10. Water Quality and Drainage

10.1 Introduction

Purpose and Scope of the Assessment

10.1.1 This chapter addresses the potential effects on water resources as a result of the proposed development. Water resources include surface waters (e.g. rivers, burns, static water bodies, tidal waters, etc.) and groundwater (e.g. shallow and deep aquifers). The assessment process comprised of characterisation of the existing water resources, identification and prediction of potential effects, and inclusion of any secondary mitigation measures (i.e. those not already included in the Scheme outline design or thought of as standard practice) required to offset any significant residual effects.

Planning Framework

10.1.2 Apart from general statutory and planning requirements for a development of this nature, the water resources aspects are regulated by a number of EU, Northern Ireland and Local instruments, comprising but not limited to: -

- EU Directive 2000/60/EC (Water Framework Directive), implemented by The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2003;
- The Water (Northern Ireland) Order 1999 in respect of discharges to surface or groundwater;
- PPS15 (Planning and Flood Risk), policy for flood prevention and planning controls; and
- Draft Belfast Metropolitan Area Plan 2015 (BMAP) - published November 2004, Carrickfergus Area Plan 2001 (adopted March 2000), and the Draft Newtownabbey Area Plan 2005 (un-adopted).

10.1.3 The resultant influence of this statutory and planning regime is discussed in Section 10.3 in deriving a set of key issues and constraints for the water resource aspects of this development.

Study Area

10.1.4 The A2 is situated on the coastal plain next to Belfast Lough, and predominantly runs through urban areas parallel to the shore of the Lough. The general topography is such that the land falls towards the Lough and therefore all surface water features drain to the Lough and cross the road alignment. The section of the A2 being upgraded under these proposals is shown on Figure 1.1 – Location Plan. In the context of these proposals, there are 14 water resources features that have been identified as part of this assessment. Within the 250m boundary considered either side of the Scheme, there are 13 surface water features, which include 13 watercourses (i.e. streams, field drains, etc.) and the remaining feature identified is the groundwater beneath the Scheme. All of these features are shown on Figure 10.1.

Water Resources Related Proposals

10.1.5 A full description of the Scheme is included in Chapter 5 – The Preferred Scheme Design, and Scheme details that will have an effect on this assessment are highlighted below. At present it is understood that the majority of run-off from Shore Road drains into a combined foul and surface water sewer before going to a wastewater treatment works. At the request of the Water Service, and as a measure of good practice, no water from the improved road will be drained to the public sewers. All road run - off will therefore be drained to nearby watercourses with appropriate measures as agreed with the authorities.

10.1.6 For any of the watercourses used as an outfall, a condition and capacity check will require to be carried out. Where appropriate, the flow of run-off will be attenuated to an appropriate level for discharge. In addition, environmental protection measures will be adopted as required to prevent pollution of the watercourses and Belfast Lough.

Road Drainage and Outfalls

10.1.7 The drainage of the online improvement and off-line new road will follow the same principles though the practical implementation will be different in some respects.

Drainage of the online improvement

10.1.8 The drainage of the road will be by kerb and gully. These will feed to a carrier drains. The gradients of the vertical alignment of the road will be low in some areas and with a number of crests it may prove to be prudent to use a combined kerb and surface water drainage system rather than individual gullies. Carrier drains and or combined systems will outfall to the nearest suitable watercourse. Given the profile of this section of road it is expected that run off will be drained to outfalls at watercourse nos. 2, 3, 4 or 5, 6, & 7 or 8.

10.1.9 As Shore Road is built up on both sides, it is not thought that there will be a need to intercept run-off from the land. However, provisions may be made for the water from some driveways to be intercepted to prevent excessive water running across footways and carriageways. In addition, shared cycleway / footway on the Lough side will fall to away from the road and will require collection by suitable means before draining to the road drainage system.

10.1.10 As the improved road will fall from landward to shoreward, the road drainage will naturally outfall to the downstream end of the culverts. The road drainage would not therefore be expected to add any demands to the culverts beneath Shore Road but would add demand to the watercourse or any culvert between the road and the Lough and attenuation measures may be necessary.

Drainage of the offline new road

10.1.11 The drainage of the road will be using a mixture of kerb and gully and combined kerb and surface water systems, depending on the falls on each section of road. A carrier drain for such a drainage system will be provided within the road verge or the central reservation. Given the profile of this section of road it is expected that run off will drain back to an outfall at watercourse no. 8 or 9 from the high point, and then the remaining length of the road from the high point to the end will drain to an outfall at watercourse no.13.

10.1.12 It is recognised that some attenuation of the road run off will be necessary to reduce it to a level that is acceptable for discharge to watercourse no.13. It is therefore proposed to provide an attenuation pond on the approach to Jointure Bay Stream near chain 3150. This feature would also provide an opportunity for secondary treatment of

the flows, and would be in accordance with Sustainable Urban Drainage System (SUDS) principles.

10.1.13 The short section of road to the east of watercourse no.13 would also drain to watercourse no.13, with appropriate attenuation and primary treatment as required. It is noted this would be independent of the SUDS feature noted above.

Watercourse Crossings

10.1.14 Where the road is being widened over existing culverts, it is intended that these will be lengthened upstream and downstream assuming that the existing culverts are structurally sound. The size and form of the original culvert will be maintained. Where the new road alignment deviates from the existing alignment, new culverts will be provided to cross watercourses and field drains. The format of new culverts is likely to be pipe culverts with masonry or concrete headwalls and splay wing walls upstream and downstream. The sizing of the culverts will be completed based on a hydrological assessment of the catchment. The culvert invert will be below the bed level of the existing watercourse to allow some level of re-establishment of the natural bed conditions. The length of the culverts will typically be equivalent to the width of the new road construction (i.e. pavement width and embankment width) as most watercourses flow perpendicular to the proposed road alignment. It is understood that the crossing at the Jointure Bay Stream will be made without encroaching into the channel or banks of the watercourse, using a bridge rather than a culvert.

10.2 Approach and Methods

10.2.1 The assessment methodology used in this Chapter is based on the generic methodology presented within Chapter 1 – Introduction of this ES. Into this methodology, the guidance and techniques presented within the "Design Manual for Roads and Bridges", Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment" have been incorporated. The following section gives further detail in regard to how the potential effects on the water resources, which may arise from the construction and operation of the development, were assessed.

Baseline Conditions

10.2.2 Water resources features around the development site were identified initially from Ordnance Survey maps, a desktop review of previous reports, and survey data collected for the study area during the preparation of this ES. This initial desktop review was supplemented by consultations with statutory organisations, and further consideration of available data. The study area assessed extends 250m either side of the proposed alignment (and further downstream where required) for surface water features, whilst groundwater features where considered over 1km either side of the Scheme.

Surface Waters

Geomorphological and Hydrological Data

10.2.3 Geomorphological conditions of each watercourse were evaluated from Ordnance Survey mapping, data collected during the field surveys for this ES, and the information within the Chapter 9 – Geology and Soils.

10.2.4 No hydrological data for any of the watercourses crossed by the Scheme is available from the National River Flow Archive. Therefore, flow assessments for the main watercourses that cross the Scheme have been made using standard low flow hydrology techniques. It is noted that these flows have been derived for the purposes

of this assessment only, and the designers of the watercourse crossings will be responsible for assessing the flows and providing crossings with adequate flow capacity.

10.2.5 The study area has not been identified as an active floodplain and so flooding considerations are restricted to individual locations at watercourses and outfalls.

Watercourse Water Quality

10.2.6 The EHS utilises both the Chemical and Biological General Quality Assessment system to describe the water quality of significant watercourses in Northern Ireland. This system categorizes watercourse water quality into A – Very Good, B – Good, C – Fairly Good, D – Fair, E – Poor, and F – Bad, and a full description of this categorisation system is available on the EHS website.

10.2.7 Given the small size of the watercourses within the study area, none of them are currently monitored or classified by the Environment & Heritage Service (EHS). Therefore the evaluation of baseline water quality for these watercourses for this assessment is based on a visual / qualitative assessment using the "Likely River Uses and Characteristics" descriptions provided as part of the General Quality Assessment system criteria. This assessment has been supplemented by consideration of the aquatic ecology from the Ecology Chapter and a review of the presence of other pollutants such as faeces, toilet paper, oils, building waste, and gross litter (furniture, motor vehicles, road cones, etc.). The evaluation also takes into account the setting of each of these watercourses e.g. the presence of surrounding infrastructure or existing discharges that may influence water quality.

10.2.8 For the purposes of this assessment, the present water quality objectives for all of the watercourses in this area are assumed to be the preservation of the assigned General Quality Assessment Class. It is noted that the creation of River Basin Management Plans for the Water Framework Directive will influence future water quality objectives, however it is understood that the water quality objectives for individual watercourses have not yet been developed.

Coastal Water Quality

10.2.9 It is understood that the Northern Ireland Estuarine and Coastal Waters Classification Scheme is currently under development, and therefore there is no classification of the nearby coastal waters available at this time.

Bathing Water Quality

10.2.10 The area of coast adjacent to the Scheme is not an identified bathing water, and therefore no monitoring results are available.

Groundwater

10.2.11 Groundwater data was sourced from:

- Consultations with EHS in regard to any areas of groundwater pollution or groundwater abstraction within the study area;
- The Geology and Soils Chapter of this ES;
- The following mapping derived by the EHS for the characterisation of groundwater for the WFD – "Groundwater Bodies Map", "Bedrock Aquifer Classification", "Groundwater Vulnerability Map", and the "Groundwater Diffuse Pollution Map";

- The Hydrogeological Map of Northern Ireland.

Impact Identification

10.2.12 Identification of the possible range and location of potential impacts was based on:

- The guidance within DMRB Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment";
- The professional experience of the assessment team;
- Consultation with relevant statutory and non-statutory organisations;
- Desk and site based research;
- An EIA scoping report and a DMRB Stage 2 report previously prepared; and
- Liaison with other Chapter Authors, and in particular the Authors of the Ecology and Geology and Soils Chapters.

10.2.13 From this work a distilled list of impacts thought to have potential to cause adverse effects on the water resource features was derived (see Section 10.4). It is noted that environmental effects on the water resource features may also lead to other impacts (such as changes to the aquatic ecology), which are addressed separately in this ES.

Level of Impacts (Impact Assessment)

10.2.14 Impact assessment was based on the generic assessment methodology presented in Chapter 6 – Approach and Methods of this ES and the guidance within DMRB Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment".

Impact Magnitude

10.2.15 The **magnitude** of a potential effect on the water resources features was evaluated using the criteria provided in Table 5.4 "Estimating the Magnitude of an Impact on an Attribute" (of the Design Manual for Roads and Bridges", Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment"), with the addition of the following criteria to cover areas not specifically dealt with in the DMRB criteria. It is noted that impact magnitudes described below are all phrased assuming adverse impacts, but these general classifications have also been used to describe beneficial impacts from the development:-

10.2.16 **High** (equivalent to "Major Adverse" in DMRB) – results in loss of attribute and / or quality and integrity of attribute. Additional criteria: -

- Degrading of the existing water quality classification;
- Significantly increased flooding of residential or commercial properties (this is in lieu of the DMRB increase in flood level >100mm);
- Loss of or serious effect on the integrity of a internationally or nationally designated aquatic ecological resource;
- Gross changes to geomorphological or hydraulic characteristics e.g. loss of natural bank and bed over a length of 50m or more, reduction in area of an existing watercourse channel by 20% or more; and

- Widespread effect on groundwater movement with a gross change to overall groundwater transfer from up gradient to down gradient resources. Widespread and gross effects on groundwater quality.

10.2.17 **Medium** (equivalent to "Moderate Adverse" in DMRB) – results in effect on integrity of attribute or loss of part of attribute. Additional criteria: -

- Degrading of either the chemical or biological quality classification one or more levels, but no change in overall water quality classification;
- Slight increased flooding of residential or commercial properties (this is in lieu of the DMRB increase in flood level >50mm);
- Slight impact on an internationally or nationally designated aquatic ecological resource, or a loss or serious effect on the integrity of a locally important aquatic ecological resource that is not designated;
- Significant, but not gross, changes to geomorphological or hydraulic characteristics e.g. loss of natural bed and bank over a length of 20m or more, reduction in the area of an existing watercourse channel by less than 20%; and
- Widespread effects on groundwater movement with a measurable, but not gross, effect on overall groundwater transfer from up gradient to down gradient resources. Widespread, but not gross, effects on groundwater quality.

10.2.18 **Low** – (equivalent to "Minor Adverse" in DMRB) – results in some measurable changes in attributes quality or vulnerability. Additional criteria: -

- Degrading of two or more individual chemical or biological quality indicators, but with no change in either the overall or the chemical / biological quality classifications;
- Some increased flooding in rural areas immediately adjacent to Scheme, but not affecting property or infrastructure (this is in lieu of the DMRB increase in flood level >10mm);
- Slight impact on a nationally or locally important aquatic ecological resource, or the loss of a moderate area of an abundant aquatic ecological resource;
- Minor changes to some geomorphological or hydraulic characteristics e.g. loss of natural bed and bank over a length of less than 20m, reduction in the area of an existing watercourse channel by less than 5%; and
- Localised effect on groundwater movement but no measurable effect on overall groundwater transfer from up gradient to down gradient resources. Widespread or localised, measurable but not gross, effects on groundwater quality.

10.2.19 **Negligible** – (equivalent to "Negligible" in DMRB) – results in effect on attribute, but of insufficient magnitude to affect the use or integrity. Additional criteria: -

- Degrading of one individual chemical or biological quality indicator, but with no change in either the overall or the chemical or biological quality classifications;
- Minor / no increased flooding in rural areas (this is in lieu of the DMRB increase in flood level <10mm);

- Slight impact on a small area of an abundant aquatic ecological resource;
- Highly localised but not measurable changes in some geomorphological or hydraulic characteristics; and
- Highly localised effect on groundwater movement but no effect on overall groundwater transfer from up gradient to down gradient resources. Widespread or localised, but not measurable, effects on groundwater quality.

Sensitivity of Receptor

10.2.20 The **sensitivity** of a water resources feature is a synthesis of its environmental importance, socio-economic value, recreational value, and also its resilience to cope with change. The sensitivity of a water resources feature was evaluated using the guidance provided in Tables 5.1 "Water Features: Attributes and Indicators of Quality" & 5.3 "Estimating the Importance of Water Environment Attributes" (of the Design Manual for Roads and Bridges", Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment"). From this guidance the following objective tests have been used in this Chapter to assess sensitivity:

- The environmental importance e.g. if the water resources feature has a designation at an international level (e.g. Special Area of Conservation) or if the water body has GQA Class at A and is therefore a valuable pristine habitat, then this would tend to increase the sensitivity value of the receptor e.g. High;
- The socio-economic value of the water resources feature e.g. if the water resources feature has notable aquatic ecological resources (e.g. an important local or national fishery) or if the groundwater is in a drinking water protected area as defined in the WFD Protected Areas Register, then this would tend to increase the sensitivity value of the receptor e.g. High;
- The recreational value of the water body e.g. if an area is a designated bathing area or if a watercourse is an important fishery this would tend to increase the sensitivity value of the receptor e.g. High; and
- The size of the water body and its ability to buffer flow and water quality changes e.g. if a water body has high dilution characteristics compared to a small proposed discharge then its sensitivity value would tend to decrease.

10.2.21 In accordance with the generic methodology, sensitivity has been scaled from **Low** to **Medium** to **High**. In this Chapter a High sensitivity attribute is considered equivalent to the Very High or High importance stated in Table 5.3 (of the Design Manual for Roads and Bridges", Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment"). To ensure the transparency of this assessment, a description of how the sensitivity of each water body was derived is included in the "Baseline" Section of this Chapter.

Impact Significance

10.2.22 Overall **significance** is a product of both the sensitivity of the receptor and the magnitude of the effect. Significance is scaled from **negligible** to **slight** to **moderate** to **substantial**. In assessing the product of **sensitivity** and **magnitude** the Matrix of Significance presented in Chapter 1 has been adopted. In this Chapter only impacts that are **moderate** or **substantial** are considered to be **significant**. The significance of a potential effect on the water resources features has been evaluated using the guidance provided in Table 5.6 "Definitions of Overall Assessment Scores" (of the

Design Manual for Roads and Bridges", Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment").

10.2.23 It is noted that primary mitigation (see section below for details) is deemed to have been included when making the initial assessment of impact significance.

10.2.24 It is also valuable to attribute a level of confidence to the predicted impact assessment. Unless otherwise stated the impacts described in this Chapter are given at a high confidence level. Where impacts are given at a low confidence level, a reason shall be stated for this i.e. lack of Scheme design data.

Mitigation

10.2.25 Mitigation measures considered appropriate for the avoidance and minimisation of effects on water resource features will be proposed in accordance with the generic guidance provided in Chapter 6 – Approach and Methods.

10.2.26 Primary mitigation has been included in the "Predicted Impacts" section of this Chapter, and these measures represent what are considered to be standard mitigation measures that would be applied to the design, construction, and operation of such a Scheme. These primary mitigation measures may be standard conditions that would usually be required by statutory authorities or measures that a designer or contractor would be expected to take based on current best practice.

10.2.27 Mitigation measures noted subsequently in the "Mitigation" section, are those that are considered necessary for this Scheme in particular in order to offset the potential environmental effects, but that would not necessarily have been included as a matter of course in the design of such a Scheme.

Assessment Years

10.2.28 The baseline established for this assessment is not considered likely to change significantly before the development is put in place (2010) or before the first 25year period of its operation is completed (2035). The reason for this is that the study area is predominately urban or agricultural land, and the existing water resources features are already impacted to some extent due to the local environment, i.e. these are not pristine habitats. Further development in the form of housing is planned for the study area, and therefore the local environment for the water resources features is likely to become more urbanised. However, this may be partially offset by the full implementation of the Water Framework Directive and its objectives to protect and enhance the water environment. Therefore, for the purposes of this Chapter a status quo in the quality of the local water resources features has been assumed. It is also noted that the specific environmental objectives for the River Basin Management Plans have not yet been set and therefore it is not possible at this time to identify specific areas targeted for improvement.

Consultations

10.2.29 Table 10.1 provides a summary of the water environment related issues highlighted during the consultation exercise completed for this ES.

Table 10.1: Consultations

Organisation	Statutory (S) / Non Statutory (NS)	Response with regard to the water environment
Environment & Heritage Service – Water Management Unit	S	Confirmed there was no ongoing watercourse monitoring within the study area, and that Belfast Lough was monitored but not classified
Environment & Heritage Service – Geological Survey of Northern Ireland	S	Confirmed that there were no Groundwater Protection Zones within the study area. There was potential for a pollution incident to spread rapidly through the superficial deposits
Department of Agriculture & Rural Development, Fisheries Division	S	Noted that the potential run off from the construction and operation phases of the Scheme should be considered in relation to aquaculture and wild shellfish in Belfast Lough
Department of Agriculture & Rural Development, Rivers Agency	S	Noted that any previously unidentified watercourse found during construction should be identified to the Agency, and that the written consent of the Agency is required for any interference with a watercourse e.g. culverts, diversions, discharge, etc.
Ulster Angling Federation	NS	Noted that small streams may play an important role in salmon reproduction and that culverts should be designed in accordance with the recommendations in "River Crossings and Migratory Fish Design Guidance" published by the Scottish Executive
Water Service	S	Noted that the existing road drainage generally passes into combined sewers and then to the treatment works. Neither the sewers nor the treatment works have any additional capacity. Requested that all road drainage is diverted to watercourses or Belfast Lough with the consent of the Rivers Agency
Fisheries Conservancy Board	S	Noted that there were several minor waterways within the study area but these had no particular fisheries interest, but some invertebrates and other aquatic life.

Copies of relevant correspondence are included in an Appendix A to this ES. The significant issues raised during these consultations have been assessed within this Chapter.

10.3 Baseline Conditions

Overview

10.3.1 There are 15 water resources features that have been identified as part of this assessment, as described earlier. For the purposes of assigning sensitivities the water resources features are described either individually (i.e. cause they differ significantly from other watercourses or have particular significance in the area cause of their size or likely conservation value) or where appropriate as a group (i.e. all with similar

characteristics). On this basis the baseline conditions are described in the following order:

- Watercourse no.2 (Figure 10.1),
- Watercourse no.3 (Figure 10.1),
- Watercourse no.10 (Figure 10.1),
- Watercourse no.13 (Figure 10.1),
- Other designated or undesignated watercourses,
- Belfast Lough,
- Groundwater.

10.3.2 In the above context, and in the context of Figure 10.1, designated and undesignated watercourses are as defined by The Drainage (Northern Ireland) Order 1973 and this does not refer to any sort of national or international conservation designation.

Watercourse No.2

10.3.3 This is a stream with virtually all of its catchment located upstream of the Scheme. It has a catchment area in the order of 1.3km^2, which is likely to produce an average flow rate in the region of 0.03m^3/s. The stream is fed from both a scarp slope behind the coastal plain and an urban area. The watercourse falls from 75mAOD to 0mAOD (average slope 1in30) and enters Belfast Lough immediately downstream of the Scheme. At the existing location of the A2 crossing the stream channel is approximately 1 – 1.5m wide and the watercourse is relatively shallow and slow flowing. The stream flows within a concrete channel on the upstream side of the A2 and onto the foreshore on the downstream side of the A2.

10.3.4 Given that this stream flows through an urban area for a large part of its length and may also be subject to run off from the playing fields and farmland in its upper reaches, the water quality is not expected to be high. Based on a review of the GQA System, a classification of D (Fair) has been assigned to this feature for the purposes of this assessment.

10.3.5 Table 10.2 below outlines the characteristics of Watercourse No. 2

Table 10.2: Watercourse No.2

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Water course 2	Water Quality D - No formal conservation designations - Low otter suitability	No specific local fishery identified and no use for abstractions	No specific local fishery identified	Little ability to buffer discharges	**Medium**

Watercourse No.3

10.3.6 This is a stream with virtually all of its catchment located upstream of the Scheme. It has a catchment area in the order of 1.3km^2, which is likely to produce an average flow rate in the region of 0.03m^3/s. The stream is fed from both a scarp slope behind the coastal plain and an urban area. The watercourse falls from 115mAOD to 0mAOD (average slope 1in20) and enters Belfast Lough immediately downstream of the Scheme. At the existing location of the A2 crossing the stream channel is approximately 1.5m wide and the watercourse is relatively shallow and slow flowing. The stream flows within a channel made up with high sided stone pitch walls on either side of the existing road crossing with a semi natural stony bed.

10.3.7 Given that this stream flows past the university campus and adjacent farmland it is likely to pick up some poor quality run off, but does not pass through extensive urban areas. Therefore the water quality is not expected to be high, but the stream does not show signs of gross pollution. Based on a review of the GQA System, a classification of C (Fairly Good) has been assigned to this feature for the purposes of this assessment.

10.3.8 Table 10.3 below outlines the characteristics of Watercourse No. 3

Table 10.3: Watercourse No. 3

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Water course 3	Water Quality C - No formal conservation designations - Some otter suitability	No specific local fishery identified and no use for abstractions	No specific local fishery identified	Little ability to buffer discharges	**Medium**

Watercourse No.10

10.3.9 This is a small stream with virtually all of its catchment located upstream of the Scheme. It has a catchment area in the order of 0.7km^2, which is likely to produce an average flow rate in the region of 0.015m^3/s. The stream is fed from both a scarp slope behind the coastal plain and surrounding farmland. The watercourse falls from 115mAOD to 0mAOD (average slope 1in20) and enters Belfast Lough downstream of the Scheme. At the existing location of the A2 crossing the stream channel is approximately 0.5 – 1.0m wide and the watercourse is very shallow and moderately fast flowing. The stream flows within culverts for at least 50m upstream and downstream of the existing road crossing. Further up the watercourse it has a semi natural channel through farmland.

10.3.10 Given that this stream flows through areas of farmland with livestock in or near the stream, it is likely to pick up some poor quality run off e.g. sediment and agricultural chemicals. Therefore the water quality is not expected to be high. Based on a review of the GQA System, a classification of E (poor) has been assigned to this feature for the purposes of this assessment.

10.3.11 Table 10.4 overleaf outlines the characteristics of Watercourse No. 10

Table 10.4: Watercourse No. 10

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Water course 10	Water Quality E - No formal conservation designations - Low otter suitability	No specific local fishery identified and no use for abstractions	No specific local fishery identified	Little ability to buffer discharges	**Low**

Watercourse No.13

10.3.12 This is a stream with virtually all of its catchment located upstream of the Scheme. It has a catchment area in the order of 1km^2, which is likely to produce an average flow rate in the region of 0.02m^3/s. It is unclear from Ordnance Survey mapping where the source of the stream is, but it is likely to be a combination of the scarp slope behind the coastal plain and surrounding farmland. The watercourse falls from 50mAOD to 0mAOD (average slope 1in20) and enters Belfast Lough immediately downstream of the Scheme. At the existing location of the A2 crossing the stream channel is approximately 1.0m wide and the watercourse is shallow and relatively slow flowing. The stream flows within a culvert for the road crossing, but for most of its length it has a mixture of natural, semi – natural, and reinforced channel sections. This watercourse forms part of the Jointure Bay Stream Site of Local Nature Conservation Importance (SLNCI), which is a non-statutory designated site protected under local planning policy.

10.3.13 The stream flows through a mixture of planted woodland and farmland. Therefore the water quality is not expected to be high, but the stream does not show signs of gross pollution. Based on a review of the GQA System, a classification of C (Fairly Good) has been assigned to these features for the purposes of this assessment.

10.3.14 Table 10.5 below outlines the characteristics of Watercourse No. 13

Table 10.5: Watercourse No. 13

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Water course 13	Water Quality C – Non statutory designated conservation site - Some otter suitability	No specific local fishery identified and no use for abstractions	Important local / regional site of nature conservation	Little ability to buffer discharges	**Medium**

Other designated or undesignated watercourses

10.3.15 The other watercourses are a mixture of very small streams and land drains, and again most of their catchments are located upstream of the Scheme. They typically have catchments < 0.5km^2, which are likely to produce flow rates less than 0.01m^3/s. It is noted that some of these watercourses were dry when inspected during site visits.

Most of these watercourses source their flows from the urban and agricultural areas on the coastal plain. The watercourses fall from around 50mAOD to 0mAOD (average slope 1in20) and enter Belfast Lough downstream of the Scheme. Many of these watercourses are within culverts throughout much of their length and are within culverts under the existing A2.

10.3.16 Given that these watercourses are extensively within culverts and run through urban or agricultural areas they are likely to pick up poor quality run off e.g. road run off, sediment and agricultural chemicals. Therefore the water quality is not expected to be high. Based on a review of the GQA System, a classification of E (Poor) has been assigned to these features for the purposes of this assessment.

10.3.17 Table 10.6 below outlines the characteristics of other watercourses

Table 10.6: Other Watercourses

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Other water courses	Water Quality E – No formal conservation designations - Low otter suitability	No specific local fishery identified and no use for abstractions	Very limited due to culverts	Little ability to buffer discharges	**Low**

Groundwater

10.3.18 The following groundwater data has been gathered:

- None of the watercourses in the area are noted as being especially dependant on groundwater, as identified from the "Groundwater dependent rivers, lakes, and ecosystems" map published by the EHS,
- The underlying bedrock is generally noted as being of "poor productivity, fracture flow" as identified from the "Bedrock aquifer classification" map published by the EHS. It is noted that there may be isolated areas of "high productivity – inter granular / fracture flow" along the coast at the western end of the Scheme, but the mapping is not at a sufficient scale to determine this,
- From the Hydrogeological Map of Northern Ireland it is noted that the route overlies two different types of aquifers with contrasting hydrogeological conditions. The southern part of the route overlies an isolated part of the Sherwood Sandstone aquifer. This is a highly permeable aquifer where inter granular flow is significant. The northern extent of the route overlies the Mercia Mudstone aquifer. The rocks of the Mercia Mudstone group are impermeable and generally contain no significant groundwater except at shallow depth in the fissured and weathered interface with the overlying Glacial Till. It is this latter aquifer that is dominant over the study area,
- From the EHS "Groundwater Vulnerability Map" the area beneath the Scheme is classified as grade 4 on a scale of 1 – 5 with 1 being the least vulnerable and 5 being the most vulnerable. The reason for this rating is the presence of highly permeable deposits of a relatively shallow nature overlying the bedrock,

- The EHS "Groundwater Diffuse Pollution Map" shows the area under the Scheme is classified as "not at risk (probably)",

10.3.19 The EHS have confirmed that there are no groundwater protection zones officially established in Northern Ireland, and therefore there are none within the study area. There have been no groundwater abstractions identified within the study area. There is no groundwater monitoring currently undertaken within the study area.

10.3.20 Table 10.7 below outlines the characteristics of Groundwater.

Table 10.7: Groundwater

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Ground water	Not a groundwater protected zone but is classed as vulnerable. Not identified as being at significant risk from diffuse pollution	No ground-water abstraction s identified within the study area and generally underlain by aquifers of poor productivity	Not applicable	Mixed due to two different bedrock areas.	**Medium**

Planning

Overarching Legislation

10.3.21 The Water Framework Directive (WFD), implemented in Northern Ireland by The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2003, aims to; protect and enhance the status of aquatic ecosystems, prevent further deterioration to such ecosystems, promote sustainable use of available water resources, and contribute to the mitigation of floods and droughts. A review of the EHS "WFD Protected Area Register" identified one protected area within the study area, and this was the Belfast Lough Special Protection Area. This review did not identify any drinking water protected areas, designated bathing waters, or nutrient sensitive areas within the study area.

PPS15 "Planning and Flood Risk"

10.3.22 PPS15 provides the current context for planning controls on flood risk. PPS15 states as general principles that new developments should not be at risk of flooding and should not increase the risk of flooding elsewhere, that natural flood plains should be secured, and that an integrated and sustainable approach to the management of development and flood risk should be promoted.

Belfast Metropolitan Area Plan and the Local Development Plans

10.3.23 There is a general presumption regarding the prevention of adverse impacts from development on international, national, and local sites of nature conservation. There is also a general presumption regarding the retention of open watercourses within new development areas.

10.4 Predicted Impacts

10.4.1 As a result of the consultations, site visits and desktop studies, the issues requiring consideration in this assessment were distilled down to those in the Table 10.8 below.

Table 10.8: Water Resource issues

General Issue	Specific Issues	Receptor/s
Surface Water Quality	Sediment mobilisation and spillage or discharge of other pollutants into watercourses (Construction Phase)	All Watercourses
	Discharge of road run off to watercourses (Operational Phase)	All Watercourses
	Other road and infrastructure maintenance (Operational Phase)	All Watercourses
Flooding	Flood risk to surrounding land from development (Construction Phase)	Surrounding land & infrastructure
	Flood Risk to surrounding land from development (Operational Phase)	Surrounding land & infrastructure
Aquatic Ecology (Note these Effects are dealt with in the Ecology Chapter)	Effects on the passage of migratory fish (Construction and Operation Phases)	Selected Watercourses
	Effects on the passage of Otters (Construction and Operation Phases)	Selected Watercourses
Geomorphology and Hydrology	Alteration / addition of watercourse crossings (Construction Phase)	All watercourses
	Alteration / addition of watercourse crossings (Operation Phase)	All watercourses
	Alteration to land drainage patterns (Construction and Operation Phase)	All watercourses
	Run off from the Scheme into watercourses (Operation Phase)	All watercourses with outfalls
Ground Water	Potential disturbance of groundwater movement (Construction Phase)	Groundwater
	Potential contamination to shallow groundwater (Construction Phase)	Groundwater
	Potential disturbance of groundwater movement from the new road construction (Operational Phase)	Groundwater
	Potential contamination to shallow groundwater (Operational Phase)	Groundwater

Effects of Construction

Surface Water Quality

10.4.2 The following assessment considers the potential for sediment release and spillage / discharge of pollutants (e.g. oils, fuels, chemicals) to surrounding surface waters during the construction phase, and the potential impacts that such a release may have on water quality.

Receptor/s	All Watercourses
Relevant Scheme	Given the nature of the project, there will be significant earth moving activities during construction. This presents a significant risk of

Information	surface water run off eroding bare slopes or material stockpiles, which can lead to increased suspended solids in watercourses. The construction phase also presents the potential for fuels, oils, and other chemicals to be spilled via an accident, improper usage, or poor storage. These could reach the receptors directly via discharge of polluted run off or via seepage into the shallow groundwater. Discharge of construction related sewage and washing effluent into watercourses should not be permitted and this potential impact is therefore not considered further.
Sensitivity of Receptor/s	**Low** to **Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Low Adverse** (localised, temporary) – risk of significant discharge of polluting substances into a watercourse should be minimised through the application of the primary mitigation noted below. Some local instances of suspended solid releases into watercourses are inevitable given that a number of extended watercourse crossings will be required. However, with primary mitigation applied the impacts should be minimised and temporary in nature. Therefore no long-term derogation of the assumed water quality classification should be experienced.
Primary Mitigation Included	Consideration should be given to the need for settlement ponds or similar for both the construction and operation phases of the Scheme. The land take required for such facilities should be considered during the finalisation of land acquisition for the project. The Contractor shall implement best practice guidance as detailed in PPG's published by the Joint Environment Agencies of the United Kingdom and CIRIA Reports C532 & C648, as a minimum. The Contractor shall produce a site management plan covering the areas noted above, and all staff on site should be trained in the relevant best practice techniques. In particular, construction materials should be stored away from watercourses, plant should be stored and maintained away from watercourses, silt fences or similar should be placed around exposed ground and stockpiles, and early re-vegetation of the completed elements of the Scheme should be undertaken to reduce further erosion. A general methodology for constructing watercourse crossings should be developed by the contractor in consultation with the Rivers Agency, to ensure that works are completed with the minimum of disturbance to the watercourse. During construction works on new or existing crossings, the flows should be over pumped or temporarily piped through the working area. The working area should then be temporarily sealed at either end so that any contaminated run off can be captured and remain largely isolated from the watercourse. For the Jointure Bay Stream, it is understood that a commitment to leaving the natural bed / bank in place and bridging the crossing with no activity in the watercourse has already been made.
Overall Significance	**Slight / Negligible Adverse**

Flooding

10.4.3 This part of the assessment considers whether or not the construction activities at each watercourse would affect the passage of water along a watercourse.

Receptor/s	Urban areas, residential properties, and other infrastructure located upstream of new watercourse crossings
Relevant Scheme Information	During the extension or replacement of watercourse crossings there will be some form of land take around each watercourse with a potential for temporary reduction in waterway capacity during the works. On the section where the road is being widened online there are residential properties immediately (within 50m) upstream of the new crossings.
Sensitivity of Receptor/s	The surrounding areas are considered as having a **High** sensitivity to increased flood risk given that residential and other infrastructure would potentially be affected.
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, temporary) – with the primary mitigation measures included the contractor should be able to complete the works without increasing the risk of flooding to upstream property.
Primary Mitigation Included	During construction works on new or existing crossings, the flows should be over pumped or temporarily piped through the working area. The temporary provisions for passing the flows through the working area should be designed to cater for a defined return period storm for each catchment, and current guidance recommends temporary works planning for a 1 in 10 year return period flow (CIRIA). Current guidance also recommends contingency planning for flows greater than this. For the Jointure Bay Stream the current proposals are understood to be to leave the natural bed in place and construct the crossing with no activity in the watercourse. It is recommended that the contractor should undertake some form of flood risk assessment where residential property or other infrastructure could be affected, and design temporary measures to ensure flood risk is not increased during the works. No material stockpiles should be stored within or immediately beside an existing watercourse, to prevent reduction in waterway capacity or local flood plain.
Overall Significance	**Slight Adverse**

Geomorphology and Hydrology

10.4.4 This assessment considers the potential effects of the construction works required to provide new / extended watercourse crossings on the structure of the bed and bank of each watercourse and the potential impact of site drainage discharges.

Receptor/s	All Watercourses
Relevant Scheme Information	During the construction / extension / replacement of pipe or box culvert watercourse crossings there will be significant disturbance to the physical features of the channel and bank in the locality of each crossing. This will be caused by the excavations required to position each culvert and associated headwall details, and from the construction vehicles required for this operation. No details have been provided at this stage regarding how the excess surface water run off from the construction site will be dealt with. For the purposes of this assessment it has been assumed that the contractor would implement best practice measures to control the volume of site run off, with a discharge to a watercourse only being made after some form of attenuation (see Mitigation for further

	details).
Sensitivity of Receptor/s	**Low** to **Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Geomorphology** **Negligible Adverse** (localised and temporary) for the watercourses that are already within culverts across the full width of the development corridor, as there will either be no works to these watercourses or the works would simply be a replacement of an existing culvert (i.e. no existing natural watercourse features would be disturbed). It is understood that the following watercourses (nos. 2, 4, 5, 6, 9, & 11) are within existing culverts over the full width of the proposed road corridor, and therefore no construction disturbance will be experienced on these watercourses outwith the length of the existing culverts. **Low Adverse** (localised and temporary) for watercourses that are within existing culverts that will have to be extended by up to 10m to accommodate the new road development corridor. As there will be construction disturbance to natural / semi natural features when the culverts are extended. The construction disturbance is likely to extend up to a maximum of 20m along the length of watercourse nos. 3, 7, 8, & 12. **Medium Adverse** (localised and temporary) for watercourses that are not currently within culverts, but will have to be placed within culverts over more than 20m to accommodate the new road development corridor. This will lead to significant construction disturbance to natural / semi natural features of the watercourse. It is understood that only watercourse no.10 will require an entirely new culvert over a previously open section. **Negligible Adverse** (localised and temporary) for the Jointure Bay Stream (watercourse no.13) as current proposals are understood to be to bridge the watercourse with set back abutments. Therefore there would be no working within the watercourse or on the banks immediately beside the watercourse. In this assessment it is assumed there would either be no temporary crossing or such a crossing would conform to the above requirements i.e. no watercourse disturbance. **Hydrology** **Negligible Adverse** (localised and temporary) for all watercourses receiving a consented discharge of site run off based on the mitigation measures recommended below.
Primary Mitigation Included	The Contractor shall, where possible, construct culverts and other watercourse crossings as the works progress, to avoid the creation of temporary watercourse crossings that are then replaced at a later date. A full topographic survey and photographic record should be completed along each watercourse covering the area predicted to be disturbed during the works. This information should provide sufficient detail to allow the alignment, levels, and form of each channel and its banks to be reinstated after the works. Reinstatement should include re-vegetation with local plant species to stabilise the structure of the

	completed banks. The Contractor should set out a working zone around each watercourse in the construction method statements, which should be agreed with the Rivers Agency. This should be the minimum area required to safely complete the works, and should not allow for the storage of any plant or materials. This area should be clearly marked out on site and operatives should be briefed on the working area restrictions. Surface water run off from the site should be controlled on a catchment-by-catchment basis, with temporary attenuation provided to control the flow to suit the capacity of each watercourse channel. The contractor will need to liase with the Rivers Agency regarding the need for temporary discharge licences.
Overall Significance	**Watercourse nos. 2, 4, 5, 6, 7, 8, 9, 11, 12, & 13 - Negligible Adverse** **Watercourse nos. 3 & 10 - Slight Adverse**

Groundwater

10.4.5 This assessment considers the potential effects of the construction works required to create the new road on the **movement** of the groundwater.

Receptor/s	Ground Water
Relevant Scheme Information	The offline section (north of watercourse no.9) is either at grade or on a low embankment between 1.5 – 3.5m above the surrounding ground. The online section is largely at grade, but it will be necessary to cut back the slopes to landward by up to 15m to create enough development space for the road. These cuts are typically 1 – 1.5m in depth, but there is a short section where the depth of cut will be up to approximately 3m. There are not understood to be any areas of rock cutting involved and the mudstone that underlies most of the site is at a depth of around 6m (see DMRB Stage 2 Report). There was no information available with regard to groundwater level during this assessment. From the data collected from the Geology and Soils Chapter it would appear that the majority of the site is underlain by impermeable bedrock, which generally contains no significant groundwater except at shallow depth in the fissured and weathered interface with the overlying Glacial Till.
Sensitivity of Receptor/s	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, temporary) – much of the Scheme is at or above ground with only existing slopes being cut back to create development space on the online section. Therefore there are no areas of cutting where the Scheme will create a divide through the drift deposits down to bedrock such that a total barrier to groundwater movement is created.
Primary Mitigation Included	The Contractor should include in the method statements a methodology for controlling groundwater in the overlying drift deposits in sections where the existing slopes are being cut back. Groundwater collecting on the site should not be allowed to discharge

	in an uncontrolled fashion into watercourses. The Contractor would need to liase with the Rivers Agency and the EHS regarding any proposed discharge from cuttings.
Overall Significance	**Negligible Adverse** (moderate confidence level pending further data from ground investigations)

10.4.6 This assessment considers the potential effects of the construction works required to create the new road on the **quality** of the groundwater.

Receptor/s	Ground Water
Relevant Scheme Information	The construction works will involve earth moving plant and other machinery, and this presents a risk of spillage of fuels, oils, and other chemicals, which can seep into the shallow groundwater and potentially any fractures in the underlying bedrock. The linear nature of the project will also likely require a number of construction compounds, providing welfare facilities for the contractor along the length of the Scheme, and each of these may retain a store of fuels, oils, and other chemicals.
Sensitivity of Receptor/s	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Low Adverse** (localised, temporary) – with the primary mitigation measures in place (see below) and continually monitored, the likelihood of significant quantities of contaminants reaching the groundwater should be low. However, there is a residual risk of some localised impacts on groundwater (e.g. small spills, oil / fuel from plant, etc.) due to the scale and nature of the construction works.
Primary Mitigation Included	The Contractor should manage the works in accordance with the best practice guidance provided in the Joint Environment Agencies Pollution Prevention Guidelines and CIRIA Reports C532 & C648. In particular the Contractor should: - provide lined bunds around all fuel, oil, and other chemical stores; centralise and minimise the number of these stores; complete all servicing, fuelling, and storage of vehicles at these major construction compounds; provide dedicated wash down areas for concrete and other delivery vehicles and capture and treat the effluent from these facilities. The Contractor should implement drainage control measures at the site to prevent areas of standing surface water or groundwater that could become contaminated and leach into the shallow groundwater. Where collection of water at the site is unavoidable, provision should be made for this water to be passed through appropriate (such as settlement and clarification) before discharge. The Contractor would need to liase with the Rivers Agency and EHS regarding any proposed discharge to the surrounding watercourses.
Overall Significance	**Slight Adverse**

Effects of Operation

Surface Water Quality

Discharge of Road Run Off

10.4.7 The main contaminants that are typically carried into the watercourses from road run-off include; suspended solids (including grit, mud, metal particles), copper and zinc (from deterioration of galvanised parts of vehicles), organic materials and hydrocarbons (such as rubber, bitumen, grease, oil and fuel), and salt.

10.4.8 DMRB Volume 11, Section 3, Part 10, HA 216/06 provides a number of assessment methods to gauge the potential impact of run-off from roads on the water environment. This Advice Note also provides guidance on suitable mitigation measures that can be applied when the above assessments indicate a risk of pollution to the water environment.

10.4.9 With regard to the potential contamination from discharge of **routine road run off** into a watercourse, the Advice Note requires that a "Simple Assessment" be made initially to determine whether the watercourse is at high or low risk of pollution. This assessment involves examining the relationship between the predicted volume of run off from the road, the assessed low flow within the watercourse, and the daily flow of vehicles (full details of the methodology are within HA 216/06). If this "Simple Assessment" puts a watercourse in the "low risk" category then no further assessment is required, and the guidance states that the simple assessment method "…produces conservative estimates, so that if it indicates low risk, there is a high level of confidence that there will be minimal impact". Should the "Simple Assessment" indicate that the watercourse is at "high risk", then the "Detailed Assessment" method needs to be used. This method compares the pre and post Scheme levels of Copper and Zinc within the watercourse against the relevant Environmental Quality Standard.

10.4.10 The Simple Assessment method was followed for all watercourses where the designers have identified a road drainage outfall i.e. watercourse nos. 2, 3, 4 or 5, 6, 7 or 8, 9, & 13. This showed that all watercourses, with the exception of Watercourse Nos. 8, 9, & 13, were classified as being at "low risk" of pollution from the anticipated road run off discharges. Watercourse Nos. 8, 9, & 13 were classified as being at "high risk" of pollution from the anticipated road run off discharges. It is noted that there is not a finalised Scheme drainage design at this stage, and therefore lengths of road draining to each watercourse have been estimated based on the longitudinal road profile. Once the surface water drainage Scheme is finalised these calculations should be reviewed to validate the previous assumptions.

10.4.11 This work identified that Watercourse Nos. 8, 9, & 13 would have to be subject to the "Detailed Assessment" to determine the magnitude of the effect from road run off discharge. This detailed assessment could not be completed, as baseline water quality data was not available. Furthermore, it may be considered that as the discharge points for road run off are within 120m of the outflows into Belfast Lough, the effects of road run off on the watercourses are immaterial and it is the potential effects on the water quality along the shore of Belfast Lough that is a more relevant consideration. This issue is discussed in terms of the potential need for an Appropriate Assessment to assess the potential impacts on the Belfast Lough SPA within the Ecology Chapter of this Environmental Statement.

10.4.12 With regard to the potential contamination of a watercourse from an **accidental spillage** on the proposed road, the Advice Note requires an "Assessment of Pollution Impacts from Accidental Spillages" to be undertaken. This involves consideration of the probability of a spillage accident with an associated risk of a serious pollution risk occurring. It is stated in the Advice Note that watercourses should be protected such that the risk of a serious pollution incident has an annual probability less than 1%. This assessment method was followed for all watercourses where an outfall has been

identified by the designers (i.e. watercourse nos. 2, 3, 4 or 5, 6, 7 or 8, 9, & 13), and in all cases the annual probability was calculated as considerably less than 1%. Given the lack of surface water drainage design information available, these calculations were completed assuming no risk reduction factors from the application of mitigations measures (e.g. oil interceptor, filter drain, etc.). Therefore, they are likely to represent a conservative estimate of pollution risk i.e. annual probability would be lower with introduction of mitigation measures.

10.4.13 De-icing salts will commonly be used on road between the months of November and March. It is noted that the concurrent flows in watercourses is relatively high during these months, and as such the salts would be subject to reasonable dilution and dispersion on entering a watercourse. From PPG 10 it is noted that the *"…use of salt on highways is unlikely to lead to levels in the water environment that could affect aquatic life or drinking water supplies"*. There is no specific assessment within the Advice Note for the potential impacts of de-icing salts on watercourses.

10.4.14 Based on the above assessment the following summary of the effects on water quality has been derived.

Receptor/s	Watercourses 2, 3, 4 or 5, 6, 7 or 8, 9, & 13
Relevant Scheme Information	It is understood that all surface water run off from the existing road is currently passed to a combined sewer and from there to a local wastewater treatment plant. Under the Scheme proposals all highway run off for the Scheme would be diverted to the existing watercourses. The proposals for the outfalls and treatment measures were not finalised at the time of this assessment. The assessment has therefore been completed by assuming no risk reduction factors on the spillage risk calculations i.e. no treatment provisions. Traffic flows in the future for the A2 are predicted to peak at 35,000 vehicles per day.
Sensitivity of Receptor/s	**Low** to **Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Watercourse nos. 8, 9, & 13 – Low Adverse** (permanent) see Table 5.4 of HA 216/06 (i.e. high risk from Method A but risk of pollution from accidental spillage <0.5%). Detailed zinc and copper calculations not completed but discharges very close to point of outfall to the sea **Watercourse nos. 2, 3, 4 or 5, & 6 – Negligible Adverse** (permanent) see Table 5.4 of HA 216/06 (i.e. low risk from Method A and risk of pollution from accidental spillage <0.5%)
Primary Mitigation Included	The concept surface water drainage design includes either trapped gullies or a kerbed off let on all drainage collection points, which will capture a portion of the grit and other solids. In addition, it is understood that each outfall will be provided with some form of oil / fuel interceptor. It is also proposed to provide an attenuation pond on the approach to watercourse no.13 near chain 3150. This feature will provide attenuation and secondary treatment of the flows before discharge to watercourse no.13.
Overall Significance	**Watercourse no.13 - Slight Adverse** (moderate confidence level pending finalisation of surface water drainage infrastructure design) **Watercourse nos. 2, 3, 4 or 5, 6, 7 or 8, & 9 – Negligible Adverse** (moderate confidence, as above)

	As noted in 10.4.10 once the surface water drainage infrastructure is finalised these calculations should be revisited to confirm assumptions that were necessary at this stage. This work may involve water quality sampling for watercourse nos. 8, 9, & 13. It is noted that this assessment broadly concurs with the guidance within the DMRB that notes "Pollution impacts from routine runoff on receiving waters appear to be restricted primarily to roads carrying more than 30,000 Annual Average Daily Traffic (AADT), although for roads carrying less than 15,000 AADT the level of pollution associated with runoff to sensitive water bodies could be of concern." Shore Road is predicted to carry up to 35,000 vehicles a day in the future.

Other Road and Infrastructure Maintenance

10.4.15 This assessment considers whether the maintenance of the road, gullies, culverts, and soft landscaping is likely to have any effect on the water quality of the surrounding watercourses. There is no specific guidance with DMRB HA 216/06 on assessing the potential impacts from this source of pollution.

Receptor/s	All Watercourses
Relevant Scheme Information	During the operation of the Scheme the principal maintenance activities are likely to be; road pavement maintenance (anticipated to be minimal during first 10years), cleaning gullies (possibly annual), cleaning debris from culverts (possibly annual), inspection and repair of other road infrastructure (crash barriers, etc.), and maintenance of any roadside verges (e.g. clearing debris, removing invasive species, etc.).
Sensitivity of Receptor/s	**Low to Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, temporary) – cleaning of debris from culverts is likely to cause only minor disturbance to the bank and bed locally at the entrance and exit of each culvert and the vehicles / plant are assumed to work from the road with the appropriate traffic control measures in place. A comparison with guidance in Scotland reveals that such an activity falls under the General Binding Rules or Registration part of the Controlled Activities Regulations, which are considered to be activities with a low risk to the water environment (i.e. do not require a licence). Cleaning gullies is highlighted in the DMRB as a potentially polluting activity i.e. disturbance of sediment with metals and hydrocarbons attached. Adopting the primary mitigation suggested below can reduce the risk associated with this activity. Repair of road infrastructure may involve repainting of parapets or use of other chemicals, and this presents a risk of materials entering watercourses. However, with the primary mitigation noted below, the risk of a major spillage should be reduced to a low level. It is understood that the landscape design for the road verges is to replant with natural grass and therefore there is not expected to be any significant ongoing requirement for the use of herbicides to maintain these areas.
Primary Mitigation Included	Works to culverts and other road infrastructure should be completed under an approved method statement and should include best practice measures (including the Joint Environment Agencies Pollution Prevention Guidelines) to reduce the risk of significant

	physical disturbance of, or major spillages to, watercourses.
Overall Significance	**Negligible Adverse**

Flooding

10.4.16 This part of the assessment considers whether or not the completed Scheme elements would permanently affect the passage of water along a watercourse.

Receptor/s	Urban areas, residential properties, and other infrastructure located upstream of new watercourse crossings
Relevant Scheme Information	The crossings for the watercourses and drains will pass under the proposed road in the existing culverts with culvert extensions / replacements as required to accommodate the new road cross-section. It is anticipated that the culverts will be sized to accommodate a certain return period of flow for each catchment, but the designers have not confirmed what this level will be at this time. It is understood that there will be no reduction in culvert size as a result of the Scheme, and any road drainage discharges will be made at the downstream end of these culverts.
Sensitivity of Receptor/s	The surrounding areas are considered as having a **High** sensitivity to increased flood risk given that residential and other infrastructure would potentially be affected.
Magnitude (and Type) of Effect	With respect to watercourse crossings the effect is predicted as **Negligible Adverse** (localised, permanent) – with the primary mitigation measures included the crossings should be able to be designed so as not to worsen any existing flooding problems. Where an opportunity exists to replace existing culverts that are inadequate or in poor condition, a **Negligible Beneficial** (localised, permanent) effect may be experienced.
Primary Mitigation Included	New and extended culverts should be sized to accept a defined return period storm, which in turn should be set by the Scheme designers in accordance with current best practice and advice from the Rivers Agency. The storm flows should be calculated for each watercourse using FEH or similar accepted methods. The culverts should be no smaller than the existing watercourse crossings they will be replacing / or acting in conjunction with.
Overall Significance	**Slight Adverse / Slight Beneficial**

Geomorphology and Hydrology
Alteration / addition of watercourse crossings

10.4.17 This assessment considers the potential effects of extending existing crossings or adding new crossings on the structure of the bed and bank and the flow conveyance of each watercourse.

Receptor/s	All Watercourses
Relevant Scheme Information	The presence of lengthened culverts on watercourses will alter the physical features of the bed and bank over the extended width of the road, and for a short distance upstream and downstream. The following is a brief summary of the anticipated crossing works: - Watercourse no.3 – culvert lengthened to landward only by 10 – 15m, Watercourse nos. 2, 4, 5, 6, 9, & 11 – no extension to existing culvert,

	Watercourse no.7 & 8 – culvert lengthened to landward by approx. 10m and to seaward by approx. 5m, Watercourse no. 10 – new culvert over approx. 35m, Watercourse no.12 - culvert lengthened to landward by approx. 5 - 10m, Watercourse no.13 – new bridge with no penetration into channel It is noted that there has been no designer's assessment of the existing culverts and therefore it is not known whether any of these will be replaced even where there are no extensions required. Assuming the extended culverts are correctly sized (see primary mitigation) for each watercourse, the overall flow capacity of the watercourse should not be decreased, however the flow characteristics may be altered over the length of the crossing.
Sensitivity of Receptor/s	**Low** to **Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Watercourse nos. 2, 4, 5, 6, 9, & 11 – Negligible Adverse** (localised, permanent) this is based on a worst case assessment of the replacement of the existing culvert as part of the new road construction, but without any disturbance out with the current limits of the culvert. **Watercourse nos. 3, 7, 8, & 12 – Low Adverse** (localised, permanent) as the watercourses are already partially within culverts and these culverts will be extended by less than 20m. **Watercourse no.10 – Medium Adverse** (localised, permanent) as a new stretch of watercourse between 20 and 50m in length will be put into a culvert. **Watercourse no.13 – Low Adverse** (localised, permanent) as all permanent works are to be outwith the channel and the abutments will be set back from the edge of the channel. However, there are likely to be effects on the upper portion of the riverbank for approximately 40m along either side of the watercourse. No detailed design information was made available for this assessment and therefore a conservative approach has been applied to the assessment of impact magnitude i.e. precautionary principle.
Primary Mitigation Included	The design of the extended / new culverts and the single bridge shall be such as to avoid changing the alignment and concentration of flows upstream and downstream of each crossing point. Bank protection works upstream and downstream should be kept to the minimum length required. Analysis of the potential for scour at all bridge and culvert sites, and good design of scour protection works. The advice within CIRIA Report C551 Manual on Scour at Bridges and other Hydraulic Structures should be taken into account in the design. Design of all new river crossings and culvert works for the Scheme in accordance with the Scottish Executive's "River Crossings and Migratory Fish: Design Guidance (April 2002)". The culverts should be sized to accept a defined return period storm (see primary mitigation in the flooding assessment above).
Overall	**Watercourse nos. 2, 4, 5, 6, 9, & 11 – Negligible Adverse**

Significance	**Watercourse nos. 3, 7, 8, & 12 – Slight Adverse** for watercourse no.3 and **Negligible Adverse** for the others **Watercourse no.10 – Slight Adverse** **Watercourse no.13 – Slight Adverse**

Run off from the Scheme into watercourses

10.4.18 This assessment considers the potential effects of road drainage outfalls on the geomorphology and hydrology of the watercourses they discharge into.

Receptor/s	All Watercourses
Relevant Scheme Information	It is understood that all surface water run off from the Scheme will be discharged into the surrounding watercourses. This is a change from the existing situation where it is understood that the surface water run off from the road generally passes to a combined sewer and is conveyed to a wastewater treatment works. The Water Service has confirmed that the combined sewer has no additional capacity, and they have also requested that the existing discharges are removed from the combined sewer. The Scheme will increase the impermeable area requiring to be drained as the road is being increased from 2 lanes to 4 lanes. The exact outfall locations are yet to be determined, but it is anticipated that watercourse nos. 2, 3, 4 or 5, 6, 7 or 8, 9, & 13 will receive a discharge from the Scheme.
Sensitivity of Receptor/s	**Low** to **Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	On the basis that the primary mitigation measures noted below are adopted the effects are assessed as **Low Adverse** (localised, temporal) – as the surface water run off should be able to be controlled to an acceptable percentage of the concurrent flow in each watercourse.
Primary Mitigation Included	Survey of the culvert and channel downstream of each proposed outfall location to determine the condition and capacity of each discharge point. Assessment of the flows within each watercourse and limiting the discharge rate from road drainage to an appropriate rate for each watercourse. One method would be to adopt a common Greenfield run off rate of 5 - 7l/s/ha (CIRIA C609), but this would need to be assessed against the capacity of each watercourse. Design of outfalls in accordance with current best practice to prevent scour and erosion of adjacent channel and bank of watercourse.
Overall Significance	**Slight to Negligible Adverse**

Alteration to land drainage patterns (overland flow)

10.4.19 This assessment considers the potential effects of the presence of the new road on the natural surface drainage patterns of the surrounding land. It is noted that given the similarities in effects between construction and operational phases, namely potential

severance of overland flow between upslope and down slope, both phases have been considered in this assessment.

Receptor/s	Watercourses
Relevant Scheme Information	The section of the route where on line widening is proposed is not expected to impact significantly upon land drainage as the road alignment lies within an existing urban area, which does not exhibit significant lengths of overland flow due to the installed surface water drainage infrastructure, presence of garden walls, etc. It is understood that there will be some provisions for drainage of large drives to control run off over footways and onto the carriageway. Therefore, this section of the route is not considered further. The section of the route that is off line will pass across some agricultural areas with a number of existing field drains. The surrounding area is relatively flat in nature. A drainage ditch or similar will be placed on the upslope side of the Scheme to collect any overland flows and convey them to the nearest watercourse.
Sensitivity of Receptor/s	The ultimate receptors will be the watercourses, and therefore sensitivity is **Low** to **Medium** (see "Baseline" section).
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, permanent) the introduction of a new linear feature (i.e. road on low embankments) will serve to create a discontinuity to any overland flows and this in turn may produce a slight concentration of overland flows at the location where the proposed road crosses a watercourse / drain. This is already the case downstream where the existing A2 and the corridor of urban development creates a discontinuity between any overland flows and Belfast Lough. Overland flows are expected to be a relatively small component of the flows in these watercourses / drains given the relatively flat nature of the area immediately surrounding the Scheme and the fact that a number of the watercourses are within culverts already.
Primary Mitigation Included	Surface flows collected upslope of the new road alignment should be discharged to the nearest watercourse or drainage feature, thereby retaining the water within its natural drainage catchment and minimising hydrological changes to each watercourse. The drainage discharge points at each watercourse should be designed in accordance with best design practice to prevent erosion of the channel and banks. Green bank reinforcement should be included locally around each culvert to prevent the additional flow input from causing erosion.
Overall Significance	**Negligible Adverse**

Ground water

10.4.20 This assessment considers the potential effects on groundwater **movement** from the presence of the Scheme.

Receptor/s	Ground Water
Relevant Scheme Information	The offline section is either at grade or on a low embankment between 1.5 – 3.5m above the surrounding ground, and is therefore not considered further as there is no significant permanent intrusion below the existing ground surface.

	The online section is largely at grade, but it will be necessary to cut back the slopes to landward by up to 15m to create enough development space for the road. These cuts are typically 1 – 1.5m in depth, but there is a short section where the depth of cut will be up to approximately 3m. There are not understood to be any areas of rock cutting involved and the mudstone that underlies most of the site is at a depth of around 6m (see DMRB Stage 2 Report). There was no information available with regard to groundwater level during this assessment. From the data collected from the Geology and Soils Chapter it would appear that the majority of the site is underlain by impermeable bedrock, which generally contains no significant groundwater except at shallow depth in the fissured and weathered interface with the overlying Glacial Till.
Sensitivity of Receptor/s	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Negligible Adverse** (highly localised, permanent) – groundwater movement within the solid geology will not be affected, as the depth of road construction will not physically impinge into this stratum. Groundwater movement within the drift deposits may be slightly disrupted over short lengths of cut, but given that the road construction is not anticipated to pass through more than half of the depth of the drift deposits at most there is not expected to be a significant disruption to overall groundwater movement.
Primary Mitigation Included	None included at this stage.
Overall Significance	**Negligible Adverse** (moderate confidence level pending further data from ground investigations)

Potential contamination to shallow groundwater

10.4.21 This assessment considers the potential effects on groundwater **quality** from the operation of road run.

Receptor/s	Ground Water
Relevant Scheme Information	The main operational element of the Scheme that has the potential to affect the groundwater quality will be the surface water run off from the road, which will carry with it hydrocarbons and metals (principally Copper and Zinc) from vehicles and salts from road de-icing. Current drainage design proposals do not include linear infiltration features e.g. filter drains to convey road run off. It is however proposed to provide an attenuation and treatment pond adjacent to watercourse no.13. No engineering proposals for this feature are available. The other potential source for pollution is from vegetation maintenance alongside the road, where herbicides are frequently used to control weeds along linear infrastructure features.
Sensitivity of Receptor/s	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Low Adverse** (widespread, permanent) – following Method C within HA216/06 puts the groundwater below the proposed development site at medium risk of impact. However, a number of the parameters

	in this assessment had to be assumed given the lack of available ground investigation data. The calculated risk of pollution from accidental spillages is <0.5%, which places the groundwater at a negligible risk of impact.
Primary Mitigation Included	None included at present
Overall Significance	**Slight Adverse** (moderate confidence level pending further data from ground investigations)

Significance of Environmental Effect
The significance of the environmental effects has been summarised in each of the above tables.

10.5 Mitigation

10.5.1 Primary mitigation, as defined in the assessment methodology, has been included in each of the above assessments, and no specific requirement for secondary mitigation measures has been identified at this stage.

10.6 Residual Impacts

10.6.1 Residual impacts (i.e. with the inclusion of primary mitigation measures) have been determined in the tables in Section 10.4. It is noted that no significant residual impacts have been predicted at this stage.

10.7 Summary

10.7.1 This chapter addresses the potential effects on water resources as a result of the proposed development. In the context of these proposals the significant water resources are the surface watercourses, the groundwater, and the coastal waters. The assessment of effects was divided into four main areas, and these were: - Surface Water Quality; Flooding; Geomorphology and Hydrology; and Groundwater. The predicted residual impacts ranged from **slight beneficial** to **slight adverse**. No significant residual impacts on water resources features have been predicted as a result of this assessment.

10.7.2 Given the lack of ground investigation data for this assessment, it is recommended that further assessment work is completed prior to the start of construction with regard to confirming the assessed impacts on groundwater. This will require ground investigation data covering the measurement of groundwater level within the drift and solid geology and characterisation of the depths and materials within these deposits for a distance either side of the alignment.

10.7.3 As noted in 10.4.10 once the surface water drainage infrastructure is finalised it will be necessary to revisit the predicted pollution impacts from run off and the spillage risk calculations to confirm assumptions that were necessary at this stage. This work may involve water quality sampling for watercourse nos. 8, 9, & 13.

10.8 References

10.8.1 The following documents / sources were utilised in undertaking this assessment.

- Carrickfergus Area Plan 2001. The Planning Service (adopted March 2000).
- Control of water pollution from construction sites: Guidance for consultants and contractors. CIRIA Report C532, Hugh Masters-Williams et al (2001).
- Control of water pollution from linear construction projects: Technical Guidance. CIRIA Report C648, E Murnane et al (2006).
- Design Manual for Roads and Bridges, Volume 11, Environmental Assessment. Department of the Environment for Northern Ireland et al (August 1994, as amended up to August 2006).
- Discoverer Series, 1:50,000, Sheet 15. Ordnance Survey of Northern Ireland.
- Draft Belfast Metropolitan Area Plan 2015. The Planning Service. (Plan Amendment Number 1, February2006).
- Draft Newtownabbey Area Plan 2005. The Planning Service.
- Environment & Heritage Service. http://www.ehsni.gov.uk/
- The Hydrogeological Map of Northern Ireland. Geology Survey of Northern Ireland, (May 2002).
- Manual on Scour at Bridges and other Hydraulic Structures. CIRIA Report C551, R. May et al (2002).
- Planning Policy Statement 15, Planning and Flood Risk. The Planning Service, (June 2006).
- A River Water Quality Monitoring Strategy for Northern Ireland. Department of the Environment, (May 2001).
- Water Framework Directive. Environment & Heritage Service.http://www.ehsni.gov.uk/environment/waterManage/wfd/wfd.shtml
- The Water (Northern Ireland) Order 1999.
- Water Pollution Publications. Joint Environment Agencies Pollution Prevention Guidelines. http://www.ehsni.gov.uk/environment/waterManage/waterPollution/publications.shmtl (as appropriate).