12. Road Drainage and the Water Environment

12.1. Introduction

12.1.1. The purpose of this chapter is to provide an assessment of the impacts on the water environment as a result of the proposed scheme. The assessment of impacts will be based on adherence to current legislative and good practice guidance.

12.1.2. The impacts are considered on a risk based approach using standardised methodology.

12.1.3. The UK Government and European Union put a high importance on maintaining and improving the quality of drinking water, watercourses, groundwater and coastal waters. Any run-off from a road which is not properly managed can result in significant damage to the existing hydrology and resident biodiversity. In addition, the UK Government places great emphasis on the management of flood risk in the planning process. The Scottish Planning Policy 2010 states various subject policies within it including a section on flooding and Drainage, which discusses the flood risk framework, flood protection and flood risk management measures.

12.1.4. Pollution of the water environment through road drainage of surface water run-off can arise from a variety of sources including accidents, vehicle and road degradation, and oil leaks. Water pollution can be defined by four categories namely diffuse pollution, acute pollution, chronic pollution and routine run-off.

- Diffuse Pollution arises from widespread activities such as agriculture or atmospheric deposition. Routine run-off is generally regarded as diffuse pollution, but in some instances can be categorised as point source pollution.
- Acute Pollution occurs as a result of severe, but transient impacts, such as accidental spillage. Acute pollution could also result from a sudden discharge of silt laden water during road construction.
- Chronic Pollution is the result of on-going low levels of pollution which may result in either lethal or non-lethal effects, the latter including reduced feeding / growth / breeding rates in certain organisms and hence impact on the ecosystem.
- Routine run-off is the normal run-off from roads, which may contain contaminates and which could result in either acute or chronic impacts.

12.1.5. This chapter is supported by a site-specific Flood Risk Assessment (FRA) (see Appendix H5).

12.2. Methodology

Introduction

12.2.1. The assessment has been undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3, Part 10, HD 45/09 Road Drainage and the Water Environment dated November 2009[78]. As the preferred scheme will affect existing watercourses along the length of the scheme, it is necessary to undertake an environmental assessment.

12.2.2. The Simple Assessment methodology has been followed for this assessment which considers four principal areas to be discussed and assessed within this chapter:

- Effects of Routine Runoff on Surface Waters;
- Effects of Routine Runoff on Groundwater;
- Pollution Impacts from Spillages; and,
- Flooding and Consequences.

12.2.3. A FRA has been undertaken for the scheme in accordance with the SEPA guidance document "Technical Flood Risk Guidance for Stakeholders" and the DMRB (2009), Volume 11, Environmental Assessment, Section 3; Environmental Assessment Techniques, Part 10 (HD 45/09); Road Drainage and the Water Environment.

12.2.4. A combination of desk top study and site walkover was undertaken to identify water resources using the following sources:

- Ordnance Survey Maps;
- Use of SEPAs River Basin Management Plan (RBMP) Interactive Mapping[79];
- Use of SEPAs Indicative River and Coastal Flood map[80];
- Previous reports; and,
- Data collated from a site visit.

12.2.5. In addition reference is also made to the Highways Agency Water Risk Assessment Tool (HAWRAT) in accordance with DMRB methodology. HAWRAT is a Microsoft Excel application which is used in the assessment of the potential ecological impacts of routine runoff on surface waters. A key input parameter for HAWRAT is the flow rate of the river under low flow conditions when exceedances of the ecological thresholds are more likely. The usual low flow parameter is the Q_{95}.

12.2.6. This initial review was supplemented by consultations with statutory organisations, SEPA and Scottish Water and further consideration of available data from these consultees.

[78] DMRB (2009), Volume 11 Section 3, Part 10, HD45/09 *Road Drainage and the Water Environment*. Available from: http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/hd4509.pdf [Accessed 6th May 2012]
[79] Scottish Environment Protection Agency (SEPA), RBMP Interactive Map. Available from: http://gis.sepa.org.uk/rbmp/ [Accessed 6th May 2013]
[80] SEPA (2010), Indicative River and Coastal Flood Map. Available from: http://www.sepa.org.uk/flooding/flood_extent_maps/view_the_map.aspx [Accessed 6th May 2013]

12.2.7. Details of the consultation undertaken are provided further in this chapter and also within Chapter 3 Consultation.

12.2.8. The study area assessed extends 500m around the scheme for surface water and groundwater features.

12.2.9. A site walkover was undertaken in April 2013 to record all waterbodies within the vicinity of the scheme extents.

Legislation, Planning Policy and Good Practice Guidance

12.2.10. The principal piece of legislation which relates to the issues of road drainage and the surrounding water environment is the Water Framework Directive, (WFD) (2000/60/EC). The WFD was introduced in 2000 to establish systems to manage the water environment, and was transposed into Scots Law in 2003[81] by the Water Environment and Water Services (Scotland) Act (WEWS) 2003.[82]

12.2.11. Within this legislation, there are two principal objectives namely: Prevent the deterioration of the status of all surface and groundwater bodies; and Protect, enhance and restore all bodies of surface water and groundwater with the aim of achieving good surface water and groundwater status by 2015.

12.2.12. Under the WFD, the Scottish Environmental Protection Agency (SEPA) is appointed as the Competent Authority with statutory powers and duties for protecting and monitoring the bodies of water as identified in river basin districts.

12.2.13. The flood defence role of SEPA is limited to flood risk assessment and provision of advice thereon, the provision of early warning of floods and river flow gauging. SEPA has general duties to conserve water resources and to promote conservation and enhancement of natural beauty. However it is not responsible for fisheries protection, which lies with the District Salmon Fisheries Boards.

12.2.14. Consents are required from SEPA for engineering works which impact on the water environment under the Water environment (Controlled Activities) (Scotland) Regulations (CAR) 2011, which came into force in March 2011. Road construction activities which require registration or licensing include culverts, watercourse diversions, Sustainable Urban Drainage Systems (SuDS) ponds, discharges and groundwater abstractions. The type of licence required will depend on the nature of the engineering work and the sensitivity of the surrounding water environment. Licences may be simple, complex or covered by general binding rules that require only registration of the proposals with SEPA.

12.2.15. The Scottish Planning Policy 2010 states the Scottish Governments policy on nationally important land use planning matters. Within the Scottish Planning Policy there are subject policies, one of which focuses on Flooding and Drainage. This section provides details on the flood risk framework, flood protection, flood risk management and drainage and culverts.

[81] The Scottish Government (2010), WFD in Scotland. Available at: http://www.scotland.gov.uk/Topics/Environment/Water/15561/WFD [Accessed 6th May 2013]
[82] The Scottish Government (2012), WEWS Act. Available at: http://www.scotland.gov.uk/Topics/Environment/Water/15561/WFD/WEWSAct [Accessed 6th May 2013]

12.2.16. Groundwater Protection Policy for Scotland V3 states the Scottish Governments policy on providing a sustainable future for Scotland's groundwater resources by protecting legitimate uses of groundwater and providing a common SEPA framework to protect groundwater quality. These is done by minimising the risks posed by point and diffuse sources of pollution as well as maintaining the groundwater resource by authorising abstractions and by influencing developments, which could affect groundwater quantity.

12.2.17. The South Ayrshire Local Plan sets out the policies, proposals and recommendations of the South Ayrshire Council regarding planning and development. Those relevant to this chapter or pertaining to the water environment are listed below:

- POLICY ENV7 - The Council will presume in favour of the protection of the banks of the River Ayr and River Doon, for their nature conservation interests, landscape importance and informal recreational purposes. In Policy ENV7 the reference to landscape importance means that the Council will have particular regard to development which affects the delicate balance of developed/undeveloped parts of these areas. Proposals which, by their very nature, alter this balance to the extent that their impact on the locality is significantly adverse will not be permitted.
- POLICY ENV3 - The Council will require development proposals to have regard to safeguarding features of nature conservation value including woodlands, hedgerows, lochs, ponds, watercourses, wetlands and wildlife corridors in accordance with the Wildlife Strategy. In operating this policy, prospective developers should be aware that the Council does not necessarily accept that in all cases, development proposals can adequately safeguard such areas of nature conservation value.

12.2.18. Additional detailed information on legislation, planning policy and good practice guidance can be obtained in Chapter 14 of this document.

Determination of Baseline Conditions

12.2.19. This chapter assesses the impacts on local water resources, water quality and drainage resulting from the proposed scheme. The information required for the assessment has been obtained from a desk top study, field investigations and consultations with SEPA regarding the proposed drainage.

Consultation

12.2.20. Consultations, in line with other chapters have been undertaken with Scottish Natural Heritage (SNH), Scottish Water, South Ayrshire Council Environmental Health, South Ayrshire Council Development and Environment, SEPA and Ayrshire Rivers Trust for advice on the water quality within the scheme extents. Consultation can be found in Appendix B.

12.2.21. SNH commented; "There are only a few minor water courses which cross the proposed alignment. However there is a probability that these will occasionally be used by otter foraging across the catchment. Appropriate culvert design should be considered. It is also likely that SuDS arrangements may prove to be attractive to otter and this should also be addressed in the design of environmental measures."

12.2.22. Scottish Water did not provide a consultation response.

12.2.23. South Ayrshire Council Environmental Health confirmed that the route of the road would have no effect on any private water supplies. They also stated that the route does not pass through any potentially contaminated areas of land.

12.2.24. South Ayrshire Council Development and Environment stated that; "The ES should fully assess any potential flooding issues arising as a result of the proposed development (in line with Scottish Planning Policy (SPP) and the advice of SEPA), ensuring that appropriate mitigation measures are in place to deal with any adverse effects" They commented that, "The ES should contain details of how surface water runoff will be addressed, providing details of any SuDS to be used." They also highlighted that part of the route is located upon an identified flood risk site at Bankend Bridge.

12.2.25. As part of the consultation process, Amey organised a meeting with SEPA 16th May 2013 to discuss the proposed scheme and its implications on road drainage and the water environment. Further to this SEPA commented that there will be no objection to this proposal but stated that, "Run off from the road must be treated via a suitably designed SuD system."

12.2.26. Ayrshire Rivers Trust (ART) confirmed that they had no objections to the route. However, they advised that mitigation measures be adopted during works to ensure the minimisation of pollution. ART also recommended that, "…future monitoring of the nearby fish populations to be included so as to allow any potential resultant issues to be highlighted."

Determination of Impact Significance

12.2.27. The sensitivity of a water environment feature is a synthesis of its environmental importance, socio-economic value, recreational value, and also its resilience to cope with change.

12.2.28. The sensitivity of a water environment feature was evaluated using the guidance provided in Table A4.1: Water Features: Attributes and Indicators of Quality and Table A4.3: Estimating the Importance of Water Environment Attributes of the DMRB. From this guidance the following objective tests have been used in this Chapter to assess the sensitivity:

- The environmental significance of the water environment feature, whether if it has a designation at an international or national level (e.g. Special Area of Conservation, etc.) or if the water body has a high or good status and is therefore a valuable unspoiled habitat, then this would tend to increase the sensitivity value of the receptor;

- The socio-economic value of the water body e.g. if the water body has notable aquatic ecological resources (e.g. an important local or national fishery) or if the surface water or groundwater is in a drinking water protected area as defined in the SEPA WFD Protected Areas Register, then this would tend to increase the sensitivity value of the receptor;
- The recreational value of the water body e.g. if an area is a SEPA designated bathing area or if a watercourse is an important local fishery this would tend to increase the sensitivity value of the receptor; 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 be lower.

12.2.29. The sensitivity of the water resources, in conjunction with the magnitude of the impact of the proposed scheme, are combined to determine impact significance. The criteria for assessing sensitivity are set out in Table 12.1: Determination of Receptor Sensitivity with sensitivity being scaled from Very High to Low. The criteria for assessing impact magnitude are set out in Table 12.2: Determination of Impact Magnitude on an Attribute. Once the sensitivity and impact magnitude have been determined, Table 2.4: Impact Significance Descriptors within Chapter 2: Methodology is used to determine the overall significance of impact.

Table 12.1 Determination of Receptor Sensitivity		
Sensitivity	**Criteria**	**Typical Criteria Descriptors**
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 Drinking Water Protected Area.
		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
		Flood Risk Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium	Attribute has a medium quality and rarity on local scale	**Surface Water** WFD Class 'Moderate'
		Groundwater Aquifer providing water for agricultural or industrial use with limited connection to surface water
		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 a low probability of flooding of residential and industrial properties

Table 12.2 Determination of Magnitude Impact on an Attribute		
Sensitivity	**Criteria**	**Typical Criteria Descriptors**
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 (Method A, Annex I) **and** compliance failure with EQS values (Method B) Calculated risk of pollution from a spillage >2% annually (Spillage Risk Assessment, Method D, Annex I) Loss or extensive change to a fishery Loss or extensive change to a designated Nature Conservation Site
		Groundwater Loss of, or extensive change to, an aquifer Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater Assessment, Method C, Annex I) Calculated risk of pollution from spillages >2% annually (Spillage Risk Assessment, Method D, Annex I) Loss of, or extensive change to, groundwater supported designated wetlands
		Flood Risk Increase in peak flood level (1% annual probability) >100 mm (Hydrological Assessment of Design Floods and Hydraulic Assessment, Methods E and F, Annex I)
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	**Surface Water** Failure of **both** soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) but compliance with EQS values (Method B) Calculated risk of pollution from spillages >1% annually and <2% annually Partial loss in productivity of a fishery
		Groundwater Partial loss or change to an aquifer Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250 Calculated risk of pollution from spillages >1% annually and <2% annually Partial loss of the integrity of groundwater supported

Table 12.2 Determination of Magnitude Impact on an Attribute		
Sensitivity	**Criteria**	**Typical Criteria Descriptors**
		designated wetlands
		Flood Risk Increase in peak flood level (1% annual probability) >50 mm
Minor Adverse	Results in some measurable change in attributes quality or vulnerability	**Surface Water** Failure of either soluble or sediment-bound pollutants in HAWRAT Calculated risk of pollution from spillages >0.5% annually and <1% annually
		Groundwater Potential low risk of pollution to groundwater from routine runoff – risk score <150 Calculated risk of pollution from spillages >0.5% annually and <1% annually Minor effects on groundwater supported wetlands
		Flood Risk Increase in peak flood level (1% annual probability) >10mm
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	The proposed scheme is unlikely to affect the integrity of the water environment
		Surface Water No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants) Risk of pollution from spillages <0.5%
		Groundwater No measurable impact upon an aquifer and risk of pollution from spillages <0.5%
		Flood Risk Negligible change in peak flood level (1% annual probability) <+/- 10 mm
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	**Surface Water** HAWRAT assessment of either soluble or sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually)

Table 12.2 Determination of Magnitude Impact on an Attribute		
Sensitivity	**Criteria**	**Typical Criteria Descriptors**
		Groundwater Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually)
		Flood Risk Reduction in peak flood level (1% annual probability) >10 mm
Moderate Beneficial	Results in moderate improvement of attribute quality	**Surface Water** HAWRAT assessment of **both** soluble and sediment-bound pollutants Becomes Pass from an existing site where the baseline was a Fail condition Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually)
		Groundwater Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually)
		Flood Risk Reduction in peak flood level (1% annual probability) >50 mm
Major Beneficial	Results in major improvement of attribute quality	**Surface Water** Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse
		Groundwater Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring Recharge of an aquifer
		Flood Risk Reduction in peak flood level (1% annual probability) >100 mm

12.3. Baseline Conditions

Study Area

12.3.1. Maybole is located within Scotland's River Basin District. The proposed scheme commences in the Water of Girvan catchment area, approximately 200m south west from Maybole town. The existing A77 road also runs through this area then continues north east, crosses the Ayr to Stranraer railway line and traverses the River Doon catchment area as it continues on through Maybole. The proposed scheme continues in a north-easterly direction, with a small section of sideroad leading to the Ranch caravan park, traversing the South Ayrshire Coastal catchment area. The proposed scheme then proceeds north east in its positioning north of the railway line into the River Doon catchment. The proposed bypass then culminates approximately 500m south from Minishant. The River Doon and Water of Girvan catchment areas are designated as protected areas for freshwater fish under the Freshwater Fish Directive 78/659/EEC as being of value to Salmonoid (trout, salmon).

Surface Water

12.3.2. There are nine watercourses in the vicinity of the site as illustrated in Drawing No. 25000182/ENV/12.1. Three of the watercourses are crossed by the proposed scheme:

- Parish March Burn (annotated No. 8 on Drawing) no classification status by SEPA.
- Black Glen Burn (annotated No. 6 on Drawing) no classification status by SEPA; and,
- Brockloch Burn (annotated No. 1 on Drawing) no classification status by SEPA.

12.3.3. A River Classification Scheme has been undertaken by SEPA to assess and monitor river quality throughout Scotland, which ties into the WFD. The rivers are classified A1, A2, B, C and D, which correspond with a range from A1; 'excellent' to D; 'seriously polluted' in terms of water quality. The quality of rivers is assessed against criteria set out in the River Classification Scheme, which includes the aesthetic quality of the water body, water chemistry, ecology, nutrient status and the presence of toxic substances.

12.3.4. The Parish March Burn watercourse adjacent to the western tie-in flows into the Barlewan Burn (Abbeymill Burn) which is monitored downstream of this point and is graded Class B (Moderate) by SEPA. The Barlewan Burn joins the Water of Girvan approximately 4km downstream of Maybole, which is Class C (poor) at this point. The two remaining minor water courses in the study area flow into the Chapelton Burn which is monitored and is Class B (Moderate) this later joins with the River Doon also Class B (Moderate).

12.3.5. Following inspection by a suitably qualified ecologist in April 2013, otter field signs including feeding remains, droppings, pathways and resting places were identified on both the Brockloch Burn and Black Glen Burn.

12.3.6. The water quality of all three watercourses has not been classified by SEPA and therefore, the river qualities of the watercourses downstream of all three have been utilised. The sensitivity of all three water bodies are assumed to be very high in accordance with Table 12.1. This is due to their location within areas protected for freshwater fish under the EC Directive; River Doon and Water of Girvan catchment areas.

- Parish March Burn – Very high sensitivity
- Black Glen Burn - Very high sensitivity
- Brockloch Burn - Very high sensitivity

Ground Water

12.3.7. The overall groundwater vulnerability classification for the Maybole district is "moderately permeable" but with superficial drift deposits of variable thickness that tend to impede groundwater recharge irrespective of soil classification (BGS Groundwater Vulnerability `Map of Scotland). With reference to the Ground Investigation Works Factual Report[83] groundwater surveys were undertaken February to April 2013. Groundwater monitoring is on-going till February 2014, to provide an overall picture of the seasonal variations and enable a representative understanding of the regional groundwater regime.

12.3.8. Base depths recorded during groundwater investigations varied from 0.86 metres below ground level (m bgl) to 25.00 m bgl (Refer to Appendix H4 for Groundwater Results).

12.3.9. Further detail on geology and soils can be found in Chapter 13: Geology & Soils should be referred too. In general, recorded groundwater levels become shallower from the south-west towards the north-east of the study area.

12.3.10. The underlying bedrock shown along the route is the Swanshaw Sandstone Formation, part of the Siluro-Devonian Lower Old Red Sandstone. The formation comprises up to 750 m of red-brown, grey-green and chocolate-brown, medium and coarse-grained terrestrial sandstones with subordinate pebble beds and conglomerates, minor sandstones, siltstones and mudstones.

12.3.11. Ground investigations undertaken along the route corridor indicate groundwater levels to vary from less than 1m bgl to in excess of 15m bgl within the drift deposits and underlying bedrock. In general, recorded groundwater levels become shallower from the south-west towards the north-east of the study area.

12.3.12. The proposed scheme is located on Swanshaw Sandstone bedrock and localised sand and gravel aquifers which has been classified as having an overall status of Poor with High confidence in 2008.

12.3.13. No private water supplies are known of in the study area and there are no known groundwater abstractions. This has been confirmed with landowners and South Ayrshire Council.

[83] WYG (2013), A77 Maybole Bypass Ground Investigation – Factual Report. Commissioned by Transport Scotland, under the supervision of Amey.

12.3.14. Despite no presence of abstraction of water for drinking purposes, the proposed scheme is part of an overall catchment within Girvan bedrock and localised sand and gravel aquifers Drinking Water Protection Area which has been classified as having an overall status of Poor with High confidence in 2008.[84] As a result, in accordance with Table 12.1, a very high sensitivity is assigned.

Flooding

12.3.15. According to SEPAs flood mapping, the majority of the proposed scheme is not located within any areas prone to flooding. The proposed scheme is however approximately 400m upstream of an area of flood plain associated with Abbeymill Burn, located south west of Maybole at the start of the proposed scheme into which the Parish March Burn flows.

12.3.16. East of Maybole, the Chapelton Burn is the other watercourse which collects water from the hillside on which Maybole lies, taking water from both the Brockloch and Black Glen Burns. Chapelton Burn then flows into the River Doon. The SEPA Flood Map indicates that there are areas at risk of flooding associated with this burn, namely at Laigh Woodstone and Chapelton Farms.

12.3.17. Where the scheme terminates at its northern end, the scheme crosses the Brockloch Burn and is the location of anecdotal localised flood risk site at Bankend Bridge. This has been clarified through SEPA's indicative flood mapping, which identifies that the Brockloch Burn in the north east of the bypass is susceptible to flooding. Approximately seven residential properties are located in areas susceptible to flooding from the Burn. Further information on flood extents can be found within the FRA Appendix H5.

12.3.18. The three watercourses crossed by the scheme have existing bridges/culverts which act as constraints to the flow at the the following locations:

- The Parish March Burn Bridge and associated culvert a short distance downstream where the watercourse crosses under the existing A77;
- The Black Glen Burn Culvert under Glasgow-Ayr-Stranraer Railway; and
- The Bankend Bridge under the Laigh Grange Road and associated culvert a short distance downstream where the watercourse crosses under the existing A77 at Smthston.

12.3.19. The sensitivity of flooding is thus assessed as medium in accordance with Table 12.1 as there is medium probability of flooding occurring to approximately seven residential properties downstream of the bypass.

Proposed Drainage Design

12.3.20. The proposed drainage design incorporating SuDs basins for treatment and attenuation as illustrated on Drawing No. 25000182/ENV/12.2.

[84] SEPA (2010), RBMP Water body information sheet for water body 150194 in Clyde. Available from: http://apps.sepa.org.uk/rbmp/pdf/150194.pdf [Accessed 17th October 2013]

12.3.21. Design of culverts will be in accordance with Culvert Design Guide HA 107 (DMRB 4.2). This specifies that culvert design should incorporate provision for the passage of fish and otter as well as other smaller animals including bats in certain circumstances. This is achieved through measures such as the inclusion of mammal runs and low flow channels to encourage fish passage.

12.3.22. The proposed drainage design for the Maybole Bypass will comprise a number of new and independent gravity drainage networks designed to collect and convey surface water runoff from impermeable surfaces.

12.3.23. The drainage (conveyance pipework) will be designed in accordance with the Design Manual for Roads and Bridges (DMRB) (2006), Volume 4: Geotechnics and Drainage, Section 2: Drainage, Part 3, HD 33/06: Surface and Sub-surface Drainage systems for Highways.

12.3.24. The new drainage pipes (carrier and filter drains) will be designed to accommodate a 1 in 1yr storm plus an allowance for climate change, without surcharge. The drainage will then be checked against a 1 in 5yr storm event, plus an allowance for climate change, to ensure no surface flooding occurs.

12.4. Impact Assessment

12.4.1. In general, the assessment of potential impacts from road projects on the water environment considers the following;

- Effects of routine run-off on coastal and inland surface waters;
- Effects of routine run-off on groundwater and pollution impacts from accidental spillages; and,
- An assessment of flood impact.

During Construction

Effects on Surface Waters

12.4.2. During construction, surface water would be managed by a temporary drainage network strategy until the operational drainage system is constructed. As part of these temporary works, any existing land drainage channels or ditches would be diverted directly to the existing drainage system.

12.4.3. Effects during construction may include the risk of pollution resulting from accidental spillages, increased surface runoff and increased sediment-risk runoff from construction works, increased traffic and reduction of water quality in watercourses.

12.4.4. There is potential for Brockloch Burn, Black Glen Burn and the Parish March Burn within the scheme extents to become polluted during construction. This pollution can occur either through a point source pollution incident such as a fuel spillage, but also through more gradual pollution such as siltation, through excavation material entering the watercourse.

12.4.5. Potential for pollutants to enter any of the three watercourses outlined above would be highest during any earthworks, the construction of outfalls, any bridge structures and culverts. There is as yet no detailed design for the structures, however general effects in terms of runoff to surface water can be assessed at this stage. Potential pollutants to surface water runoff include:

- Concrete, cement or admixtures spillage from construction of the new carriageways and bridges.
- Sediment run-off from earthworks required for construction of new carriageways, bridges and culverts.
- Sediment runoff water or wind-blown dust from spoil heaps.
- Leakage or spillage of fuel, oil or chemicals.

12.4.6. Sedimentation can have an adverse impact on the water quality and in turn, affect the in-stream flora and fauna. Suspended solids can also significantly reduce dissolved oxygen levels within the water and this could have adverse effects on fish and other aquatic organisms.

12.4.7. There will be no direct discharge of surface water runoff to groundwater during construction.

12.4.8. The majority of the potential effects which could arise during construction should be avoided or effectively mitigated, and it is anticipated that there would be negligible effects during construction.

12.4.9. The magnitude of impact during construction is assessed as minor for all three watercourses in accordance with Table 12.2.

- Parish March Burn – minor magnitude
- Black Glen Burn - minor magnitude
- Brockloch Burn - minor magnitude

12.4.10. This combined with a very high sensitivity value, due to their location upstream of areas protected for freshwater fish, contributes to an impact significance of moderate adverse in accordance with Table 2.4: Determination of Impact Significance; Chapter 2: Methodology.

12.4.11. This is due to the potential for a partial loss or /damage to key characteristics, features or elements. There is also potential for spillages of fuels or oils from construction plant and/ or sedimentation from excavation of soils on site.

<u>Effects on Groundwater and Pollution Impacts from Spillages</u>

12.4.12. Spillage and leakage of oils, fuels and chemicals during construction (commonly during delivery and/or refuelling) could potentially affect groundwaters. Spillages could seep into the ground and enter the groundwater or be washed into nearby ditches through site runoff.

12.4.13. Small quantities of oil have the ability to form extensive thin films which cover a large surface area of receiving waters. During turbulent conditions, the oil film can form an emulsion with the water. Oil also has the ability to bind to the surface of sediments, strata, flora and fauna. Even at relatively low concentrations, oil can be toxic to aquatic species and make the water unsafe for human consumption.

12.4.14. Uncured concrete has been shown to increase the pH of a watercourse and this change could seriously affect aquatic life.

12.4.15. Excavations into bedrock will be required in areas to allow for the construction of structures, carriageway and utilities. This could have potential impact on groundwater levels and associated flows. However, the boreholes (BH) within the cutting sections showed the depth of groundwater is below the level of excavation (Table 12.3 below).

Table 12.3 Depths of cutting at associated groundwater boreholes

Cut area	Max cut depth (m below ground level)	Typical highest groundwater level recorded (m below ground level)
Chg 0m – 650m Boomknowes to Culzean Road Rbt (B7023) BH104R AND BH106R	12m	Boreholes dry to 15m
Chg 1201m to 1700m Gardenrose Path to Kirklandhill Road BH118R, BH120, BH121R, BH123,	11m	13.4m
Chg 1701m to 2300m Kirklandhill Road to Alloway Road (B7024) BH126, BH128R	3m	9.7m
Chg 2301m to 5080 Alloway Road to Smithston Rbt (A77) BH177, BH137, BH172, BH139, BH136R, BH141, BH174, BH175, BH144, BH146	9m	11.5m

12.4.16. The boreholes within the cutting sections showed the depth of groundwater is below the level of excavation, however, there is still potential for contaminants being released into shallow groundwater through spillage.

12.4.17. The scheme will require at least one major construction compound, providing welfare facilities for the Contractor. The compound area will likely retain a store of fuels, oils, and other chemicals.

12.4.18. The magnitude of impact during construction is therefore determined as moderate in accordance with Table 12.2. In combination with a very high sensitivity this results in an overall moderately adverse impact significance during construction in accordance with Table 2.4 within Chapter 2: Methodology.

Flooding and Consequences

12.4.19. A Flood Risk Assessment (FRA) was conducted by Amey which is included in Appendix H5. This documents was formulated with reference to SEPA guidance document "Technical Flood Risk Guidance for Stakeholders" and the DMRB (2009), Volume 11, Environmental Assessment, Section 3; Environmental Assessment Techniques, Part 10 (HD 45/09); Road Drainage and the Water Environment. The FRA assesses the potential flood risk from fluvial, pluvial, groundwater and existing drainage infrastructure sources on the proposed scheme. Information presented in this section is based on the data collected through the FRA.

12.4.20. The proposed bypass crosses the floodplain of Brockloch Burn, around which there are approximately seven residential properties which are located within an area identified by SEPA as being susceptible to flooding as indicated on SEPA flooding mapping Figure 12.1.

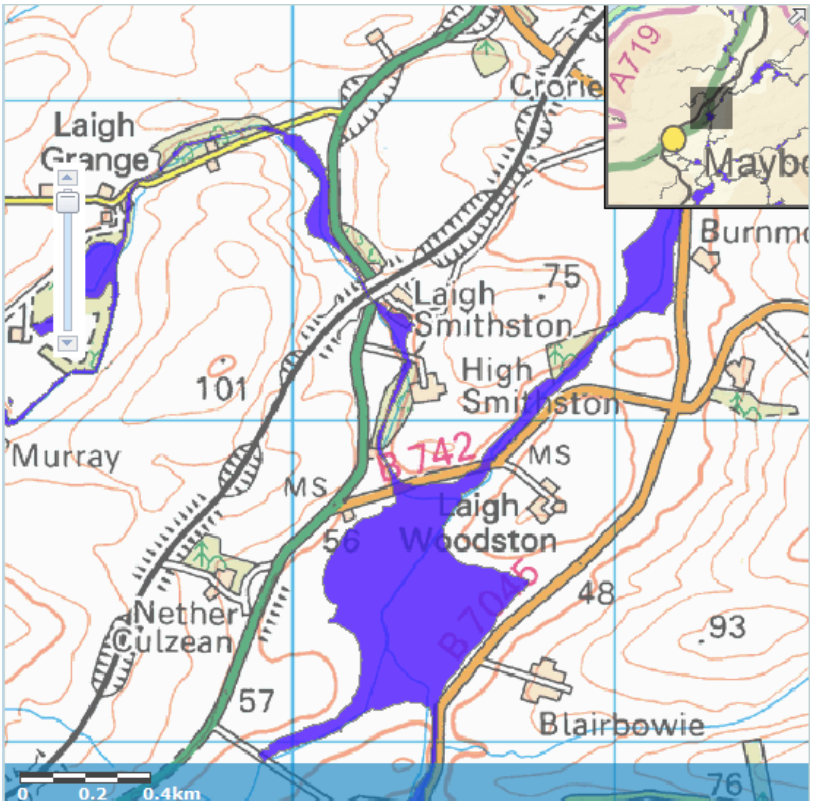

Figure 12.1 Susceptible flooding areas as indicated by purple shading

12.4.21. In addition, South Ayrshire Council highlighted that part of the proposed bypass, where the scheme terminates north-east from Maybole, is located near an identified anecdotal localised flood risk site at Bankend Bridge.

12.4.22. In accordance with Table 12.2 the magnitude of impact is therefore determined to be moderate as there is an increased risk of flooding to approximately seven residential properties downstream of the bypass where it crosses the Brockloch Burn.

12.4.23. Combined with a medium sensitive value, the overall impact significance during construction is determined as moderate adverse in accordance with Table 2.4 within Chapter 2: Methodology.

12.4.24. A summary of impacts during construction without mitigation are shown in Table 12.4 below.

Table 12.4 Summary of Impacts During Construction without Mitigation						
Potential Impact	**Feature**	**Attribute**	**Quality**	**Importance**	**Magnitude**	**Significance**
Water Quality/ sedimentation/ spillage	Parish March Burn	Water Quality	Unclassified by SEPA	Very High	Minor	Moderate
	Black Glen Burn	Water Supply	Unclassified by SEPA	Very High	Minor	Moderate
	Brockloch Burn	Water Supply	Unclassified by SEPA	Very High	Minor	Moderate
Water Quality/spillage	Groundwater	Water supply/quality	Moderately permeable aquifer	Very High	Minor	Moderate
Dewatering	Groundwater	Conveyance of flows	Poor	Very High	Minor	Moderate
Flooding	Brockloch Burn	Conveyance of flow	Unclassified by SEPA	Medium	Moderate	Moderate

Post Construction

Effects of Routine Runoff on Surface Waters

12.4.25. The potential effects on the three minor watercourses; Parish March Burn, Black Glen Burn and Brockloch Burn within the study area have been determined by using their confluences with Water of Girvan and River Doon which have been classified by SEPA and thus have available water quality information.

12.4.26. The effects have been determined using the methods and calculations set out in Volume 11, Section 3, Part 10 of DMRB. The guidance deems it necessary to run the Highways Agency Water Risk Assessment Tool (HAWRAT) when the Annual Average Daily Traffic (AADT) is greater than 10,000. The following identifies Worst Case Scenario traffic figures at each of the three minor watercourses for the opening year 2018;

- Parish March Burn (South of Maybole and South of the scheme): 9,130 AADT;
- Black Glen Burn (North of the scheme): 6,765 AADT; and,
- Brockloch Burn (North of Maybole and North of the scheme): 11,893 AADT.

12.4.27. Despite only one of the watercourses exceeding 10,000 AADT, the receiving watercourses, the Water of Girvan and River of Doon's catchment areas are designated as protected areas for freshwater fish under the Freshwater Fish Directive 78/659/EEC as being of value to Salmonoid (trout, salmon). As a result it is necessary, in accordance with DMRB, to undertake HAWRAT for all three watercourses outlined.

12.4.28. HAWRAT adopts a tiered consequential approach to assessment which reports results at three different stages depending upon the level of assessment required for each three sites. These are:

- Step 1: the runoff quality (prior to any pre-treatment and discharge to water body);
- Step 2: in river impacts (after dilution and dispersion); and,
- Step 3: in river impacts post-mitigation.

12.4.29. At Step 1, HAWRAT predicts the statistical distribution of key pollutant concentrations in untreated and undiluted road runoff (the 'worst case' scenario) over a long release period. The distribution uses a statistical model, developed through research, which is based on a ten year rainfall series relevant for the chosen site and its climatic region.

12.4.30. The tool requires certain site-specific data to make an assessment, including the Annual Average Daily Traffic (AADT) data for the opening year (2018), location details, and data relating to the receiving watercourse which was obtained through the Centre for Ecology and Hydrology[85] . Due to the proposed scheme being located in Scotland, it has been assumed to have Low water hardness (Low = <50mg CaCO3/l). The widths of channels for each watercourse were taken from A77 Maybole Bypass Otter Survey Confidential Report (Appendix D6).

12.4.31. The proposed drainage design incorporating SuDs basins for treatment and attenuation as on illustrated on Drawing No. 25000182/ENV/12.2.

12.4.32. HAWRAT uses a 'pass / fail' reporting methodology against toxicity thresholds which represent a guideline emission standard in the absence of any pre-treatment within the drainage system or in-river dilution and dispersion, 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;
- 'Pass' indicates that there will be no short-term impact associated with road runoff.

12.4.33. The initial assessments for sediment and pollution, involving Steps 1 & 2 of HAWRAT, at crossing point of each watercourse based on the proposed scheme in the opening year with the watercourses as existing (output sheets can be found in Appendix H):

- Parish March Burn 'Pass' prediction (Appendix H1);
- Black Glen Burn 'Pass' prediction (Appendix H2); and,
- Brockloch Burn 'Pass' prediction (Appendix H3).

12.4.34. It is noted that all three watercourses failed for Step 1. HAWRAT was used to estimate the in-river annual average concentrations for both dissolved copper and zinc for both assessment runs, including contribution from road runoff, and as Table 12.5 shows Annual Average Concentrations did not exceed the relevant EQS.

12.4.35. Assessment at this stage also accounts for the dispersion effects of run-off entering the three watercourses.

12.4.36. Any future year assessment would be similar to the design year as the traffic flows for 2031 remain under 50,000 AADT.

[85] Centre for Ecology and Hydrology (CEH) (2013), Natural Research Council – National River Flow Archive. Available at: http://www.ceh.ac.uk/data/nrfa/data/search.html [Accessed 31st July 2013]

Table 12.5 Summary of HAWRAT Assessment of Water Quality predicted for the scheme				
HAWRAT Assessment Run for 2018 Test 2	HAWRAT Annual Average Concentrations (µg/l)		Environmental Quality Standard (EQS) for Water Hardness Band >250mg/l CaCO3	
	Dissolved Copper (µg/l)	Dissolved Zinc (µg/l)	Dissolved Copper (µg/l)	Dissolved Zinc (µg/l)
Parish March Burn	0.11	0.34	1	7.8
Black Glen Burn	0.00	0.01	1	7.8
Brockloch Burn	0.00	0.01	1	7.8

12.4.37. It is important to note that Q95 values should be used with caution in view of the problems associated with both the measurement of discharges and the increasing proportional variability between the natural flow and the net impact of artificial influences, such as abstractions, discharges, and storage changes as the river flow diminishes.

12.4.38. In addition, despite all watercourses assessed passing Steps 1 and 2 of HAWRAT, this does not mean that no mitigation measures are required.

12.4.39. Traffic data forecasted for the year 2031 remain under 50,000 AADT flows. The results show no significant increase in the average concentration of dissolved pollutant concentrations from the scheme, thereby indicating negligible impact to river water quality in the long-term for each watercourse in accordance with Table 12.2. A very high sensitivity value combined with a negligible magnitude of impact gives an overall slight impact significance in accordance with Table 2.4 for all three watercourses, Parish March Burn, Black Glen watercourse and Brockloch Burn.

- Parish March Burn – Slight Adverse
- Black Glen burn - Slight Adverse
- Brockloch burn - Slight Adverse

<u>Effects of Routine Runoff on Groundwater</u>

12.4.40. During normal operation there will be a moderate potential for substances to enter the groundwater due to water entering the SuDS systems in place.

12.4.41. The result of a pollution event such as accidental spillage on the road could lead to a reduction in surface water quality that, in turn, could affect the quality of groundwater and associated habitats.

12.4.42. In accordance with Method C of HD 45/09 the risk of pollution to groundwater from routine runoff has been determined, as shown in the following table. The predicted risk of pollution to groundwater is for the operation of the scheme in the opening year 2018. According to the Met Office website[86] the average annual rainfall for the local area is between 1000 and 1500mm.

Table 12.6 Risk of Impact of Pollution from Routine Runoff to Groundwater

Property or Parameter	Weighting Factor	Site Data	Risk Score	Component Score
Traffic density	15	11,893 (AADT)	1	15
Rainfall volume	15	1000-1500mm	3	75
		43mm FEH 1 hour rainfall	2	
Soakaway geometry	15	eight attenuation ponds	2	30
Unsaturated zone	20	Varies, typically 15m	2	40
Flow type	20	Fracture flow	2	40
Effective grain size	7.5	Fine	1	7.5
Lithology	7.5	<5%-<1% clay minerals	2	15
Overall Risk Score: 222.5				

12.4.43. The overall risk score of routine runoff to groundwater is 222.5, categorised as a medium risk of impact. As a result, a magnitude of moderate impact can be assigned in accordance with Table 12.2 which produces, in combination with a very high sensitivity, a Large adverse overall impact significance with respect to Table 2.4 within Chapter 2: Methodology.

Pollution Impacts from Spillages

12.4.44. The operation of the scheme would bring an additional potential risk of accidental spillage of fuel or other materials through vehicle accidents on this stretch of road.

12.4.45. The result of a pollution event such as an accidental spillage on the road could lead to a reduction in surface water quality that, in turn, could affect the quality of groundwater and river base flow. These impacts can be persistent because of the often slow movement of water and the slow rates of diffusion.

12.4.46. This scheme, however, is not expected to significantly increase traffic volumes or to alter vehicle type distribution, as no viable alternative routes exist on the A77, and hence no additional traffic is expected to be attracted to the new proposed scheme.

[86] MET Office (2013), UK Actual and Anomaly Maps. Available at: http://www.metoffice.gov.uk/climate/uk/summaries/anomacts [Accessed 31st July 2013]

12.4.47. To determine the spillage risk associated with a particular stretch of road, the DMRB requires information concerning predicted traffic flow on the proposed road, the percentage of traffic with a Heavy Goods Vehicle (HGV) classification, the road length and the type of junction, and takes into account the time it would take the emergency services to respond to an emergency situation.

12.4.48. The probability of a serious accidental spillage was calculated using Method D, Annex I of DMRB, Volume 11, Section 3, Part 10, is as follows:

$\mathbf{P_{SPL}}$ =RL x SS x (AADT x 365 x 10^{-9}) x (%HGV ÷ 100)

Where:

$\mathbf{P_{SPL}}$ = annual probability of a spillage with the potential to cause a serious pollution incident;

RL = road length in km within each drainage catchment draining to each watercourse =

- Parish March Burn: 1.89km
- Black Glen: 1.94km
- Brockloch: 2.7km

SS = serious spillage rate (Annex 1 Table D1.1: Serious Accidental Spillages in Billion HGV km/year (DMRB, volume 11, Section 3, Part 10: Road Drainage and the Water Environment)) = **3.09** (A value of 3.09 represents the serious spillage rate of a rural trunk road with a Roundabout). This is considered a worst-case scenario approach as two roundabouts are present within the scheme extents.

$\mathbf{P_{INC} = P_{SPL} \times P_{POL}}$

Where:

$\mathbf{P_{INC}}$ = the probability of a spillage with an associated risk of a serious pollution incident occurring

$\mathbf{P_{POL}}$ = the probability, given a spillage, that a serious pollution incident will result. The risk reduction factor, dependent upon emergency services response times (Annex 1 Table D1.2: Probability of a Serious Pollution Incident Occurring as a Result of a Serious Spillage (DMRB, volume 11, Section 3, Part 10: Road Drainage and the Water Environment)) = **0.6** (Representing probability of a serious pollution incident occurring as a result of a serious spillage based on a surface water course in a rural location with a response time of less than 1 hour).

The acceptable risk of a serious pollution incident occurring will be where the annual probability is predicted to be less than 1%.

Parish March Burn

$\mathbf{P_{SPL}}$ = 1.89 x 3.09 x (9130 x 365 x 10^{-9}) x 0.138

$\mathbf{P_{SPL}}$ = 2.66 x 10^{-3}

$\mathbf{P_{INC}}$ = 2.66 x 10^{-3} x 0.6

P_{INC} = 0.27% (The value is less than 1% annual probability of a serious accidental spillage causing a pollution incident).

Black Glen Burn

$P_{SPL} = 1.94 \times 3.09 \times (6765 \times 365 \times 10^{-9}) \times 0.173$

$P_{SPL} = 2.56 \times 10^{-3}$

$P_{INC} = 2.56 \times 10^{-3} \times 0.6$

P_{INC} = 0.15% (The value is less than 1% annual probability of a serious accidental spillage causing a pollution incident).

Brockloch Burn

$P_{SPL} = 2.7 \times 3.09 \times (11893 \times 365 \times 10^{-9}) \times 0.106$

$P_{SPL} = 3.83 \times 10^{-3}$

$P_{INC} = 3.83 \times 10^{-3} \times 0.6$

P_{INC} = 0.23% (The value is less than 1% annual probability of a serious accidental spillage causing a pollution incident).

12.4.49. As the DMRB indicates that the acceptable risk of a pollution incident should normally be 1 in 100 years for discharges to aquifers and to reaches of sensitive watercourses, the magnitude of impact resulting from accidental spillages to surface waters is negligible in accordance with Table 12.2. This is due to the probability being below 0.5% well within the acceptable thresholds. In accordance with Table 2.4 in Chapter 2: Methodology, the impact significance is assessed as slight.

Flooding and Consequences

12.4.50. The proposed bypass crosses the floodplain of Brockloch Burn, which downstream contains approximately seven residential properties at Smithston which are located within an area identified by SEPA as being susceptible to flooding. This is the same area and watercourse that South Ayrshire Council highlighted an anecdotal localised flood risk site at Bankend Bridge.

12.4.51. Without attenuation, the rate of surface water runoff from the proposed scheme would be increased due to the impermeable area proposed, but this would be mitigated by the provision of SuDS attenuation ponds which limit discharge from the scheme to

12.4.52. In accordance with Table 12.2 the magnitude of impact is therefore determined to be moderate as there is an increased risk of flooding to approximately seven residential properties. As a result, the overall impact significance post construction is determined as moderate adverse in accordance with Table 2.4 within Chapter 2: Methodology.

12.4.53. A summary of impacts post construction without mitigation are shown in Table 12.7 below. In addition to this further information on flooding in relation to the scheme can be found in the FRA included as Appendix H5.

Table 12.7 Summary of Impacts Post Construction without Mitigation						
Potential Impact	**Feature**	**Attribute**	**Quality**	**Importance**	**Magnitude**	**Significance**
Surface Water Quality/river flows	Parish March Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Slight
	Black Glen Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Slight
	Brockloch Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Slight
Potential pollution incident	River/ Stream	Water Supply	Good	Very High	Negligible	Slight
Water Quality	Groundwater	Water supply/quality	Minor or moderately permeable aquifer	Very High	Moderate	Large
Flooding	Brockloch Burn	Conveyance of flow	Good	Medium	Moderate	Moderate

12.5. Mitigation

During Construction

12.5.1. A construction Environmental Management Plan (EMP) will be developed by the contractor and will be in line with relevant SEPAs Pollution Prevention Guidance including:

- Pollution Prevention Guidance (PPG) 1 - General guide to the prevention of pollution;
- PPG 5 - Works and maintenance in or near water;
- PPG 6 - Working at construction and demolition sites;
- PPG 8 – Safe storage and disposal of used oil;
- PPG 18 - Managing fire water and major spillages;
- PPG 21 - Pollution incident response planning;
- PPG 22 - Dealing with spillages on highways; and,
- CIRIA - Control of Water from Construction Sites.

12.5.2. Licences under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) will be required due to construction works which have the potential to cause pollution taking place in surface waters. All details must be confirmed with the local SEPA office prior to works commencing. All method statements regarding de-watering of excavations must be approved by the local SEPA office prior to works commencing.

12.5.3. Conditions imposed on any CAR licences from SEPA must be adhered to by the contractor. If there any changes to the engineers design they must consult and submit an application for an altered/new CAR licence prior to commencement of works.

12.5.4. To mitigate any potential adverse effects to surface waters and groundwater during the construction phase, the following measures are proposed:

- Management of construction works so as to comply with the necessary standards and consent conditions as identified by SEPA, South Ayrshire Council and SNH.
- All construction workers should be briefed on the importance of maintaining water quality, the location of surface water features and the location and use of accidental spill kits as part of the site induction.
- The construction drainage network should incorporate measures (e.g. potentially an interceptor) to prevent the discharge of hydrocarbons to surface or ground water systems.

- In areas where there is increased risk of hydrocarbon/chemical spillage and around hazardous substance stores, additional precautions should be taken. These would include bunding (in accordance with PPG 8: Safe storage and disposal of used oil), impermeable bases, suitable drainage systems and sited away from any open drainage channels.
- Any stockpiled materials should be stored within enclosed areas to enable the runoff to be stored and treated where required.
- Any concrete works should be carefully controlled, and where required any concrete tankers would be washed out in controlled areas.
- All plant and machinery should be maintained in a good condition and any maintenance required would be undertaken within safe areas.
- A Pollution Prevention and Spill Response Procedure should be developed by the contractor and a site kit and clean up equipment would be maintained on site.
- Wheel washers and dust suppression measures should be used to prevent the migration of pollutants.
- Continual monitoring of the surface water courses before, during and after construction should be undertaken to measure adverse impacts on water quality and implement a mitigation strategy should impacts be identified.

Post Construction

12.5.5. No further mitigation in relation Groundwater will be necessary during the construction phase as it was identified that excavation will be above the depth of the water table as identified in borehole investigations.

12.5.6. To mitigate the risk of deterioration in water quality of the three watercourses and groundwater bodies, the drainage design for the scheme includes attenuation and treatment ponds.

12.5.7. This approach is detailed in CIRIA C697 'The SuDS Manual', and outlines the most appropriate uses and combinations of SuDS measures to treat surface water runoff and improve water quality through each stage of the surface water management system.

12.5.8. The drainage systems would serve to intercept surface water runoff from the carriageway and remove pollutants as near to the source before disposal to the on-site conveyance network. This network is formed of the following components:

- Carrier and filter drains;
- Grass swales
- Gullies;
- Kerb and drainage systems;
- Catchpits and manholes;
- Pollution control valves;

- Infiltration/ SuDs ponds with forebays;
- Headwalls;
- Culverts.

12.5.9. In relation to flooding adjacent to the scheme, it was identified in the FRA that there was some potential of the Brockloch Burn to flood between Laigh Grange Road and Smithston Bridge and again between Smithston Bridge. The FRA also identified three downstream culverts under the existing A77 and the Ayr to Stranraer railway line which currently constrain the flow of water and present a potential flood risk if alleviated. Both the Chapelton and Abbeymill Burns downstream of these constraints were identified as susceptible to flooding. In addition the scheme will result in an increase to impermeable surfaces increasing the risk of localised flooding.

12.5.10. Mitigation for this will include retention of the existing downstream culverts so as not to affect the Chapelton and Abbeymill Burns, with attenuation ponds used to limit outflow from the scheme and relieve some pressure on the existing culverts. These will also mitigate for the increase in impermeable area, treat road run-off and provide spillage containment facilities.

12.5.11. Bankend Bride, which is also an existing constraint to flow on the Brockloch Burn, will require replacement as part of the realignment of Laigh Grange Road. This will be installed to current standards and will therefore alleviate some of flooding in this area, which is adjacent to approximately seven properties. To mitigate for releasing flow at this constraint, new flood plain will be included in the design between Bankend Bride and the existing culvert downstream where the Brockloch Burn crosses under the existing A77 at Smithston.

12.6. Residual Impacts

During Construction

12.6.1. Implementation of the mitigation measures detailed above will result in a negligible impact magnitude during construction as the integrity of the water environment is unlikely to be affected as summarised in Table 12.8 below.

Post Construction

12.6.2. Mitigation measures for post construction impacts have been fully incorporated into design. Therefore, the significance of the residual impacts remain unchanged from the construction phase and are negligible. The exception to this is flooding where there will be a slight beneficial impact through the provision of attenuation to limit flow from the scheme and improvement to a known flooding constraint at Bankend Bridge

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Table 12.8 Impacts During Construction with Mitigation							
Potential Impact	**Feature**	**Attribute**	**Quality**	**Importance**	**Mitigation**	**Magnitude**	**Significance**
Water Quality	Parish March Burn	Water Supply	Unclassified by SEPA	Very High	Sediment control	Negligible	Neutral
	Black Glen Burn	Water Supply	Unclassified by SEPA	Very High	Sediment control	Negligible	Neutral
	Brockloch Burn	Water Supply	Unclassified by SEPA	Very High	Sediment control	Negligible	Neutral
Dilution and Removal of waste products (Septic Tank on site used by residential properties)	River/ Stream	Removal of Waste products	Good	Very High	Use of attenuation ponds	Negligible	Neutral
Water Quality	Groundwater	Water supply/quality	Minor or moderately permeable aquifer	Very High	Use of attenuation ponds	Negligible	Neutral
Dewatering	Groundwater	Conveyance of flows	Poor	Very High	Use of attenuation ponds	Negligible	Neutral
Flooding	Brockloch Burn	Conveyance of flow	Good	Medium	Use of attenuation ponds and filter drains	Negligible	Slight

Table 12.9 Summary of Residual Impacts						
Potential Impact	**Feature**	**Attribute**	**Quality**	**Importance**	**Magnitude**	**Significance**
Water Quality	Parish March Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Neutral
	Black Glen Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Neutral
	Brockloch Burn	Water Supply	Unclassified by SEPA	Very High	Negligible	Neutral
Dilution and Removal of waste products (Septic Tank on site used by residential properties)	River/ Stream	Removal of Waste products	Good	Very High	Negligible	Neutral
Water Quality	Groundwater	Water supply/quality	Minor or moderately permeable aquifer	Very High	Negligible	Neutral
Dewatering	Groundwater	Conveyance of flows	Poor	Very High	Negligible	Neutral
Flooding	Brockloch Burn	Conveyance of flow	Good	Medium	Negligible	Slight Beneficial

12.7. Assumptions and Limitations

12.7.1. The approach to assigning significance of effect relies on reasoned argument, professional judgement and taking on board the advice and views of appropriate organisations. Therefore it can be argued subjectivity is present.

12.7.2. It is pertinent to quote the cautionary note in the British Geological Survey (BGS) Hydrometric Register and Statistics (Ref 32) describing the Q95 flow data. *'The reliability of the 95 percentile flows must be considered carefully as representative measures of low flow. The values should be used with caution in view of the problems associated with both the measurement of very low discharges and the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes.'*[87]

12.8. Conclusions

12.8.1. Conclusions from the Flood Risk Assessment (FRA) are as follows:

- The surface water drainage will be designed to the current standards.
- The potential flooding associated with all the watercourses south and east of Maybole and also south and east of the railway will be marginally improved by the proposals.
- This improvement will be achieved by the use of SuDs basins and small flood plains.

12.8.2. Please refer to FRA within Appendix H5 for further information.

12.8.3. The proposed A77 Maybole bypass scheme is not predicted to present significant impacts on surface water bodies, groundwater or flooding.

12.8.4. It is predicted the proposed road drainage layout will improve the current situation at Bankend Bridge adjacent to the A77. It is envisaged the installation of eight treatment ponds, in line with the WFD, will prevent deterioration, improve water quality and restore bodies of surface water.

[87] DMRB (2009), Volume 11 Section 3, Part 10, HD45/09 *Road Drainage and the Water Environment*. Available from: http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/hd4509.pdf [Accessed 6th May 2012]