Contaminated Land and Groundwater), including **Mitigation Items G-01 to G-05, G-07, G-08 and G-13**.	Scheme Wide	Water Quality
WC-13	Water quality monitoring of downstream watercourses will be undertaken one year prior to construction, during construction and one-year post construction. The monitoring regime should include monthly laboratory analysis, visual inspections and real time monitoring. Water quality criteria and standards to be achieved for all site discharges during construction, and sampling locations, will be agreed in consultation with SEPA and will be set out within a site-specific Water Quality Monitoring Plan that will form part of the CEMP (refer to **Mitigation Item SM-01**).	Scheme Wide	Water Quality
WC14	In relation to groundwater, the proposed scheme will include standard excavation dewatering practices involving passive and/or active dewatering, as required. It would protect construction personnel, works, plant and machinery associated with the new cuttings.	Scheme Wide	Hydrology and Flood Risk

Table 13.15: Mitigation During Operation

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WO-01	Further design of the outfalls (during the Specimen and Detailed design stages) will ensure compliance to good practice (e.g. CIRIA 2015b; Highways Agency et al. 2004; SEPA 2008b) wherever practical, which will include, but may not be limited to: • directing each outfall downstream to minimise impacts to flow patterns; • avoiding projecting the outfall into the watercourse channel; • avoid installation of outfalls at locations of known historical channel migration; • avoid positioning in flow convergence zones or where there is evidence of active bank erosion/instability; • directing an outfall away from the banks of a river to minimise any potential risk of erosion (particularly on the opposite bank); • where possible, scour protection should use green bank protection methods, such as willow spiling, as opposed to grey bank protection; • attenuation for road runoff prior to discharge to reduce flow rates to greenfield runoff rates and to encourage siltation reducing fine sediment delivery to the receiving watercourse; • minimising the size / extent of the outfall headwall where possible to reduce the potential impact on the banks; • post project appraisal to identify if there are issues that can be investigated and addressed as early in the operational phase as possible; and • re-planting of vegetation around outfall structures where required, typing in with natural vegetation. The re-planting of trees, if removed is of particular importance.	SWF03 SWF04 SWF08 Inner Moray Firth Estuary	Hydrology and Flood Risk Fluvial Geomorphology Water Quality
WO-02	Further design of the watercourse crossings (during the Specimen and Detailed design stages) will ensure compliance with good practice (SEPA 2010a) wherever practical, which will include, but may not be limited to: • appropriate hydraulic design of all culvert structures to mitigate flood risk impacts, as assessed against the 0.5% AEP (200-year) plus an allowance for climate change design flood event; • design will mitigate any loss of floodplain storage volume, where required, by appropriate provision of compensatory storage; • design will mitigate impacts on the water environment through appropriate design of culvert structures and watercourse modifications (e.g. realignments) with respect to fluvial geomorphology, and both riparian and aquatic ecology; • an experienced fluvial geomorphologist will input to the design of all watercourse crossings and associated engineering activities where appropriate; • the design of culverts and associated watercourse modifications shall incorporate wherever practical: ○ adherence to design standards and good practice guidance (refer to Table 13.1); ○ the channel cross section through culverts will be profiled to replicate the existing channel shape (and width) up to the predicted QMED water level where appropriate, thereby allowing for the appropriate conveyance of water and sediment for a range of flows (including during low flow conditions) and preserving existing morphological processes; ○ maintenance of the existing channel gradient to avoid erosion at the head (upstream) or tail (downstream) end of a culvert; ○ avoidance of reduction of watercourse length through shortening of watercourse planform; ○ minimisation of culvert length; ○ close alignment of the culvert with the existing water feature;	SWF03 SWF04 SWF05 SWF08	Hydrology and Flood Risk Fluvial Geomorphology

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
	○ energy dissipation (e.g. stilling basins) and sediment retention measures where necessary; ○ depressing the invert of culverts to allow for reinstatement of natural bed with embedment of the culvert invert to a depth of at least 300mm. Culvert C09 (Beechwood Burn (SWF03) is an exception to this stipulation which is restricted in height and can only be buried to minimum depth of 150mm; and ○ roughening of culvert inverts to help reduce water velocities where required; • re-planting of vegetation around culverts where required, tying in with natural vegetation, where the re-planting of trees, if removed is of particular importance; and • post project appraisal to identify if there are issues that can be investigated and addressed as early in the operational phase as possible. SEPA shall be consulted on the final design solutions for watercourse crossing specifically in relation to flood risk.		
WO-03	Where new watercourse crossings are proposed, particularly on Beechwood Burn (SWF03), Scretan Burn (SWF04), SWF05 and Cairnlaw Burn (SWF08) opportunities exist to provide morphological improvements to these watercourses upstream and downstream of crossing structures, which will offset the morphological impacts of the proposed scheme and any cumulative impacts with the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. The design of the morphological improvements will be developed (during the Specimen and Detailed design phases) in conjunction with the watercourse crossing designs (see **Mitigation Item WO-02**) due to the interdependencies between these two design elements. Any morphological improvements will be undertaken in accordance with good practice (refer to Table 13.1) where practical, including, but not limited to: • minimise the length of any offline realignments; • design of the realignment in accordance with channel type and gradient (maintaining the existing gradient where possible); • use of sediment transport analysis, reference reach dimensions and historical mapping to check the proposed channel realignment is appropriate and stable under the proposed conditions; • if required, low flow channels or other design features will be incorporated to improve morphological functioning, thereby reducing the potential for excessive or unwanted erosion and deposition; • if required, low flow channels or other design features will be incorporated to reduce the potential for siltation; • a suitably qualified geomorphologist will inform the design in consultation with SEPA; • realignment designs will be led by a suitably qualified geomorphologist; and • post project appraisal to identify if there are issues that can be investigated and addressed as early in the operational phase as possible. Where channel realignments are not considered to be appropriate, improvements to morphology can be made to encourage the watercourse to recover sinuosity in a two-stage channel through the use of berms and/or flow deflectors. For Cairnlaw Burn (SWF08) SEPA's Water Classification Hub (2018c) currently states 'Hydromorphology' status as 'Moderate' but after consultation with SEPA on this issue (June 2018) Jacobs were advised that it has been reassessed as 'Bad'. This change in status is expected to be recorded when SEPA publishes 2018 data for the Water Classification Hub, however at the time of writing this had yet to happen. In anticipation of this change and to mitigate the impact of the proposed scheme, morphological improvements are proposed to an approximate 40m reach upstream and 60m downstream of culvert C06 and 200m reach upstream and 50m downstream of culvert C07 to encourage the existing artificially straightened channel to recover sinuosity in a two-stage channel (as above).	SWF03 SWF04 SWF05 SWF08	Hydrology and Flood Risk Fluvial Geomorphology

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
	A similar approach is also proposed for Beechwood Burn (SWF03) (an approximate 60m reach downstream of culvert C05), Scretan Burn (SWF04) (an approximate 60m reach upstream and 190m reach downstream of culvert C01 and an approximate 45m reach upstream and 35m reach downstream of culvert C04) and SWF05 (an approximate 95m reach upstream and 30m reach downstream of culvert C02 and an approximate 30m upstream and 65m downstream of culvert C03). SEPA shall be consulted on the final design solutions relating to morphological improvements specifically in relation to flood risk.		
WO-04	In relation to SuDS, the following mitigation measures will be implemented: • where required, authorisations for the road drainage discharge under CAR would be obtained from SEPA; • SuDS system designed to limit road drainage outflow to the greenfield pre-development runoff rate of a 50% AEP (1 in 2-year return period) flood event; • Specimen and Detailed design to adhere to design standards and good practice guidance (refer to Table 13.1), including The SuDS Manual (CIRIA 2015b) and SuDS for Roads (SCOTS 2010); • for each drainage run, a minimum of two levels of SuDS treatment within a 'treatment train' (see Table 13.16 for further details) to limit the volume of discharge and risk to water quality; • management of vegetation within ponds and drains through grass cutting, pruning of any marginal or aquatic vegetation (as appropriate to the SuDS component) and removal of any nuisance plants, especially trees; • inspect inlets, outlets, banksides, structures and pipework for any blockage and/or structural damage and remediate where appropriate; • regular inspection and removal of accumulated sediment, litter and debris from inlets, outlets, drains and ponds to avoid sub-optimal operation of SuDS; and • adherence to the maintenance plans specific to each SuDS component type as detailed within The SuDS Manual (CIRIA 2015b).	SWF03 SWF04 SWF08 Inner Moray Firth Estuary	Hydrology and Flood Risk Water Quality
WO-05	Operational SuDS: Treatment Train 1 comprising Swale and Retention Pond (wet) (and filter drains when A96 drainage is considered). The calculated treatment efficiencies are provided in Appendix A13.3 (SuDS and Water Quality) and these calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage catchment A (Cairnlaw Burn – tie in with A96 proposed scheme drainage).	SWF08	Water Quality
WO-06	Operational SuDS: Treatment Train 2 comprising a swale and wetland. The calculated treatment efficiencies are provided in Appendix A13.3 (SuDS and Water Quality) and these calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage catchments B, C and F.	SWF08 SWF03	Water Quality
WO-07	Operational SuDS: Treatment Train 3 comprising a swale with a filter drain within its base (Enhanced Swale). The calculated treatment efficiencies are provided in Appendix A13.3 (SuDS and Water Quality) and these calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage catchments D and G.	SWF04 SWF03	Water Quality
WO-08	Operational SuDS: Treatment Train 4 comprising a wetland and filter drain. The calculated treatment efficiencies are provided in Appendix A13.3 (SuDS and Water Quality). and these calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage catchment E.	SWF04	Water Quality
WO-09	Operational SuDS: Treatment Train 5 comprising a filter drain and a swale. The calculated treatment efficiencies are provided in Appendix A13.3 (SuDS and Water Quality) and these calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage catchment H.	Inner Moray Firth Estuary	Water Quality

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WO-10	A double box culvert for Crossing C05 will be adopted to convey out-of-bank flood flows underneath the proposed scheme, whilst minimising the increases in flood depths associated with the proposed scheme being located within the 0.5% AEP (200-year) plus CC flood extent. The existing structure located on Beechwood Burn (SWF03) at the south of the Inverness Retail and Business Park breaks the flood embankment located on the left bank of the watercourse. The proposed C05 culvert will need to incorporate a closed abutment which ties into the existing flood embankment located upstream of the structure. This is to prevent overtopping of the left bank which will mitigate the flooding in this area. SEPA shall be consulted on the final design solutions for culvert C05 specifically in relation to flood risk.	SWF03	Hydrology and Flood Risk
WO-11	To the south-west of culvert C01 Scretan Burn (SWF04), two rectangular flood relief culverts of dimensions 2m by 1.5m will be provided to mitigate the increased flood risk caused by the proposed scheme being located within the 0.5% AEP (200-year) plus CC flood extent. Ground re-profiling will be undertaken downstream of the flood relief culverts to the south of the bend in Scretan Burn (SWF04) so the crest of the embankment is lowered to a uniform 35mAOD over an approximate 76m arch. The maximum depth dug will be approximately 0.103m. This area is included within the CPO boundary. This approach will minimise flow being diverted towards the Inverness Campus, and as such will result in the reduction of flood risk to the existing Inverness Campus west of the proposed scheme. The depth of water in the floodplain upstream of culvert C01 will also be reduced by 1.597m. SEPA shall be consulted on the final design solutions for this mitigation specifically in relation to flood risk.	SWF04	Hydrology and Flood Risk
WO-12	Implementation of a 20m stretch of raised bank upstream of culvert C06 Cairnlaw Burn (SWF08) will be undertaken to prevent water spilling into the right floodplain as a result of culvert C06. The right bank will be raised by 0.1m to 0.3m. SEPA shall be consulted on the final design solutions for this mitigation specifically in relation to flood risk.	SWF08	Hydrology and Flood Risk
WO-13	Implementation of a 25m stretch of raised bank on the left bank of SWF05 between the existing Highland Main Line Railway (HML) culvert and culvert C02. This will be undertaken to prevent water ponding against the proposed scheme at this location. The top of the left bank will be raised by 0.08 to 0.27m (to an average level of 34.89mAOD). SEPA shall be consulted on the final design solutions for flood risk.	SWF05	Hydrology and Flood Risk
WO-14	Implementation of a 18m stretch of raised bank upstream of culvert C08 on the left bank of Scretan Burn (SWF04) and a 17m stretch of raised bank downstream of this culvert on the left bank of Scretan Burn (SWF04). The top of the left bank will be raised to prevent water spilling into the left floodplain in the vicinity of culvert C08. By raising the top of the left bank by 0.23m to 0.52m upstream of culvert C08 and by a maximum of 0.24m downstream of this culvert flood risk to the non-motorised user (NMU) facility access associated with the proposed scheme would be reduced. SEPA shall be consulted on the final design solutions for flood risk.	SWF04	Hydrology and Flood Risk
WO-15	Implementation of a flood storage area on the left floodplain of SWF05 upstream of existing Highland Main Line railway culvert. Ground levels would be adjusted in an area of existing natural depression to 35mAOD. This will provide an additional storage volume of 4,826m^3 during the design flood event. This will reduce pass forward flow through the existing Highland Main Line railway culvert and assist in the prevention of out of bank flow downstream of the culvert. The depth of ponding next to the Highland Main Line railway is also reduced. SEPA shall be consulted on the final design solutions for flood risk.	SWF04 SWF05	Hydrology and Flood Risk
WO-16	Implementation of a flood mitigation area adjacent to Cairnlaw Burn (SWF08) upstream of culvert C06. The proposed scheme has been simulated to result in flooding upstream of culvert C06 with a maximum depth of 0.808m. Ground re-profiling in the left floodplain of Cairnlaw Burn is therefore proposed to prevent flood risk to the proposed scheme and significantly reduce floodplain inundation. This will involve adjusting the existing ground level to an average 33.15mAOD. The area will be sloped towards the watercourse to guide out of bank flow back to the channel. SEPA shall be consulted on the final design solutions for flood risk.	SWF08	Hydrology and Flood Risk

Mitigation Item	Description	Applicable Surface Water Feature	Relevant Element of Assessment
WO-17	In relation to groundwater, the following mitigation measures will be implemented: • To protect flood sensitive receptors from groundwater flooding during the operational phase, groundwater seepage will be collected by the proposed road drainage system. • Pre-earthworks drainage will be sized appropriately to intercept and accommodate all shallow groundwater flows entering the works area to protect flood sensitive receptors. • All foundations expected to intercept high groundwater levels will be designed to allow existing groundwater flow paths to function. This will prevent an increase in groundwater flood risk to flood sensitive receptors elsewhere.	Scheme Wide	Hydrology and Flood Risk

13.5.17 In relation to mitigation item WO-15 a total flood storage of 4,826m^3 is proposed as part of the scheme design in order to mitigate impacts of the proposed scheme on flood risk. As the proposed scheme will result in the total loss of 687m^3 of floodplain storage (mitigation reduces the loss of floodplain storage from 725m^3 to 687m^3) there will be an overall additional 4,139m^3 of flood storage implemented as part of the proposed scheme.

13.5.18 In relation to mitigation items WO-05 to WO-09 described in Table 13.15, further detail on the proposed SuDS features and discharge location are detailed in Table 13.16 below.

Table 13.16: Proposed SuDS and Levels of Treatment

Drainage Catchment	Receiving Water Feature	SuDS Treatment Level 1	SuDS Treatment Level 2	Treatment Train No.
A	Cairnlaw Burn (SWF08)	Swale	Retention Pond (part of Catchment D of A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme)	1
B	Cairnlaw Burn (SWF08)	Swale	Wetland	2
C	Cairnlaw Burn (SWF08)	Swale	Wetland	2
D	Scretan Burn (SWF04)	(Enhanced) Swale	Filter Drain	3
E	Scretan Burn (SWF04)	Wetland	Filter Drain	4
F	Beechwood Burn (SWF03)	Swale	Wetland	2
G	Beechwood Burn (SWF03)	(Enhanced) Swale	Filter Drain	3
H	Inner Moray Firth (Estuary)	Filter Drain	Swale	5

13.6 Residual Impacts

13.6.1 Following implementation of the mitigation measures outlined in Section 13.5 (Mitigation), the potential for significant impacts on the surface water environment would be avoided/prevented, reduced or offset.

13.6.2 The residual significant impacts likely to occur during either the construction or operational phase following the application of mitigation measures are identified for each watercourse for hydrology and flood risk, fluvial geomorphology and water quality in the below paragraphs.

Construction

Hydrology and Flood Risk

13.6.3 No residual impacts of Moderate significance or above are expect during the construction phase provided all proposed mitigation measures are adhered to.

Fluvial Geomorphology

13.6.4 No residual impacts of Moderate significance or above are expect during the construction phase provided all proposed mitigation measures are adhered to.

Water Quality

13.6.5 No residual impacts of Moderate significance or above are expect during the construction phase provided all proposed mitigation measures are adhered to.

Operation

Hydrology and Flood Risk

13.6.6 The majority of potential impacts arising from the operation of the proposed scheme would have a Neutral or Slight significance.

13.6.7 However residual impacts with a Large to Very Large significance for flood risk were identified for the operational phase of the proposed scheme as follows:

- A residual adverse impact of Very Large significance is attributed to Scretan Burn (SWF04) in the floodplain upstream of culvert C01. This is due to increases in the peak fluvial flood depth of 0.319m during the design flood event. Allowing this area to flood is part of the flood mitigation strategy. A residual adverse impact of Very Large significance is also attributed to Scretan Burn in the floodplain downstream of culvert C01. This is due to increases in the peak fluvial flood depth of 0.127m during the design flood event. The receptor both upstream and downstream of culvert C01 is agricultural land. The lowest lying receptor, the proposed scheme, is assessed as not being at flood risk as there is greater than 0.6m freeboard. This land will be purchased through the CPO process in order to allow the construction of the proposed scheme.
- A residual adverse impact of Very Large significance is attributed to Cairnlaw Burn (SWF08) in the area of floodplain upstream of culvert C06. The peak increase in fluvial flood depth during the design flood event is 0.527m. The receptor is agricultural land. Allowing this area to flood is part of the flood mitigation strategy. The lowest lying receptor, the proposed scheme, is assessed as not being at flood risk as it has greater than 0.6m freeboard. The land will be purchased in order to allow the construction of the proposed scheme.
- A residual adverse impact of Very Large significance is attributed to Beechwood Burn (SWF03) in the floodplain upstream of culvert C05. The peak increase in fluvial flood depth during the design flood event is 0.128m. The inundation extents are not affected, maintaining the existing flood mechanisms. The receptor is agricultural land and a path / access road. The proposed culvert C05 may be at flood risk as there is reduced freeboard (of approximately 0.25m upstream of the culvert / 0.19m downstream of the culvert) for the design flood event. This land will be purchased in order to allow the construction of the proposed scheme.
- A residual adverse impact of Large significance is attributed to Cairnlaw Burn (SWF08) in the floodplain upstream of culvert C07. The peak increase in fluvial flood depth during the design flood event is 0.098m. The receptor is currently agricultural land. The inundation extents remain the same as the baseline but with increased flood depths. The lowest lying receptor is the proposed scheme which is not at flood risk (greater than 0.6m freeboard). The land will be purchased in order to allow the construction of the proposed scheme.
- A residual adverse impact of Large significance is attributed to the tributary of Scretan Burn (SWF05) in the floodplain upstream of the existing Highland Main Line culvert. The peak increase in fluvial flood depth is 0.701m during the design flood event. The receptor is agricultural land. Allowing this area to flood is part of the flood mitigation strategy. The lowest lying receptor, the proposed scheme, is not assessed as being at flood risk as it has greater than 0.6m freeboard. The land will be purchased in order to allow the construction of the proposed scheme.
- A residual beneficial impact of Very Large significance is attributed to Scretan Burn (SWF04) in the floodplain to the west of culvert C01. In the baseline modelling floodwater was simulated to spill from the Scretan Burn and flow west towards Inverness Campus inundating grounds and sections of two local roads. The peak fluvial flood depth was simulated as 0.112m for the design flood event. With the proposed scheme in place flooding to Inverness Campus would be reduced.
- A residual beneficial impact of Very Large significance is also attributed to Cairnlaw Burn (SWF08) in the floodplain downstream of culverts C06 and C07 and a residual beneficial impact of Large significance is attributed to the tributary of Scretan Burn (SWF05) just downstream of culvert C03. This is as a result of the reduction in flood depths due to the proposed scheme and associated mitigation. The receptors are areas of agricultural land.

13.6.8 The change in peak flood depth at a number of sensitive receptors (Cradlehall Residential Area, Cradlehall Business Park, Inverness Campus and the Highland Main Line railway) was assessed for the 3.33% AEP (30-year) event and the 0.5% AEP (200-year) event plus climate change (+CC). The results of this assessment indicate that there is generally a negligible change to the peak flood depth within these areas for the 3.33% AEP (30-year) event and 0.5% AEP (200-year) + CC event. The exception to this is that there is a minor increase in the peak flood depth for the 3.33% AEP (30-year) event in the Cradlehall Business Park area with the peak flood depth increasing from 0.654m in the baseline to 0.694m in the with proposed scheme scenario. This minor increase in peak flood depth has, however, been assessed as due to model instability and not due to the proposed scheme. There is also a minor increase to the peak flood depth (of 1mm) for the Cradlehall Residential Area (including Cradlehall Meadows and Cradlehall Farm Drive areas) for the 0.5% AEP (200-year) event plus climate change (+CC) which has also been attributed to model instability and not due to impacts of the proposed scheme. For further details regarding model instability refer to Section 7 in Appendix A13.7 (Hydraulic Modelling Report). The Inverness Campus has a major beneficial decrease in the peak flood depth as noted above with flood risk to the campus being significantly reduced for the 0.5% AEP (200-year) plus CC event. For further details refer to Table 12 in Appendix A13.1 (Flood Risk Assessment).

13.6.9 In general, a neutral impact on flood risk has been achieved to sensitive receptors (residential properties and critical infrastructure), and the proposed scheme (including SuDS) has been designed to be above the 0.5% AEP (200-year) plus CC flood level. This has been achieved at the expense of the localised increases in flood depths noted above, which generally occur on agricultural land which is largely inundated during the design flood event. The areas of increased flood depth noted in paragraph 13.6.7 will be included within the CPO for the proposed scheme and maintained as flood mitigation areas to prevent any future development.

13.6.10 The impact of the proposed scheme on downstream flood risk was also assessed to ensure the proposed scheme did not have any adverse impacts on downstream receptors. For Scretan Burn (SWF04) there was a reduction in the peak flow for the design flood event of 0.147m^3/s and the level was assessed as reducing slightly (-7mm). For Cairnlaw Burn (SWF08) there was also a reduction in the peak flow for the design flood event of 0.034m^3/s. Water level was also simulated to be reduced (-1mm). These small reductions in peak flow and water level for the design flood event are likely to be due to the flood storage proposed as part of the proposed scheme.

13.6.11 Further detail on the residual flood risk is contained within Appendix A13.1 (Flood Risk Assessment).

Fluvial Geomorphology

13.6.12 No residual significant fluvial geomorphology impacts (including cumulative impacts with the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme) are expected from operation of the proposed scheme. However, if appropriate mitigation and design (during the Specimen and Detailed design stages) is not undertaken there is likely to be a morphological response by watercourses across the proposed scheme which could result in deterioration of the watercourse or ongoing management issues. Mitigation will include geomorphologically informed culvert design to ensure a sediment transport regime is established which minimises erosion and does not interrupt natural fluvial processes (further details are included in Table 13.5 and in Appendix A13.4: Fluvial Geomorphology).

13.6.13 To offset the impact of the proposed scheme, mitigation in the form of morphological improvements up and downstream of new culverts are proposed. These include improving river sinuosity, installation of berms to mimic natural riffle-pool spacing and the preference to use green rather than grey bank protection where applicable (further details are included in Table 13.15 and Appendix A13.4: Fluvial Geomorphology).

Water Quality

13.6.14 The HAWRAT assessment (for both single and cumulative outfalls) concludes that after the adoption of SuDS (as outlined in Table 13.16), all operational impacts on Water Quality are reduced to negligible magnitude and Neutral significance. In addition, the HAWRAT assessment of cumulative impacts with the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme concludes that operational

impacts on Water Quality are reduced to negligible magnitude and Neutral significance. Detailed post-mitigation results from the HAWRAT assessment are provided in Appendix A13.3 (SuDS and Water Quality).

WFD and RBMP Screening

13.6.15 The assessment of the likely operational effects on Environmental Standards detailed in Appendix A13.6 (WFD and RBMP) demonstrates that if good practice guidance is adhered to, and appropriate mitigation measures are implemented, the proposed scheme design will pose no risk to the degradation of the current quality elements for Cairnlaw Burn (SWF08) considered under the WFD.

13.7 Statement of Significance

13.7.1 An assessment of potential impacts on the surface water environment, considering the attributes of hydrology and flood risk, fluvial geomorphology and water quality was undertaken for the proposed scheme at both construction and operational phases.

Hydrology and Flood Risk

13.7.2 No significant impacts on hydrology and flood risk are anticipated during the construction phase, provided mitigation is adhered to.

13.7.3 During operation, adverse impacts of Large to Very Large significance are reported for Beechwood Burn (SW03), Scretan Burn (SW04), tributary of Scretan Burn (SWF05) and Cairnlaw Burn (SWF08), due to localised increases in flood depths occurring within the CPO for the proposed scheme. These increases occur as a result of flood mitigation measures aimed at avoiding increases in flood risk outwith the CPO. A neutral impact on flood risk is reported on land and receptors outwith the CPO for the proposed scheme.

13.7.4 During operation, beneficial impacts of Large to Very Large significance are reported for Scretan Burn (SWF04), tributary of Scretan Burn (SWF05) and Cairnlaw Burn (SWF08) due to reductions in peak flood depth during the design flood event. The largest beneficial impact of the proposed scheme is the reduction of flood risk to the Inverness Campus for the design flood event from Scretan Burn.

Fluvial Geomorphology

13.7.5 For all surface water features within the proposed scheme study area, the significance of fluvial geomorphology impacts at both construction and operation phases has been assessed as being Slight or Neutral following the implementation of all proposed mitigation measures. Therefore, within the context of EIA Regulations, the proposed scheme is predicted to not have a significant impact on fluvial geomorphology.

Water Quality

13.7.6 For all surface water features within the proposed scheme study area, the significance of water quality impacts at both construction and operational phases has been assessed as being Slight or Neutral following the implementation of all proposed mitigation measures. Therefore, within the context of EIA Regulations, the proposed scheme is predicted to not have a significant impact on water quality.

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