Llywodraeth Cymru / Welsh Government

A487 New Dyfi Bridge

Environmental Statement – Volume 1: Chapter 15 Road Drainage and the Water Environment

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15 Road Drainage and the Water Environment

15.1 Introduction

15.1.1 The chapter describes and characterises the existing surface water resources and groundwater resources in the proximity of the proposed new A487 New Pont-ar-Ddyfi (the Scheme). It sets out the assessments of potential impacts to water bodies, surface water drainage and flood risk due to the proposed scheme during the construction and operation phases. The assessment sets out proposed mitigation to ensure that the construction and operation of the new bridge structure and the surface water drainage systems do not adversely affect:

- The quality of surface water or groundwater due to routine runoff or spillages of hazardous material;
- The existing local drainage pattern and flood regime; or
- The hydraulic conditions, geomorphology and habitat of the riparian corridor.

15.1.2 The assessment in this chapter has been undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) (HD 45/09) Volume 11, Section 3, Part 10: HD 45/09 Road Drainage and the Water Environment (November 2009), subsequently referred to in the report as HD 45/09.

15.1.3 This chapter also includes the Water Framework Directive (WFD) assessment to determine whether there is the potential for the Scheme to cause deterioration of any water body or prevent it reaching Good status in the future.

15.2 Legislation, Policy Context and Guidance

European Legislation

Water Framework Directive (WFD) 2000/60/EC

15.2.1 The WFD 2000/60/EC provides a framework for integrated management of inland surface waters and groundwater, and to achieve long-term protection of water resources. The Directive requires all inland, estuarine and coastal waters to reach ‘good’ status by 2015.

Groundwater Daughter Directive 2006/118/EC

15.2.2 A daughter directive of the WFD, the Groundwater Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater.

Priority Substances Directive 2013/39/EU

15.2.3 The Priority Substances Directive amends WFD 2000/60/EC and the Directive on Environmental Quality Standards (Directive 2008/105/EC) by updating the list of priority substances that would apply to WFD assessment.

Habitats Directive 92/43/EEC & Birds Directive 2009/147/EC

15.2.4 The Habitats Directive and Birds Directive ensure the conservation of a range of rare or threatened species. They establish the EU wide Natura 2000 ecological network of protected areas to safeguard against potentially damaging developments.

Urban Wastewater Treatment Directive 91/271/EEC (as amended) (UWWT Directive (consolidated))

15.2.5 This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the above mentioned waste water discharges.

Flood Directive 2007/60/EC

15.2.6 The Flood Directive aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU.

National Legislation

Environmental Protection Act 1990

15.2.7 The Act makes provision to control pollution arising from industrial and other processes for waste management.

Water Industry Act 1991

15.2.8 The Water Industry Act relates to water supply and the provision of wastewater services in England and Wales.

Land Drainage Act 1991 (as amended)

15.2.9 The Land Drainage Act 1991 requires that a watercourse be maintained by its owner. The Act provides functions to internal drainage boards and local authorities to manage watercourses and provide consenting powers for proposed works to watercourses associated with development.

Water Resources Act (England and Wales) 1991 (Amended 2009)

15.2.10 The Water Resources Act 1991 (WRA) (as amended) sets out the responsibilities of Natural Resources Wales (NRW) and the Environment Agency (EA) in relation to water pollution, resource management, flood defence, fisheries, and navigation.

Environment Act 1995

15.2.11 The Environment Act set new standards for environmental management, such as requiring national strategies for air quality and waste. It also deals with the establishment of an Environment Agency (including Natural Resources Wales and the Scottish Environmental Protection Agency).

Water Act 2003

15.2.12 The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991 to make provision with respect to compensation under Section 61 of the Water Resources Act 1991.

Flood and Water Management Act 2010

15.2.13 The Act makes provision for water, including provision about the management of risks in connection with flooding and coastal erosion.

Well-being of Future Generations (Wales) Act 2015

15.2.14 The Act strengthens existing governance arrangements for improving the social, economic, environmental and cultural well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The Act ensures that when making decisions public bodies take into account the impact they could have on people living in Wales in the future.

Environment (Wales) Act 2016

15.2.15 The Act puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way. The Act clarifies the law relating to shellfisheries, marine licencing, flood risk management and land drainage in Wales.

National Regulations

Water Environment (England and Wales) Regulations 2003

15.2.16 The WFD has been transposed into the Water Environment (England and Wales) Regulations 2003. WFD is delivered in England and Wales through a framework of River Basin Management Plans (RBMPs). England and Wales are divided into 11 River Basin Districts (RBDs), each consisting smaller management units known as water bodies, including all river, lake, groundwater, coastal, and transitional waters located within that RBD.

Water Resources (Abstraction and Impounding) Regulations SI 2006/641

15.2.17 These Regulations contain provisions relating to the licensing of abstraction and impounding of water in England and Wales in the light of amendments made by the Water Act 2003 to the Water Resources Act 1991.

Flood Risk Regulations 2009

15.2.18 The Flood Risk Regulations 2009 transposes the EC Floods Directive (Directive 2007/60/EC) on the assessment and management of flood risk into domestic law in England and Wales and implements its provisions. The regulations designate a Local Lead Flood Authority (LLFA) and imposes duties on the EA, NRW and Lead Local Flood Authorities to prepare a number of documents including:

- Preliminary Flood Risk Assessments;
- Flood hazard and flood risk maps; and
- Flood Risk Management Plans.

Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009

15.2.19 These regulations are based on the 'polluter pays principle and impose obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage. They apply to damage to protected species, natural habitats, sites of special scientific interest (SSSIs), water and land and implement Directive 2004/35/EC, on environmental liability.

The Groundwater (England and Wales) Regulations 2009

15.2.20 These regulations implement parts of the WFD that apply to groundwater (such as the Groundwater Directive). They supplement the Environmental Permitting Regulations 2010 and existing water pollution legislation.

The Water Supply (Water Quality) Regulations 2010

15.2.21 These regulations provide the framework for drinking water quality in England in respect of public supplies provided by water companies and licensed water suppliers. The Drinking Water Inspectorate, acting on behalf of the Secretary of State, enforces the legislation.

The Water Framework Directive (Standards and Classification) Directions England and Wales 2015

15.2.22 The Water Framework Directive (WFD) Directions presents the updated environmental standards to be used in the second cycle of the Water Framework Directive (2000/60/EC) river basin management planning process in England and Wales. Environmental standards help assess risks to ecological quality of the water environment.

The Environmental Permitting Regulations 2016

15.2.23 The Environmental Permitting (England and Wales) (Amendment) (No. 2) Regulations SI 2016/475 came into force on 6 April. They amend the Environmental Permitting (England and Wales) Regulations SI 2010/675 in order to extend the requirement for an environmental permit to flood risk activities in addition to polluting activities included under the previous regulations. The new permitting requirements for flood risk activities replaces the current "flood defence consent scheme", allowing the Environment Agency and Natural Resources Wales (NRW) to concentrate on higher risk activities. NRW is identified out as the regulator for Wales.

National Planning Policy

Wales Spatial Plan (Update 2008)

15.2.24 The Wales Spatial Plan (WSP) sets out the planning agenda for Wales at the spatial level. Its main principle is that development should be sustainable and protect water resources and manage flood risk.

Planning Policy Wales Edition 9 (November 2016)

15.2.25 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It specifically outlines design approaches and techniques that improve water efficiency and minimise adverse impacts on water resources, surface water quality, the ecology of rivers and groundwater. It also ensures that new development is not exposed unnecessarily to flooding. Chapter 13 ‘Minimising and Managing Environmental Risk and Pollution’ provides much of the information relevant to the water environment.

Technical Advice Note (TAN) 5: Nature Conservation and Planning (2009)

15.2.26 TAN 5 gives advice as to the consideration of impacts on designated sites in relation to the water environment.

Technical Advice Note (TAN) 15: Development and Flood Risk (2004)

15.2.27 TAN 15 provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. It advises on development and flood risk and provides a framework for the assessment of flooding.

Welsh Government: Taking Wales Forward 2016-2021

15.2.28 Taking Wales Forward sets out the priorities of Welsh Government. It includes priorities relating to reductions in carbon emissions, delivering improvements to trunk roads and investment in flood defence / water management.

Western Wales River Basin Management Plan (RBMP) 2015

15.2.29 River Basin Management Plans (RBMPs) are drawn up for the 11 river basin districts in England and Wales as a requirement of the WFD. The plan for the Western Wales River Basin District is managed by NRW and sets out the

programme of measures needed to achieve the objective of the WFD over the next six year period (2015-2021).

Western Wales Flood Risk Management Plan (FRMP) 2015

15.2.30 The Western Wales FRMP was first published in 2015 by NRW. The plan give an overview of the flood risk in the Western Wales River Basin District and set out intended priorities to manage and reduce flood risk over the next 6 year and beyond.

Local Planning Policy

Powys Unitary Development Plan (UDP) 2001 – 2016

15.2.31 The following policies are considered relevant as part of this assessment:

- UDP SP14 - Development in flood risk areas;
- Policy DC13 - Surface water drainage; and
- Policy DC14 - Flood prevention measures.

Eryri Local Development Plan (LDP) 2007-2022 for Snowdonia National Park

15.2.32 The following policies are considered relevant as part of this assessment:

- Strategic Policy A - National Park purposes and sustainable development;
- Strategic Policy B - Major development;
- Development Policy 1 - General development principles (1);
- Strategic Policy Ch - Social and physical infrastructure in new developments (CH);
- Strategic Policy D - Natural environment; and
- Strategic Policy Dd – Climate change.

15.2.33 The Snowdonia National Park Authority has issued Supplementary Planning Guidance (SPG). The SPGs considered relevant for this assessment are as follows:

- SPG 1. Sustainable Development in the National Parks of Wales;
- SPG 2. General Development Principles; and
- SPG 6. Nature Conservation and Biodiversity.

Relevant Guidance

15.2.34 The Environment Agency's Pollution Prevention Guidelines (PPG's) have now been revoked and will be replaced by the Guidance for Pollution Prevention (GPP's). These will provide guidance on similar areas of practice, however in the absence of the updated guidance series the PPGs are still promoted as

best practice in order to minimise pollution impacts during construction. The relevant PPGs include:

- PPG 1 - Understanding your environmental responsibilities – good environmental practices;
- PPG 2 - Above ground oil storage tanks;
- PPG 3 - Use and design of oil separators in surface water drainage systems;
- PPG 4 - Treatment and disposal of sewage where no foul sewer is available;
- PPG 5 - Works and maintenance in or near water;
- PPG 6 - Working at construction and demolition sites;
- PPG 7 - Safe storage – The safe operation of refuelling facilities;
- PPG 8 - Safe storage and disposal of used oils;
- PPG 13 - Vehicle washing and cleaning;
- PPG 18 - Managing fire water and major spillages;
- PPG 21 - Pollution incident response planning;
- PPG 22 - Incident response – dealing with spills; and
- PPG 26 - Safe storage – drums and intermediate bulk containers (PPG 26).

15.2.35 CIRIA Guidance used for the assessment includes:

- Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156);
- Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532);
- Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648); and
- Environmental good practice on site (C692).

15.3 Study Area

15.3.1 The study area for the assessment includes the geographical extent of the works in the site boundary, all water bodies within 500m and high-value water bodies over 500m, up to the point of potential effect from the proposed Scheme. The underlying groundwater body has also been considered within the assessment. The 500m buffer was selected based on professional judgement of the potential impacts posed by the proposed Scheme and is in line with study areas for assessments of the impact on the water environment undertaken for other highway construction projects. Water bodies outside of the 500m buffer were selected based on professional judgement of their value and connectivity to the proposed Scheme area.

15.3.2 Water bodies outside of the 500m buffer that were considered but screened out of the assessment, include the Afon Dulas (South), which enters the Dyfi from the south approximately 900m upstream of the proposed crossing, the Nant Wenlas and other minor watercourses, which cross the northern floodplain of the Afon Dyfi 550m downstream of the Pont-ar-Dyfi cottages, and the coastal water body of Cardigan Bay. The potential for possible impacts on these water features was considered negligible based on the source – pathway – receptor basis for the following reasons:

- The Afon Dulas (South) and Nant Wenlas were excluded from the assessment as they will not receive flows or otherwise be affected by the proposed Scheme and therefore no pathway is present for potential impacts; and
- Cardigan Bay was excluded as the effect of dilution and capture in the Dyfi Estuary limited the potential pathway of any pollutants.

15.3.3 The surface water bodies that have been assessed for potential effects from the proposed Scheme are highlighted in Figure 15.1, Volume 2. They include:

- Afon Dyfi, up to and including the Dyfi Estuary downstream;
- Afon Dulas (North) – a tributary of the Dyfi whose confluence is approximately 500m upstream of the proposed Scheme;
- A drainage ditch that drains the existing highway at the southern end of the proposed Scheme, hereby referred to as the Southern Drainage Ditch;
- Two small watercourses that drain the hillside to the north of the Dyfi, one 150m upstream and one 100m downstream of Pont-ar-Dyfi. They are labelled as 'Tributary' on Figure 15.1, Volume 2 and are subsequently referred to as watercourses to the north west of the proposed Scheme; and
- A drainage ditch that flows parallel with the railway line to the south of the proposed Scheme, before entering a culvert under the railway and flow north-westwards across the Dyfi floodplain (labelled as 'Ditch' on Figure 15.1, Volume 2).

15.4 Methodology

15.4.1 The assessment has been undertaken in accordance with HD 45/09, which provides the methodology and criteria for identifying likely impacts of a proposed road scheme on the water environment and predicting their magnitude and the significance of the resulting effects. There are four topic areas assessed as part of the HD 45/09 approach:

- Determining the effect from routine highway runoff on the quality of surface watercourses;
- Determining the effect from routine highway runoff on the quality of groundwater resources;
- Predicting the likelihood of an accidental spillage causing pollution to receiving water bodies; and

- Assessing flood risks.

15.4.2 In addition to the topic areas set out in HD 45/09 further assessment have been carried out where other impacts have been identified, including:

- Assessment of the potential effects on the water environment due to construction related impacts has been considered, using a source – pathway – receptor based assessment; and
- Assessment of impacts on the geomorphology have been assessed in order to consider the wider impacts on WFD compliance.

15.4.3 HD 45/09 provides a standard methodology for the assessment of each topic area, which has four key steps:

- Step 1 – Identification of water features within the study area (Figure 15.1, Volume 2) and an assessment of the importance/value/sensitivity of each of these receptors, using the criteria in Table 15.3;
- Step 2 - Identification of potential impacts to the water features identified in Step 1, from construction (Table 15.10: Section 15.6) and/or operation (Table 15.11: Section 15.7). Under the WFD, an impact is defined as causing a deterioration in the status of a water body or preventing a water body from reaching Good status in the future;
- Step 3 – Assessment of the potential magnitude of the effect of any construction or operation impacts on the receptor using the criteria in Table 15.4; and
- Step 4 – Assessment of the overall significance of any effects to receptors due to impacts, using the Table 15.5 matrix (see Section 15.4.41 on Significance Criteria).

15.4.4 Specific methods required by HD 45/09, which only have relevance to particular construction or operation impacts (e.g. HAWRAT), are detailed in Section 15.4.14 for construction and Section 15.4.19 for operation.

Identification of Baseline

15.4.5 The drainage and water environment baseline data for the study area has been obtained from a combination of Ordnance Survey maps, desktop studies, consultation and site walkover as outlined in paragraphs 15.4.7 to 15.4.13.

15.4.6 The baseline describes the current conditions of surface water and groundwater bodies and the current flood risk within the study area. The importance or sensitivity to change was considered for each water feature. Table 15.1 sets out the attribute for each water feature considered, in defining the baseline. This has been adapted from HD 45/09 to take account of WFD attributes.

Table 15.1: Surface water features, their attributes and indicators of quality (adapted from HD 45/09)

Feature	Attribute/Service	Indicator of quality	Possible measure
River/stream	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural); Chemical water quality.	Location and number of abstraction points; Volume abstracted daily; Physio-chemical quality elements of WFD ecological status; Supporting hydrological regime element of WFD ecological status.
	Dilution and removal of waste products	Presence of surface water discharges and effluent discharges.	Daily volume of discharge (treated/untreated)
	Recreation	Access to river; Use of river for recreation.	Length of river used for recreation (fishing, water sports) and number of clubs
	Biodiversity	Biological water quality	WFD ecological status class
		Fisheries quality	Fish Status; Supporting hydromorphological element of WFD ecological status, includes geomorphology
	Value to economy	Value of use of river	Length of river used for recreation commercially; Number of people employed; Length of river bank developed; Length of river fished commercially.
	Conveyance of flow	Presence of watercourses	Number and size of watercourses
Floodplain	Conveyance of flood flows	Presence of floodplain; Flood flows.	Developed area within extent of floodplain affected; Existing flood risk/flood return period; Location/importance of flood flow routes.
Groundwater	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural).	Location and number of abstraction points; Volume abstracted daily; Location and grade of source protection zone; WFD groundwater quantitative chemical status.

Feature	Attribute/Service	Indicator of quality	Possible measure
	Soakaway	Presence of soakaways or other discharges to the ground	Location and number of discharge points; and Daily volume discharged.
	Vulnerability	Groundwater vulnerability	Classification of aquifer vulnerability
	Economic value	Extent of use for abstractions	Number of people employed
	Conveyance of flow	Presence of groundwater supported watercourses Potential for groundwater flooding Groundwater interception by road structures or drainage	Changes to groundwater recharge, levels or flows; Number and size of watercourses.
	Biodiversity	Presence of groundwater supported wetlands	Changes to groundwater recharge, levels or flows; Status or classification of wetland.

Surface Water Baseline Conditions

15.4.7 Baseline information was collected for surface water bodies within the study area defined in Section 15.3.

15.4.8 Baseline information included the current WFD status and status objectives, environmental designations, river flows, existing drainage of the A487 and any discharge and abstraction points. The following sources were consulted:

- Observations from a site walkover carried out on 13 January 2016;
- NRW 'Water Watch Wales' (last accessed 22/12/2016[1]);
- NRW (2015) Western Wales River Basin Management Plan;
- Existing highway drainage plans (See Appendix 15.1, Volume 3);
- NRW, National River Flow Archive (last accessed 22/12/2016[2]);
- LowFlows software to calculate Q95 (the annual river flow level exceeded for 95% of the time) for drainage ditches;
- Envirocheck Report (2015) (Appendix 10.1);
- Drinking Water Inspectorate (DWI) Map showing the rate of hardness in mg/l as Calcium Carbonate in England and Wales, May 2001; and
- Natural England, MAGIC[3];
- Online historical maps[4];

[1] http://waterwatchwales.naturalresourceswales.gov.uk/en/
[2] http://nrfa.ceh.ac.uk/data/station/meanflow/64001
[3] http://www.magic.gov.uk/
[4] https://www.old-maps.co.uk

- WFD data obtained directly from NRW (Appendix 15.2, Volume 3); and
- Consultation data with NRW on site to understand the current issues with river bank erosion of the Afon Dyfi.

15.4.9 The geomorphology baseline conditions were identified during a site inspection by a senior engineer with 10 years' experience of river morphology and engineering. Information was collated in line with standard river morphology survey methodology using professional judgement. During the site visit information on river geomorphology, baseline flow dynamics and sediment transport processes within the Afon Dyfi were gathered.

15.4.10 A visual inspection during a site visit is an appropriate method for undertaking a geomorphology survey to inform this level of assessment, particularly where access to the river is not considered safe.

Groundwater Baseline Conditions

15.4.11 Published geological and groundwater vulnerability plans relevant to the hydrogeology of the area, and the potential for contaminated land have been reviewed to inform the baseline conditions. Existing ground conditions and the potential for opening up pollution pathways from existing contaminated land have been considered in Chapter 10 Geology & Soils. The baseline methodology sources used to identify the groundwater and geology of the site include:

- Topographical maps;
- Envirocheck Report (Appendix 10.1);
- The Coal Authority interactive map viewer (Coal Authority, 2016);
- Historic Ordnance Survey (OS) maps;
- The Mineral Resources Map for Wales;
- Ordnance Survey (OS) maps at scales of 1:50,000 and 1:25,000;
- Land use and ground conditions encountered during previous investigations (exploratory hole locations are shown in Appendix 10.2);
- Information from historic and recent ground investigations has been reviewed;
- Geological maps and memoirs;
- The British Geological Survey (BGS) borehole records database; and
- Consultation with the Pollution Control department of Powys County Council regarding potential geo-environmental issues.

Accidental Spillage Risk Baseline

15.4.12 Accidents occurring on roads can cause fuel spills and other spills of potentially polluting substances. These spills can enter into the road drainage system, and consequently enter surface water bodies that receive highway drainage.

There is also a risk of spills entering groundwater from natural infiltration. Information relating to pollution incidents within the study area, and traffic collisions have been obtained from the following sources:

- Envirocheck Report (2015) (See Appendix 10.1, Volume 3);
- Arup (2016) Traffic Collision Report Document reference 900237-ARP-ZZ-ZZ-RP-YT-00005 – data retrieved from Department for Transport Road Accidents and Safety Data database.

Flood Risk Baseline

15.4.13 The flood risk baseline has been informed by detailed hydraulic modelling of the Afon Dyfi undertaken by Wallingford HydroSolutions in consultation with NRW. The hydraulic assessment was carried out using a detailed ISIS TUFLOW model of the Afon Dyfi, relevant tributaries and the associated floodplain. Further details of the methodology for the baseline flood modelling are set out in the Flood Consequence Assessment (FCA) in Appendix 15.8.

Methodology for Construction Impacts

15.4.14 The assessment of construction impacts follows the guidance set out in HD 45/09, which recommends that construction impacts are considered using the source – pathway – receptor approach and defers specific guidance of bridge/highway construction impacts to CIRIA 648 Control of Water Pollution from Linear Construction Projects.

15.4.15 The potential impacts of construction on surface water or sediment runoff, water quality, flood risk and groundwater quality or levels have been assessed based on the planned construction methods and sequencing and after discussion with the contractor. Where construction methods were not available, standard construction practices were assumed. Cumulative impacts as a result of construction phasing were also assessed.

15.4.16 The construction phasing of the proposed Scheme is described in detail in Chapter 2 and when considered against impacts on the water environment, includes four main phases:

- Phase 1 covers the preparation of the site and includes establishing site offices, compounds and laydown areas, along with site clearance;
- Phase 2 covers the majority of earthworks across the site and includes the construction of the flood bund around the Dyfi Eco Park, excavation of the north cutting area for the new A487/A493 junction, haulage of material from north cutting to south embankment and construction of the southern embankment;
- Phase 3 covers the piling activities and the construction of the viaduct/bridge structure, and begins with the construction of the access/haul road alongside the proposed route; and

- Phase 4 covers the final stages of construction and includes road surfacing/lining, landscaping and permanent fencing.

15.4.17 Due to the sensitivity of the proposed site, close to a main river and within the floodplain, specific approaches for surface water management across the site and dewatering during piling activities have been considered in liaison with the contractor.

15.4.18 Where measures to reduce construction impacts are considered standard practice they are included in the Pre-CEMP Appendix 17.1, Volume 3, whilst measures above those typically used are detailed in Section 15.8.

Methodology for Operational Impacts

15.4.19 An assessment of the potential impacts during operation has been undertaken for the five assessment components as set out below.

Surface Water Quality

15.4.20 An assessment of the potential impacts of routine runoff on surface waters has been undertaken to determine whether there is an environmental risk and if pollution mitigation measures are needed. The assessment has used the Highways Agency Water Risk Assessment Tool (HAWRAT), which has been developed specifically for the purpose of supporting Water Quality assessments carried out as part of an HD 45/09 assessment.

15.4.21 The HAWRAT tool adopts a tiered consequential approach to assessment and can assist in reporting the results at different steps. At Step 1 HAWRAT predicts the statistical distribution of key pollutant concentrations in untreated and undiluted highway runoff (worst case scenario) against the Runoff Specific Thresholds (RSTs) values for acute effects over 24 hours (RST 24) and over 6 hours (RST 6).

15.4.22 At Step 2 HAWRAT uses details of the highway catchment draining to the outfall, the flow rate of the receiving watercourse and its physical dimensions to calculate the available dilution of soluble pollutants and potential dispersion of sediments. A further comparison with pollutant thresholds is then made.

15.4.23 Based on input parameters the HAWRAT model uses a pass/fail reporting method whereby:

- ‘Fail’ indicates either: an unacceptable impact; a need to carry out further assessment steps; or a need to refer the situation to specialist judgement; or
- ‘Pass’ indicates that there would be no short-term impact associated with road runoff.

15.4.24 Where outfalls discharge to the same watercourse or river reach[5] a cumulative assessment is also undertaken. If both outfalls are located within 100m the combined risk of sediment discharge are assessed. If the outfalls are within 1km the combined risk of soluble materials are assessed. Using HAWRAT in accordance with the principles in HD 45/09, the last outfall is the point selected for cumulative assessment.

15.4.25 Where a discharge is assessed as failing the RST limits, the final stage of HAWRAT is to assess the long term impacts of runoff using the annual average concentrations of dissolved copper and dissolved zinc calculated from the HAWRAT model and compared against Environmental Quality Standards (EQS). The EQSs for Zinc and Copper are presented in Schedule 3 Part 2 in the WFD (Standards and Classification) Directions 2015. The standard for Copper is 1µg/l bioavailable. The standard for Zinc is 10.9 µg/l plus the ambient background concentration for freshwaters depending on the river catchment[6]. The ambient background concentration for the Afon Dyfi catchment is 3.2 µg/l.

15.4.26 If the predicted annual average concentrations are found to be below the EQS thresholds then no further action need be taken with respect to long-term risks.

Geomorphology

15.4.27 A qualitative assessment of possible impacts on the river geomorphology was undertaken based on an experienced river engineer's understanding of the potential for impacts to the river flow dynamics and sediment transport processes and the subsequent effects this this might have on the ecological potential of the water body.

15.4.28 Where possible, the 1 and 2D results of the flood modelling were used to gain insight into the impacts of the proposals on flow dynamics during flood events. Small scale turbulence such as that expected around the piers that would act on the immediate sediments on the river bed, however, is not captured by the modelling. These type of impacts were assessed based on experience of previous schemes and a theoretical understanding of flow.

15.4.29 Potential geomorphological responses to any anticipated changes in flow dynamics were then evaluated.

15.4.30 Other geomorphological risks associated with natural, ongoing evolution of the morphology of the Afon Dyfi upstream and downstream of the site were also examined.

15.4.31 The assessment was made using professional judgement and experience and supported by consultation with the NRW officers who were present during the site visit.

[5] A reach is defined as a length of watercourse between two confluences. The reason for this is that the available dilution and stream velocity will naturally change at confluences and influence the assessment (HD 45/09).
[6] Ambient Background Concentration is an estimate of background concentration based on a low percentile of monitoring data. Ambient Background Concentration is the environmental concentration expected where no (or only minor) anthropogenic inputs are present.

Groundwater

15.4.32 Annex I of the HD 45/09 provides a methodology (Method C) to assess the potential impact on the quality of groundwater resources from routine runoff discharges to the ground.

15.4.33 This risk assessment procedure is based on the study of the source-pathway-receptor (S-P-R) protocol. The principles of this approach have been applied to the disposal of road drainage whereby the:

- Source term comprises the road drainage water with any pollutants it contained as it enters any unlined ditch, watercourse or soakaway discharge system that has the potential to transmit water through the ground to groundwater;
- Pathway term represents the processes that may modify the pollutants during transmission through the discharge system and the soil and subsoil until the actual 'point of entry' to groundwater (including the unsaturated zone); and
- Receptor is the groundwater.

15.4.34 For there to be a risk of impact to groundwater, all elements of the S-P-R model have to be present to create a pollutant linkage. In the context of this chapter, sources comprise the drainage water that would be discharged at the outfalls, and the receptors are defined as controlled water bodies, including the groundwater that underlies the proposed Scheme area.

15.4.35 In accordance with HD 45/09, a pathway to the groundwater receptor is only considered to be feasible if the receiving watercourse at the proposed outfall has little flow during dry periods. In accordance with HD 45/09 this is assessed as a Q95 flow of less than 0.001m3/s.

15.4.36 On this basis, Outfalls 2 and 3 are considered to be the only locations where pollution linkages are present, and it is these locations that have been further assessed for potential impacts.

15.4.37 For this assessment, Method C has been undertaken for proposed drainage outfalls 2 and 3 as shown on the drainage scheme presented in Figure 15.2, Volume 2.

15.4.38 The risk assessment methodology takes account of the different sources of pollution in combination with the pathway characteristics that influence the level of groundwater protection using two matrices.

15.4.39 The method uses Table 15.2 to determine the risk score, by incorporating the key factors affecting level of risk posed by the source of pollutants, the persistence and movement of pollutants within the pathway to groundwater, and linkages between them. In this way the matrix provides a means of scoring specific road drainage discharge sites in terms of their potential risks of having an effect upon groundwater.

Table 15.2: Matrix to determine risk of effect of pollution to groundwater from routine runoff (extract from HD 45/09, Annex I, Table C.1)

Component Number		Weighting Factor	Property or Parameter	Low Risk (Score 1)	Medium Risk (Score 2)	High Risk (Score 3)
1	SOURCE	15	Traffic Density (AADT)	<15,000	15,000– 50,000	>50,000
2		15	Rainfall (annual averages)	<740mm	740-1060mm	>1060mm
			Rainfall Intensity	Even (<35mm FEH 1 hour rainfall)	Uneven (35-47mm FEH 1 hour rainfall)	Concentrated (>47mm FEH 1 hour rainfall)
3	PATHWAY	15	Soakaway Geometry	Continuous linear (e.g. ditch, grassed channel)	Single point, or shallow soakaway (e.g. (lagoon) serving low road area	Single point, deep serving high road area (>5,000 m2)
4		20	Unsaturated Zone	Depth to water table >15m and non-aquifers	Depth to water table <15 >5m	Depth to water table <5m
5		20	Flow Type	Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow)	Consolidated deposits (i.e. mixed fracture and intergranular flow)	Heavily consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)
6		7.5	Effective Grain Size	Fine sand and below	Coarse sand	Very coarse sand and above
7		7.5	Lithology	>15% clay minerals	<5% - >1% clay minerals	<1% clay minerals

15.4.40 The overall risk score assigns the proposed discharge points to one of three risk impact classes, namely low, medium or high as follows:

- Low (overall risk score <150): The identified risks to groundwater are minimal;
- Medium (overall risk score 150-250): Mitigating measures should be considered to protect groundwater, although the need for and nature of the mitigation measures should be informed by additional risk assessment; or
- High (overall risk score >250): It is necessary to collect further data and complete a more detailed risk assessment.

15.4.41 In accordance with HD 45/09, an outfall with a low overall risk score would have a minimal risk to groundwater, therefore discharge to groundwater can

be selected to most effectively meet the hydraulic requirements of road drainage. A medium overall risk score reflects the situation whereby the groundwater is deemed to be at potential risk from contamination, and the additional risk assessment is required to assess the need for and nature of any mitigation measures that may be required. For a high overall risk score, groundwater is also deemed to be at potential risk from contamination and it is necessary to collect further data to complete a more detailed risk assessment.

15.4.42 For outfalls with a medium overall risk score, additional groundwater risk assessment is carried out comprising the Environment Agency's P20 Hydrogeological Risk Assessment for Land Contamination. This method has been agreed with NRW[7]. This is a more detailed computer based model, which takes account of transport and fate properties, aquifer properties and contaminant degradation to identify the extent of any ongoing contaminative impact on the groundwater. The conceptual site model applied in the assessment is presented in Appendix 15.4, Volume 3.

15.4.43 The purpose of this additional risk assessment is to demonstrate the level of concern of contamination in relation to specific receptors by determining the distance that a contaminant would reduce in concentration from an initial runoff value to a specific threshold value. Threshold values include UK Drinking Water Standards (UKDWS) or Environmental Quality Standard (EQS) guidelines, whichever is the higher. In this case receptors include watercourses with a Q95 flow of greater than 0.001m3/s.

15.4.44 Initial contaminant concentrations of runoff have been deduced by using the HAWRAT model. This model is intended to be used for surface water risk assessment, however the Q95 flow has been reduced to zero, and therefore runoff represents that entering the ground water body (following minor attenuation within the unsaturated zone). The P20 risk assessment uses the mean concentrations (annual average) of the soluble marker contaminants copper and zinc, both of which are contaminants of concern within road runoff.

Accidental Spillage

15.4.45 The operational pollution effects from accidental spillage were calculated using Method D from the HD 45/09 guidance.

15.4.46 When considering the risk of spillages the calculated spillage risk return period must not be greater than 1 in 100 years, or 1 in 200 years where spillage could affect protected areas for conservation such as Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs) and Special Area of Conservation (SACs).

15.4.47 For assessment of the risk posed by accidental spillage, in line with HD 45/09 guidance, if the annual probability that a spillage would cause a serious pollution incident to a water body is less than 1%, then the risk posed is considered acceptable and no further assessment has been carried out.

[7] Correspondence dated 18 August 2016 from Meryl Read Natural Resources Wales. A487 New Pont-ar-Ddyfi. Draft Environmental Statement and Statement to inform an Appropriate Assessment

15.4.48 The risk is assessed initially without any mitigation measures. If mitigation measures are needed to reduce the probability, a reduction factor is applied, depending on the type of mitigation applied.

Flood Risk

15.4.49 The assessment of potential flood impacts has been undertaken in accordance with the principles of DMRB and TAN15. The 1 in 100 year and 1 in 1000 year probability flood events have been assessed and an additional 30% has been applied to the 1 in 100 year flood event to account for future climate change.

15.4.50 The principles of the modelling methodology were agreed with NRW prior to the commencement of any modelling. The flood modelling has been undertaken by Wallingford HydroSolutions and the results have been used to inform the assessment of impacts on flood risk. The full assessment, including the technical details incorporated in the flooding assessment, is provided in the FCA in Appendix 15.8, Volume 3.

Significance Criteria

15.4.51 The significance of effects on the water environment has been assessed using the methodology contained within the HD 45/09 guidance.

15.4.52 For risks posed to the water environment, the significance of the effects has been assessed based on the importance/sensitivity of the affected receptor in combination with the magnitude of any effects.

Environmental Value (or Sensitivity) of Resource/Feature

Table 15.3: Criteria for estimating the importance of environmental attributes (adapted from HD 45/09, Annex 1, Table A4.3)

Importance	Criteria	Examples
Very High	Attribute has a high quality and rarity on regional or national scale	**Surface Water**: EC Designated Salmonid/ Cyprinid fishery. WFD Class 'High' Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, WPZ, Ramsar site, salmonid water)/ Species protected by EC legislation **Groundwater**: Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation SPZ1 **Flood Risk**: Floodplain or defence protecting more than 100 residential properties from flooding
High	Attribute has a high quality and rarity on local scale	**Surface Water**: WFD Class 'Good' Major Cyprinid Fishery, Species protected under EC or UK habitat legislation **Groundwater**: Principal aquifer providing locally important resource or supporting river ecosystem SPZ2 **Flood Risk**: Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium	Attribute has a medium quality	**Surface water**: WFD class 'Moderate';

Importance	Criteria	Examples
	and rarity on local scale	**Groundwater**: Aquifer providing water for agriculture use. **Flood risk**: Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low	Attribute has a low quality and rarity on local scale	**Surface water**: WFD class 'Poor'; **Groundwater**: unproductive strata; Flood risk: Floodplain with limited constraints and low probability of flooding.

Magnitude of Impact

15.4.53 The magnitudes of potential effects have been assessed using the criteria set out below.

Table 15.4: Estimating the magnitude of an impact on an attribute (adapted from HD 45/09, Annex 1, Table A4.4 to include geomorphological examples)

Magnitude	Criteria	Typical Example
Major Adverse	Results in loss of attribute and/or quality and integrity of the attribute.	**Surface Water**: Failure of both soluble and sediment bound pollutants in HAWRAT and compliance failure with EQS values. Calculated risk of pollution from accidental spillage >2% annually. Loss or extensive change to a fishery. Loss or extensive change to a designated Nature Conservation Site. Major impedance or disruption of natural geomorphological processes. Loss of, or permanent impacts to, in-channel geomorphological features. Likelihood of scour and/or bank erosion that would require installation of hard revetment during the design life of the scheme over a significant stretch of river. Expected deterioration in WFD status or prevention of achievement of 'Good' status. Permanent loss of critical or sensitive habitat. **Groundwater**: Loss of, or extensive change to, an aquifer. Potential high risk of pollution to groundwater from routine runoff (>250). Calculated risk of pollution from accidental spillage >2% annually. Expected deterioration in WFD status or prevention of achievement of 'Good' status. **Flood Risk**: Increase in peak flood level (1% annual probability) >100mm
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	**Surface Waters**: Failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values. Risk of pollution from spillage >1% annually and <2% annually. Partial loss in productivity of to a fishery.

Magnitude	Criteria	Typical Example
		Effect on the integrity of the existing flora and fauna. Effects on the occurrence of natural geomorphological processes. Effects on the size and/or quality of geomorphological features. Risk of scour and/or bank erosion that would require installation of bioengineering during the design life of the scheme at a localised level. Moderate impact on WFD quality element with no anticipated reduction in WFD status. Partial loss of critical or sensitive habitat. **Groundwate**r: Partial loss or change to an aquifer. Potential medium risk of pollution to groundwater from routine runoff (score 150-250) Calculated risk of pollution from spillage >1% annually and <2% annually. Partial loss of the integrity of groundwater supported designated wetlands. Moderate impact on WFD quality element with no anticipated reduction in WFD status. **Flood Risk**: Increase in peak flood level (1% annual probability) >50mm.
Minor Adverse	Results in some measurable change in attributes quality or vulnerability.	**Surface Waters**: Failure of either soluble or sediment-bound pollutants in HAWRAT. Risk of pollution from spillage >0.5%. Low risk of scour and/or bank erosion. Minor impact on WFD quality element with no anticipated reduction in WFD status. **Groundwate**r: Potential low risk of pollution to groundwater from routine runoff (risk score <150). Minor impact on WFD quality element with no anticipated reduction in WFD status. **Flood Risk**: Increase in peak flood level (1% annual productivity) >10mm.
Negligible	Results in effect on attribute but of insufficient magnitude to affect the use or integrity	**Surface Water**: No risk identified by HAWRAT (pass both soluble and sediment-bound pollutants). Risk of pollution from accidental spillages <0.5% annually. No change to geomorphological processes or forms and no new risks introduced. No change in WFD status, potential to achieve WFD objectives or habitat impacts. **Groundwate**r: No predicted change in quality of any type of aquifer Risk of pollution from accidental spillages <0.5% annually. No change in WFD status or potential to achieve WFD objectives. **Flood Risk**: Negligible change in peak flood level (1% annual probability) <±10mm.
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of	**Surface water**: HAWRAT assessment of either soluble or sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition.

Magnitude	Criteria	Typical Example
	negative effect occurring	Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually) (Method D). Minor enhancements to geomorphological features or riparian habitat to support natural geomorphological processes. Delivery of WFD enhancements that provide ecosystems benefits but are unlikely to contribute directly to improving WFD status. **Groundwater**: - Calculated reduction in existing pollution risk from accidental spillages by 50% or more to an aquifer (when existing spillage risk is <1% annually) (Method D). Delivery of WFD enhancements that provide some benefit but are unlikely to contribute directly to improving WFD status. **Flood Risk**: Reduction in peak flood level (1% annual probability) >10mm.
Moderate Beneficial	Results in moderate improvement of attribute quality	**Surface Water**: HAWRAT assessment of both soluble and sediment bound pollutants Pass from an existing site where the baseline was a Fail condition. Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually) (Method D). Significant enhancements to geomorphological features or riparian habitat to support natural geomorphological processes. Delivery of WFD enhancements that contribute to improving WFD status. **Groundwater**: - Calculated reduction in existing pollution risk from accidental spillages by 50% or more to an aquifer (when existing spillage risk >1%) (Method D). Delivery of WFD enhancements that contribute to improving WFD status. **Flood Risk**: Reduction in peak flood level (1% annual probability) >50mm.
Major Beneficial	Results in major improvement of attribute quality	**Surface Water**: Removal of existing polluting discharge, or removing the likelihood of polluting discharge occurring to a watercourse. Restoration of natural geomorphological processes and forms where they are currently impeded or degraded. Improvement in WFD status. **Groundwater**: Removal of existing polluting discharges to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. Improvement in WFD status. **Flood Risk**: Reduction in peak flood level (1% annual probability) >100mm.

Significance of Effect

15.4.54 The significance of potential effects was then determined using Table 15.5, by comparison of the identified importance/sensitivity of the receptors with the estimated magnitude of the effect. Effects were either beneficial or adverse, as defined in Table 15.4. It is considered that significance values of Moderate and above are defined as significant potential effects, and mitigation measures are necessary.

Table 15.5: Estimating the significance of potential effects (extract from HD 45/09, Annex 1, Table A4.5)

Magnitude of Impact					
		Negligible	**Minor**	**Moderate**	**Major**
Importance of Attribute	**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

15.4.55 The definitions of the significance values are further explained in Table 15.6.

Table 15.6: Definitions of significance values

Score	Comment
Very Large Adverse	Where the proposed scheme would result in degradation of the water environment, because it results in predicted very significant adverse impacts on at least one water attribute and/or on several water attributes.
Large Adverse	Where the proposed scheme would result in degradation of the water environment because it results in predicted highly significant adverse impacts on a water attribute and/or significant adverse impacts on several water attributes.
Moderate Adverse	Where the proposed scheme may result in the degradation of the water environment because it results in predicted moderate adverse impacts on at least one attribute.
Slight Adverse	Where the proposal may result in a degradation of the water environment because it results in a predicted slight impact on one or more attributes. More than one attribute may be affected.
Neutral	Where the net impact of the proposed scheme is neutral, because it results in no appreciable effect, either positive or negative, on the identified attributes.
Slight Beneficial	All other situations where the proposed scheme provides an opportunity to enhance the water environment or provide an improved level of protection to an attribute.
Moderate Beneficial	Where the proposed scheme provides an opportunity to enhance the water environment because it results in a moderate improvement for an attribute.
Large Beneficial	It is unlikely that any proposed scheme incorporating the construction of a new or improved trunk road would fit into this category. However, proposals could have a large positive impact if it is predicted that it would result in a 'very' or 'highly' significant improvement to a water attribute(s), with insignificant adverse impacts on other water attributes.

Consultation

15.4.56 During the EIA process, a scoping report was produced which included the approach to the assessment of road drainage and the water environment. A draft version of the report was circulated for review, feedback and comment from both statutory and non-statutory consultees (see Appendix 1.4, Volume 3). The recommendations from the scoping report have been incorporated into the assessment and further consultation has been undertaken with NRW in regards to flood risk modelling, geomorphology and mitigation measures. This collaborative approach aligns with the objectives of the Well-being of Future Generations (Wales) Act 2015 to ensure prevention of longer term detrimental impacts and has resulted in a number of efficiency savings and improvements to the design of the proposed Scheme.

15.4.57 Liaison with NRW has been undertaken throughout the design of the scheme to establish agreement in the scope and extent of the flood modelling, and the parameters to apply in judging the acceptability of the results for the investigations undertaken.

15.4.58 Further consultation was also undertaken with NRW regarding the geomorphological impacts and the level of WFD compliance assessment required. NRW attended a site visit on 13 January 2016 where the level of WFD assessment was agreed and a number of WFD mitigation measures were discussed.

Limitations and Assumptions

15.4.59 Assessment of the drainage and the water environment aspects of the Scheme have been carried out in accordance with HD 45/09. Limitations and assumptions associated with the recommended methods are discussed below.

Surface Water

15.4.60 The accuracy of the baseline condition described in the assessment is dependent upon the accuracy of information obtained from NRW and via its 'Water Watch Wales' website.

15.4.61 For the HAWRAT model flow data is required. Due to the lack of flow data available for the series of drainage ditches to the south of the study area, the Q95 flow has been estimated using LowFlows software. The catchment area for the ditches has been manually defined as they are too small to map on the river network used by the software. The Q95 estimated by the LowFlows software was < 0.001 m^3/s and therefore, in accordance with HD 45/09 guidance, a Q95 of 0.001 m^3/s is used.

15.4.62 The water hardness parameter for HAWRAT was taken from the Drinking Water Inspectorate (DWI) map which shows the rate of water hardness. This data was considered to be appropriate to use, in the absence of river chemical data. It was assumed that local potable water would have a similar hardness characteristic as the local surface water and the three water hardness levels used by the HAWRAT model are based on broad ranges.

15.4.63 The threshold limits for soluble zinc and copper and for sediments are based on the limits set by the HAWRAT model.

15.4.64 It has been assumed that the existing drainage of the A487 to the south of the site conveys flows towards the open drainage ditch identified in the baseline study, located north of the railway line (see Figure 15.1, Volume 2).

15.4.65 The geomorphological assessment is a qualitative assessment of the risk, type and severity of potential geomorphological adjustment as a result of the development including construction activities.

Groundwater

15.4.66 The Method C groundwater assessment assumes a worst case scenario that all runoff is discharged to ground.

Accidental Spillage Risk

15.4.67 The HD 45/09 Method D assessment assumed a worst case scenario using the highest vehicle numbers from either 2015 or 2034.

15.4.68 Values from 2015 have been used for the side roads and the 2034 figures have been used for the proposed main highway sections. This is because traffic counts were undertaken on the main roads in the study area as they contain traffic flows on them. Traffic surveys were not undertaken on the smaller side roads as traffic from these roads would be surveyed on the main links and it was considered that the traffic from these links would be minor. Worst case flows have therefore only been considered on the main roads.

15.4.69 Spillage rates used in the calculations for accidental spillages are based on assumptions, taken directly from the appropriate sections of the HD 45/09 guidance.

Flood Risk

15.4.70 The flood risk assessment is based on a flood model undertaken by Wallingford HydroSolutions. The model took into account the south embankment and the proposed bridge piers. The north abutment of the proposed Scheme was omitted from the modelling as it was located above the floodplain and would not influence the modelling outcome.

15.5 Baseline Environment

Surface Water Baseline

Surface Water Features

15.5.1 A number of surface water features have been identified within the study area described in Section 15.3. These features are shown on the Surface Water Features Map (Figure 15.1, Volume 2) and include:

- Afon Dyfi, up to and including the Dyfi Estuary downstream;
- Afon Dulas – a tributary of the Dyfi whose confluence is approximately 500m upstream of the proposed Scheme;
- A drainage ditch that drains the existing highway at the southern end of the proposed Scheme, hereby referred to as the Southern Drainage Ditch;
- Two small watercourses that drain the hillside to the north of the Dyfi, one 150m upstream and one 100m downstream of Pont-ar-Dyfi. They are labelled as 'Tributary' on Figure 15.1, Volume 2 and are subsequently referred to as watercourse to the north west of the proposed Scheme; and

- A drainage ditch that flows parallel with the railway line to the south of the proposed Scheme, before entering a culvert under the railway and flow north-westwards across the Dyfi floodplain (labelled as 'Ditch' on Figure 15.1, Volume 2).

Afon Dyfi

15.5.2 The Afon Dyfi through the study area is an active alluvial channel that runs in a westerly direction into the Dyfi Estuary and then Cardigan Bay. Above Machynlleth, the Afon Dyfi exceeds 35km in length and has a catchment area of approximately 470 km^2.

15.5.3 The upper reaches and catchment area of the Dyfi drains from the Aran Mountains, and the main river channel is generally incised into a steep and narrow valley with a limited floodplain. In the middle reaches, the valley broadens progressively towards the Estuary.

15.5.4 In the middle reaches, the valley broadens progressively towards the estuary. Here, the floodplain (typically <1 km wide) is formed predominantly of alluvial deposited sands and gravels with silt and clay overburden.

15.5.5 The lower reaches of the Afon Dyfi broaden out into the Dyfi Estuary. The proposed Scheme lies in the middle reaches of the Dyfi, located approximately 11km from the Dyfi Estuary.

15.5.6 The geomorphology in the area of the proposed Scheme is characterised by active sediment transport forming bars, riffles and pools and by a broad, flat floodplain. The river channel, between the Millennium Cycle Bridge and Pont-ar-Dyfi, currently runs along the northern side of the valley. Historical maps show that the course of the river in this reach has remained stable for over 100 years; however, in filled oxbow lakes and meander scars in the floodplain to the south suggest that the river actively migrated across the full width of the valley prior to this date. These areas remain lower than the surrounding floodplain and are visible during wet periods (See Appendix 15.5, Photo 1 in Volume 3). Blockstone and a river wall currently bound the course of the river from near the Millennium Cycle Bridge through the Pont-ar-Dyfi, restricting lateral movement (See Appendix 15.5, Photo 3 in Volume 3).

15.5.7 The main in-channel geomorphological features in the study reach are two large gravel bars, one located on the right (looking downstream) bank centred at approximately 150m upstream of the Millennium Cycle Bridge and the other on the left bank on the inside of the meander bend over which the proposed new bridge would cross.

Afon Dulas

15.5.8 The Afon Dulas flows southwards into the Dyfi approximately 500m upstream of the proposed Scheme crossing. It has a catchment area of 63 km^2 and a length of 18.5km. The catchment has a classic U-shaped, glacial relief with flat valley bottoms, dominated by pastoral agriculture, and steep hillsides, dominated by forestry.

15.5.9 The river is constrained with limited floodplain for most of its length, only widening as it enters the Dyfi valley where numerous gravel bars and a sinuous planform are evident.

Southern Drainage Ditch

15.5.10 The location of the open drainage ditch is shown on Figure 15.1 in Volume 2 and is found to the north of the railway line, running in a northeast to southwest direction. The ditch acts as surface water drainage from the highway. The ditch is approximately 20m long and holds a running flow of water discharging from a culvert running beneath the highway. Part of the ditch is overgrown with vegetation before the flow of water outfalls into a culvert running beneath the railway embankment (See Appendix 15.5, Photo 2 in Volume 3). It is assumed that the drainage ditch flows only during wet weather conditions.

15.5.11 The ditch connects via the culvert to another drainage ditch to the south of the railway bridge. This ditch is approximately 50m long and runs along the field boundary connecting to a network of field ditches to the south west. A flow of water was present during a site visit carried out on 13th January 2016.

Watercourses to the north west of the proposed Scheme

15.5.12 The forested hillside to the north of the Dyfi and the proposed Scheme is drained by two small, steep watercourses. The first tributary is approximately 600m in length and enters the Dyfi 150m upstream of Pont-ar-Dyfi, whilst the second is mapped at <100m in length and enters the Dyfi 100m downstream of Pont-ar-Dyfi. The lower lengths of both watercourses are culverted through the retaining wall that forms the right (northern) bank of the Dyfi.

Dyfi Floodplain & Railway Drainage Ditches

15.5.13 A drainage ditch is located parallel to the railway line to the south of the proposed Scheme. The ditch appears to flow westwards along the southern side of the railway line into a ponded, swale area before entering a culvert beneath the railway, re-emerging in a drainage ditch 200m south-east of the proposed Scheme, within the Dyfi floodplain.

15.5.14 A series of drainage ditches and informal storage swales/ponds are present in the Dyfi floodplain in the vicinity of the proposed Scheme. As the water table in this area is typically <1m from the surface, these drainage ditches are required to maintain usable farmland.

Surface Water Drainage

15.5.15 The existing surface water drainage networks in the study area receive highway surface runoff and surface water runoff from the surrounding land. See Figure 15.1 (Volume 2) and Appendix 15.1 (Volume 3) for the existing highway drainage layout.

- A487 Existing Catchment 1 – Highway surface water and land drainage network constructed as part of the Fridd Gate A487 improvements. Existing

pipe drainage network outfalls directly to Afon Dyfi via headwall located on northern river bank, immediately downstream on Millennium Footbridge;

- A487 Existing Catchment 2 – Highway surface water and land drainage open drainage ditch drains south along eastern side of existing A487 before being culverted under A487 to the open drainage ditch north of the railway; and
- A493 Existing Catchment – Highway surface water drainage of A493, north of Pont-ar–Dyfi, immediately in front of Dyfi Cottages consists of numerous letterbox drains through stone parapet wall, and individual gulleys and direct outfalls to Afon Dyfi.

15.5.16 Non-highway surface water runoff from the site drains through natural filtration and field ditches.

Discharge Consents, Abstractions and Potential Pollution Sources to Surface Waters

15.5.17 Information about discharge consents to surface waters, abstractions from surface waters and other potential pollution sources were obtained from an Envirocheck Report (Appendix 10.1, Volume 3) and are detailed below:

- Discharge of storm sewage overflow into the Garswin Ditch, a tributary of the Dyfi, 307m to the south-west of the proposed Scheme at Machynlleth Sewage Treatment Works;
- Discharge of final/treated effluent, from a septic tank, into the Afon Dyfi, 308m to the northwest of the proposed Scheme, close to Pont-ar-Dyfi;
- Discharge of storm sewage overflow into the Garswin Ditch, a tributary of the Dyfi, 494m to the south of the proposed Scheme at Machynlleth Sewage Treatment Works;
- Discharge from a sewage pumping station into the Garswin Ditch, a tributary of the Dyfi, 532m to the south-west of the proposed Scheme at Machynlleth Sewage Treatment Works;
- Discharge of final/treated effluent into the Afon Dyfi, 546m to the south-west of the proposed Scheme at Machynlleth Sewage Treatment Works;
- Discharge of storm overflow into the Afon Dyfi, 553m to the south-west of the proposed Scheme at Machynlleth Sewage Treatment Works;
- The nearest surface water abstraction is taken from the Afon Dyfi 771m to the north-east of the proposed Scheme and is used for pipe pressure testing;
- Surface drainage from the recycling centre adjacent to the south of the site and in close proximity to the Southern Drainage Ditch drains into a groundwater soakaway;
- There is one historical and local authority landfill site 493m to the south west of the site;

- There is a licensed waste management facility within the Dyfi Eco Park (industrial estate) to the south of the site; and
- An old Common Clay and Shale mine is recorded north of Pont-ar-Ddyfi, adjacent to the A487.

Geomorphology

Afon Dyfi

15.5.18 The river banks are natural and composed of non-cohesive alluvial deposits upstream of the Millennium Cycle Bridge. Just downstream of the bridge, the right bank is formed by a steep bluff. The bank material appears to be cohesive and supports the growth of a number of mature trees. Further downstream, approximately 80m from the bridge, the right bank is formed, in places, by a retaining wall supporting the A487 (See Appendix 15.5, Volume 3). Blockstone is present on the bank as it approaches the Pont-ar-Dyfi. The left bank downstream of the Millennium Cycle Bridge is naturally deposited non-cohesive alluvium, and the floodplain surface is significantly lower than the bluff forming the right bank. Downstream of the bend and gravel bar, the left bank has been stabilised in places using blockstone.

15.5.19 Specific areas along the reach are currently experiencing bank erosion. The bar forming approximately 150m upstream of the Millennium Cycle Bridge is coupled with erosion of the opposite left bank (See Appendix 15.5). Continued growth of the bar would likely result in the formation of a meander bend at this location.

15.5.20 Immediately downstream of the Millennium Cycle Bridge, interaction of the river flow with the left bridge abutment has caused turbulence and eddying resulting in localised scour of the bank (See Appendix 15.5, Photo 6).

15.5.21 From a distance of approximately 75 to 100m upstream of the Pont-ar-Dyfi, the left bank is undergoing erosion that is currently threatening the cycle path (See Appendix 15.5). Timber palisades had been installed to offer some protection, but these have failed.

15.5.22 There is potential for the silt component of the alluvium forming the river banks to contain toxic metals, including lead, derived from former mining activity in the region.

Afon Dulas

15.5.23 No works are proposed to the Afon Dulas as part of the proposed Scheme and its location upstream of any works negates any potential impact on geomorphology and it will, therefore, not be assessed.

Southern Drainage Ditch

15.5.24 The proposed Scheme does not propose any works to the southern drainage ditch, other than maintenance cutting of any overgrown vegetation, therefore impacts to geomorphology will not be assessed.

Watercourses to the north west of the proposed Scheme

15.5.25 Prior to entering a culvert beneath the A487, the watercourse to the east of Pont-ar-Dyfi has a steep, densely vegetated channel. There are no proposed works to this length of the channel other than maintenance cutting of any overgrown vegetation, and therefore geomorphological impacts will not be assessed.

15.5.26 The watercourse to the west of Pont-ar-Dyfi is culverted beneath properties and the A493 and therefore has limited geomorphological value. As a result the impact of the proposed Scheme on geomorphology will not be assessed.

Dyfi Floodplain & Railway Drainage Ditches

15.5.27 The size and artificial, channelized nature of these features limits their geomorphological value. Therefore the geomorphological impact of the proposed Scheme will not be formally assessed, although consideration of the cumulative impacts on the water features will incorporate this.

Surface Water Flow Rates

Afon Dyfi

15.5.28 The Afon Dyfi flow data is recorded at a monitoring station adjacent to the Pont-ar-Dyfi. Flow rates have been recorded by NRW, and previously Environment Agency Wales and National Rivers Authority, since 1962. Flow data from gauging station "64001 - Dyfi at Pont-ar-Ddyfi" is presented in Table 15.7 (National River Flow Archive).

Table 15.7: Afon Dyfi flow rate data

Parameter	Data
Period of Record:	1962 – 2013
Percent Complete:	91 %
Base Flow Index:	0.39
Mean Flow:	23.432 m^3/s
95% Exceedance (Q95):	2.339 m^3/s
70% Exceedance (Q70):	7.431 m^3/s
50% Exceedance (Q50):	13.05 m^3/s
10% Exceedance (Q10):	54.4 m^3/s

Afon Dulas

15.5.29 The Afon Dulas catchment does not contain a gauging station and enters the Dyfi upstream of the Pont-ar-Ddyfi gauging station. As the proposed Scheme would not alter flows or increase road runoff in this catchment an estimate of flow in the Afon Dulas is deemed unnecessary.

Southern Drainage Ditch

15.5.30 As the southern drainage ditch would receive some of the road runoff from the proposed Scheme a more detailed assessment of flows was made using LowFlows software. The flow exceeded 95% of the time (Q95) was estimated to be 0.00083 m^3/s for the drainage ditch located north of the railway. The base flow index was estimated to be 0.65.

Watercourses to the north west of the proposed Scheme

15.5.31 Both watercourses are ephemeral and would not receive an increase in road runoff as a result of the proposed Scheme. Therefore estimates of flow are deemed unnecessary.

Dyfi Floodplain & Railway Drainage Ditches

15.5.32 These watercourses receive local surface water runoff from surrounding fields, along with near-surface groundwater flow in the Dyfi floodplain and act as water stores with little to no flowing water. As a result of this combination of the flat land and small catchment size (<0.5 km^2), estimates of Q95 flow are deemed unnecessary.

Groundwater Baseline

15.5.33 A full description of the geology of the study area is provided within Chapter 10.5 Geology and Soils. A summary of the baseline of relevance to groundwater is provided below.

15.5.34 Within the study area the groundwater is not part of any designated areas or source protection zones and the immediate groundwater body does not support the Afon Dyfi ecosystem.

15.5.35 The proposed Scheme is located over superficial deposits, classified as Secondary A aquifer, and the bedrock classified as Secondary B aquifer. Secondary A aquifers are described as 'permeable layers supporting water suppliers at a local, rather than strategic scale, and in some cases forming an important source of base flows for rivers'. Secondary B aquifers are predominantly layers with a lower permeability which may store and yield a limited amount of groundwater due to localised fissure, thin permeable horizontal horizons and weathering.

15.5.36 The groundwater is classified as having high leaching potential (H1) – soils which transmit liquid discharges because they are either shallow or susceptible to rapid by-pass flow directly to rock gravel or groundwater.

15.5.37 Ground investigations have been undertaken within the proposed Scheme area and encountered made ground materials within the southern scheme area, possibly associated with a field track. In the northern scheme area, made ground materials are associated with the construction of either or both the Welsh Millennium Cycle Bridge and the former Corris Railway Bridge. Refer to Chapter 10 Soils and Geology for details on potential sources of contamination and risk assessments in relation to impact on the water environment.

15.5.38 The groundwater in the proposed Scheme area is generally anticipated to be at shallow depths or at ground level. The floodplain is also known to experience regular flooding originating from the Afon Dyfi.

Water Framework Directive Classification

15.5.39 The Afon Dyfi is included within the Western Wales RBMP in the North West Wales Management Catchment. Four WFD water bodies were identified within close proximity of, or downstream of, the proposed Scheme:

- The 'Dyfi – tidal limit to Afon Twymyn' river water body (GB110064048390);
- The 'Dulas North' river water body (GB110064048570); and
- The 'Dyfi & Leri' transitional water body (GB511006407000);
- The 'Meirionnydd' groundwater body (GB41002G203200).

Dyfi – tidal limit to Afon Twymyn

15.5.40 The proposed Scheme crosses the floodplain and channel of the Afon Dyfi within the Dyfi – tidal limit to Afon Twymyn water body. The water body has a Moderate overall status and a detailed breakdown of the classification of ecological and chemical elements is shown in Table 15.8 below (Cycle 2, 2015 classification).

Table 15.8: WFD baseline for 'Dyfi – tidal limit to Afon Twymyn'

Quality Element	Status
Overall Status	Moderate
Overall Ecological Status	Good
Invertebrates	High
Fish	Not provided
Supporting physio-chemical elements	
Ammonia BOD Dissolved oxygen pH Phosphate Temperature	High High High High Good High
Supporting hydromorphological elements	
Hydrological regime Morphology	High Supports Good
Chemical Status	Failing to achieve Good
Chemical Objective	Fail by 2021 – Technically infeasible
Ecological Objective	Good Status by 2021

Quality Element	Status
Alternative Measures	Mine water and contaminated land remediation

15.5.41 The primary reason for the Dyfi – tidal limit to Afon Twymyn water body not achieving Good chemical status is diffuse pollution from abandoned mines and quarries within the catchment (NRW (2014) Water Framework Directive - River Catchment Summary; Dyfi - tidal limit to Afon Twymyn).

Dulas North

15.5.42 The proposed Scheme comes within 200m of the southern end of the Dulas North water body. The water body has a Moderate overall status, Good chemical status and Moderate ecological status, with an aim to achieve Good overall status by 2027 (Cycle 2, 2015 classification). The water body is failing to achieve Good status due to low pH (acidification) which is also the driver of the moderate status for invertebrates. Acidification is suspected to be driven by atmospheric deposition and forestry.

Dyfi & Leri

15.5.43 Downstream of the proposed Scheme, the Dyfi Estuary is included within the Dyfi & Leri transitional water body and has an overall status of Moderate, ecological status of Good and chemical status of Fail (Cycle 2, 2015 classification). The water body is not heavily modified and aims to achieve Good overall status by 2021. It is failing to achieve Good status due to elevated levels of brominated diphenylether (BDPE) from a currently unidentified source. The water body is protected under the Bathing Waters Directive and is also designated as a Shellfish Water Protected Area.

15.5.44 The Dyfi & Leri water body is designated as part of the Dyfi SSSI, the Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC), the Dyfi Estuary / Aber Dyfi Special Protection Area (SPA) and the Cors Forchno and Dyfi Ramsar site. The closest of these sites is located approximately 5km from the proposed river crossing. The potential impacts on designated sites are considered within Chapter 9 Nature Conservation & Ecology.

Meirionnydd

15.5.45 The entire study area is underlain by the Meirionnydd groundwater body, which has an overall WFD status of Poor, a quantitative status of Good and a chemical status of Poor (Cycle 2, 2015 classification). The water body is failing to achieve Good status due to the chemical status of dependent surface water bodies, resulting from mining/quarrying activities.

Accidental Spillage Risk Baseline

15.5.46 A review of water pollution incidents occurring within the study area from Envirocheck identified the following incidents:

- A category 3 – minor pollution incident occurred at Machynlleth Railway Station on 4 October 1994, 123m south-west of the proposed Scheme; and
- A category 2 – significant pollution incident, which resulted in crude sewage entering the water environment, is recorded by NRW as occurring on 14 August 2002.

15.5.47 Recorded accidental spillage into the water environment from road accidents have not been identified. As part of the study into the A487 New Pont-ar-Ddyfi, an analysis of the Road Traffic Accidents in the area for the past five years (2010 - 2014) has been undertaken to determine if there are any particular accident trends on the road network at or near the proposed Scheme location.

15.5.48 Overall, 19 accidents were recorded in the five year period, this equates to 3.8 accidents per year. Most of which were in the town of Machynlleth and not near the Afon Dyfi and study area.

Flood Risk Baseline

15.5.49 The proposed Scheme is located in Zone C2 of the floodplain of the Afon Dyfi, as described in the TAN15. Flood Zone C2 are areas of floodplain without significant flood defence infrastructure. The Afon Dyfi is prone to flooding on a regular basis.

15.5.50 The average river level at the gauge at Pont-ar-Dyfi ranges from 6.576 to 7.826m Above Ordnance Datum (AOD).

15.5.51 During flood conditions, flows overtop the river banks and inundate the floodplain. The highest recent river level recorded at Pont-ar-Dyfi is 9.93m AOD recorded on 18 November 2009. The Afon Dyfi also peaked within 9mm of this level recently on 12 December 2015.

15.5.52 In accordance with the requirements of TAN15, the 1 in 100 year and 1 in 1000 year probability flood events have been assessed. An additional 30% has also been applied to the 1 in 100 year flood event to account for future climate change. The 1 in 100year with climate change has been used to identify the flood extent for the area.

15.5.53 At the peak of the flood event, the informal earth bund to the south of the river is overtopped, and floodwaters flow over the A487 roadway. The Dyfi Eco Park industrial estate experiences extensive flooding, and floodwaters also flow along the A487/Heol y Doll underneath the railway bridge and encroach into several residential properties at Railway Terrace. See Appendix 15.8 (Volume 3), Section 4.

15.5.54 To the north of the river, a small volume of floodwater spills onto the A493 immediately downstream of the Pont-ar-Ddyfi, and the model outputs indicate that floodwaters encroach into Numbers 1, 2 and 3 of the terraced Dyfi Cottages properties. This corresponds with anecdotal evidence from local residents that when water levels rise above the A493 carriageway level, river water can currently flow through existing ‘letterbox’ drains in the stone parapet

retaining wall, and back through the existing piped drainage network, flooding the A493 and encroaching on Dyfi Cottages which have threshold levels below the A493 carriageway level.

Environmental Value (or sensitivity) of Water Features

15.5.55 The environmental value of each water feature included in the study area has been estimated following the criteria set out within Table 15.3.

Afon Dyfi

15.5.56 It is considered that the Afon Dyfi is of high importance in relation to water quality, due to the Good ecological status and High supporting elements status. The Afon Dyfi downstream from the proposed Scheme is also a SAC/SPA/SSSI designated feature and therefore contributes to importance of the Afon Dyfi as a biodiversity attribute.

15.5.57 The geomorphological importance of the Afon Dyfi is considered to be of *high* importance due to the High hydrological regime status and a morphology that supports Good ecological status.

Afon Dulas

15.5.58 As a result of its Moderate overall/ecological WFD status, the Afon Dulas is considered to be of medium importance.

Southern Drainage Ditch

15.5.59 The southern drainage ditch located to the north of the railway bridge is included within the 'Dyfi – tidal limit to Afon Twymyn' water body. Despite the Afon Dyfi, in the same WFD water body, being considered of *high* importance, the southern drainage ditch is considered of *medium* importance for this assessment, as a result of its smaller size/importance and lower habitat quality (than the main watercourse).

Watercourses to the north west of the proposed Scheme

15.5.60 These watercourses are within the 'Dyfi – tidal limit to Afon Twymyn' water body. The minor size, ephemeral nature and existing culverting of these watercourses means that they are considered of low importance for this assessment.

Dyfi Floodplain & Railway Drainage Ditches

15.5.61 These watercourses are within the 'Dyfi – tidal limit to Afon Twymyn' water body. The minor size, artificial construction and lack of flow in these watercourses means that they are considered of low importance for this assessment.

Groundwater

15.5.62 The local groundwater is classified as Poor quality under WFD, however NRW has indicated that this is due to the effect from contaminated mine waters on

surface water away from the study area and the groundwater within the study is not of a poor quality[8]. The local groundwater functions as a secondary aquifer and it is considered to be of *medium* importance because it is not protected and does not support downstream ecosystems for the Afon Dyfi and designated SSSI and SAC located over 5km away. This is consistent with HD 45/09, Annex 1, Table A4.3.

The Floodplain

15.5.63 It is considered that the sensitivity of the floodplain is of *high* importance due to its size and the potential risk of flooding to residential properties along the north bank of the river and industrial premises to the south of the proposed Scheme. The floodplain is important for its conveyance of flood waters, as it is regularly inundated (floods more than once every two years).

15.6 Potential Construction Effects - Before Mitigation

15.6.1 The assessment of the effects on the water environment considers possible changes to the water environment during the construction phase. In line with the DMRB methodology, the significance of the effects would depend on a combination of the potential for pollution and flooding and the sensitivity of the receptor.

15.6.2 Potential construction impacts are summarised in Table 15.9 below.

15.6.3 Potential construction impacts and mitigation measures (see Section 15.8) have been incorporated into the summary WFD compliance table included in Appendix 15.6 (Volume 3).

Table 15.9: Potential adverse construction impacts of the proposed Scheme

General Issue	Potential Impact	Receptor
Surface Water	Disturbance of silt/soil generating surface runoff with high sediment concentrations (mobilised suspended solids). Potential for natural silts within the floodplain to contain metals (including lead) that could be washed downstream.	All watercourses
	Accidental spillage of fuels, oils, chemicals and materials (e.g. concrete, plant fuels/oils, lubricants, hydraulic fluids and floating solids such as litter) resulting in pollution of watercourses and potential impacts on fish and downstream ecological designated features.	All watercourses
	Discharge of water with high suspended solid concentrations and/or contaminants	Afon Dyfi

[8] Correspondence dated 18 August 2016 from Meryl Read Natural Resources Wales. A487 New Pont-ar-Ddyfi. Draft Environmental Statement and Statement to inform an Appropriate Assessment

General Issue	Potential Impact	Receptor
	(particularly from concrete pouring) due to a flood event overwhelming the site.	
	Dewatering of excavations and discharge of high suspended solid content to receiving watercourses.	Afon Dyfi
Geomorphology	Obstructions within the channel / floodplain or plant trafficking at the top of the river bank causing an increased risk of erosion or scouring.	Afon Dyfi; Floodplain
	Deposition of silt causing clogging of river bed gravels with adverse impacts on stream ecology.	Afon Dyfi
	Alteration of geomorphological features through plant trafficking or excavation.	Afon Dyfi; Floodplain
Groundwater	Risk that piling works may open up pollution pathways from previously unidentified contaminated land and made ground, which may increase the possibility of infiltration of contaminated water to the aquifer.	Groundwater; Afon Dyfi
	Localised reduction in groundwater level associated with dewatering at piling locations. This may lead to temporary changes in the hyporheic zone.	Groundwater; Afon Dyfi
	Contamination to groundwater as a result of accidental spillage of fuels, oils, chemicals and other materials during construction (particularly during piling).	Groundwater; Afon Dyfi
Flooding	Increased risk of localised flooding. Loss of floodplain capacity due to temporary haul roads, surface water management bunds and temporary embankment/structure for push launch construction.	Floodplain

Significance of Effect - Surface Water

Afon Dyfi

Surface Water Quality

15.6.4 The most likely sources of water quality impacts in the Afon Dyfi are sediment runoff, spillages from vehicles/plant and during specific activities that may create contaminated water, such as piling and concrete pouring.

15.6.5 These risks of pollution impacts (silt/sediment and spills) are heightened during particular activities near and within the limits of the watercourse, including but not limited to, construction of:

- The southern bridge abutment;

- The northern river bridge abutment and cattle pass; and
- Enabling works including the construction of the haul road, the laydown area for precast concrete elements of the bridge and the crane platform.

15.6.6 As the majority of works would be taking place in an active floodplain, there is a heightened risk of a flood event creating a pathway for sediment runoff from the construction site to enter the Afon Dyfi. This risk is heightened over periods when areas of exposed earthworks would be at their greatest extent including:

- During/shortly after construction of the flood bund;
- During excavation of the north cutting;
- During/shortly after construction of the southern embankment;
- During/shortly after construction of the temporary embankment to allow push-launch construction of the viaduct (if used); and
- During construction and decommissioning of the haul road and laydown areas.

The risk of sediment runoff from these newly excavated/constructed features would last until vegetation became established (typically at least one growing season). Although this risk could cause widespread impacts at a site level it is unlikely that the addition of silts during high flows would have a significant effect on the Dyfi. During flood flows the majority of silts mobilised across the site would likely be flushed into the Dyfi Estuary where they would add to the aggradation of existing mudflats, causing negligible environmental impact.

15.6.7 The risk of flooding causing an uncontrolled release of sediments and/or waters from the surface water management system would be present over the construction sequence. Over much of the construction cycle the potential for pollutants in these waters are limited to sediments from runoff and hydrocarbons spilled from vehicles but during higher risk activities (e.g. piling and/or concrete pouring) these impacts have the potential to be greater.

15.6.8 During concrete pouring for the pilings, pier columns and abutments, concrete washout, particularly where dewatering is required to install the pilings, will create waters which would be damaging if released into the Afon Dyfi. There is the potential for these waters to enter the Dyfi during a flood event, via an uncontrolled release from the surface water management system or via groundwater pathways.

15.6.9 A common constraint of linear construction projects such as this, and of particular relevance given the site location in an active floodplain, is the limited area to store and, if needed, treat surface water runoff across the site. A potential impact of insufficient storage capacity is that the surface water management system could be overwhelmed during a rainfall event, causing an uncontrolled release of sediments and/or pollutants to the Afon Dyfi. As a result of the high hydrological connectivity between the floodplain (i.e. shallow groundwater) and river, any spills that might happen on the floodplain or activities that could mobilise pollutants in groundwater have the potential to affect water quality in the Afon Dyfi.

15.6.10 The magnitude of these impacts would be moderate adverse and short term in timeframe. Due to the high importance of the Afon Dyfi, the potential construction impacts of the proposed Scheme would have a temporary significance of effect of *moderate/large adverse*.

Geomorphology

15.6.11 Plant trafficking and excavation activities within the floodplain or channel have the potential to cause bank failure, erosion or scouring and modification of geomorphological features. Work on the north abutment (right bank) is anticipated to be carried out from the top of the bank; however, excavation for the pile cap at the south abutment (left bank) would require excavation of the gravel bar.

15.6.12 Mobilisation of silts, during excavation, work on the river banks or by surface water runoff from bare areas, could result in washing of sediment into the Afon Dyfi and siltation within the riverbed gravels. Clogging of river gravels by silt would reduce in-stream habitat quality. The effects of siltation could be medium term, as high flows are required to re-mobilise the silt and flush it downstream.

15.6.13 The potential magnitude of temporary geomorphological impacts is anticipated to be moderate adverse, due to the potential impact on the water body WFD quality elements, but with no anticipated reduction in WFD status expected. This is because the impacts on morphological status within the water body are localised and wider impacts would be temporary. The significance of effect would therefore be *moderate/large adverse*.

Afon Dulas

15.6.14 There are no works planned as part of the proposed Scheme in the vicinity of the Afon Dulas or within its catchment. As the Afon Dulas is upstream of the proposed Scheme, the only potential impact is that noise/light/vibrations from the works, or a release of sediments or contaminants into the Afon Dyfi could inhibit migratory species from reaching spawning grounds on the Afon Dulas. This impact is covered further in Chapter 9 Nature Conservation.

15.6.15 The magnitude of construction impacts on the Afon Dulas is assessed as negligible and therefore, when combined with its medium importance, the significance of effect is *neutral*.

Southern Drainage Ditch

15.6.16 There is a risk of pollution impacts from silt/sediment and spills to the drainage ditch from the discharge of Catchment 2 (Figure 15.2) during construction of the flood bund and road embankment.

15.6.17 Part of the proposed flood bund is located adjacent to the southern drainage ditch and therefore there is a high potential for sediment runoff into the ditch during construction. In the event of a spill or sediment entering the ditch, the magnitude of impact would be moderate adverse. Based on the ditches medium level of importance, the temporary construction impacts would be considered to have a *moderate adverse* significance of effect.

15.6.18 The ditch itself has low geomorphological quality and as there are no works proposed within the ditch itself, other than maintenance cutting of any overgrown vegetation, the geomorphological impacts are considered to be *negligible*.

Watercourses to the north west of the proposed Scheme

15.6.19 During construction there are no works proposed to either watercourse and therefore impacts on geomorphology or water quality are considered to have a negligible magnitude. When combined with the low importance of these watercourses, this leads to an assessment of significance of effect of *neutral*.

Dyfi Floodplain & Railway Drainage Ditches

15.6.20 These watercourses are in close vicinity of the proposed Scheme and therefore have an elevated risk of impacts from sediment/pollutant runoff and/or accidental spills, particularly during construction of the flood bund and the access road / laydown areas.

15.6.21 During construction, ditches crossing the proposed route would be temporarily culverted in order to provide access. Although these ditches are of low geomorphological value there would be temporary impacts.

15.6.22 The magnitude of these impacts is moderate adverse and when combined with the low importance of these features, leads to an assessment of significance of *slight adverse*.

Significance of Effect - Groundwater

15.6.23 The alluvial deposits forming the floodplain constitute a shallow, permeable aquifer. The nature of the aquifer means that spills or historical contamination mobilised by construction activities could be easily transmitted and would be likely to impact on the Afon Dyfi. Furthermore, activities like piling could open up new pathways to the underlying aquifer.

15.6.24 Sources of potential pollutants to groundwater include spills (e.g. from vehicles/plant) or from water contaminated during specific activities, such as piling or concrete pouring/washing. Potential pathways for these pollutants include direct infiltration at source or in the case of spillages, infiltration from the drainage ditch used as a surface water management system during periods of low flow.

15.6.25 The potential magnitude of the risk of contamination of moderate adverse and when combined with the classification of medium importance (see 15.5.62), the significance of effect associated with temporary activities is considered to be *moderate adverse*.

Significance of Effect - Flood Risk

15.6.26 The proposed Scheme is located within a floodplain considered to be of high importance due to its conveyance of flood waters and frequent flooding. During

construction there would be a slight change in flood storage volume on the floodplain due to earthworks, surface water management and piling activities.

15.6.27 In order to construct the new bridge, a temporary embankment or scaffold structure would be required at the southern end of the bridge and a crane access platform at the northern end of the bridge. The embankment would enable the new bridge to be push-launched into position, minimising the amount of plant within the floodplain. A temporary haul road would be constructed within the floodplain, consisting of alternate layers of geo fabric and two layers of compacted processed rock. The temporary haul road would restrict infiltration of surface water, so water would drain to the edges of the haul road, prior to capture in a surface water management ditch or infiltration to groundwater. Temporary haul roads within the floodplain would be kept at grade to ensure no impedance of flood flows. The use of bunds has the potential to reduce floodplain capacity during construction.

15.6.28 Although unlikely, it is possible that an extreme flood event would occur at Machynlleth during the construction phase. Therefore, the temporary works were incorporated into the proposed scenario, and the model was rerun to ensure that the Scheme can remain compliant with TAN 15 even during the construction phase. The results for the 1 in 2 year and the 1 in 100 year flood event show that the temporary works do not cause an adverse impact on third party property immediately upstream of the existing Pont-ar-Ddyfi. Furthermore, there are no predicted impacts for additional areas other than those already present for the Scheme. It should be noted that climate change was not incorporated into this scenario, as the Scheme is to be completed within the next 18-36 months. Therefore, it was not considered appropriate to apply climate change to the peak flows. Refer to Chapter 7 of the Flood Consequences Assessment Report, attached in Appendix 15.8.

15.6.29 Based on the above, the magnitude of impact of flooding from these construction works is considered to be negligible. The significance of effect would therefore be *neutral* in the event of flooding.

15.7 Potential Operational Effects - Before Mitigation

15.7.1 This section considers effects on the water environment when the proposed Scheme is in operation. Similar to the assessment for the construction phase, the significance of the effects would depend on a combination of the potential for pollution and flooding as well as the sensitivity of the receptor.

15.7.2 Potential impacts are summarised in Table 15.10 below.

15.7.3 The potential impacts and mitigation measures (see section 15.8) have been incorporated into the summary WFD compliance table included in Appendix 15.6.

Table 15.10: Potential adverse operational impacts

General Issue	Potential Impact	Receptor
Surface Water	Pollution associated with routine runoff	All watercourses
	Risk of an accident resulting in a serious pollution incident	All watercourses
Geomorphology	Removal of trees on the northern (right) bank may result in a higher risk of bank erosion or failure over the long term	Afon Dyfi
	High risk of bank erosion and scouring around piers	Afon Dyfi; Floodplain
Groundwater	Where outfalls discharge into ditches, infiltration of polluted runoff during periods of low flow may result in groundwater contamination	Groundwater; Afon Dyfi
Flooding	Potential increased flood levels associated with pumping of surface water runoff at the railway bridge into the southern drainage ditch; and increased flooding levels at existing properties to the north of the scheme at Pont-ar-Dyfi.	Floodplain

Significance of Effect - Surface Water

15.7.4 The proposed Scheme includes four surface runoff outfall points that would discharge into the Afon Dyfi and southern drainage ditch. The locations of the outfalls and water bodies are illustrated in Figure 15.2. These include:

- Proposed A487 Outfall 1 – Located to the north east of the Scheme, re-use of existing A487 outfall 1. Road drainage would be discharged via a headwall on north river bank, immediately downstream of Millennium Footbridge, into the Afon Dyfi;
- Proposed A487 Outfall 2 – Located to the south of the proposed Scheme, would re-use the existing A487 outfall 2. Road drainage would be discharged into the southern drainage ditch via a swale adjacent to Dyfi Eco Park, and culverted beneath the existing A487;
- Proposed A487 Outfall 3 – Located in the centre of the proposed cheme, the existing ditch to eastern side of A487 south of Pont-ar-Dyfi would be re-graded to fall northwards and discharge directly into the Afon Dyfi via a new culvert under the existing A487, and a length of new unlined ditch to west of existing A487. The ditch would be widened to reduce the width of the NMU route and lined with erosion control coir matting pre-seeded with native aquatic and marginal seeds;
- Proposed A493 Outfall – Located to north of Pont-ar–Dyfi immediately in front of Dyfi Cottages, the existing numerous direct drainage outfalls to Afon Dyfi would be consolidated into a single network and outfall.

Afon Dyfi

Surface Water Quality

15.7.5 As described in Section 15.5.56, the Afon Dyfi has been defined as high importance for this assessment based on its Good ecological status and the protected status of downstream waters.

15.7.6 Method A of HD 45/09 has been utilised to assess the operational effects of the road surface runoff from outfalls 1 and 3 on the Afon Dyfi. A cumulative assessment of impacts associated with soluble pollutants has also been undertaken because outfalls 1 and 3 fall within 1km of each other, requiring a combined assessment.

15.7.7 The methodology used for the Method A assessment and the HAWRAT model is presented in Section 15.4.

15.7.8 The predicted traffic data for the proposed Scheme is 5212 AADT in 2019 and 6291 AADT in 2034[9], which is significantly below the lowest range used in the HAWRAT assessment of between 10,000 and 50,000 AADT. A HAWRAT assessment has still been undertaken to address a worst-case scenario despite very low traffic volumes. Therefore the HAWRAT assessment is likely to overstate the potential risk to water quality.

15.7.9 Outfall 3 discharges surface runoff from the proposed Scheme via a new unlined ditch. Under HD 45/09 Method A, where the value of the Q95 is less than 0.001 m^3/s for a new drainage ditch, it is not necessary to undertake a HAWRAT assessment and a groundwater assessment Method C can be used instead. It was considered within this assessment that a HAWRAT assessment should still be undertaken to address a worst-case scenario. The HAWRAT model, however, does not take into account attenuation and infiltration of surface runoff as it flows along the new ditch. Therefore, the HD 45/09 Method C groundwater assessment has additionally been utilised to assess pollution impacts from routine runoff into groundwater from infiltration from the new ditch. This is presented below in the section on significance of effect for groundwater.

15.7.10 The surface water quality of the undiluted runoff for all sections on the road fail Step 1 of the assessment because levels of sediment and dissolved metals in the runoff are above the threshold levels set in the HAWRAT model.

15.7.11 At Step 2, Tier 1 the surface water quality passes the HAWRAT assessment for both sediment and dissolved metals. The levels of annual average concentration levels of Copper and Zinc are below limits of detection.

15.7.12 The HAWRAT model input parameters are presented in Appendix 15.3. The results of the HAWRAT assessment are summarised in Table 15.11 and the detailed results are provided in Appendix 15.3.

Table 15.11: HAWRAT water quality modelling results – Afon Dyfi

[9] Appendix 13.1, NMU Context Report, Table 1.

Outfall assessment number	Step 1	Step 2 (Tier 1)	Annual Average Concentration		Long term assessment based on EQS Copper 1 ug/l and Zinc 10.9ug/l (plus Ambient Background Concentration (3.2 µg/l) dissolved)
			Copper ug/l	Zinc ug/l	
1	Fail	Pass	0.00	0.00	Pass
3	Fail	Pass	0.00	0.00	Pass
1 & 3 (cumulative)	Fail	Pass	0.00	0.00	Pass

15.7.13 A long term impact assessment of surface water runoff from the highway into the Afon Dyfi has been undertaken by comparing the annual average concentrations of copper and zinc predicted in the HAWRAT results with the EQSs stated in the WFD (standards and classifications) Directions 2015. The predicted concentrations are under the EQS thresholds for watercourses.

15.7.14 It is therefore considered that the magnitude of impact of sediment and dissolved metals discharging into the Afon Dyfi is negligible. Therefore, the significance of potential effects of the proposed Scheme on water quality of the Afon Dyfi is considered to be *neutral*.

Geomorphology

15.7.15 The northern (right bank) bridge abutment would be located above the predicted 1 in 100 year flood level. Some minor excavation would be required to construct the pile cap, but it is intended that the natural bank profile is unaltered. Removal of the mature trees for the construction of the abutment is also required, which could destabilise the bank resulting in erosion or failures during the operational phase.

15.7.16 The southern (left bank) bridge abutment would be located just outside the limits of the gravel bar, but the pile cap would extend into the bar. This area would be inundated during large magnitude events. Although average channel velocities through the bridge section are predicted to remain unchanged for the range of flood events modelled, see Flood Consequence Assessment in Appendix 15.8, local turbulence and eddying around the abutment and remaining viaduct piers is expected.

15.7.17 The bridge pier nearest to the southern riverbank would be oriented parallel with the predicted direction of flow across the floodplain based on the flood modelling. This would aid in minimising scour around the structure.

15.7.18 However, there would still be potential for bank erosion and scouring immediately downstream of the bridge pier nearest to the southern riverbank, similar to what has occurred downstream of Millennium Cycle Bridge. There would also be potential for scour around the remaining viaduct piers.

15.7.19 The planned new surface water drainage ditch outfall immediately downstream of Pont-ar-Dyfi has the potential to cause localised erosion of the river bank.

15.7.20 It is considered that the magnitude of the impact of the proposed Scheme on geomorphology is moderate adverse as a result of the likelihood of the risk of scour and bank erosion associated with the new viaduct and bridge, which

could require the installation of bioengineering in the future. The corresponding significance is *moderate/large adverse*.

Afon Dulas

15.7.21 As the proposed Scheme is downstream and outside of the catchment area of the Afon Dulas there are no operational impacts expected from the proposed Scheme. The magnitude of impact is therefore assessed as negligible, leading to a significance of effect of *neutral*.

Southern Drainage Ditch

15.7.22 Outfall 2 discharges to the existing stone culvert, prior to Southern drainage ditch emerging upstream of the railway and passing into another culvert under the railway. In addition, a pumping station is proposed to pump overflow surface water during periods of flooding at the railway underpass into the upstream end of the network. The pump would only be operated during those flood occasions.

15.7.23 Method A of HD 45/09 was utilised to assess the operational effect of the road drainage from outfall 2 on the southern drainage ditch. Under HD 45/09 Method A, where the value of the Q95 is less than 0.001 m3/s for a new drainage ditch, it is not necessary to undertake a HAWRAT assessment and a groundwater assessment Method C can be used instead. It was considered, however, that a HAWRAT assessment should be undertaken as best practice and to address a worst-case scenario.

15.7.24 A HD 45/09 Method C groundwater assessment was also undertaken to assess pollution impacts from routine runoff on groundwater. The results are presented in the next section which covers significance of effect on groundwater.

15.7.25 The HAWRAT model input parameters are presented in Appendix 15.3. The results of the HAWRAT assessment are summarised in Table 15.12 and the detailed results are provided in Appendix 15.3.

Table 15.12: HAWRAT water quality modelling results – Southern drainage ditch

Outfall assessment number	Step 1	Step 2 (Tier 1)	Annual Average Concentration		Long term assessment based on EQS Copper 1 ug/l and Zinc 10.9ug/l (plus Ambient Background Concentration (3.2 µg/l) dissolved)
			Copper ug/l	Zinc ug/l	
Proposed – runoff the proposed highway 2	Fail	Zinc – Pass; Copper -Pass; Sediments – Pass.	0.15	0.51	Pass

15.7.26 At Step 1 of the assessment, the surface water quality of the undiluted runoff fails because the predicted levels of sediment and dissolved metals are above the threshold levels set in the HAWRAT model.

15.7.27 At Step 2, Tier 1, dissolved copper, dissolved zinc and sediment all pass the assessment. The detailed results are presented in Appendix 15.3 and a summary is provided in Table 15.12.

15.7.28 A long-term impact assessment of surface water runoff from the highway into the drainage ditch has been undertaken by comparing annual average concentrations of copper and zinc predicted in the HAWRAT results with the EQSs. The annual average concentrations of dissolved metals are under the EQS thresholds for watercourses of low water hardness and pass the assessment.

15.7.29 The results show that the discharge passes the HAWRAT assessment and therefore is assessed as negligible in magnitude, therefore the significance of effect of discharge of Outfall 2 is considered to be *neutral*.

Watercourses to the north west of the proposed Scheme

15.7.30 As the proposed Scheme does not involve any drainage outfall into these water features there are no expected impacts on water quality during operation. Neither watercourse would be included in the works to increase flood protection at Pont-ar-Dyfi cottages therefore the assessment of magnitude of impact is negligible. When combined with the low importance of the watercourses the significance of effect is *neutral*.

Dyfi Floodplain & Railway Drainage Ditches

15.7.31 These watercourses would be reinstated and any temporary haul road culverts removed after construction and would not receive any discharges from the proposed Scheme. It is therefore expected that there would be a negligible impact during operation, leading to a significance of effect of *neutral*.

Significance of Effect - Groundwater

15.7.32 The proposed Scheme design is for routine runoff to be discharged to surface watercourses. However, a number of the ditches into which the carriageway runoff would be discharged are intermittently dry in the summer months.

15.7.33 For outfall 1, routine runoff is to be discharged directly to the Afon Dyfi. As a result, there is no change to the magnitude of impact in terms of the pollution effects on groundwater, and the significance of effect is therefore *neutral*.

15.7.34 Outfalls 2 and 3 discharge to ditches and have Q95 flows of 0.001m^3/s or below. Therefore, infiltration may be expected and in line with HD 45/09, these proposed outfall locations require assessment as discharges to groundwater.

15.7.35 The predicted traffic data for the proposed Scheme in 2019 is 5212 AADT, which is at the lower end of the low risk range (0-50,000 AADT) used in the standard Method C approach for assessing pollution impacts from routine runoff to groundwater. On this basis, the assessments carried out for the Scheme are likely to overstate the potential risk to groundwater quality.

15.7.36 The full Method C assessments for the potential impacts to the groundwater body and specific receptors are provided in Appendix 15.4.

Method C Assessment

15.7.37 For Outfalls 2 and 3, the overall risk score for the HD 45/09 Method C assessment was 177.5. This is within the 150 to 250 suggested action class range, which indicates there is a 'medium' risk of impact as a result of discharge to groundwater from routine runoff at these locations.

15.7.38 In accordance with the HD 45/09 Method C assessment, mitigation measures should be considered for the protection of groundwater, with the need for and nature of any measures to be informed by additional risk assessment.

Additional Risk Assessment

15.7.39 The result of the Method C assessment indicates that routine runoff discharges at Outfalls 2 and 3 present a 'medium' long term risk of impact to the groundwater body. However, this risk would not be presented to the entire groundwater body, but rather a localised area around the outfalls because of the dilution and degradation behaviour of contaminants in groundwater. Consequently, an additional risk assessment has been carried out to understand the extent of the impact. The assessment was undertaken in accordance with the Environment Agency's (England and Wales) P20 Hydrogeological Risk Assessment for Land Contamination (see Appendix 15.4).

15.7.40 The results of the additional risk assessment demonstrate that the contaminant concentrations resulting from a long-term discharge of surface run-off diminish to the acceptable levels for the marker contaminants, copper and zinc, at a distance of approximately 10m from the outfalls. Therefore, the initial 'medium' risk of impact to groundwater is considered invalid beyond this radius.

Considering the very localised impact is limited to the proximity of the outfall, a minor adverse to negligible magnitude of impact is applicable to the groundwater body. In addition, the next closest receptor to these outfalls is the Afon Dyfi, located more than 300m to the north of the nearest outfall and therefore there is no risk to the surface water receptors from the Outfall 2 and 3 routine discharge.

15.7.41 The groundwater body beneath the proposed Scheme area is classified as a secondary aquifer, which according to Table A4.3 of HD 45/09, has a medium sensitivity in terms of groundwater vulnerability. Consequently, the significance of effect of discharge of routine run-off on the groundwater body is *slight adverse to neutral*. Therefore, no mitigation measures are necessary.

Significance of Effect - Accidental Spillage Risk

15.7.42 The risk of an accident resulting in a serious pollution incident on the Afon Dyfi and drainage ditch has been assessed for each proposed drainage outfall using the assessment Method D outlined in the HD 45/09 Volume 11, Section 3, Part 10. This assessment was carried out using highest vehicle numbers from either 2015 or 2034 AADT flows.

15.7.43 On all roads there is a risk that an accidental spillage or vehicle fire may lead to an acute pollution incident. It is generally accepted that the risk on any road is proportionate to the risk of an HGV road traffic accident. Because new or improved roads are designed to reduce the accident rate, they should be associated with fewer acute pollution effects. Where a spillage does reach a surface watercourse the pollution effect can be severe but is usually of short duration.

15.7.44 The acceptable risk of a pollution incident is stated in HD 45/09 to be a risk with an annual probability of less than 1%, or a return period of 1 in 100 years, of discharges reaching a sensitive watercourse or groundwater.

15.7.45 Using the HD 45/09 assessment method, the risk of spillages has been calculated for both the current and proposed situations. The results for 2034 are summarised in Table 15.13. The full assessment is provided in Appendix 15.7.

Table 15.13: Spillage probability for design year (2034)

Road	Receiving water body	Spillage probability	
		Surface water	Ground water
A487	Afon Dyfi Outfall 1	0.001%	0.000%
	Afon Dyfi Outfall 2	0.000%	0.000%
A487	Drainage ditch Outfall 3	0.001%	0.000%

15.7.46 The risks of accidental spillages, as corroborated by the analysis presented in Sections 15.5.46 to 15.5.48, are very low and well within the acceptable limits (i.e. 1%). Based on the spillage assessment, the magnitude of potential impact on the Afon Dyfi is considered to be negligible. The significance of effect is therefore *neutral*.

Significance of Effect - Flood Risk

15.7.47 In assessing flood impacts, DMRB state that the highway must remain operational and safe for users in times of flood, result in no net loss of floodplain storage, not impede water flows and not increase flood risk elsewhere.

15.7.48 The proposed Scheme proposes to raise the new bridge above the floodplain through a design of pier structures, and an embankment to the south of the bridge to ensure that the route is not at risk of flooding during an extreme event. The proposed Scheme includes a flood embankment to protect the Dyfi Eco Park industrial estate which would extend along the western boundary of the existing A487, tying in to the existing railway embankment. The flood modelling of the Scheme has incorporated these structures.

15.7.49 To address existing flooding issues at the Cambrian Line Railway Bridge the proposed Scheme design includes a new pumped drainage solution at this location. The Dyfi Eco Park flood embankment would prevent overland flow in this area during periods of river flooding, and the pumped drainage system would discharge to the west of the bund via the normal highway drainage outfalls.

15.7.50 In a 1 in 100 year storm event the flood extent with the proposed Scheme in place would be reduced compared to the current baseline model. The Dyfi Eco Park estate and Railway Terrace properties in the south of the proposed Scheme would be protected, and impacts to properties to the south of the railway bridge would be reduced. Following DMRB standards, the magnitude of impact to the south of the proposed Scheme would be major beneficial. This would be as a result of multiple properties in the Dyfi Eco Park experiencing flood depths in excess of 100mm lower during the 1 in 100 year extreme flood event.

15.7.51 However flood levels would increase on agricultural fields surrounding the proposed viaduct structure and the Scheme would increase the risk of certain properties flooding, namely the Pont-ar-Dyfi Cottages, to the north of the river and downstream of the bridge. When considering the impacts of the Scheme to south of the river in isolation, the significance of effect is therefore *large/very large* beneficial.

15.7.52 The flood levels at the properties at Pont-ar-Dyfi are predicted to increase by approximately 2mm during a 1 in 10 year storm event and 50mm during a 1 in 100 year + 30% climate change storm event.

15.7.53 In accordance with the guidance in HD 45/09 (see Table 15.4), the change in flood levels to the north of the Scheme of 50mm during a 1 in 100 year + 30% climate change storm event is on the boundary of minor to moderate adverse.

15.7.54 When considering the combined magnitude of impact, both to the north and south of the river, the precautionary principle has been applied. This leads to an assessment of the magnitude of impact of minor to moderate adverse as a

result of the increased peak flood depth at the properties to the north of Pont-ar-Dyfi.

15.7.55 Based on the classification of the floodplain as being of high importance, the significance of potential effect in an extreme flood event would be *slight/moderate to moderate/large adverse*.

15.8 Mitigation and Monitoring

15.8.1 The following mitigation measures are required to protect water quality and the water environment. These are summarised in the WFD summary table provided in Appendix 15.6.

Construction Mitigation

15.8.2 This section details mitigations required to reduce the significance of effect associated with construction. Measures that are considered as standard good practice have been included in a Pre-CEMP that would be implemented by the construction contractor, see Appendix 17. Measures that are non-standard or site specific are detailed below and these should be incorporated into the contractor's construction method statement.

15.8.3 The standard measures included in the Pre-CEMP are based on the Environment Agency's Pollution Prevention Guidelines (PPGs), as discussed in Section 15.2.34.

15.8.4 Examples of the standard practice mitigations included in the Pre-CEMP include the provision of spill kits, restricting site traffic to dedicated haul roads and ensuring hard-standing areas are regularly swept and maintained.

15.8.5 Effective delivery of the measures set out here and in the CEMP would be monitored during the construction phase, by the Environmental Clerk of Works.

Surface Water

Surface Water Quality

15.8.6 To reduce the significance of effect associated with construction (moderate adverse without mitigation) the following mitigation measures should be implemented.

15.8.7 As part of further development of the CEMP an Outline Water Management Plan has been created in liaison with the Contractor (Appendix 17.1 Annex F in Volume 3). This Plan includes site-specific measures to manage the impacts on the surface water environment such as:

- All potentially polluting substances including chemicals and oils would be stored outside of the floodplain on impermeable surfaces with controlled drainage to protect against pollution. This would include all activities such as refuelling of and washing out of plant and machinery;

- No materials or topsoil would be stockpiled within the floodplain or near the Afon Dyfi. Areas of exposed ground would be minimised to reduce silty runoff;
- A surface water management system, using measures such as temporary silt fencing, cut off ditches, settlement ponds and bunds would be set up as early in the construction period as possible to capture all runoff within or traversing the construction corridor. The bunds would be approximately 0.6m above ground level and the adjacent channel would remain vegetated (i.e. the topsoil would not be stripped);
- Captured runoff would be directed (e.g. by pumping) to a settlement lagoon or sump from where it can be treated. It is recommended that the proposed outfall ditch to be constructed alongside the existing A487 would be used, along with appropriate treatment measures (e.g. stop-logs, straw bales) to return site runoff to an acceptable quality before being discharged into the Afon Dyfi;
- Further local measures (e.g. silt fencing / straw bales) to prevent ingress of sediments/contaminants into existing drainage ditches should be implemented. In particular these measures should be used to protect the southern drainage ditch during construction of the adjacent flood bund;
- Water with a higher risk of contamination, including groundwater pumped out of pilings during concrete pouring, would be contained and treated using appropriate measures such as coagulation of sediments, dewatering and pH neutralisation prior to discharge. There are various proprietary package treatment plants available that can provide these measures. Contaminated water that cannot be treated on site will, if necessary, be pumped to a suitably licenced tanker before being exported off site for treatment at an appropriately permitted facility;
- Works for the river bridge and within 7m of any watercourse would be carried out in accordance with the conditions of the relevant Flood Risk Activity Permit;
- All water pumped from excavations would be pumped via a pipe and gravel sump in order to prevent silt being agitated from the base of the excavation and to provide rudimentary filtration to the water prior to abstraction. For low volume pumping, water would either be pumped into a vegetated area remote from surface water drainage or into a small attenuation lagoon prior to being directed into the drainage system. For high volume pumping (0.052 m3/s or above) water would be passed through an attenuation tank with a capacity of not less than $8m^3$. The outlet from the tank could be placed directly into site drainage, provided the water is free from silt contamination;
- Activities such as concrete pouring for piles, pier columns and abutments, as well as washout of vehicles/equipment would create water contaminated with concrete. This water should be collected and pumped to an appropriate treatment solution, of water before it is returned to the surface water management system. Treatment may need to include a carbon dioxide adjustment system to neutralise high pH cement laden water and

settlement of sediments to remove fines from wash waters. Settlement units use gravity to remove fines and can be combined with coagulants or flocculants to treat higher volumes of water. Any residual material (i.e. solids) from this process should be, where possible, re-used onsite under a Materials Management Plan or otherwise transported to an appropriately licenced waste facility;

- Areas of exposed sediment deemed at risk of erosion during heavy rainfall or flood inundation should be protected using either temporary measures (e.g. sheeting) or semi-permanent measures (e.g. coir matting) until vegetation is able to establish on these surfaces. The use of temporary or semi-permanent measures would vary based on the planned construction in that area. For example, the flood bund, once constructed, should be protected with semi-permanent erosion control until vegetation is established, whilst areas excavated for the haul road/laydown areas may only be exposed for a short period during construction and would therefore only require temporary erosion control;
- During works, the Site Manager would regularly check river levels, via the NRW flood monitoring station, and the three day weather/flood risk forecasts. Prior to any works, a comprehensive evacuation procedure for the workforce to secure and evacuate the works areas would be agreed;
- Works should be suspended during out-of-bank river flows and plant moved out of the floodplain to a position of safety behind the flood bund, or a level on the embankment above the flood level. Following a flood event any equipment or temporary works would be checked for integrity prior to commencing works. These measures would minimise the likelihood of polluted water entering the Afon Dyfi during a flood;
- Water that is unpolluted other than with fairly coarse particles as well as relatively small flows may be treated by passing through tanks or skips with a suitable filter such as gravel, geotextiles, straw bales or silt-busters;
- A water quality monitoring programme prior to and during construction works would be agreed with NRW; and
- The process and procedure for responding to and reporting environmental incidents would be agreed with NRW and included within the CEMP.

Geomorphology

15.8.8 The significance of potential construction effects of the proposed Scheme on geomorphology is considered to be moderate/large adverse. Mitigation measures should therefore be incorporated and are described below.

- The risk of bank and floodplain erosion and alteration of geomorphological features should be managed by minimising in-channel working, minimising and protecting the extents of excavations and controlling plant trafficking routes;
- The extent of the excavation for the pier nearest to the southern riverbank (left bank) should be kept to a minimum, and the excavation and reinstatement carried out in such a way as to preserve the original structure

and extent of the gravel bar. First, the coarse surface layer should be scraped off and stockpiled separately. The remaining material should then be excavated to allow for construction of the pile cap. At the earliest opportunity, the bar material should be replaced and the coarse surface layer reinstated;

- Plant should be excluded from the area of the gravel bar outside the limits of the excavation;
- The extent of the excavation for the northern abutment (right bank) and cattle pass should also be kept to a minimum. Vegetation removal to enable the work should be minimised and existing tree roots left in place with no modifications made to the natural bank profile beyond the lower limit of excavation;
- Bare areas exposed during any works to the river banks or by excavation or soil stripping on the floodplain should be protected with temporary measures to ensure no erosion or scouring during flood events prior to the installation of bioengineering and/or establishment of vegetation;
- Defined plant trafficking routes should be located away from the channel and river banks to prevent any further modification to in-channel features or loading of the banks which could cause bank failure; and
- Construction activities affecting the river banks or any in-channel features should be carried out under the supervision of a qualified geomorphologist.

Groundwater

15.8.9 The significance of potential construction effects of the Scheme on groundwater is considered to be moderate adverse. As the main risk to groundwater is from infiltration of contaminated surface water, the mitigation measures detailed in 15.8.7 also apply here. These include measures for the containment and treatment of site runoff, water extracted during piling and water contaminated with concrete. These measures apply in addition to the standard procedures included in the CEMP as discussed in 15.8.2.

Flood Risk

15.8.10 The significance of potential construction effects of the proposed Scheme on flood risk is considered to be neutral.

Operational Mitigation

15.8.11 This section identifies mitigation measures where adverse effects due to operation of the proposed Scheme have been identified. For this assessment these include impacts on flood risk.

Afon Dyfi

Surface Water Quality

15.8.12 The significance of potential operational effects of the proposed Scheme on water quality of the Afon Dyfi has been assessed to be neutral. It has also been assessed that in the event of an accidental spillages the significance of effect on the Afon Dyfi is neutral.

15.8.13 However, due to the high sensitivity of the European conservation site downstream of the Scheme[10], it has been agreed that enhancements, in the form of containment facilities, are required at the following locations:

- For Proposed A487 Outfall 1 a full retention petrol interceptor and isolation device consisting of a pen stock gate valve or similar would be installed to act as a containment facility in the event of a tanker spill. This would enable isolation of spills and prevent them entering the Afon Dyfi from Outfall 1. This measure is considered the most appropriate at this location, due to the steep topography and limited space available; and
- For Proposed A487 Outfall 3 a petrol interceptor and isolation device consisting of a pen stock gate valve or similar would be installed to act as a containment facility in the event of a tanker spillage on the viaduct. A further isolation device would also be provided within the existing re-profiled ditch to east side of existing A487, consisting of stop logs or similar, to isolate spillages from the existing A487 south of Pont-ar-Ddyfi. Containment within the existing re-profiled ditch would be within the floodplain and prone to mixing with flood water. However due to the unlikelihood of a spillage and flood event coinciding this risk is considered to be negligible.

Geomorphology

15.8.14 The significance of potential operational effects on geomorphology is considered to be moderate/large adverse as a result of the high risk of scour and bank erosion. The mitigation measures outlined below would be implemented.

- To reduce risk to the integrity of the northern (right) bank at the location of the new abutment, tree clearance would be minimised. Where tree removal is required, stumps would be left in place to continue to provide cohesion to the bank material and buffering from flows. Compensatory planting of appropriate woody species should be carried out to further reduce the risk of bank erosion. Hard revetment should be avoided;
- The pile cap at the southern abutment would extend into the gravel bar. The size would be minimised to the greatest extent possible and the top of the cap buried to beneath the minimum average flow level (6.576mAOD). This would allow the reinstated gravel bar to continue functioning naturally

[10] Correspondence dated 18 August 2016 from Meryl Read Natural Resources Wales. A487 New Pont-ar-Ddyfi. Draft Environmental Statement and Statement to inform an Appropriate Assessment

with natural exchange of bed material. It is also aimed at eliminating the need for hard revetment and helping preserve the aesthetics of the site over the long term;

- Scouring around the piers on the floodplain is likely to be less severe. Bioengineering methods would be incorporated into the detailed design stage to prevent the formation and growth of scour holes on the floodplain. Similar measures would be used around the southern abutment. Pre-established coir matting should be considered as an alternative to seeding in order to provide immediate protection and aid in rapid vegetation establishment;
- These areas should be monitored to ensure establishment and continued performance of bioengineering in erosion and scour protection;
- The new ditch outfall to the Afon Dyfi downstream of the Pont-ar-Dyfi should be designed in such a way as to manage the risk of bank erosion using softer engineering solutions or bioengineering rather than hard revetment; and
- The design and construction supervision of these mitigation measures would be led by a qualified geomorphologist.

Southern Drainage Ditch

15.8.15 The significance of potential operational effects of the proposed Scheme on water quality of the southern drainage ditch is considered to be neutral, therefore no mitigation measures have been deemed necessary.

15.8.16 However it is proposed to add enhancements to the highways drainage which would consist of a swale on the eastern side of the carriageway, adjacent to Dyfi Eco Park. This would provide attenuation and treatment of surface water, prior to discharge via Outfall 2, to the Southern Drainage Ditch. An isolation device consisting of stop logs or similar would also be installed prior to the outfall to act as a containment facility in the event of a tanker spill. This would isolate spills from entering the southern drainage ditch in the event of an accident.

Groundwater

15.8.17 The significance of potential operational effects of the proposed Scheme on groundwater is considered to be slight adverse to neutral. No receptors were identified within a 10m radius of Outfalls 2 and 3; therefore, mitigation measures are considered unnecessary.

Accidental Spillage Risk

15.8.18 The significance of potential operational effects of the proposed Scheme from accidental spillage is considered to be neutral. Therefore mitigation measures are considered unnecessary. However, the inclusion of petrol interceptors at Outfalls 1 and 3, and isolation devices on all outfalls would be enhancements that reduce the risk of a hydrocarbon spillage entering a watercourse.

Flood Risk

15.8.19 To mitigate the adverse flood risk effect to the Pont-ar-Dyfi Cottages, it is proposed to protect the A493 and Dyfi Cottages from fluvial flooding using a single longitudinal carrier drain installed beneath the A493 in order to intercept and consolidate the numerous existing drainage networks into a single network with a single gravity outfall to the river. A non-return flap valve would be installed on the single gravity outfall. Existing drainage outfalls would be removed or grouted up, and the existing stone parapet wall sealed to provide an effective flood barrier. These measures would act to prevent any flow path for river flood water, and thereby protect the A493 and Dyfi Cottage from fluvial flooding up to and beyond the 1 in 1000 year fluvial flood event.

15.8.20 A pump station would be provided within a chamber under the A493 which would operate when the river is in flood and the flap valve on the drainage gravity outfall is closed, preventing outflow. The pump station would be sized to ensure no flooding of the cottages up to the 100yr pluvial storm event. A 100mm raised kerb would be installed along the northern edge of the A493 carriageway to prevent surface water drainage from the carriageway running off into the adjacent cottage properties which are set at a lower level than the carriageway.

15.8.21 With the proposed embankment along the northern side of the Dyfi Eco Park and the pump station beneath the Cambrian Line Railway Bridge being constructed as part of the Scheme and providing significant flood risk prevention, further mitigation measures to the south of the Afon Dyfi are deemed unnecessary.

15.9 Construction Effects - With Mitigation

Significance of Effect - Surface Water

Afon Dyfi

15.9.1 Following the implementation of mitigation measures and the CEMP during construction, the magnitude of any pollution incident is likely to be negligible. Therefore, significance of effect would be reduced to *neutral*.

15.9.2 Additional mitigation measures have been outlined to manage temporary geomorphological risks. With these in place, the magnitude of the potential impacts would reduce to negligible and the significance to *neutral*.

Southern Drainage Ditch

15.9.3 Additional mitigation measures have been outlined to manage temporary risks of sediment and pollutant runoff during construction, along with implementation of the CEMP. With these in place, the magnitude of potential impacts would reduce to negligible and the significance of effect to *neutral*.

15.9.4 It has been assessed that the significance of effect on geomorphology during construction is *neutral* and therefore no further mitigation measures were proposed.

Afon Dulas

15.9.5 Mitigation measures have not been provided beyond best practice measures and implementation of a CEMP. Therefore, the significance of effects during construction remains unchanged (*neutral*).

Watercourses to the north west of the proposed Scheme

15.9.6 Mitigation measures have not been provided beyond best practice measures and implementation of a CEMP. Therefore, the significance of effects during construction remains unchanged (*neutral*).

Dyfi Floodplain & Railway Drainage Ditches

15.9.7 Following the implementation of the CEMP and additional mitigation measures, the magnitude of any pollution incident is likely to be negligible. Therefore the significance of effect would be reduced to *neutral*.

15.9.8 Temporary geomorphological risks, as a result of temporary culverting of the floodplain ditches, is necessary to gain access to the construction areas. The assessment of potential impacts of this therefore remains moderate adverse and the significance remains *slight adverse*.

Significance of Effect - Groundwater

15.9.9 Additional mitigation measures to reduce the potential construction impacts on groundwater have been detailed in Section 15.8. With these measures and those set out in the CEMP in place, the magnitude of impact is reduced from moderate adverse to negligible, leading to a significance of effect of *neutral*.

Significance of Effect - Flood Risk

15.9.10 Mitigation measures have not been provided beyond best practice measures and implementation of a CEMP. Therefore, the significance of effects during construction remains unchanged (*neutral*).

15.10 Operational Effects - With Mitigation

Significance of Effect - Surface Water

Afon Dyfi

15.10.1 Although petrol interceptors are included in the proposed Scheme as enhancement measures, the significance of effects of routine runoff is assessed as neutral without mitigation measures in place and therefore, based on the criteria in Table 15.5, the significance of effect remains as *neutral*.

However they would be expected to provide some benefits in relation to the removal of hydrocarbons from surface water runoff from the carriageway.

15.10.2 Additional mitigation measures have been outlined to manage geomorphological risks and comply with WFD. If these are implemented successfully, the magnitude of the potential impacts would reduce to minor adverse and thus the significance to *slight/moderate adverse*. It is considered that with implementation of these measures the WFD status of either the 'Dyfi – tidal limit to Afon Twymyn' or 'Dyfi & Leri' water bodies would not be reduced or prevented from attaining Good status in the future.

15.10.3 A number of WFD enhancements have been identified that would provide minor benefits. However these are not committed to within the current programme of works and it is not expected that implementing these measures would improve the WFD status of the water body.

Afon Dulas

15.10.4 The significance of effects remains the same (*neutral*) as no mitigation measures were deemed necessary. The WFD status of the Dulas North water body would not be reduced or prevented from attaining Good status in the future as a result of the proposed Scheme.

Southern Drainage Ditch

15.10.5 The significance of effects of routine runoff on the water quality of the southern drainage ditch has been assessed as neutral without mitigation measures in place. Although a swale is included as an enhancement measure in the proposed Scheme, in accordance with the criteria in Table 15.5, the significance of effect remains as *neutral.*

Watercourses to the north west of the proposed Scheme

15.10.6 The significance of effects remains the same (*neutral*) as no mitigation measures were deemed necessary.

Dyfi Floodplain and Drainage Ditches

15.10.7 The significance of effects remains the same (*neutral*) as no mitigation measures were deemed necessary.

Significance of Effect - Groundwater

15.10.8 The assessment of effects on groundwater without mitigation measures in place concluded that any impacts would be limited to a 10m radius of the point source at each outfall. No receptors were identified within a 10m radius of outfalls 2 and 3; therefore, the significance of effects was considered to be *slight adverse* to *neutral*, and no mitigation is required. It is considered that the proposed Scheme would not cause a degradation in the WFD status of the Meirionnydd groundwater body and would not prevent it from attaining Good status in the future.

Significance of Effect - Accidental Spillage Risk

15.10.9 Petrol interceptors and containment devices are included in the proposed Scheme as enhancement measures for outfalls to the Afon Dyfi and a spillage containment device is included for the outfall to the southern drainage ditch. Without mitigation measures, the significance of effects has been assessed as neutral. Following the criteria set out in in Table 15.5, the mitigation provides no significant gain and therefore the significance of effect for all outfalls remains as *neutral (i.e. no specific benefit can be identified under the assessment criteria adopted)*. Nevertheless in the unlikely event of a spillage, the enhancement measures would provide containment, reducing the potential impacts on the water environment.

Significance of Effect - Flood Risk

15.10.10 The significance of effect to the south of the proposed Scheme remains the same (*large/very large* beneficial) as the Dyfi Eco Park embankment and pumped solution beneath the Cambrian Line Railway Bridge, assessed as part of the Scheme, would provide the majority of flood protection improvements in this area.

15.10.11 To the north of the proposed Scheme, provision of a consolidated drainage network with non-return flap valves, sealing of the existing stone parapet wall and provision of a pumping station would protect the section of A493 and Dyfi Cottages from fluvial flooding up to 1 in 1000 year, and surface water flooding up to 1 in 100 year storm event. The proposed works would remove the existing risk of up to 270mm flooding in 100yr + 30% climate change fluvial event and therefore, according to Table 15.5, the magnitude of impact is assessed as major beneficial. The significance of the Scheme in relation to the properties to the north of the river is considered to be *large/very large* beneficial.

15.10.12 Therefore, after mitigation, when the impacts of the proposed Scheme to the north and south of the river are considered together the significance of effect on flood risk is *large/very large* beneficial.

Conclusion

15.10.13 A full summary of the conclusions and required mitigation measures with regard to WFD compliance are provided in Appendix 15.6, Volume 3.

15.10.14 It has been concluded the neither the temporary nor the operational impacts would adversely affect the current status of the various WFD elements of the water bodies in question or prevent these or any other water bodies from reaching Good status (or potential) provided the outlined mitigation measures are implemented.

15.11 Inter-relationships

15.11.1 The assessment on road drainage and water environment is inter-related with the assessment of impacts on Chapter 9 Nature Conservation and Chapter 10 Geology and Soils.

15.11.2 This assessment has focused on impacts of the operation of the proposed Scheme on the water quality and geomorphology of the Afon Dyfi from routine road runoff and new infrastructure which could have ecological impacts on species and habitats. The toxicity levels of runoff and geomorphological risks have been considered within the assessment to be slight/moderate or neutral in significance of effect. Impacts on specific species and habitats associated with the Afon Dyfi and impacts on the downstream SAC and SSSI are considered further within Chapter 9.

15.11.3 The assessment of groundwater impacts has concluded that the effect of surface runoff would have a neutral effect on groundwater quality. Further information on potential pollution pathways from contaminated soils would be identified from ground investigations during detailed design stage of the Scheme. As such at this stage the assessment of Geology and Soils within Chapter 10 considers that the risk of encountering unexpected localised contamination would have a neutral to slight adverse significance of effect.

As this chapter assesses the impacts of the proposed Scheme on flood risk it is worth noting the wider benefits provided to the local community (see Chapter 14 Community and Private Assets) and all travellers (Chapter 13 Effects on Travellers). One of the key drivers of the proposed Scheme is to provide a crossing of the Afon Dyfi that is passable during times of flood, which has associated benefits to all travellers, including pedestrians. Another benefit to the local community as a result of the proposed Scheme would be the improvement in current levels of flood protection offered to the Dyfi Eco Park and the cottages to the north of Pont-ar-Dyfi.

15.12 Summary

Table 15.14: Summary of impacts to the water environment

Activity	Feature	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact without mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
Construction phase	Afon Dyfi	High – Good ecological status, downstream designations and geomorphological features of high importance	Pollution and degradation of water quality	Short	Moderate adverse	Negligible	Neutral	Implement CEMP and additional measures
			Alterations of geomorphological features, obstructions within the channel/ floodplain	Short/ Medium	Moderate adverse	Negligible	Neutral	Mitigation measures as described in WFD assessment table (Appendix 15.6)
	Afon Dulas	Medium – A main watercourse with Moderate WFD status	No expected impacts other than potential impact on migratory fish during construction	N/A	Negligible	Negligible	Neutral	No mitigation measures necessary
	Southern Drainage Ditch	Medium –Not a main watercourse but provides a natural flow of water connected to Dyfi catchment	Pollution and degradation of water quality	Short	Moderate adverse	Negligible	Neutral	Implement CEMP and additional measures
	Watercourses to the north west of the proposed Scheme	Low – Small, ephemeral watercourses that drain hillside to the north of Afon Dyfi	Pollution and degradation of water quality or geomorphological impacts	Short	Negligible	Negligible	Neutral	No mitigation measures necessary

Activity	Feature	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact without mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
	Dyfi Floodplain and Railway Drainage Ditches	Low – Ponded watercourses that drain small areas south of the railway and on the floodplain	Pollution and degradation of water quality	Short	Moderate adverse	Negligible	Neutral	Implement CEMP and additional measures
			Alterations of geomorphological features, obstructions within the channel	Short/Medium	Moderate adverse	Moderate adverse	Slight adverse	Implement CEMP and additional measures
	Groundwater	Medium – Secondary aquifer and no protected designations	Pollution of groundwater	N/A	Moderate adverse	Negligible	Neutral	Implement CEMP and additional measures
	Floodplain/ Flood risk	High – Conveyance of flood waters and frequent flooding	Increase in flood risk to surrounding properties	Short	Negligible	Negligible	Neutral	Implement measures in the CEMP
Operational phase	Afon Dyfi	High	Pollution and degradation of water quality	Long	Negligible	Negligible	Neutral	Enhancement measures include a petrol interceptor and containment device.
			Accidental spillage pollution impacts	Long	Negligible	Negligible	Neutral	Enhancement measures include a petrol interceptor and containment device.

Activity	Feature	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact without mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
			Alterations of geomorphological features, increased risk of bank erosion and scour that may require installation of bioengineering.	Long	Moderate adverse	Minor adverse	Slight/ Moderate adverse	Mitigation measures as described in WFD assessment table (Appendix 15.6)
	Afon Dulas	Medium – A main watercourse with Moderate WFD status	No expected impacts	N/A	Negligible	Negligible	Neutral	No mitigation measures necessary
	Southern Drainage Ditch	Medium	Pollution and degradation of water quality	Long	Negligible	Negligible	Neutral	Mitigation measures not necessary.
			Accidental spillage pollution impacts	Long	Negligible	Negligible	Neutral	Enhancement measures include a containment device.
	Watercourses to the north west of the proposed Scheme	Low – Small, ephemeral watercourses that drain hillside to the north of Afon Dyfi	No expected impacts	N/A	Negligible	Negligible	Neutral	Mitigation measures not necessary
	Dyfi Floodplain and Railway Drainage Ditches	Low – Ponded watercourses that drain small areas south of the railway and on the floodplain	No expected impacts	N/A	Negligible	Negligible	Neutral	Mitigation measures not necessary
	Groundwater	Medium	Pollution of groundwater	Long	Minor adverse to Negligible	Minor adverse to Negligible	Slight adverse/ Neutral	No mitigation measures necessary

Activity	Feature	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact without mitigation	Magnitude of impact with mitigation	Significance of impact following mitigation	Notes/ Comments
	Floodplain	High	Reduction in flood risk south of the Scheme but increase in flood levels at Pont-ar-Dyfi Cottages	Long	Minor/Moderate adverse	Major beneficial	Large/Very Large beneficial	Mitigation measures are outlined from 15.8.19 to 15.8.21.