Appendix 16A: Assessment Methodology

1.1 Introduction

1.1.1 The road drainage and the water environment assessment has involved the following key tasks:

- consultations with the relevant statutory and non-statutory bodies to establish the principal water environment issues associated with the study area;
- detailed desk studies and field surveys to ascertain the current baseline conditions on site;
- assessment of the potential impacts related to the construction and operation of the proposed development; and
- identification of measures to avoid, minimise or mitigate predicted impacts.

1.1.2 Further details on the baseline data collection and assessment methods used are provided below.

1.2 Baseline Data Collection

1.2.1 The desk study involved:

- review of the Road Drainage and Water Environment chapter of the 2007 Interim Environmental Assessment Report, prepared by Penny Anderson Associates ltd;
- review of the Aecom Flood Risk Assessment Report and Ground Investigation Report;
- identification of all catchments, surface and groundwater bodies including watercourses, drains, ponds, wetlands and springs;
- estimation of watercourse low, mean and peak flows using the software LowFlows 2000 and the Institute of Hydrology Flood Studies Report and Flood Estimation Handbook;
- collation of Environment Agency data on water quality and Water Framework Directive status of waterbodies;
- collation of data on existing abstractions and discharges; and
- review of data on the existing road drainage systems on the A555, provided by Aecom.

1.2.2 A site visit carried out on the 9th and 10th of June 2010 concentrated on gaining a good overall understanding of the water environment of the study area. Visual inspections and geomorphological assessments of the main watercourses were also undertaken.

1.3 Construction Assessment

1.3.1 A qualitative assessment of construction impacts was carried out, which involved a review of areas where construction is proposed in close proximity to waterbodies and the proposed mitigation measures targeted at avoiding or minimising the risk of construction pollution.

1.4 Routine Runoff Assessment

1.4.1 DMRB Volume 11, Section 3, Part 10, HD 45/09 – Road Drainage and the Water Environment specifies procedures for the assessment of pollution impacts from routine runoff on surface waters and groundwaters, known as Method A and Method C respectively.

1.4.2 In this instance only Method A has been used as all proposed road drainage outfalls have been designed to discharge to surface waters, and therefore there will be no pollution impact on groundwaters from routine runoff.

1.4.3 The Method A assessment comprises two separate elements:

- ***HAWRAT Assessment***: the Highways Agency Water Risk Assessment Tool (HAWRAT) is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road runoff. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment bound pollutants respectively;
- ***EQS Assessment***: Environmental Quality Standards (EQS) are the maximum permissible annual average concentrations of potentially hazardous chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

1.4.4 These assessments are carried out for each proposed road drainage outfall.

HAWRAT Assessment

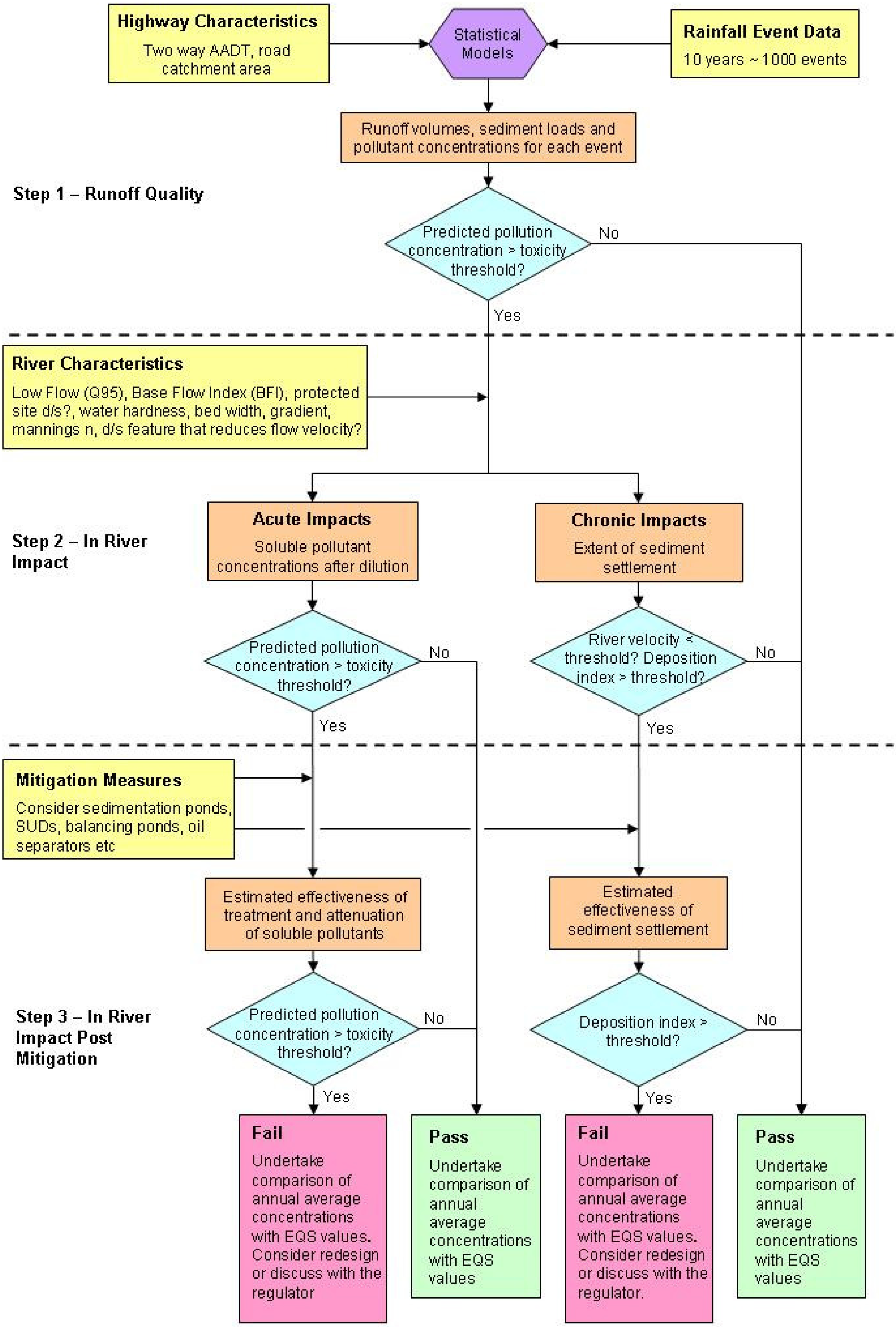
1.4.5 HAWRAT is a tiered consequential system which involves up to three assessment stages, as can be seen in Table 06A.1 Stage 1 uses statistical models to determine pollutant concentrations in raw road runoff prior to any treatment or dilution in the receiving watercourse. Stage 2 assesses in-river pollutant concentrations after dilution and dispersion but without active mitigation. Stage 3 considers the in-river pollutant concentrations with active mitigation.

1.4.6 As can be seen in Table 06A.1 acute impacts due to soluble pollutants and chronic impacts due to sediment bound pollutants are assessed separately. For an individual outfall to pass the HAWRAT assessment, it must pass both elements.

1.4.7 The underlying algorithms for assessing pollutant concentrations are based on recent research undertaken by the HA and the EA on road runoff quality under a range of traffic and weather conditions. Recent ecological research has determined the toxicity thresholds for the typical pollutants in road runoff, and this is used in the tool to evaluate whether predicted concentrations are acceptable or not.

1.4.8 Full details on the development and use of HAWRAT can be found in DMRB 11.3.10 HD 45/09 and in the HAWRAT Users Manual, which includes background information on the research programme behind the tool, derivation of the toxicity thresholds used and explanation of the background calculations.

Table 06A.1 HAWRAT Tiered Flow Diagram



User Parameters

1.4.9 The HAWRAT parameters that must be entered by the user at each stage of the assessment are summarised in Table 16A.2 with details of the respective data sources.

Table 16A.2 HAWRAT User Parameters

Parameter	Data Source
Step 1	
AADT	Annual Average Daily Traffic flow data has been provided by Atkins SEMMMS Highways and Transportation Team. One of three broad ranges of AADT must be selected within HAWRAT. The majority of road drainage catchments within the Proposed Scheme have an AADT in the range of >10,000 and < 50,000 vehicles (the lowest band). There are a small number of road drainage catchments which have an AADT of greater than 50,000 (the intermediate band).
Climatic Region	Four options are available to choose from: Colder Wet, Colder Dry, Warmer Wet and Warmer Dry. In this instance the Colder Wet option was selected
Rainfall Site	Having selected a Climatic Region a restricted list of rainfall sites are available to choose from. The Warrington rainfall site was chosen in this instance as it was geographically closest to the road scheme.
Step 2	
Impermeable road area drained (ha)	The Aecom SEMMMS Drainage Design Team have provided details of the permeable and impermeable areas within each drainage network.
Permeable road area drained (ha)	
Annual 95%ile river flow (m^3/s)	The 95%ile (Q95) river flows have been calculated for each outfall location using the software LowFlows 2TM. Derivation of the Q95 requires the upstream catchment of the receiving watercourse to be defined. This has been done based on OS mapping and professional judgement. As the study area is generally quite flat and the natural topography has been modified with urbanisation there was some uncertainty regarding the extent of some of the catchments, in particular the Baguley Brook.
Baseflow Index (BFI)	The baseflow index for each receiving watercourse has been taken from the LowFlows 2 software.
Conservation Area Proximity	The locations of downstream conservation sites has been provided by the Mouchel SEMMMS Ecology Team. This data has been entered into a GIS and the distance from the road drainage outfalls determined. Where a conservation site lies within 1km downstream of an outfall the drop down option for this is chosen

Parameter	Data Source
Water Hardness	Data on the water hardness of the receiving watercourses, which is required for the assessment of soluble zinc only, has been collated from Environment Agency water quality data. One of three broad ranges must be chosen within HAWRAT.
Downstream Structure Proximity	The location of downstream structures, lakes, pond and canals has been determined from map and aerial photo interpretation.
Estimated River Width (m)	Used in the Tier 1 assessment of chronic sediment impacts, this was derived from aerial photo interpretation.
Bed Width (m) / Side Slope (m/m) / Long Slope (m/m)	Used in the Tier 2 assessment of chronic sediment impacts, this information was partially provided by the Aecom SEMMMS Drainage Design Team from topographic survey data. Data on the upper Spath Brook has been derived from as built drawings for the A555. No data was available for the lower Spath Brook and Gatley Brook, therefore these have been estimated based on past experience and professional judgement.
Manning's n	Used in the Tier 2 assessment of chronic sediment impacts, this information was derived from site photographs, aerial photography and professional judgement.
Step 3	
Proposed Mitigation Measures	Text description of the proposed mitigation measures. Appropriate mitigation measures have been identified through an iterative design & assessment process undertaken by the Aecom Drainage Design and Mouchel Water Environment teams. Further information on specific routine runoff mitigation is provided in Appendix 16C – Calculations & Results and Appendix 16D - Mitigation.
Treatment for Solubles (%)	An estimate of the probable effectiveness of the mitigation measures in reducing soluble pollutant concentrations is entered. See Appendix 16C - Calculations & Results and Appendix 16D - Mitigation for further details.
Restricted Discharge Rate (l/s)	Restriction of the road runoff discharge rate has not been used as a mitigation measure for the proposed scheme outfalls. Where the assessment found that mitigation was required, the receiving watercourses were generally very small with very low 95%ile flows. In these instances the discharge rate would have had to be restricted to an impracticably low rate for attenuation to be effective. Treatment of soluble pollutants was considered the only practical solution in these cases.
Settlement of Sediments (%)	An estimate of the probable effectiveness of the mitigation measures in reducing sediment concentrations is entered. See Appendix 16C - Calculations & Results and Appendix 16D - Mitigation for further details.

Cumulative Assessment

1.4.10 Where more than one outfall discharges into the same reach of a watercourse the combined impacts will be more significant. In these circumstances the outfalls should be aggregated for the purposes of aggregate assessment in HAWRAT.

1.4.11 To aggregate the outfalls the drained areas are simply added together. The location on the watercourse used for the cumulative assessment should be positioned downstream of the last outfall in the reach. For this purpose a reach is defined as a length of watercourse between two confluences, the reason being that the available dilution and stream velocity will naturally change at confluences and influence the assessment.

1.4.12 However watercourse reaches can vary greatly in length. Therefore for the assessment of the impacts of soluble pollutants only outfalls within 1km of each other along the length of a watercourse were aggregated for cumulative assessment. When assessing the combined impact of sediment bound pollutants outfalls within 100m of one another are assessed. Beyond 100m the road runoff sediment, if it settles at all, is likely to be sufficiently diluted with natural sediments so as not to have an adverse impact.

1.4.13 As with the assessment of individual outfalls, if the cumulative assessment fails mitigation should be applied to one or more of the outfalls and the calculations re-run.

EQS Assessment

1.4.14 The EQS Assessment provides an assessment of the long-term risks to receiving water ecology from soluble pollutants. The annual average concentrations for dissolved copper and zinc are calculated and compared with the published EQS, shown in Table 16A.3 to assess whether there is likely to be a long-term impact. It should be noted that at present there are published EQS values for total zinc, but not dissolved zinc. The values quoted for dissolved zinc are proposed and are likely to be adopted before 2013.

Table 16A.3 Environmental Quality Standards for Dissolved Copper and Zinc.

Water Hardness Bands (mg/l $CaCO_3$)	EQS for Dissolved Copper (µg/l)	EQS for Dissolved Zinc (µg/l)
0 – 50	1	7.8
>50 – 100	6	
>100 – 250	10	
> 250	28	

1.4.15 The annual average concentrations are calculated within HAWRAT at both Step 2 and Step 3. In calculating the annual average concentrations for dissolved copper and dissolved zinc, HAWRAT assumes that the background/upstream concentrations are zero. This enables an assessment of the added risk rather than the total risk i.e. the additional risk to organisms in the receiving water when they are exposed to road runoff.

1.4.16 Where multiple outfalls discharge into the same reach of a watercourse a cumulative EQS assessment is required as per the cumulative HAWRAT assessment.

1.5 Accidental Spillage Assessment

1.5.1 Spillages resulting from road traffic accidents or other causes could occur anywhere along the Proposed Scheme road network. Although the Proposed Scheme has been designed to minimise the risk of collision, it is important to assess the risk of serious pollution incident occurring. This assessment has carried out in accordance with Method D as detailed in DMRB Vol. 11 Section 3, Part 10 Road Drainage and the Water Environment.

1.5.2 The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- the probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and
- the probability that, if such a spillage did occur, the polluting substance would reach the receiving watercourse and cause a serious pollution incident.

1.5.3 Factors which influence the overall probability within a road drainage network are:

- the type of road i.e. motorway, rural trunk road or urban trunk road. In this case the proposed scheme has been assessed as urban trunk road.
- the road components within each road drainage network i.e. no junction, slip road, roundabout, crossroad and side road. This data has been determined from the DF7 layout.
- the length of each road component within the road drainage network, again determined from the DF7 layout.
- the AADT two way flow, provided by the Atkins SEMMMS Highways and Transportation Team.
- the percentage of the AADT flow that comprises HGV's, also provided by the Atkins SEMMMS Highways and Transportation Team.
- the response time of the emergency services. Given the urban nature of the study area it has been assumed that a response time of less than 20 minutes is appropriate.
- the receiving waterbody. In this case all outfalls are designed to discharge to surface watercourses.

1.5.4 The annual probability of a spillage occurring on any road component within the drainage catchment is calculated as:

Spillage Probability = road length x spillage rate x (AADT x 365 x 10-9) x (percentage HGV's / 100)

1.5.5 Where the spillage rate is determined from Table 16A.4 below.

Table 16A.4 Spillage Rates for Serious Spillages (Billion HGV km/year)

Road Component	Road Type		
	Motorway	Rural Trunk Roads	Urban Trunk Roads
No Junction	0.36	0.29	0.31
Slip Road	0.43	0.83	0.36
Roundabout	3.09	3.09	5.35
Crossroad	-	0.88	1.46
Side Road	-	0.93	1.81

1.5.6 The spillage probabilities for each road component type within the road drainage network are summed to give the overall spillage probability for the drainage network under assessment.

1.5.7 The probability of a serious pollution incident occurring as a result of a serious spillage is determined from Table 16A.5 below.

Table 16A.5 Probability of a Serious Pollution Incident Occurring as a Result of a Serious Spillage

Receiving Waterbody	Urban (response time to site < 20 mins)	Rural (response time to site < 1 hour)	Remote (response time to site > 1 hour)
Surface Water	0.45	0.6	0.75
Groundwater	0.3	0.3	0.5

1.5.8 Finally the overall annual probability of a serious pollution incident as a result of accidental spillage is calculated by multiplying the spillage probability and response time probability together. Within HAWRAT this probability is expressed as a return period such as 1 in 50 years i.e. there is a 1 in 50 (2%) probability of such an event occurring in any one year.

1.5.9 The DMRB guidance recommends that the receiving watercourses are protected such that the risk of a serious pollution incident has an annual probability of less than 1% (or 1 in 100 year return period). However where outfalls are to discharge within 1km of a protected site a higher level of protection will be required such that the annual probability is less than 0.5% (or a 1 in 200 year return period).

1.5.10 If any outfalls are found to fail these criteria then mitigation, such as oil separators, penstocks or ponds, should be designed into the drainage network, which will capture and contain any potential pollutant before it reaches the watercourse. The accidental spillage calculations should be re-run applying the appropriate risk reduction factors from Table 16A.6.

Table 16A.6 Risk Reduction Factors for Drainage Systems

Drainage System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration Basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / Valve	0.4
Notched Weir	0.6
Oil Separator	0.5

1.6 Flood Risk Assessment (FRA)

1.6.1 The FRA has been carried out by Aecom in accordance with Planning Policy Statement 25 (PPS25): Development and Flood Risk, and the supporting document PPS25: Development and Flood Risk: A Practice Guide.

1.6.2 The objectives of the FRA were to:

- assess the risk to the development from all potential sources of flooding;
- assess the risk of increasing flooding elsewhere as a consequence of the development; and
- determine appropriate mitigation measures to limit the impact of flooding on the development and offsite flooding due to increased runoff.

1.6.3 The flood risk baseline was established through desk study, site walkover and consultation, and collated data on principal watercourses and field drains, existing flood defences, EA flood zones, public water mains and sewers, artificial waterbodies, existing private and highway drainage, geology and hydrogeology and details of historic flooding.

1.6.4 A drainage assessment has been carried out which seeks to demonstrate that the proposed development is able to discharge surface water flows without increasing the flood risk both on and off site. The drainage assessment has considered: existing and proposed drainage arrangements; the implications of climate change; and the mitigation measures needed for surface water disposal, including the surface water drainage strategy to be implemented and the use of SUDS.

1.6.5 A detailed hydraulic assessment of the Norbury Brook has been undertaken, due to the existing fluvial flood risk indicated on the EA Flood Map and the proximity of the proposed highway to the brook.

1.6.6 A number of small watercourses and land drains will be bisected by the proposed highway. A case-by-case assessment of culverting and realignment requirements has been carried out for these waterbodies.

1.6.7 An assessment of flood risk from all sources has been undertaken using all the information gathered from the above assessments, and practical mitigation measures identified where necessary.

1.6.8 Full details of the FRA methodology are provided in the SEMMMS A6 to Manchester Airport Relief Road Flood Risk Assessment Report, Document Ref: 1007/6.7/061 (Aecom, 2011).

1.7 Geomorphological Assessment

1.7.1 A qualitative geomorphological assessment was carried out using data collated through desk studies and field surveys. Aerial photography and historic mapping were studied for evidence of historic channel instability in the relevant river reaches. The field investigations took a river reconnaissance or fluvial audit approach, which identified channel morphology, bed and bank material, degree of vegetation, sinuosity, braiding, areas of erosion and deposition and land use. Any evidence of historic channel change was recorded including palaeochannels, terraces and raised bars.

1.7.2 From this baseline assessment a qualitative estimation can be made of both how ‘active’ the river is and the likely effect the development proposals (such as culverts, bridges and watercourse realignments) may have on the existing status of the water environment.

1.8 Groundwater Assessment

1.8.1 To determine the likely impact of dewatering of cuttings on groundwater flows and levels the drawdown distance/area of influence has been calculated for each cutting.

1.8.2 There is no published formula for the distance of influence from linear features such as cuttings, therefore the empirical formula of Sichardt for calculating the radius of influence of groundwater abstractions has been used:

$$L = C\Delta H\sqrt{K}$$

where L = distance/radius of influence, K = permeability, ΔH = groundwater table drawdown i.e. penetration of the cutting beneath the water table and C = 2000, where C is a constant.

1.8.3 The permeability of the aquifer has been estimated from ground investigations carried out by the highway designers.

1.8.4 A qualitative assessment was then made of the impact on the aquifer and nearby groundwater dependent receptors, such as public water supply boreholes and wetlands.

1.9 Impact Assessment Criteria

1.9.1 The predicted significance of impacts on surface waters and groundwaters has been based on the importance or sensitivity of the relevant waterbody and the magnitude of the impact from the proposed development, as recommended in DMRB document HD 45/09.

Importance / Sensitivity

1.9.2 The importance or sensitivity of the waterbodies has been evaluated taking into account their quality, rarity, scale and substitutability. The criteria used in determining the importance of each waterbody are shown in Table 16A.7 below.

Table 16A.7 Importance Criteria

Importance	Criteria
Very high	Large or medium watercourses with pristine / near pristine water quality High WFD Overall Status Watercourses Watercourse supporting major/critical public water supplies Designated Salmonid fisheries Sites protected under EU or UK wildlife legislation (SAC, SPA, Ramsar, SSSI sites) Water dependent ecosystems of international/national biodiversity value Watercourses supporting a wide range of significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity such as salmon or freshwater pearl mussels Watercourses with diverse morphological features such as pools and riffles Dynamic watercourses showing evidence of channel migration and other morphological changes such as bar evolution Watercourses or floodplains, with direct flood risk to adjacent populated areas and/or presence of critical infrastructure such as schools and hospitals etc, which are highly sensitive to increased flood risk by the possible increase in water levels Watercourses or floodplains that provide critical flood alleviation benefits Principal groundwater aquifer supporting public water supply Groundwater Source Protection Zone (SPZ) 1 – Inner Protection Zone or 2 – Outer Protection Zone Good WFD Overall Status Groundwaters
High	Medium or small watercourses with minor degradation of water quality as a result of anthropogenic factors Good WFD Overall Status Watercourses

Importance	Criteria
	Watercourses supporting minor/non-critical public drinking water supplies Designated Cyprinid fisheries with imperative and guideline limit passes Water dependent ecosystems of regional/county biodiversity value Watercourses supporting some species and habitats sensitive to changes in suspended sediment concentrations and turbidity Watercourses with some morphological features such as pools and riffles Watercourses showing some evidence of historic channel migration and other morphological changes Watercourses or floodplains, with a possibility of direct flood risk to less populated areas without critical infrastructure, which are sensitive to increased flood risk by the possible increase in water levels Watercourses or floodplains that provide significant flood alleviation benefits Principal groundwater aquifer supporting private water supply or secondary groundwater aquifer supporting public/private water supply Groundwater SPZ 3 – Source Catchment Protection Zone Good WFD Overall Status Groundwaters
Medium	Small watercourses with degradation of water quality as a result of anthropogenic factors Moderate WFD Overall Status Watercourses Watercourses supporting private drinking water supplies or for agricultural/industrial use Designated Cyprinid fisheries with imperative limit passes but guideline limit failures Water dependent ecosystems of county/district biodiversity value Watercourses supporting limited species and habitats sensitive to changes in suspended sediment concentrations and turbidity Watercourses with limited morphological diversity Watercourses showing limited evidence of historic channel migration and other morphological changes Watercourses or floodplains, with a possibility of direct flood risk to high value agricultural areas, which are moderately sensitive to increased flood risk by the possible increase in water levels Watercourses or floodplains that provide some flood alleviation benefits Principal/secondary A groundwater aquifer not currently supporting a drinking water supply Poor WFD Overall Status Groundwaters
Low	Small heavily modified watercourses or drains with poor water quality as a result of anthropogenic factors Poor/Bad WFD Overall Status Watercourses

Importance	Criteria
	Watercourses not supporting water abstractions Water dependent ecosystems of local/less than local biodiversity value Watercourses which do not support any significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity Watercourses with no morphological diversity Watercourses showing no evidence of active fluvial processes and unlikely to be affected by modification to boundary conditions Watercourses or floodplains passing through low value agricultural areas, which are less sensitive to increased flood risk by the possible increase in water levels Watercourses or floodplains that provide limited flood alleviation benefits Secondary B aquifers / unproductive strata / no aquifers Poor WFD Overall Status Groundwaters

Impact Magnitude

1.9.3 The magnitude of impacts are evaluated using the criteria shown in Table 16A.8.

Table 16A.8 Impact Magnitude Criteria

Magnitude	Criteria
Major Adverse	High risk of pollution during construction, significant temporary or long-term change in water quality, resulting in a permanent change in WFD status Failure of both soluble and sediment bound pollutants in HAWRAT and EQS compliance failure Risk of pollution from accidental spillage during operation > 2% annually Major change in geomorphological conditions i.e. major changes in sediment patterns due to deposition or erosion, major reduction in morphological diversity, or major interruption to fluvial processes such as channel planform evolution, all with significant consequences for ecological quality Major groundwater flow changes with significant consequences on nearby groundwater dependent habitats/abstractions Increase in the peak flood level of >100mm for the 1% annual probability (1 in 100 year) flood Significant increase in extent of Zone 2 and 3 flood risk areas as defined in PPS25 and EA strategic flood maps.
Moderate Adverse	Moderate risk of pollution during construction, moderate temporary change in water quality, resulting in a temporary change of WFD status Failure of both soluble and sediment bound pollutants in HAWRAT but compliance with EQS limits Risk of pollution from accidental spillage during operation > 1% annually

Magnitude	Criteria
	Moderate change in geomorphological conditions i.e. moderate changes in sediment patterns due to deposition or erosion, moderate changes in morphological diversity, or moderate interruption to fluvial processes such as channel planform evolution, all with moderate consequences for ecological quality Moderate groundwater flow changes with minor consequences on nearby groundwater dependent habitats/abstractions Increase in the peak flood level of >50mm for the 1% annual probability (1 in 100 year) flood Moderate increase in extent of Zone 2 and 3 flood risk areas as defined in PPS25 and EA strategic flood maps.
Minor Adverse	Minor risk of pollution during construction, relatively minor temporary changes in water quality such that ecology is temporarily affected. Equivalent to a temporary minor, but measurable, change within WFD status class Failure of either soluble and sediment bound pollutants in HAWRAT but compliance with EQS limits Risk of pollution from accidental spillage during operation > 0.5% annually Minor change in geomorphological conditions i.e. minor changes in sediment transport, minor changes in morphological diversity, or minor interruption to fluvial processes such as channel planform evolution, all with minimal impact on ecological quality. Any changes are likely to be highly localised Minor groundwater flow changes with minimal impact on nearby groundwater dependent habitats/abstractions Increase in the peak flood level of >10mm for the 1% annual probability (1 in 100 year) flood Minor increase in extent of Zone 2 and 3 flood risk areas as defined in PPS25 and EA strategic flood maps, magnitude of change similar to the errors associated with the estimate of the extent
Negligible	Negligible risk of pollution during construction, very slight temporary change in water quality with no discernible effect on watercourse ecology All elements of HAWRAT and EQS assessments passed Risk of pollution from accidental spillage during operation < 0.5% annually Negligible change in geomorphological conditions i.e. No discernible changes in sediment patterns, negligible changes in morphological diversity, no change to fluvial processes, all with no discernible impact on ecological quality. Any changes are likely to be highly localised Negligible groundwater flow changes with no discernible impact on nearby groundwater dependent habitats/abstractions Increase in the peak flood level of <10mm for the 1% annual probability (1 in 100 year) flood No discernible increase in extent of Zone 2 and 3 flood risk areas, as defined in PPS25 and EA strategic flood maps, the magnitude of change being much less than errors associated with the estimate of the extent.

Impact Significance

1.9.4 The estimation of the impact significance has been arrived at by combining the estimated importance of the affected waterbodies and the magnitude of the impacts using the matrix shown in Table 16A.9 below. Where the significance is shown as being one of two alternatives a single description is provided based upon reasoned judgement of the specific case.

Table 16A.9 Impact Significance Matrix

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

Appendix 16B – Baseline Environment

16.1 Corridor Overview

16.1.1 The water environment study area lies within an area of predominantly agricultural land on the urban fringe of Greater Manchester. The topography of the corridor is generally flat and occasionally gently undulating with elevations ranging between 120mAOD in the east to 70mAOD in the west.

16.1.2 North West England has a temperate maritime climate characterised by cool summers and mild, wet winters. Rainfall in the Greater Manchester area is relatively low due to the 'rain shadow' effect of the high ground of North Wales. The standard annual average rainfall (SAAR) for the site has been estimated from the Flood Estimation Handbook (FEH) CD-ROM as varying from 968mm in the east to 829mm in the west. To put this into context these values can be compared with annual totals of about 500mm in the drier parts of eastern England and over 4000mm in the western Scottish Highlands. The seasonal rainfall pattern of the study area can be seen in the average monthly rainfall data collected at the Manchester Airport gauging station, shown in Table 16B.1.

Table 16B.1 Average Monthly Rainfall at Manchester Airport (69m AOD)

Time Period	Rainfall (mm)
January	71.5
February	51.8
March	64.0
April	49.1
May	53.8
June	66.8
July	59.5
August	70.9
September	69.9
October	86.0
November	81.9
December	81.4
Year	806.6

16.1.3 The principal watercourses comprise the Oxhey Brook, Threaphurst Brook, Norbury Brook, Lady Brook and Poynton Brook at the eastern end of the corridor, the Spath Brook in the central part of the corridor and the Gatley Brook and Baguley Brook at the western end of the corridor, as shown in Figure 16.1. Most of these watercourses drain generally northwards towards the Upper River Mersey upstream of the Manchester Ship Canal, with the exception of the Spath Brook which drains southwards to the River Dean.

16.1.4 In addition to the principal watercourses there is a network of small streams, drains and ditches throughout the corridor, including the Hill Green Brook and Bramhall Brook which are minor tributaries of the Lady Brook. Due to historic land use and urbanisation many of the surface waters of the study area are heavily modified due to realignment, straightening and culverting. This, in addition to the generally flat topography, has resulted in poorly defined catchment boundaries.

16.1.5 There are numerous small ponds scattered throughout the rural areas of the corridor. These are kettleholes formed during the last period of glaciation.

16.1.6 At the far eastern end of the corridor, around Hazel Grove, the bedrock geology consists of Carboniferous Pennine Coal Measures which are made up of alternating layers of sandstone, coal seams, mudstone and shales. The sandstone layers act as individual secondary aquifer units capable of supporting small to medium sized water supplies.

16.1.7 The eastern and central parts of the corridor, between Hazel Grove and Styal, are underlain by the Triassic Sherwood Sandstone which forms part of a principal aquifer unit. In the wider area this aquifer is heavily utilised for public water supply, with groundwater flow generally from north to south. However, in places the aquifer is divided into poorly connected blocks due to the geological structure and the presence of low permeability faults.

16.1.8 West of Styal the corridor is underlain by Triassic Mercia Mudstone. Due to its relative impermeability the Mercia Mudstone is considered a secondary aquifer, capable of supporting only very small private water supply abstractions. Occasional, isolated deposits of Quaternary Sands and Gravels are also present in this area and are considered a secondary aquifer.

16.1.9 There are two areas of notable floodplain and flood risk. The first is associated with the confluence of the Norbury Brook, Poynton Brook and Lady Brook. The second is related to the Spath Brook.

16.1.10 The key surface water and groundwater features of the study area are shown in Figures 16.1 and 16.2.

16.2 A6 to A555

16.2.1 The principal watercourses within this section are the Oxhey Brook, Threaphurst Brook, Norbury Brook, Poynton Brook and Lady Brook. The proposed route also passes within close proximity of a number of small ponds and crosses a principal groundwater aquifer.

Oxhey Brook

16.2.2 At the far eastern end of this section the Oxhey Brook rises immediately adjacent to the proposed A6 junction (Ch. 1150) and flows 550m north-west to join the Threaphurst Brook. From here the Threaphurst Brook continues flowing north into the Poise Brook 1.7km downstream. The Poise Brook continues northwards to join the River Goyt approximately 5km downstream of the proposed scheme.

16.2.3 The proposed scheme overlies a short section of the Oxhey Brook, close to its headwaters, and it is proposed to realign this section of the Oxhey Brook to flow immediately adjacent to the proposed scheme.

16.2.4 The section of the Oxhey Brook which is proposed for realignment is a very small, heavily modified stream / ditch (as shown in Figure 16B.1), which follows the wooded field boundary on the edge of Hazel Grove Golf Course. A small culverted field drain joins the brook within this reach. The channel is heavily overgrown with a silty bed and is of low geomorphological importance. Very low, sluggish flow was observed during the site visit.

Figure 16B.1 Oxhey Brook at SJ 935 859 on 9th June 2010

16.2.5 The Oxhey Brook immediately downstream of the proposed realignment location has a catchment area of 0.18km^2. Estimated flow statistics for the Oxhey Brook at the proposed outfall location are presented in Table 16B.2.

Table 16B.2 Oxhey Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)*	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
0.18	2.26	0.26	200	200	300	300	400	500

Q95, a standard measure of low flow, is the flow exceeded 95% of the year

16.2.6 The Oxhey Brook is too small to feature on the EA strategic flood mapping and there are no records of historic flooding related to this watercourse.

16.2.7 No abstractions have been identified on the Oxhey Brook, however there is one discharge at SJ 935 858. The purpose of this discharge is unclear, however it is assumed that it is an overflow from the nearby water company service reservoir.

16.2.8 As the Oxhey Brook is very small, flows through agricultural land and has no flood risk associated with it, the brook is considered to have a low hydrological & flood risk importance.

16.2.9 There is no EA water quality data available for the Oxhey Brook, however the downstream section of the Threaphurst Brook is classified under the WFD as part of the Poise Brook waterbody. The current WFD status of the Poise Brook is 'Bad', due to low macroinvertebrate levels and elevated phosphate and ammonia concentrations. This is likely to be due to diffuse pollution from golf courses and agricultural land in the upper catchment and point source pollution from sewer storm overflows in the lower catchment. The Oxhey Brook is not designated under the FFD.

16.2.10 As part of the assessment for earlier SEMMMS schemes aquatic macroinvertebrate surveys have been undertaken on the upper Threaphurst Brook, upstream of the confluence with the Oxhey Brook. The invertebrate surveys revealed moderate biological water quality, with the seasonality of water levels the limiting factor on invertebrate diversity rather than water quality. Given that the Oxhey Brook is within the same locale but considerably smaller than the Threaphurst, it is reasonable to assume that the same trend applies to the Oxhey Brook, with less invertebrate diversity due to lower flows.

16.2.11 The project ecologists have assessed the Oxhey Brook as having a biodiversity value within the zone of influence only (i.e. the project site and its immediate surroundings).

16.2.12 Consequently the water quality and biodiversity of the Oxhey Brook is considered to be of low sensitivity.

Threaphurst Brook

16.2.13 The Threaphurst Brook rises on the outskirts of High Lane and flows for 2km through Hazel Grove Golf Course before being joined by the Oxhey Brook. From here the Threaphust Brook continues through Torkington Park and Hazel Grove before flowing into the Poise Brook 1.7km downstream.

16.2.14 A single road drainage outfall is proposed on the Threaphurst Brook, approximately 100m downstream of where the Oxhey Brook joins.

16.2.15 The Threaphurst Brook is a small stream which meanders through clough woodland and is approximately 2m wide. The Threaphurst Brook could not be accessed during the site visit, therefore there is no information available on the channel character. However based on other streams in the study area it is likely to have a gravel and cobble bed and is considered likely to be of medium geomorphological value.

16.2.16 The Threaphurst Brook at the proposed outfall location has a catchment area of 1.94km^2. Estimated flow statistics for the Threaphurst Brook at the proposed outfall location are presented in Table 16B.2.

Table 16B.3 Threaphurst Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)*	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
1.94	24.4	2.83	1000	1300	1600	1900	2300	2800

16.2.17 The EA strategic flood mapping indicates a very small area of flooding for the 1 in 100 year return period flows on the Threaphurst Brook in the immediate vicinity of the proposed scheme outfall. The affected are is immediately adjacent to the brook and is agricultural land. Flooding is indicated for the 1 in 100 year return period flows 1km downstream, north of the A627, which affects residential properties on Hazelwood Road in Hazel Grove.

16.2.18 No abstractions have been identified on the Threaphurst Brook, however there are a number of water company sewer storm overflow outlets into the brook approximately 1.5km downstream of the proposed scheme.

16.2.19 On the basis of the above information the Threaphurst Brook is considered to have a medium sensitivity in relation to hydrology and flood risk.

16.2.20 The downstream section of the Threaphurst Brook is classified under the WFD as part of the Poise Brook waterbody. The current WFD status of the Poise Brook is 'Bad', due to low macroinvertebrate levels and elevated phosphate and ammonia concentrations. This is likely to be due to diffuse pollution from golf courses and agricultural land in the upper catchment and point source pollution from sewer storm overflows in the lower catchment.

16.2.21 The Threaphurst Brook is designated under the FFD as a Cyprinid fishery i.e. capable of supporting species such as tench, roach, chub and minnow. Under the FFD there are two levels of compliance - guideline and imperative. The imperative limits are essentially a minimum water quality standard that must be achieved for the watercourse to achieve its fisheries potential, while the guideline limits are an optimum to aim for. The Threaphurst Brook is passing the imperative water quality limits, but failing the guideline limits

16.2.22 Aquatic macroinvertebrate surveys undertaken on the upper Threaphurst Brook revealed moderate biological water quality, with the seasonality of water levels the limiting factor on invertebrate diversity rather than water quality.

16.2.23 The project ecologists have assessed the Threaphurst Brook as having a biodiversity value of district level.

16.2.24 Consequently the water quality and biodiversity of the Threaphurst Brook is considered to be of medium sensitivity.

Norbury Brook

16.2.25 The Norbury Brook rises on the far western edge of the Peak District National Park, near Lyme Park, flowing north, then westwards for approximately 8.5km before joining with the Poynton Brook to form the Lady Brook between Poynton and Hazel Grove. The catchment is largely agricultural, however the lower reaches are bounded to the north by residential development.

16.2.26 The proposed scheme runs parallel to the lower reach of the Norbury Brook for approximately 1.5km. It is proposed to realign one meander of the Norbury Brook in the vicinity of Old Mill Lane (Ch. 8850), where the scheme overlies the current course of the brook.

16.2.27 Within the study area the brook (shown in Figure 16B.2) meanders east to west through clough woodland and is approximately 2-4m wide. The gravel, cobble and boulder bed forms a series of pools and riffles throughout the reach, with several small natural and artificial waterfalls. There are numerous gravel bars within the reach indicating active deposition of material.

16.2.28 In the vicinity of Old Mill Lane the brook is steeply incised up to 10m into the heavily weathered shale bedrock. The banks show evidence of historic and contemporary erosion, with frequent areas of bank undercutting, exposed tree roots and fallen trees. There is a particularly prominent meander at the bottom of Old Mill Lane, where it is proposed to realign the brook to accommodate the road alignment. There is evidence of continued erosion on the apex of this meander, with historic mapping suggesting it has migrated north-west a short distance and sharpened in the past 130 years.

16.2.29 Further downstream the brook is less incised, but is still very active with evidence of bank erosion and transportation and deposition of gravel and cobbles. There is also evidence of bank poaching by cattle. Upstream of Norbury Bridge there is evidence from aerial photography and the site walkover of palaeochannels on both sides of the brook. These are dry ancient channels that indicate the previous meandering route of the brook across the floodplain. A number of palaeochannels have been identified to the north of the Norbury Brook (SJ 928 853, Ch. 9150) which the footprint of the proposed scheme overlies. During flood events flood flows will preferentially follow the palaeochannels, exacerbating erosion in these areas which may impact on the road embankment in this area.

Figure 16B.2 Norbury Brook at SJ 931 854 on 9th June 2010

16.2.30 Further evidence of the instability of the Norbury Brook channel is provided by the historic mapping, which shows that over 130 years ago the channel 300m upstream and downstream of Norbury Bridge was straightened. Over the intervening years the brook has been allowed to migrate and revert to a more natural planform, developing significant meanders. It is reasonable to assume that, without intervention, this meandering and migration will continue.

16.2.31 As a result of the above evidence the Norbury Brook is considered to be of high geomorphological value.

16.2.32 The Norbury Brook at it's confluence with the Poynton Brook has a catchment area of 11.82km^2. Estimated flow statistics for the Norbury Brook immediately upstream of the confluence are presented in Table 16B.2.

Table 16B.4 Norbury Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
11.82	194	25	8600	10900	13000	15900	18500	21700

16.2.33 The EA strategic flood mapping shows that for a flood event of 1% annual probability (1 in 100 year return period) the Norbury Brook may flood a limited area of the adjacent floodplain. The majority of the area affected is agricultural land however some buildings at the Brookside Garden Centre may be at risk. There is more extensive flooding of agricultural land around the confluence with the Poynton Brook.

16.2.34 The EA flood mapping indicates that the proposed route alignment lies within the 1 in 100 year return period floodplain in the vicinity of Old Mill Lane (140m at Ch. 8850).

16.2.35 However flood modelling undertaken for the SEMMMS scheme has demonstrated that the flood outline is not as extensive as indicated on the EA mapping. The proposed scheme does not lie within this modelled floodplain, nor do the buildings of Brookside Garden Centre.

16.2.36 No abstractions have been identified on the Norbury Brook within the study area. There are a number of water company storm sewage and emergency outlets which discharge to the Norbury Brook.

16.2.37 On the basis of the above information the Norbury Brook is considered to have a medium sensitivity in relation to hydrology and flood risk.

16.2.38 The current WFD status of the Norbury Brook is 'Good Ecological Potential' as the brook is designated as a heavily modified waterbody due to water supply reservoirs in the upper catchment. The WFD status is based on physico-chemical monitoring only, with the majority of parameters recording high status results. Ammonia levels were 'good'.

16.2.39 The Norbury Brook is a FFD Cyprinid fishery, which is passing the imperative water quality limits, but failing the guideline limits.

16.2.40 Aquatic invertebrate sampling was carried out as part of the ecology assessments for the previous SEMMMS scheme at the site of the proposed river diversion (Ch. 8850). Good water quality was indicated by the large number of species identified, including species typical of well oxygenated unpolluted water. EA fisheries surveys around Norbury Bridge recorded brown trout and bullhead, both species requiring good habitat and water quality.

16.2.41 The Norbury Brook is a good example of semi natural river habitat which is considered to have biodiversity value at district level.

16.2.42 Based on the information presented above, the water quality and biodiversity of the Norbury Brook is considered to be of high sensitivity.

Poynton Brook

16.2.43 The Poynton Brook rises on the far western edge of the Peak District National Park, on the slopes of Park Moor, flowing west, then northwards for approximately 8.7km before joining with the Norbury Brook to form the Lady Brook between Poynton and Hazel Grove. The catchment is largely agricultural, however the lower reaches of the brook skirt around Poynton. A small tributary flows through the centre of the village into Poynton Lake, which discharges into the brook shortly above it's confluence with the Norbury Brook.

16.2.44 The proposed scheme lies on the subcatchment boundary between the Poynton Brook and the downstream Lady Brook, and is generally located at least 300m from Poynton Brook itself.

16.2.45 Within the study area the Poynton Brook is incised through clough woodland, bounded on either side by pasture. The brook itself (shown in

Figure 16B.3) is 2-4m wide, and shallow with a gravel and silt bed. Gravel and silt side bars are separated by pools throughout. Old weirs, a sluice and bank reinforcement were noted in the lower reach of the brook near Barlowfold Farm. There is significant build up of woody debris around some of these structures. There is also evidence of erosion, with undercutting of the banks within the reach. Historical mapping indicates there has been a minor change in the planform of the brook since the 1870's, confined within the river valley. The geomorphological value of the Poynton Brook is considered to be moderate.

Figure 16B.3 Poynton Brook at SJ 920 850 on 9th June 2010

16.2.46 The Poynton Brook at it's confluence with the Norbury Brook has a catchment area of 20.83km^2. Estimated flow statistics for the Poynton Brook immediately upstream of the confluence are presented in Table 16B.5

Table 16B.5 Poynton Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
20.83	280	40	9600	12100	14500	17600	20500	24000

16.2.47 The EA strategic flood mapping shows that the Poynton Brook will generally flood a limited area within the immediate river valley for a flood event of 1% annual probability (1 in 100 year return period). This area is undeveloped and does not pose a flood risk to any properties. As discussed above hydraulic modelling of the Norbury, Poynton and Lady Brook confluence has demonstrated that the flood outline is considerably smaller than shown on the EA flood mapping and that no properties are at risk.

16.2.48 No abstractions have been identified on the Poynton Brook. A number of storm overflow sewage outlets discharge to the Poynton Brook upstream of the study area, where the brook flows through the village.

16.2.49 On the basis of the above information the Poynton Brook is consider to have a medium sensitivity in relation to hydrology and flood risk.

16.2.50 The WFD status of the Poynton Brook is 'Moderate', which is due to elevated levels of ammonia and phosphate and lowered levels of dissolved oxygen and macroinvertebrates. This is likely to be due to diffuse pollution from agricultural land and point source pollution from storm sewage overflows.

16.2.51 The Poynton Brook is a FFD Cyprinid fishery, which is passing the imperative water quality limits, but failing the guideline limits.

16.2.52 Environment Agency fisheries surveys around Philips Bridge (SJ 916 844) recorded brown trout and bullhead, both species requiring good habitat and water quality. Based on the above data the project ecologists have assessed the Poynton Brook as having a biodiversity value of District value

16.2.53 The water quality and biodiversity of the Poynton Brook is considered to be of medium sensitivity.

Lady Brook

16.2.54 The Lady Brook is formed by the confluence of the Norbury Brook and Poynton Brook. From this confluence it flows north-west, becoming the Micker Brook before joining the River Mersey upstream of the Manchester Ship Canal approximately 9km downstream.

16.2.55 The proposed scheme crosses the Lady Brook immediately downstream of the confluence of the Norbury Brook and Poynton Brook. Two road drainage outfalls are also proposed at this location. In the western region of the Lady Brook catchment the proposed scheme alignment runs close to the headwaters of the Hill Green Brook and the Bramhall Brook, minor tributaries of the Lady Brook.

16.2.56 Within the study area the Lady Brook (shown in

Figure 16B.4) is steeply incised into the sandstone bedrock, which in the area of the proposed crossing forms a steep sided gorge 5-8m deep. The watercourse channel is 2 to 3 m wide in this area, widening up to 5m in places downstream. The substrate is cobble and gravel, with sand and silt accumulations in slower flowing stretches. The reach is characterised by a pool and riffle sequence. There is evidence of bank instability, with undercutting of the steep northern bank. Large trees on the bank are adding to the instability as the forces (weight and gravity) acting to pull the trees out of the bank become greater than the forces (binding of roots and soil) resisting failure. There is also evidence of deposition in the channel in the form of lateral bars, which could lead to more concentrated flow with higher shear stresses. This could exacerbate the undercutting and erosion of the northern bank. The geomorphological value of the Lady Brook is considered to be high.

Figure 16B.4 Lady Brook at SJ 918 850 on 9th June 2010

16.2.57 The Lady Brook immediately downstream of the proposed crossing has a catchment area of 32.69km^2. Estimated flow statistics for the Poynton Brook immediately upstream of the confluence are presented in Table 16B.6

Table 16B.6 Lady Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
32.69	475	67	17900	22500	26900	32700	38100	44500

16.2.58 Hydraulic modelling in the vicinity of the proposed crossing has demonstrated that there is minor flooding around the confluence of the Norbury Brook and Lady Brook for the 1% annual probability (1 in 100year return period) flood event. This flooding does not pose a risk to the proposed scheme or nearby properties. Further downstream the EA strategic flood mapping shows the flood outline is generally contained to the incised valley of the Lady Brook and does not pose a flood risk to any properties.

16.2.59 No abstractions have been identified on the Lady Brook, however there is a sewage treatment works discharge located approximately 450m downstream of the proposed crossing and road drainage outfalls.

16.2.60 On the basis of the above information the Lady Brook is consider to have a medium sensitivity in relation to hydrology and flood risk.

16.2.61 The WFD status of the heavily modified Lady Brook is ‘Moderate Ecological Potential’, which is due to elevated levels of phosphate and lowered levels of macroinvertebrates. This is likely to be due to diffuse pollution from agricultural land and point source pollution from sewage outfalls. The Lady Brook is a FFD Cyprinid fishery, which is passing the imperative water quality limits, but failing the guideline limits.

16.2.62 Aquatic invertebrate sampling was carried out as part of the ecology assessments for the previous SEMMMS scheme at the site of the proposed river crossing. Good water quality was indicated by the diverse species identified, typical of well oxygenated unpolluted water and varied semi-natural habitat structure. EA fisheries surveys around Millhill Bridge (SJ 915 853) recorded brown trout and bullhead, both species requiring good habitat and water quality. The project ecologists have assessed the Lady Brook as having a biodiversity value of district level.

16.2.63 Consequently the water quality and biodiversity of the Lady Brook is considered to be of medium sensitivity.

Standing Waters

16.2.64 There are a series of small ponds scattered throughout the study area (as shown in Figure 16.1), which have formed in kettle holes created during the last period of glaciation. Kettle holes are a common feature in the Cheshire countryside, with frequent and widespread occurrences. They are typically 10-20m in diameter and 1-3m deep, although there are a small number which are larger or smaller within the study area. They are randomly distributed and often not found in topographical lows.

16.2.65 They generally have no discernable inflow or outflow, and are usually fed by a combination of direct rainfall and localised surface runoff, resulting in the smaller ponds drying out in the summer months. There may be a groundwater contribution to some ponds, however the underlying superficial geology of the study area is generally clayey with low permeability, making a significant groundwater inflow unlikely.

16.2.66 Many of the kettle holes have been colonised by trees, shrubs and grasses and have a high degree of humification (anaerobic decomposition) within the small areas of open water. GCNs have been shown to breed in some of the ponds to the north-west of Poynton, within the scheme construction boundary. The project ecologists have assessed these ponds as having a biodiversity value of district level.

16.2.67 None of the ponds are classified under the WFD due to their relatively small size. At least one pond is used as a fishing lake within 150m of the proposed route.

16.2.68 Based on the information presented above the ponds between the A6 and A555 are considered to be of medium sensitivity.

Groundwaters

16.2.69 The superficial geology between the A6 and A555 largely consists of glacial till, which generally has a low permeability and is considered a secondary B aquifer, yielding limited amounts of groundwater from thin permeable horizons.

16.2.70 The glacial till is classified as having a low vulnerability to contamination due to the low permeability of the formation and the associated overlying soils.

16.2.71 There are no abstractions from the glacial till.

16.2.72 Based on the data presented above the groundwaters of the Glacial Till are considered to be of low importance.

16.2.73 Isolated deposits of glaciofluvial sands and gravels are located in the vicinity of Hazel Grove. These deposits have a high permeability and are considered a secondary A aquifer. Groundwater is present but not in exploitable quantities, however it may contribute to local river baseflow.

16.2.74 The glaciofluvial sands and gravels are classified as having a high vulnerability to contamination due to the high permeability of the formation and the associated overlying soils.

16.2.75 There are no known abstractions from these deposits in the vicinity of the scheme.

16.2.76 Based on the data presented above the groundwaters of the Glaciofluvial Sands and Gravels are considered to be of medium importance.

16.2.77 Between Ch. 0 and Ch. 9100 the bedrock geology consists of Carboniferous Pennine Coal Measures which are made up of alternating layers of sandstone, coal seams, mudstone and shales. The sandstone layers act as individual secondary A aquifer units capable of supporting small to medium sized private water supplies, while the remaining layers are unproductive strata with low permeability which have negligible significance for water supply or river baseflows.

16.2.78 In the vicinity of the scheme the groundwater within the Pennine Coal Measures has been classified as having a low vulnerability to contamination due to the generally low permeability of the overlying glacial till and associated soils.

16.2.79 Under the WFD the Pennine Coal Measures form part of the M&EC Carboniferous Aquifers. These have been assessed as having ‘Good’ quantitative quality, but ‘Poor’ chemical quality with a deteriorating trend.

16.2.80 There are no known abstractions from the coal measures in the vicinity of the scheme.

16.2.81 Based on the data presented above the groundwaters of the Carboniferous Pennine Coal Measures between the A6 and A555 are considered to be of medium importance.

16.2.82 The remainder of this section is underlain by the Triassic Sherwood Sandstone which forms part of a principal aquifer unit. In the wider area this aquifer is heavily utilised for public water supply. Groundwater flow is generally from north to south, however in places the aquifer is divided into poorly connected blocks due to the geological structure and the presence of low permeability faults.

16.2.83 In the vicinity of the scheme the groundwater within the Sherwood Sandstone has been classified as having a low vulnerability to contamination due to the generally low permeability of the overlying glacial till.

16.2.84 The Sherwood Sandstone in this area forms part of the WFD Manchester and East Cheshire Permo-Triassic Aquifers, which have both 'Poor' quantitative and chemical status. Again, the chemical status of the aquifer is deteriorating.

16.2.85 Three non-potable private groundwater abstractions have been identified in and around Bramhall, all are over 750m from the proposed scheme and will be unaffected by the proposals. There is a public water supply abstraction near Woodford, which is located approximately 1.4km from the nearest part of the scheme. The western end of this section (from Ch. 12400) lies within the total catchment, or Source Protection Zone 3 (SPZ3), for this abstraction.

16.2.86 Based on the data presented above the groundwaters of the Triassic Sherwood Sandstone between the A6 and A555 are considered to be of high importance.

Summary of Importance / Sensitivity of Water Environment between the A6 and A555

16.2.87 Table 16B.7 below summarises the importance of each feature of the water environment identified between the A6 and A555.

Table 16B.7 Importance of Water Features Between the A6 and A555

Feature	Attribute	Comment	Importance
Oxhey Brook	Geomorph-ology	Small heavily modified field drain	Low
	Hydrology & Flood Risk	Flows through agricultural land, no associated flood risk	Low
	Water Quality & Biodiversity	'Bad' WFD status downstream, no FFD designation, low invertebrate diversity, no fish data, zone of influence biodiversity value	Low
Threaphurst Brook	Geomorph-ology	Assumed moderately diverse, some modification, moderately active	Medium
	Hydrology & Flood Risk	Flood risk to residential properties 1km downstream	Medium
	Water Quality & Biodiversity	'Bad' WFD status, FFD Cyprinid fishery with imperative pass but guideline failure, aquatic species indicative of good water quality, district biodiversity value	Medium
Norbury Brook	Geomorph-ology	Highly active & diverse geomorphology, some modification	High
	Hydrology & Flood Risk	Minor flood risk to agricultural land	Medium
	Water Quality & Biodiversity	'Good' WFD potential, FFD Cyprinid fishery with imperative pass but guideline failure, aquatic species indicative of good water quality, district biodiversity value	High
Poynton Brook	Geomorph-ology	Moderately diverse, some modification, moderately active	Medium
	Hydrology & Flood Risk	Minor flood risk to agricultural land	Medium

Feature	Attribute	Comment	Importance
	Water Quality & Biodiversity	'Moderate' WFD status, FFD Cyprinid fishery with imperative pass but guideline failure, aquatic species indicative of good water quality, district biodiversity value	Medium
Lady Brook	Geomorph-ology	Highly active & diverse geomorphology, some modification	High
	Hydrology & Flood Risk	Minor flood risk to agricultural land	Medium
	Water Quality & Biodiversity	'Moderate' WFD status, FFD Cyprinid fishery with imperative pass but guideline failure, aquatic species indicative of good water quality, district biodiversity value	Medium
Standing Waters	Water Quality & Biodiversity	Numerous kettle hole ponds, common within county, do not support abstractions or discharges, no water quality data, some support great crested newt breeding, district biodiversity value	Medium
Glacial Till	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary B aquifer, low vulnerability WFD – not classified No abstractions within the study area	Low
Glaciofluvial Sands & Gravels	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary A aquifer, high vulnerability WFD – not classified No abstractions within the study area	Medium
Carboni-ferous Pennine Coal Measures	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary A aquifer, low vulnerability WFD – quantitative status 'Good', chemical status 'Poor' and deteriorating No abstractions within the study area	Medium
Triassic Sherwood Sandstone	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Primary aquifer, low vulnerability WFD – quantitative status 'Poor', chemical status 'Poor' and deteriorating Three private non-potable abstractions within study area, all more than 750m from proposed alignment SPZ3 for public water abstraction within study area, abstraction borehole within 1.5km of scheme	High

16.3 A555

16.3.1 This section of the proposals comprises the existing A555. Minor modifications to the existing road are proposed, including widening of the carriageway on the junctions at either end of the section and the A555/A34 roundabout. Modifications are also proposed to the road drainage system.

16.3.2 Given the limited works to be carried out in the section it is considered that there will be no impact on nearby standing waters or groundwater. Subsequently only the Spath Brook is considered here.

Spath Brook

16.3.3 The Spath Brook rises between Woodford and Kitt's Moss, flowing broadly westward parallel to the A555, before turning south at Handforth to join the River Dean. The total length of the brook is approximately 4.8km.

16.3.4 There are two existing A555 outfalls on the Spath Brook, one upstream of Hall Moss Lane, the other where the Spath Brook flows through Handforth Dean Industrial Estate (immediately adjacent to the railway line). It is proposed that some road drainage from the sections of the proposed scheme immediately east and west of the A555 will discharge via these outfalls.

16.3.5 The Spath Brook has been heavily modified throughout its length, with numerous sections straightened and culverted. The most significant modification is the realignment which was carried out as part of the construction of the A555, in the early 1990's. This has resulted in a 1.3km stretch of the brook which is routed through a concrete channel running alongside the southern boundary of the road. The original section of the Spath Brook to the north of the A555 remains as a heavily vegetated field drain with very little flow. The geomorphological value of the Spath Brook is considered low.

16.3.6 The Spath Brook immediately downstream of the existing A555 outfall at Hall Moss Lane has a catchment area of 1.34km^2. Estimated flow statistics for the Spath Brook at this location are presented in Table 16B.8.

Table 16B.8 Spath Brook (at Hall Moss Lane) Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
1.34	13.8	1.62	700	1000	1200	1500	1800	2200

16.3.7 The EA strategic flood mapping shows that downstream of the A555 the Spath Brook floods a small area of the adjacent Stanley Green Trading Estate during a 1% annual probability (1 in 100 year) flood event. More widespread flooding of this area is predicted for the 0.1% annual probability (1 in 1000 year) flood event. The proposed widening of the carriageway at the A555/A34 roundabout will impinge slightly on this floodplain.

16.3.8 At present the A555 road drainage discharges into the Spath Brook via tank storage and a pumping system. The tank storage is designed to attenuate road runoff flows to pre-development greenfield flows, thereby mitigating potential increases in flood risk.

16.3.9 No abstractions have been identified on the Spath Brook. In addition to the A555 road discharges there are a number of water company combined sewer storm overflow outlets on the Spath Brook downstream of the study area.

16.3.10 On the basis of the above information the Spath Brook is considered to have a high sensitivity in relation to hydrology and flood risk.

16.3.11 The Spath Brook is classified under the WFD as part of the River Dean (Bollington to Bollin) waterbody. The current status of the River Dean is 'Moderate', due to lowered levels of fish and macroinvertebrates. Slightly elevated levels of phosphate indicate that the overall status of the river is likely to be influenced by diffuse agricultural pollution and point source pollution from sewage discharges. The Spath Brook has no FFD designation, however the downstream River Dean is classified as a Cyprinid fishery, which is passing both the imperative and guideline limits.

16.3.12 There is no EA fishery data or prior SEMMMS ecology assessment data on the Spath Brook. The project ecologists have assessed the biodiversity value of the Spath Brook as being of local value.

16.3.13 The water quality and biodiversity of the Spath Brook is considered of medium sensitivity.

Summary of Importance / Sensitivity of Water Environment Along the A555

16.3.14 Table 16B.9 below summarises the importance of each feature of the water environment identified along the A555.

Table 16B.9 Importance of Water Features Along the A555

Feature	Attribute	Comment	Importance
Spath Brook	Geomorph-ology	Heavily modified channel, no geomorphological diversity	Low
	Hydrology & Flood Risk	Flood risk to commercial properties downstream, proposed scheme impinges on 1 in 1000 year return period floodplain	High
	Water Quality & Biodiversity	'Moderate' WFD status, no FFD designation, no aquatic species surveys undertaken, heavily modified channel, local biodiversity value	Medium

16.4 A555 to Styal Road

16.4.1 The principal watercourse between the A555 and Styal Road is the Gatley Brook. The proposed scheme also passes within close proximity of a number of small ponds and crosses a principal groundwater aquifer.

Gatley Brook

16.4.2 The proposed scheme lies in the upper catchment of the Gatley Brook, however the brook itself is only evident 650m north of the alignment at Outwood Farm. It is possible that there is piped land drainage in the upper catchment, underlying the proposed scheme, which discharges at this location. From this point the brook flows northwards for approximately 4.5km to join the Upper River Mersey.

16.4.3 The proposed scheme to a considerable distance from the open channel of the Gatley Brook. However it is proposed that road drainage from the Styal Junction will discharge into the Gatley Brook near Irvin Drive.

16.4.4 The brook is heavily modified with many sections of culverting as it passes through the urban areas. The open reach closest to the proposals is a straightened field drain with no geomorphological diversity. The geomorphological importance of the brook in the vicinity of the scheme is considered to be low.

16.4.5 The Gatley Brook at the proposed outfall location has a catchment area of 1.41km^2. Estimated flow statistics for the Gatley Brook at the head of the open reach are presented in Table 16B.10.

Table 16B.10 Gatley Brook Flow Statistics

Catchment Area (km^2)	Annual Mean Flow (l/s)	Low Flow (Q_{95}) (l/s)	Peak runoff (l/s) for each return period (yrs)					
			Annual	5	10	25	50	100
1.41	15.7	1.3	1100	1400	1700	2100	2500	3000

16.4.6 There is no flood risk associated with the Gatley Brook.

16.4.7 There are no abstractions on the Gatley Brook. No discharges have been identified; however it is likely that there are combined sewer storm overflow outlets in the urbanised areas downstream of the proposed scheme.

16.4.8 Based on the data presented above the Gatley Brook is considered to have low hydrological and flood risk importance.

16.4.9 The Gatley Brook is classified under the WFD as part of the Upper River Mersey (upstream of Manchester Ship Canal) waterbody. The current status of the Upper River Mersey is 'Moderate Ecological Potential', as it has been designated a heavily modified waterbody. The moderate status is due to elevated levels of ammonia and phosphate which are likely to be a result of diffuse agricultural pollution and point source pollution from sewage discharges.

16.4.10 EA water quality data is available for the Gatley Brook specifically. Under the old GQA classification the brook was assessed as Grade B (Good) for chemistry, Grade 3 (Moderately Low) for nitrates, and Grade 5 (Very High) for phosphates in 2009.

16.4.11 The Gatley Brook is a FFD Cyprinid fishery, which is passing the imperative water quality limits, but failing the guideline limits.

16.4.12 There is no EA fishery data or prior SEMMMS ecology assessment data on the Gatley Brook. The project ecologists have assessed the biodiversity value of the Gatley Brook as being of local value.

16.4.13 Consequently the water quality and biodiversity of the Gatley Brook is considered of medium sensitivity.

Standing Waters

16.4.14 This section has a number of small kettlehole ponds, the proposed alignment overlies three of these ponds. The existing conditions and the assessed sensitivity associated with these ponds are discussed above.

16.4.15 Based on the information presented previously the ponds between the A555 and Styal Road are considered to be of medium sensitivity.

Groundwaters

16.4.16 The superficial geology between the A555 and Styal Road comprises Glacial Till. The baseline data on this formation are presented above.

16.4.17 The groundwaters of the Glacial Till between the A555 and Styal Road are considered to be of low importance.

16.4.18 The whole of this section is underlain by the Triassic Sherwood Sandstone which forms part of a principal aquifer unit. The characteristics of the aquifer are discussed above.

16.4.19 As previously discussed the aquifer is heavily utilised for public water supply in the wider area, however between the A555 and Styal Road there are no known abstractions

16.4.20 No groundwater abstractions have been identified between the A555 and Styal Road.

16.4.21 Based on the data presented the groundwaters of the Triassic Sherwood Sandstone between the A555 and Styal Road are considered to be of medium sensitivity.

Summary of Importance / Sensitivity of Water Environment between the A555 and Styal Road

16.4.22 Table 16B.11 below summarises the importance of each feature of the water environment identified between the A555 and Styal Road.

Table 16B.11 Importance of Water Features Between the A555 and Styal Road

Feature	Attribute	Comment	Importance
Gatley Brook	Geomorph-ology	Heavily modified channel, no geomorphological diversity	Low
	Hydrology & Flood Risk	No identified flood risk	Low
	Water Quality & Biodiversity	'Moderate' WFD status, FFD Cyprinid fishery with imperative pass but guideline failure, no aquatic species surveys undertaken, heavily modified channel, local biodiversity value	Medium
Standing Waters	Water Quality & Biodiversity	Numerous kettle hole ponds, common within county, do not support abstractions or discharges, no water quality data, some support great crested newt breeding, district biodiversity value	Medium
Glacial Till	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary B aquifer, low vulnerability WFD – not classified No abstractions within the study area	Low
Triassic Sherwood	Water Supply, Water Quality, Groundwater	Primary aquifer, low vulnerability WFD – quantitative status 'Poor', chemical	Medium

Feature	Attribute	Comment	Importance
Sandstone	Flow, Biodiversity	status 'Poor' and deteriorating No groundwater abstractions within study area	

16.5 Styal Road to Shadowmoss Road

16.5.1 The principal watercourse between Styal Road and Shadowmoss Road is the Baguley Brook. The proposed route also passes within close proximity of a number of small ponds and crosses a secondary groundwater aquifer.

Baguley Brook

16.5.2 The Baguley Brook issues from a culvert on the northern side of the Ringway Road West and flows northwards for 600m, passing through a series of small ponds, before entering the Painswick Park Lake. The outlet from the lake is culverted northwards for a considerable distance, running broadly parallel with the M56. The Baguley Brook emerges from this culvert on the western side of the M56 and flows broadly north then westwards for approximately 10km before joining with the Fairywell Brook to form the Sinderland Brook. The Sinderland Brook continues westward to join the Manchester Ship Canal at Partington.

16.5.3 Field drains in the vicinity of Holly Lane and Moss Lane to the east of the Manchester International Airport runway generally flow westwards to join together and sink on the eastern edge of the runway. It is believed that these field drains are culverted under the runway and airport car parks to emerge on the northern side of Ringway Road West as the Baguley Brook. However this has not been confirmed.

16.5.4 As part of the scheme a new airport link road is proposed which will cross the Baguley Brook and two of its tributaries. Several proposed road drainage outfalls will discharge into the Baguley Brook, within 250m of where the brook issue from the culvert under the existing Ringway Road West. A single outfall is also proposed on the tributary which issues to the north of Outwood Lane West.

16.5.5 Immediately downstream of the airport the Baguley Brook is a small heavily modified stream approximately 1m wide, which flows for approximately 1km before joining the pond in Painswick Park. En route to Painswick Park the stream flows through a series of small ponds in the vicinity of Woodhouse Park. The channel has been culverted, realigned and straightened in numerous areas. In the open sections the substrate largely consists of silt and sand. The geomorphological value of the Baguley Brook is considered to be low.

16.5.6 Due to the heavily modified and urbanised environment surrounding Baguley Brook, it has not been possible to determine an effective catchment. Much of the historical catchment has been intercepted or diverted, leaving the local road drainage as the principal source of inflow. Therefore, a conservative value of 0.5l/s has been used for the Q_{95} low flow. If further data becomes available for this watercourse, this value should be reviewed.

16.5.7 There is no flood risk associated with the Baguley Brook in the vicinity of the proposed scheme.

16.5.8 No abstractions or discharges have been identified on the Baguley Brook; however it is likely that there are combined sewer storm overflows in the urbanised areas downstream of the proposed scheme. Manchester International Airport does not discharge into the Baguley Brook; surface runoff from the northern areas of the airport is discharged, after treatment, into the Bollin River to the south of the airport.

16.5.9 Based on the data presented above the Baguley Brook is considered to have low hydrological and flood risk importance.

16.5.10 The Baguley Brook is classified under the WFD as part of the Sinderland Brook (Fairywell Brook and Baguley Brook) waterbody. The current status of the Sinderland Brook is 'Moderate Ecological Potential', as it has been designated a heavily modified waterbody. The moderate status is due to elevated levels of phosphate and lowered macroinvertebrate levels, which is likely to be a result of diffuse agricultural pollution and point source pollution from sewage discharges. The brook is a FFD Cyprinid fishery, which is passing the imperative water quality limits, but failing the guideline limits.

16.5.11 There is no EA fishery data or prior SEMMMS ecology assessment data on the Baguley Brook. The project ecologists have assessed the biodiversity value of the brook as being of local value.

16.5.12 Consequently the water quality and biodiversity of the Baguley Brook is considered of medium sensitivity.

Standing Waters

16.5.13 Between Styal Road and Shadowmoss Road there are a small number of small kettlehole ponds, the proposed scheme would overlie three of these ponds. The existing conditions and the assessed sensitivity associated with these ponds are discussed above.

16.5.14 Based on the information presented previously the ponds between Styal Road and Shadowmoss Road are considered to be of medium sensitivity.

Groundwaters

16.5.15 The superficial deposits between Styal Road and Shadowmoss Road generally comprise Glacial Till. The baseline data on this formation are presented within above.

16.5.16 The groundwaters of the Glacial Till between Styal Road and Shadowmoss Road are considered to be of low importance.

16.5.17 In the central area of the section there is a limited area of Glaciofluvial Sand and Gravels, which is a small outlier of the Dane and Weaver (D&W) Quaternary Sand and Gravel Aquifers. As discussed previously above these deposits have a high permeability and are considered a secondary A aquifer. The aquifer also has a high vulnerability.

16.5.18 There are no known abstractions from these deposits in the vicinity of the scheme.

16.5.19 Under the WFD the Weaver and Dane Quaternary Sand and Gravel Aquifers have been assessed as having 'Good' quantitative quality, but 'Poor' chemical quality.

16.5.20 Based on the data presented above the groundwaters of the Glaciofluvial Sands and Gravels are considered to be of medium importance.

16.5.21 Between Styal Road and Shadowmoss Road the bedrock geology consists of the Triassic Mercia Mudstone. Due to its relative impermeability the Mercia Mudstone is considered a secondary B aquifer, which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. It is unlikely to support abstractions other than very small private water supplies.

16.5.22 The groundwater vulnerability of the Mercia Mudstone in this section of the scheme is generally low due to the superficial glacial till deposits. However where overlain by the sand and gravel deposits is classified as having a high vulnerability due to their permeable nature and lack of protective cover.

16.5.23 No groundwater abstractions from the Mercia Mudstone have been identified between Styal Road and Shadowmoss Road.

16.5.24 Based on the data presented above the groundwaters of the Triassic Mercia Mudstones between Styal Road and Shadowmoss Road is considered to be of low importance.

Summary of Importance / Sensitivity of Water Environment Between Styal Road and Shadowmoss Road

16.5.25 Table 16B.12 below summarises the importance of each feature of the water environment identified between Styal Road and Shadowmoss Road.

Table 16B.12 Importance of Water Features Between Styal Road and Shadowmoss Road

Feature	Attribute	Comment	Importance
Baguley Brook	Geomorph-ology	Heavily modified channel, no geomorphological diversity	Low
	Hydrology & Flood Risk	No identified flood risk	Low
	Water Quality & Biodiversity	'Moderate' WFD status, FFD Cyprinid fishery with imperative pass but guideline failure, no aquatic species surveys undertaken, heavily modified channel, local biodiversity value	Medium
Standing Waters	Water Quality & Biodiversity	Numerous kettle hole ponds, common within county, do not support abstractions or discharges, no water quality data, some support great crested newt breeding, district biodiversity value	Medium
Glacial Till	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary B aquifer, low vulnerability WFD – not classified No abstractions within the study area	Low
Glaciofluvial Sands & Gravels	Water Supply, Water Quality, Groundwater Flow,	Secondary A aquifer, high vulnerability WFD – quantitative status 'Good', chemical status 'Poor' No groundwater abstractions within the study	Medium

Feature	Attribute	Comment	Importance
	Biodiversity	area	
Triassic Mercia Mudstone	Water Supply, Water Quality, Groundwater Flow, Biodiversity	Secondary B aquifer, low vulnerability WFD – not classified No abstractions within the study area	Low

Appendix 16C - Calculations and Results

16.1 Routine Runoff Assessment

16.1.1 Individual HAWRAT and EQS assessment have been carried out for each of the seven proposed SEMMMS road drainage networks. Additionally cumulative assessments have been carried out where the SEMMMS networks interact either with each other or with adjacent networks associated with the existing A555, the proposed Ringway Road Highway Improvements Works and the proposed Airport City development.

16.1.2 The results of the HAWRAT and EQS assessments for each network are discussed below. The HAWRAT worksheets are presented in Annex A.

16.1.3 The water quality treatment principles that have been applied to each of the networks are discussed in Appendix 16D – Mitigation.

Network A

16.1.4 Network A will drain the proposed realigned section of the A6, between Norbury Hollow Road and Yew Tree Avenue, an area of approximately 2.5Ha. The proposed network outfall will be located on the Threaphurst Brook, adjacent to the Hazel Grove Golf Club access road.

16.1.5 Network A passes all elements of both the HAWRAT and EQS assessments without mitigation.

16.1.6 The Threaphurst Brook has been assessed as having a medium importance for water quality. As the network passes both the HAWRAT and EQS assessments the routine runoff impact magnitude has been assessed as negligible, giving an impact significance of **neutral**.

16.1.7 As the routine runoff impact has been assessed as having a neutral significance no specific water quality treatment is proposed for this network. However an attenuation pond is proposed to mitigate potential downstream flood risk impacts. This attenuation pond will have a secondary benefit of providing some mitigation for routine runoff impacts.

Networks B and C

16.1.8 Network B will drain the proposed scheme between the A6 junction and the bridge over the Lady Brook at Mill Hill Hollow, an area of approximately 5.6Ha. The proposed network outfall will be located on the Lady Brook, downstream of the proposed road bridge and the Network C outfall.

16.1.9 Network C will drain the scheme between Mill Hill Hollow and the WCML, an area of approximately 6.4Ha. The proposed network outfall will be located on the Lady Brook, upstream of the proposed road bridge and Network B outfall.

16.1.10 Due to the close proximity of the Network B and Network C outfalls on the Lady Brook cumulative HAWRAT and EQS assessments have been undertaken in addition to individual assessments for each outfall.

16.1.11 Both networks B and C pass the HAWRAT and EQS assessments individually without mitigation. In addition Networks B and C pass all elements of the cumulative assessment without mitigation.

16.1.12 The Lady Brook has been assessed as having a 'Medium' importance for water quality. The results of the individual HAWRAT and EQS assessments indicate individual routine runoff impact magnitudes of negligible, giving an impact significance of **neutral** for each network. Similarly the cumulative routine runoff impact has been assessed as having a negligible magnitude and subsequent **neutral** significance.

16.1.13 As the routine runoff impacts have been assessed as having a neutral significance no specific water quality treatment is proposed for either Network B or Network C. However an attenuation pond is proposed on each network to mitigate potential downstream flood risk impacts. These attenuation ponds will have a secondary benefit of providing some mitigation for routine runoff impact.

Network D & E

16.1.14 Networks D and E drain the eastbound and westbound carriageways of the scheme between the WCML and the proposed junction with the A5102 Woodford Road at the eastern end of the A555, an area of approximately 8.3Ha. For the purposes of the water quality assessment these networks are considered as a single entity. It is proposed that Network D & E will discharge into the Spath Brook via an existing A555 drainage network, referred to as A555/PS4.

16.1.15 Network A555/PS4 drains the A555 between the A5102 Woodford Road and the A34 junction, an area of approximately 7.2Ha. The outfall for this network is located on the Spath Brook near Hall Moss Lane and discharges via an oil interceptor, attenuation tanks and a pumping station.

16.1.16 The A555 does not form part of the proposed scheme scheme planning application. However DMRB document HD 45/09 states that the interaction of new impacts from highway works with existing impacts may produce cumulative impacts, which should be considered. Therefore an individual assessment has been carried out for Network D & E and a cumulative assessment for Networks D & E and A555/PS4.

16.1.17 The individual routine runoff assessment found that without treatment Network D & E would pass both the sediment bound pollutant element of the HAWRAT assessment and the EQS assessment, but would fail the soluble pollutant element of HAWRAT. It was found that a 29% reduction in soluble pollutants was required for the network to pass the HAWRAT assessment.

16.1.18 In order to provide sufficient soluble pollutant treatment a surface flow wetland designed to accept the first flush runoff and located to the south of the proposed scheme road alignment and east of Woodford Road is proposed. Due to engineering and landtake constraints it has not been possible to design a wetland which will treat all the first flush from the network. However it has been possible to provide a wetland which will accept the first flush runoff from 60% of the network. This wetland will provide 60% treatment of soluble pollutants in this proportion of the network first flush. Therefore the overall effective treatment level for the whole network will be 31%. With this treatment in place Network D & E will pass both elements of the individual HAWRAT assessment and the EQS assessment.

16.1.19 In addition to the wetland an attenuation pond is also proposed on this network to attenuate flows from Network D & E before they enter Network A555/PS4. The attenuation pond will have a secondary benefit of providing some additional mitigation for routine runoff impact.

16.1.20 The Spath Brook has been assessed as being of medium importance. The results of the individual HAWRAT and EQS assessments with mitigation indicate an individual routine runoff impact magnitude of negligible, giving an impact significance of **neutral**.

16.1.21 The cumulative routine runoff assessment found that without any treatment on either Network D & E or Network A555/PS4 both the soluble pollutants element of HAWRAT and the EQS assessment would be failed. The combined networks would pass the sediment bound pollutant element of HAWRAT. It was found that a 57% overall reduction in soluble pollutants was required for all elements of the cumulative HAWRAT and EQS assessments to be passed.

16.1.22 The existing attenuation tanks and bypass oil separator located on A555/PS4 do not provide any treatment from soluble pollutants.

16.1.23 The treatment proposed above for Network D & E represents an overall effective treatment level of 14% for the combined network area of 15.7Ha (i.e. 60% treatment of first flush from 27% of combined network area). With this treatment in place the cumulative results improve as the EQS assessment is passed. However the combined networks will continue to fail the cumulative soluble pollutants HAWRAT assessment. An additional 42% reduction in soluble pollutants from the Network D&E runoff would be required to pass the cumulative HAWRAT and EQS assessments.

16.1.24 As discussed in Appendix 16D – Mitigation, no further treatment has been proposed at present as sufficient treatment through the use of conventional SUDS techniques is not technically feasible. However it is proposed that during the detailed design specialist proprietary systems will be investigated and a suitable solution incorporated into one or both of the networks, if deemed appropriate.

16.1.25 With the currently proposed Network D & E treatment in place the results of the cumulative HAWRAT and EQS assessments indicate that the combined networks will achieve a cumulative impact magnitude of minor adverse' giving an impact significance of **slight**.

Network L

16.1.26 Network L will drain the scheme between the proposed junction with the B5358 Wilmslow Road, at the western end of the A555, and from approximately 300m east of the Styal railway line. This network drains an area of approximately 5.2Ha. It is proposed that Network L will discharge into the Spath Brook via an existing A555 drainage network, referred to as A555/PS3.

16.1.27 Network A555/PS3 drains the A555 between the A34 junction and the B5358 Wilmslow Road, an area of approximately 6.7Ha. This network discharges via an oil interceptor, storage tanks, pumping station and c.980m long pipe into the Spath Brook as it passes through the Handforth Dean Industrial Estate (immediately adjacent to the Handforth railway line).

16.1.28 As discussed previously HD 45/09 stipulates that a cumulative assessment should be carried out where the interaction of new and existing impacts may result in a cumulative impact. Therefore an individual assessment has been carried out for Network L and a cumulative assessment for Networks L and A555/PS3.

16.1.29 Individually it was found that Network L will pass all elements of the HAWRAT and EQS assessments without treatment. Therefore no water quality treatment is proposed for this network in relation to routine runoff impacts.

16.1.30 The Spath Brook has been assessed as being of medium importance. The results of the individual HAWRAT and EQS assessments indicate an individual routine runoff impact magnitude of negligible, giving an impact significance of **neutral**.

16.1.31 Cumulatively Networks L and A555/PS3 will pass the sediment bound pollutant element of the HAWRAT assessment and the EQS assessment without treatment. However they will fail the cumulative soluble pollutant element of HAWRAT. It was found that a 8% overall reduction in soluble pollutants was required for all elements of the cumulative HAWRAT and EQS assessments to be passed.

16.1.32 As discussed above for Networks D & E and A555/PS4, no further mitigation is currently proposed. However proprietary systems will be investigated and if appropriate incorporated into the proposals at the detailed design stage.

16.1.33 Without any proposed treatment on the combined Networks L and A555/PS3 the results of the cumulative HAWRAT and EQS assessments indicate a cumulative impact magnitude of minor adverse, giving an impact significance of **slight**.

Network M

16.1.34 Network M will drain the scheme from approximately 300m east of the Styal railway line to the B5166 Styal Road, an area of approximately 1.7Ha. It is proposed Network M will discharge into the Gatley Brook adjacent to Cunningham Drive via an existing surface water sewer c.730m long.

16.1.35 Network M passes the sediment bound pollutant element of the HAWRAT assessment and the EQS assessment without treatment. However the network fails the soluble pollutant element of the HAWRAT assessment and requires a 28% reduction in soluble pollutants in order to pass.

16.1.36 A first flush surface flow wetland is proposed, which will accept the first flush from the entire network. The wetland will be located adjacent to the Styal Road junction, between Tedder Drive and the Styal Road. This wetland will provide 50% treatment of the first flush. With this proposed treatment in place the network will pass all elements of the HAWRAT and EQS assessments.

16.1.37 The Gatley Brook has been assessed as being of medium importance. The results of the individual HAWRAT and EQS assessments indicate an impact magnitude of negligible, giving an impact significance of **neutral**.

Network F

16.1.38 Network F will drain the scheme between the B5166 Styal Road junction and the Ringway Road, an area of approximately 2.7Ha. It is proposed that Network F will discharge into the Baguley Brook via the network associated with the Ringway Road Highway Improvement Works (RRHIW).

16.1.39 Full details of the RRHIW drainage network are not available however it is believed that this will drain the widened Ringway Road West and the new Metrolink line which will run parallel to this road. No information is available regarding proposed treatment for this drainage network however it will discharge into the Baguley Brook immediately adjacent to the Ringway Road and opposite the Hilton Hotel.

16.1.40 In addition the trunk road associated with the proposed Airport City development, running between the RRHIW and Thorley Lane, will drain into the Baguley Brook within the same reach as Network F and the RRHIW. No information is available regarding proposed treatment for the Airport City network.

16.1.41 Individual HAWRAT and EQS assessments have been carried out for Network F and cumulative assessments for Network F, the RRHIW network and Airport City network.

16.1.42 Individually it was found that Network F will fail all elements of the HAWRAT but passed the EQS assessments without treatment. There are no water quality treatment processes currently proposed for this network in relation to routine runoff impacts. However 39% reduction in soluble pollutants and 10% reduction in sediment bound pollutants would be required for the Network F to pass the HAWRAT element of the assessment.

16.1.43 The Baguley Brook has been assessed as being of medium importance. The results of the individual HAWRAT and EQS assessments indicate an individual impact magnitude of moderate adverse, giving an impact significance of **moderate**.

16.1.44 Cumulatively Networks F and RRHIW and AC will fail the sediment bound pollutant element of the HAWRAT assessment and the EQS assessment without treatment. It was found that a 71% overall reduction in soluble pollutants and sediment bound pollutants would be required for all elements of the cumulative HAWRAT and EQS assessments to be passed. For Network F, RRHIW and AC, the results of the cumulative HAWRAT and EQS assessments indicate that the combined networks will achieve a cumulative impact magnitude of ‘Major Adverse’, giving an impact significance of ‘Large’. An additional 71% reduction in soluble pollutants and 71% reduction in sediment bound pollutants from the cumulative Network F, RRHIW and AC runoff would be required if the impact were to be ‘neutral.’

16.1.45 It is judged that a cumulative impact of large significance is not acceptable in this instance and further treatment of routine runoff would need to be proposed beyond that outlined above for Network F. In order to achieve the 71% reduction in soluble pollutants and sediment bound pollutants, a series of SuDS treatments would be required, for example grass channels followed by surface flow wetlands. However, due to the constrained location, alternative proprietary treatment mechanisms may be considered.

Summary of Routine Runoff Assessment Results

16.1.46 The assessments discussed above are summarised in Table 16C.1 and

16.1.47 Table 16C.2 overleaf.

Table 16C.1 Summary of Individual Routine Runoff Assessment Results

Water Feature	Importance	Network ID	Proposed Treatment / Mitigation	HAWRAT Results			EQS Results		Magnitude	Significance
				Cu[1]	Zn[2]	Sed[3]	Cu[1]	Zn[2]		
Threaphurst Brook	Medium	A	Attenuation pond	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
Lady Brook	Medium	B	Attenuation pond	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
		C	Attenuation pond	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
Spath Brook	Medium	D&E	Wetland & attenuation pond treating 60% of network	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
		L	None	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
Gatley Brook	Medium	M	Wetland	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
Baguley Brook	Medium	F	None	Fail	Fail	Fail	Pass	Pass	Moderate Adverse	Moderate

Table 16C.2 Summary of Cumulative Routine Runoff Assessment Results

Water Feature	Importance	Network ID	Proposed Treatment / Mitigation	HAWRAT Results			EQS Results		Magnitude	Significance
				Cu[1]	Zn[2]	Sed[3]	Cu[1]	Zn[2]		
Lady Brook	Medium	B + C	2 x attenuation ponds	Pass	Pass	Pass	Pass	Pass	Negligible	Neutral
Spath Brook	Medium	D&E + A555/PS4	Wetland & attenuation pond treating 27% of cumulative network area	Fail	Fail	Pass	Pass	Pass	Minor Adverse	Slight
		L + A555/PS3	None	Fail	Pass	Pass	Pass	Pass	Minor Adverse	Slight
Baguley Brook	Medium	F + RRHIW + Airport City	None	Fail	Pass	Pass	Fail	Pass	Major Adverse	Large

[1] Cu - soluble copper, [2] Zn - soluble zinc, [3] Sed – sediment

16.2 Accidental Spillage Assessment

16.2.1 Individual accidental spillage assessments have been carried out for each of the seven proposed SEMMMS road drainage networks. Additionally cumulative assessments have been carried out where the SEMMMS networks interact either with each other or with adjacent networks associated with the existing A555, the proposed Ringway Road Highway Improvements Works and the proposed Airport City development

16.2.2 The results of the individual and cumulative accidental spillage assessments for each network are summarised in Table 16C.3 and Table 16C.4 below. The accidental spillage worksheets are presented in Annex A.

Table 16C.3 Summary of Individual Accidental Spillage Assessment Results

Water Feature	Importance	Network ID	Accidental Spillage Return Period (years)	Magnitude	Significance
Threaphurst Brook	Medium	A	1010	Negligible	Neutral
Lady Brook	Medium	B	1041	Negligible	Neutral
		C	3849	Negligible	Neutral
Spath Brook	Medium	D&E	496	Negligible	Neutral
		L	1616	Negligible	Neutral
Gatley Brook	Medium	M	2041	Negligible	Neutral
Baguley Brook	Medium	F	1693	Negligible	Neutral

16.2.3

Table 16C.4 Summary of Cumulative Accidental Spillage Assessment Results

Water Feature	Importance	Network ID	Accidental Spillage Return Period (years)	Magnitude	Significance
Lady Brook	Medium	B + C	922	Negligible	Neutral
Spath Brook	Medium	D&E + A555/PS4	121	Negligible	Neutral
		L + A555/PS3	214	Negligible	Neutral
Baguley Brook	Medium	F + RRHIW + Airport City	233	Negligible	Neutral

16.2.4

16.3 Groundwater Assessment

16.3.1 A groundwater assessment has been carried out for each of the ten proposed road cuttings.

16.3.2 The locations and lengths of the cuttings were identified from the long sections provided by the SEMMMS design team. The maximum depth of the cutting was estimated from the topographical profiles for existing ground level and proposed new ground level.

16.3.3 Water table elevations were determined from available ground investigation data provided by Aecom. In all cases, the greatest separation between identified water inflow and proposed new ground level was taken, to provide a worst-case estimate of impact.

16.3.4 No site specific permeability testing was carried out as part of the ground investigations. Therefore generic permeability ratings were assigned to the bedrock and superficial deposits encountered in each individual cutting, based on the geological descriptions within the ground investigation borehole and trial pit logs. Where a cutting will penetrate both superficial deposits and bedrock, the more permeable strata have been used for the assessment. Permeabillity values were assigned as shown in Table 16C.5.

Table 16C.5 Permeability values used in groundwater assessment

Permeability Rating	Value Used in Calculation
Very High (VH)	1×10^{-4} m/s
High (H)	1×10^{-5} m/s
Medium/High (M/H)	1×10^{-5} m/s
Medium (M)	1×10^{-6} m/s
Low/Medium (L/M)	1×10^{-6} m/s
Medium/Low (M/L)	1×10^{-7} m/s
Low (L)	1×10^{-8} m/s

16.3.5 Once all the parameters had been assigned, the radius of influence was calculated as shown in Table 16C.6.

Table 16C.6 Radius of influence & parameters used in groundwater calculations

Water Feature	Chainage (m)	Cutting no.	Length (m)	Max. depth below water table (m)	Permeability rating	Radius of influence (m)
Glaciofluvial Sands & Gravels	800-1100	1	300	Water table below new ground level	M/H	0.0
Carboniferous Pennine Coal Measures	8250-8820	2	570	4.0	H	19.0
	8875-9150	3	275	0.0	M/H	0.0
Glacial Till	9610-9940	4	330	Water table below new ground level	M/H	0.0
	10080-10175	5	95	Water table below new ground level	M/H	0.0

Water Feature	Chainage (m)	Cutting no.	Length (m)	Max. depth below water table (m)	Permeability rating	Radius of influence (m)
	10380-10850	6	470	1.0	M/L	1.5
	11125-11625	7	500	2.8	M/L	4.2
Triassic Sherwood Sandstone (Woodford Area SPZ3)	12580-13600	8	1020	5.6	M/H	24.7
Glacial Till / Triassic Sherwood Sandstone (Other Areas)	500-1575	9	1075	No data	M/H	No data
Glacial Till	2740-3350	10	610	Water table below new ground level	M/H	0.0

16.3.6 As can be seen the calculated radii of influence are all small, for those cuttings that are likely to intersect the groundwater table. For a number of the cuttings, the depth of recorded water strikes indicates that the cuttings are unlikely to intersect groundwater and therefore will have no radius of influence.

16.3.7 Following the determination of radii of influence, an assessment has been made of the significance of this effect on the potential receptors. Receptors considered were nearby surface watercourses, waterbodies or wetlands with important groundwater contribution, public or private water supply abstractions, water abstractions for non-potable usage and the superficial and bedrock aquifers themselves.

16.3.8 Cutting 8 lies entirely within the SPZ 3 of a public abstraction. Identified receptors for the remaining cuttings are all groundwater aquifers.

16.3.9 Table 16C.7 summarises the impact assessment from the cuttings on groundwater.

Table 16C.7 Assessment results

Water Feature	Importance	Cutting no.	Radius of Influence (m)	Magnitude	Significance
Glaciofluvial Sands & Gravels	Medium	1	0	Negligible	Neutral
Carboniferous Pennine Coal Measures	Medium	2	19.0	Minor adverse	Slight
		3	0	Negligible	Neutral
Glacial Till	Low	4	0	Negligible	Neutral
		5	0	Negligible	Neutral
		6	1.5	Minor adverse	Neutral
		7	4.2	Minor adverse	Neutral

Water Feature	Importance	Cutting no.	Radius of Influence (m)	Magnitude	Significance
Triassic Sherwood Sandstone (Woodford Area SPZ3)	High	8	24.7	Minor adverse	Slight
Glacial Till / Triassic Sherwood Sandstone (Other Areas)	Low / Medium	9	No data	Unknown – likely minor adverse	Unknown – likely neutral
Glacial Till	Low	10	0	Negligible	Neutral

16.3.10 Cutting 9 is located within an area where there are no ground investigation data available at present, so it has not been possible to calculate a radius of influence or a significance of impact. Given the Neutral or Slight significances determined for the other cuttings, it is judged likely that Cutting 9 will also not have a significant impact on groundwater.

16.3.11 It is recommended that as part of the detailed design phase further ground investigation works are undertaken to gather groundwater data for Cutting, in addition to permeability data for all the proposed cuttings. The groundwater assessment for each cutting should be re-visited as more data becomes available.

16.4 Annex A – HAWRAT and Accidental Spillage Worksheets

Network A

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Summary of predictions

Soluble - Acute Impact / **Sediment - Chronic Impact**

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 (Soluble)

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper (ug/l)	Zinc (ug/l)
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1 (Sediment)

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
Units	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.5**	**0.4**
No. of exceedances/worst year	2	2
No. of exceedances/summer	0.5	0.4
No. of exceedances/worst summer	2	2

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	0.52	1.82

		Copper (ug/l)	Zinc (ug/l)
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	2.39	7.00
	90%ile	6.16	18.39
	95%ile	9.45	29.18
	99%ile	17.13	65.68

Step 2

Velocity 0.15 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.20**	**0.10**
No. of exceedances/worst year	2	1
No. of exceedances/summer	0.2	0.1
No. of exceedances/worst summer	2	1

DI -

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.10**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	0.37	1.28

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	1.67	4.90
	90%ile	4.31	12.87
	95%ile	6.61	20.43
	99%ile	11.99	45.98

Details of the chosen rainfall site	
SAAR (mm)	830
Altitude (m)	20
Easting	3610
Northing	3885
Coastal distance (km)	15

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

Additional columns for use if other roads drain to the same outfall

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	850	450						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Urban	Urban						
D5	Junction type	No junction	Side road						
D6	Location	< 20 minutes	< 20 minutes						
D7	Traffic flow (AADT two way)	27,952	27,952						
D8	% HGV	20	20						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	1.81						
D9	Risk of accidental spillage	0.00054	0.00166	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45						
D11	Risk of pollution incident	0.00024	0.00075	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**						
D13	Return period without pollution reduction measures	0.00024	0.00075	0.00000	0.00000	0.00000	0.00000	0.0010	1010
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00024	0.00075	0.00000	0.00000	0.00000	0.00000	0.0010	1010
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00024	0.00075	0.00000	0.00000	0.00000	0.00000	0.0010	1010

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.52	1.82	ug/l
Step 3	0.37	1.28	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.15	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 393136	Northing	386249
OS grid reference of outfall structure (m)	Easting 393136	Northing	386249
Outfall number	Network A	List of outfalls in cumulative assessment	
Receiving watercourse	Threapwood Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00283 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.56 Permeable area draining to outfall (ha): 1.35

Base Flow Index (BFI): 0.35 Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 2.5 Manning's n: 0.035 Side slope (m/m): 0.47 Long slope (m/m): 0.013

Step 3 Mitigation

	Brief description	Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Retention Pond	30		Unlimited	D	60	

(Estimated effectiveness)

Predict Impact

Show Detailed Results

Exit Tool

Network B

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Return To Interface

Summary of predictions

		Soluble - Acute Impact		Sediment - Chronic Impact							
		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Prediction of impact	Step1										
	Step2										
	Step3										

DETAILED RESULTS

In Runoff

Step 1 — Soluble

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	92
Thresholds ***RST6***	42	184
Event Statistics Mean	22.90	68.73
90%ile	43.63	142.38
95%ile	59.00	198.46
99%ile	89.58	353.10

Step 1 — Sediment

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.08	0.28
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	92
Thresholds ***RST6***	42	184
Event Statistics Mean	0.39	1.15
90%ile	0.96	2.88
95%ile	1.53	5.08
99%ile	3.80	14.37

Step 2

Velocity 0.22 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.05	0.19
	(ug/l)	*(ug/l)*
Thresholds hresholds ***RST24***	21	92
Thresholds ***RST6***	42	184
Event Statistics Mean	0.27	0.80
90%ile	0.67	2.02
95%ile	1.07	3.56
99%ile	2.66	10.06

DI -

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

Additional columns for use if other roads drain to the same outfall

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse					
D2	Length of road draining to outfall *(m)*	1,750	200	250					
D3	Road Type *(A-road or Motorway)*	A	A	A					
D4	If A road, is site urban or rural?	Urban	Urban	Urban					
D5	Junction type	No junction	Slip road	Cross road					
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes					
D7	Traffic flow (AADT two way)	32,708	21,945	32,708					
D8	% HGV	13	13	21					
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	1.81	1.46					
D9	Risk of accidental spillage	0.00084	0.00038	0.00092	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45					
D11	Risk of pollution incident	0.00038	0.00017	0.00041	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**					
D13	Return period without pollution reduction measures	0.00038	0.00017	0.00041	0.00000	0.00000	0.00000	0.0010	1041
D14	Existing measures factor	1	1	1					
D15	Return period with existing pollution reduction measures	0.00038	0.00017	0.00041	0.00000	0.00000	0.00000	0.0010	1041
D16	Proposed measures factor	1	1	1					
D17	Residual with proposed Pollution reduction measures	0.00038	0.00017	0.00041	0.00000	0.00000	0.00000	0.0010	1041

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.08	0.28	ug/l
Step 3	0.05	0.19	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.22	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 391759	Northing 385054	
OS grid reference of outfall structure (m)	Easting 391759	Northing 385054	
Outfall number	Network B	List of outfalls in cumulative assessment	
Receiving watercourse	Lady Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 — Climatic region: Colder Wet — Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0667 — (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 6.44 — Permeable area draining to outfall (ha): 3.05

Base Flow Index (BFI): 0.42 — Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 6.1 — Manning's n: 0.04 — Side slope (m/m): 1.51 — Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Retention Pond	30		Unlimited	D	60	

Predict Impact

Show Detailed Results

Exit Tool

Network B+C

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 (Soluble)

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1 (Sediment)

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
Units	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.13	0.44

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	0.62	1.82
	90%ile	1.55	4.63
	95%ile	2.43	8.06
	99%ile	5.94	21.61

Step 2

Velocity 0.22 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

DI -

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.09	0.31

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	0.44	1.28
	90%ile	1.08	3.24
	95%ile	1.70	5.65
	99%ile	4.16	15.13

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse					
D2	Length of road draining to outfall *(m)*	2,950	200	250					
D3	Road Type *(A-road or Motorway)*	A	A	A					
D4	If A road, is site urban or rural?	Urban	Urban	Urban					
D5	Junction type	No junction	Slip road	Cross road					
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes					
D7	Traffic flow (AADT two way)	32,708	21,945	32,708					
D8	% HGV	13	13	21					
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	0.36	1.46					
D9	Risk of accidental spillage	0.00142	0.00007	0.00092	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45					
D11	Risk of pollution incident	0.00064	0.00003	0.00041	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**					
D13	Return period without pollution reduction measures	0.00064	0.00003	0.00041	0.00000	0.00000	0.00000	0.0011	922
D14	Existing measures factor	1	1	1					
D15	Return period with existing pollution reduction measures	0.00064	0.00003	0.00041	0.00000	0.00000	0.00000	0.0011	922
D16	Proposed measures factor	1	1	1					
D17	Residual with proposed Pollution reduction measures	0.00064	0.00003	0.00041	0.00000	0.00000	0.00000	0.0011	922

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.13	0.44	ug/l
Step 3	0.09	0.31	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.22	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 391759	Northing	385054
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Network B+C	List of outfalls in cumulative assessment	Network B
Receiving watercourse	Lady Brook		Network C
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000

Climatic region: Colder Wet

Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0667

(Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 10.71

Permeable area draining to outfall (ha): 4.12

Base Flow Index (BFI): 0.42

Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only

Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only

Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 6.1

Manning's n: 0.04

Side slope (m/m): 1.51

Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Retention Pond	30	Unlimited D	60

Estimated effectiveness

Predict Impact

Show Detailed Results

Exit Tool

Network C

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 (Soluble)

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper *(ug/l)*	Zinc *(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1 (Sediment)

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.05	0.19

		Copper *(ug/l)*	Zinc *(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	0.27	0.78
	90%ile	0.65	1.94
	95%ile	1.03	3.47
	99%ile	2.63	9.82

Step 2

Velocity 0.22 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

DI -

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.04	0.13

		Copper *(ug/l)*	Zinc *(ug/l)*
Thresholds hresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	0.19	0.55
	90%ile	0.46	1.36
	95%ile	0.72	2.43
	99%ile	1.84	6.88

Details of the chosen rainfall site

SAAR (mm)	830
Altitude (m)	20
Easting	3610
Northing	3885
Coastal distance (km)	15

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,200							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Urban							
D5	Junction type	No junction							
D6	Location	< 20 minutes							
D7	Traffic flow (AADT two way)	32,708							
D8	% HGV	13							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31							
D9	Risk of accidental spillage	0.00058	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.45							
D11	Risk of pollution incident	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**							
D13	Return period without pollution reduction measures	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3849
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction measures	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3849
D16	Proposed measures factor	1							
D17	Residual with proposed Pollution reduction measures	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3849

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.05	0.19	ug/l
Step 3	0.04	0.13	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.22	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 391867	Northing	385013
OS grid reference of outfall structure (m)	Easting 391867	Northing	385013
Outfall number	Network C	List of outfalls in cumulative assessment	
Receiving watercourse	Lady Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0667 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.27 | Permeable area draining to outfall (ha): 1.07

Base Flow Index (BFI): 0.42 | Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 6.1 | Manning's n: 0.04 | Side slope (m/m): 1.51 | Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Retention Pond	30	Unlimited D	60

Predict Impact

Show Detailed Results

Exit Tool

Network D+E

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Summary of predictions

Soluble - Acute Impact

Prediction of impact	Copper	Zinc
Step1		
Step2		
Step3		

Sediment - Chronic Impact

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1								
Step2								
Step3								

DETAILED RESULTS

In Runoff

Step 1

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1

Toxicity Threshold

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**5.1**	**2.5**
No. of exceedances/worst year	8	6
No. of exceedances/summer	4.2	1.9
No. of exceedances/worst summer	6	5

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.6**	**0.2**
No. of exceedances/worst year	3	2
No. of exceedances/summer	0.5	0.1
No. of exceedances/worst summer	3	1
Annual average concentration (ug/l)	1.52	5.04

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	6.51	18.86
	90%ile	14.91	45.18
	95%ile	21.81	67.71
	99%ile	34.00	126.56

Step 2

Velocity 0.10 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**1.60**	**0.90**
No. of exceedances/worst year	5	3
No. of exceedances/summer	1.4	0.6
No. of exceedances/worst summer	5	2

DI -

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.10**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	1.05	3.47

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	4.49	13.02
	90%ile	10.29	31.18
	95%ile	15.05	46.72
	99%ile	23.46	87.33

Details of the chosen rainfall site

SAAR (mm)	830
Altitude (m)	20
Easting	3610
Northing	3885
Coastal distance (km)	15

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse					
D2	Length of road draining to outfall *(m)*	2,380	920	600					
D3	Road Type *(A-road or Motorway)*	A	A	A					
D4	If A road, is site urban or rural?	Urban	Urban	Urban					
D5	Junction type	No junction	Slip road	Side road					
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes					
D7	Traffic flow (AADT two way)	43,828	43,828	43,828					
D8	% HGV	13	13	13					
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	0.36	1.81					
D9	Risk of accidental spillage	0.00153	0.00069	0.00226	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45					
D11	Risk of pollution incident	0.00069	0.00031	0.00102	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**					
D13	Return period without pollution reduction measures	0.00069	0.00031	0.00102	0.00000	0.00000	0.00000	0.0020	496
D14	Existing measures factor	1	1	1					
D15	Return period with existing pollution reduction measures	0.00069	0.00031	0.00102	0.00000	0.00000	0.00000	0.0020	496
D16	Proposed measures factor	1	1	1					
D17	Residual with proposed Pollution reduction measures	0.00069	0.00031	0.00102	0.00000	0.00000	0.00000	0.0020	496

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.52	5.04	ug/l
Step 3	1.05	3.47	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.10	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 388246	Northing	383835
OS grid reference of outfall structure (m)	Easting 388246	Northing	383835
Outfall number	Network D+E	List of outfalls in cumulative assessment	
Receiving watercourse	Spath Brook u/s		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment eficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00162 — (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 8.53 — Permeable area draining to outfall (ha): 10.41

Base Flow Index (BFI): 0.35 — Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 1.5 — Manning's n: 0.03 — Side slope (m/m): 1.13 — Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Fist Flush Wetland & Retention Pond (treating 60% of the network)	31		Unlimited	D	50	

Predict Impact

Show Detailed Results

Exit Tool

Network D+E+A555

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**46.80**	**45.20**
No. of exceedances/worst year	60	57

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**15.60**	**18.60**
No. of exceedances/worst year	23	28

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	27.83	86.41
	90%ile	53.03	179.00
	95%ile	71.71	249.50
	99%ile	108.87	443.92

Step 1

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**55.90**	**77.00**	**0.90**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	69	90	3	38	83	38	23	72
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	367	1634	1	15514	2684	2575	164	726
90%ile	797	3723	2	28184	4876	4679	299	1319
95%ile	1031	4988	3	35481	6138	5890	376	1661
99%ile	1399	7787	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**11**	**6.7**
No. of exceedances/worst year	17	10
No. of exceedances/summer	8.5	4.6
No. of exceedances/worst summer	13	7

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**2.3**	**1.2**
No. of exceedances/worst year	6	4
No. of exceedances/summer	1.9	0.8
No. of exceedances/worst summer	5	2
Annual average concentration (ug/l)	2.56	8.72

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	10.87	32.57
	90%ile	24.51	74.73
	95%ile	33.89	108.63
	99%ile	54.72	209.10

Step 2

Velocity 0.10 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**9.20**	**5.00**
No. of exceedances/worst year	15	9
No. of exceedances/summer	7.4	3.3
No. of exceedances/worst summer	11	6

DI -

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**1.70**	**0.70**
No. of exceedances/worst year	4	3
No. of exceedances/summer	1.5	0.4
No. of exceedances/worst summer	4	2
Annual average concentration (ug/l)	2.21	7.50

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	9.35	28.01
	90%ile	21.08	64.26
	95%ile	29.14	93.42
	99%ile	47.06	179.83

Details of the chosen rainfall site

SAAR (mm)	830
Altitude (m)	20
Easting	3610
Northing	3885
Coastal distance (km)	15

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse				
D2	Length of road draining to outfall *(m)*	4,300	2,340	600	780				
D3	Road Type *(A-road or Motorway)*	A	A	A	A				
D4	If A road, is site urban or rural?	Urban	Urban	Urban	Urban				
D5	Junction type	No junction	Slip road	Side road	Side road				
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes	< 20 minutes				
D7	Traffic flow (AADT two way)	61,369	61,369	42,948	30,895				
D8	% HGV	12	15	12	21				
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	0.36	1.81	5.35				
D9	Risk of accidental spillage	0.00358	0.00283	0.00204	0.00988	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45	0.45				
D11	Risk of pollution incident	0.00161	0.00127	0.00092	0.00445	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**				
D13	Return period without pollution reduction measures	0.00161	0.00127	0.00092	0.00445	0.00000	0.00000	0.0083	121
D14	Existing measures factor	1	1	1	1				
D15	Return period with existing pollution reduction measures	0.00161	0.00127	0.00092	0.00445	0.00000	0.00000	0.0083	121
D16	Proposed measures factor	1	1	1	1				
D17	Residual with proposed Pollution reduction measures	0.00161	0.00127	0.00092	0.00445	0.00000	0.00000	0.0083	121

Justification for choice of existing measures factors:

Network D+E+A555

Justification for choice of proposed measures factors:

Oil interceptor and pumping station in A555 network

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	2.56	8.72	ug/l
Step 3	2.21	7.50	ug/l

Copper	Zinc
River Fails Toxicity Test. Try more mitigation	River Fails Toxicity Test. Try more mitigation

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.10	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 388246	Northing	383835
OS grid reference of outfall structure (m)	Easting 388246	Northing	383835
Outfall number	Network D+E +A555P4	List of outfalls in cumulative assessment	Network D+E
Receiving watercourse	Spath Brook u/s		A555 P4
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment eficiency values		

Step 1 Runoff Quality

AADT: >=50,000 and <100,000

Climatic region: Colder Wet

Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00162

(Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 15.73

Permeable area draining to outfall (ha): 10.41

Base Flow Index (BFI): 0.35

Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only

Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only

Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 1.5

Manning's n: 0.03

Side slope (m/m): 1.13

Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Fist Flush Wetland & Retention Pond (treating 27% of the network)	14		Unlimited	D	23	

Predict Impact

Show Detailed Results

Exit Tool

Network F & F Low Flow

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Summary of predictions

	Soluble - Acute Impact		Sediment - Chronic Impact							
	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Prediction of impact *Step1*										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**37.10**	**35.20**
No. of exceedances/worst year		47	47
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**10.10**	**12.10**
No. of exceedances/worst year		17	20
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		22.90	68.73
90%ile		43.63	142.38
95%ile		59.00	198.46
99%ile		89.58	353.10

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
					Toxicity Threshold			
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**6.8**	**0**
No. of exceedances/worst year		12	0
No. of exceedances/summer		5.7	0
No. of exceedances/worst summer		10	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.7**	**0**
No. of exceedances/worst year		3	0
No. of exceedances/summer		0.6	0
No. of exceedances/worst summer		3	0
Annual average concentration (ug/l)		1.71	5.68
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		7.36	21.33
90%ile		17.16	52.09
95%ile		25.01	76.85
99%ile		38.00	150.95

Step 2

Velocity	**0.10**	m/s
DI	**110.13**	
% settlement needed	10	%

Tier 2 is used for the calculation

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**0.70**	**0.00**
No. of exceedances/worst year		3	0
No. of exceedances/summer		0.6	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.10**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0.1	0
No. of exceedances/worst summer		1	0
Annual average concentration (ug/l)		0.86	2.84
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.68	10.66
90%ile		8.58	26.05
95%ile		12.50	38.43
99%ile		19.00	75.47

DI **22.03**

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	385
Thresholds	RST6	42	770
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**6.8**	**0**
No. of exceedances/worst year	12	0
No. of exceedances/summer	5.7	0
No. of exceedances/worst summer	10	0

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.7**	**0**
No. of exceedances/worst year	3	0
No. of exceedances/summer	0.6	0
No. of exceedances/worst summer	3	0
Annual average concentration (ug/l)	1.71	5.68

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	385
Thresholds	RST6	42	770
Event Statistics	Mean	7.36	21.33
	90%ile	17.16	52.09
	95%ile	25.01	76.85
	99%ile	38.00	150.95

Step 2

Velocity 0.10 m/s

Tier 2 is used for the calculation

DI 110.13

% settlement needed 10 %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	RST24	21	385
Thresholds	RST6	42	770
Event Statistics	Mean	-	-
	90%ile	-	-
	95%ile	-	-
	99%ile	-	-

DI -

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.71	5.68	ug/l
Step 3	-	-	ug/l

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. D/S Structure. 10 % settlement needed.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.10	Low flow Vel m/s
Extensive?	Yes	110	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 383080	Northing	385824
OS grid reference of outfall structure (m)	Easting 382080	Northing	385824
Outfall number	Network F	List of outfalls in cumulative assessment	Network F
Receiving watercourse	Baguley Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 — Climatic region: Colder Wet — Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0005 — (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.72 — Permeable area draining to outfall (ha): .19

Base Flow Index (BFI): 0.33 — Is the discharge in or within 1 km upstream of a protected site for conservation? No — D

For dissolved zinc only — Water hardness: High = >200mg CaCO3/l

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 0.75 — Manning's n: 0.035 — Side slope (m/m): 0.1 — Long slope (m/m): 0.008

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	900	100						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Urban	Urban						
D5	Junction type	No junction	Cross road						
D6	Location	< 20 minutes	< 20 minutes						
D7	Traffic flow (AADT two way)	49,770	49,770						
D8	% HGV	17	17						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	1.46						
D9	Risk of accidental spillage	0.00086	0.00045	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45						
D11	Risk of pollution incident	0.00039	0.00020	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**						
D13	Return period without pollution reduction measures	0.00039	0.00020	0.00000	0.00000	0.00000	0.00000	0.0006	1693
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00039	0.00020	0.00000	0.00000	0.00000	0.00000	0.0006	1693
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00039	0.00020	0.00000	0.00000	0.00000	0.00000	0.0006	1693

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.71	5.68	ug/l
Step 3	0.86	2.84	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.10	Low flow Vel m/s
Extensive?	No	22	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 383080	Northing	385824
OS grid reference of outfall structure (m)	Easting 383080	Northing	385824
Outfall number	Network F	List of outfalls in cumulative assessment	Network F
Receiving watercourse	Baguley Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	06/08/2013	Version of assessment	v3.1.1
Notes	Mitigation with potential swale		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0005 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.72 | Permeable area draining to outfall (ha): 0.19

Base Flow Index (BFI): 0.33 | Is the discharge in or within 1 km upstream of a protected site for conservation? No | D

For dissolved zinc only Water hardness: High = >200mg CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No | D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 0.75 | Manning's n: 0.035 | Side slope (m/m): 0.1 | Long slope (m/m): 0.008

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Swale taking 100% of the runoff from Network F	50		Unlimited	D	80	

Predict Impact

Show Detailed Results

Exit Tool

Network F+RR+AC & Low Flow

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Summary of predictions

Soluble - Acute Impact | **Sediment - Chronic Impact**

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 — Soluble

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	22.90	68.73
90%ile	43.63	142.38
95%ile	59.00	198.46
99%ile	89.58	353.10

Step 1 — Sediment

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**11.9**	**0.1**
No. of exceedances/worst year	17	1
No. of exceedances/summer	9.2	0
No. of exceedances/worst summer	14	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**2.5**	**0**
No. of exceedances/worst year	6	0
No. of exceedances/summer	2.1	0
No. of exceedances/worst summer	5	0
Annual average concentration (ug/l)	2.76	9.06
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	11.64	33.78
90%ile	24.88	78.24
95%ile	35.27	115.63
99%ile	55.25	195.53

Step 2

Velocity 0.10 m/s

DI 334.64

% settlement needed 71 %

Tier 2 is used for the calculation

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**2.50**	**0.00**
No. of exceedances/worst year	6	0
No. of exceedances/summer	2.1	0
No. of exceedances/worst summer	5	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.20**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	1.38	4.53
	(ug/l)	*(ug/l)*
Thresholds hresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	5.82	16.89
90%ile	12.44	39.12
95%ile	17.63	57.81
99%ile	27.62	97.77

DI 66.93

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 (Soluble)

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	37.10	35.20
No. of exceedances/worst year	47	47
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	10.10	12.10
No. of exceedances/worst year	17	20
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	22.90	68.73
90%ile	43.63	142.38
95%ile	59.00	198.46
99%ile	89.58	353.10

Step 1 (Sediment)

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	48.50	66.50	0.80	28.10	67.70	28.10	13.50	55.60
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	11.9	0.1
No. of exceedances/worst year	17	1
No. of exceedances/summer	9.2	0
No. of exceedances/worst summer	14	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	2.5	0
No. of exceedances/worst year	6	0
No. of exceedances/summer	2.1	0
No. of exceedances/worst summer	5	0
Annual average concentration (ug/l)	2.76	9.06
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	11.64	33.78
90%ile	24.88	78.24
95%ile	35.27	115.63
99%ile	55.25	195.53

Step 2

Velocity 0.10 m/s

Tier 2 is used for the calculation

DI 334.64

% settlement needed 71 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	-	-
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	-	-
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds hresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

DI -

Details of the chosen rainfall site	
SAAR (mm)	830
Altitude (m)	20
Easting	3610
Northing	3885
Coastal distance (km)	15

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse				
D2	Length of road draining to outfall *(m)*	2,050	415	100	290				
D3	Road Type *(A-road or Motorway)*	A	A	A	A				
D4	If A road, is site urban or rural?	Urban	Urban	Urban	Urban				
D5	Junction type	No junction	Side road	Cross road	Roundabout				
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes	< 20 minutes				
D7	Traffic flow (AADT two way)	49,770	49,770	49,770	49,770				
D8	% HGV	17	17	17	17				
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	1.81	1.46	5.35				
D9	Risk of accidental spillage	0.00196	0.00232	0.00045	0.00479	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45	0.45				
D11	Risk of pollution incident	0.00088	0.00104	0.00020	0.00216	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**				
D13	Return period without pollution reduction measures	0.00088	0.00104	0.00020	0.00216	0.00000	0.00000	0.0043	233
D14	Existing measures factor	1	1	1	1				
D15	Return period with existing pollution reduction measures	0.00088	0.00104	0.00020	0.00216	0.00000	0.00000	0.0043	233
D16	Proposed measures factor	1	1	1	1				
D17	Residual with proposed Pollution reduction measures	0.00088	0.00104	0.00020	0.00216	0.00000	0.00000	0.0043	233

Justification for choice of existing measures factors:

Network F+RRHIW+AC

Justification for choice of proposed measures factors:

Table D1

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	2.76	9.06	ug/l
Step 3	-	-	ug/l

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. D/S Structure. 71 % settlement needed.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.10	Low flow Vel m/s
Extensive?	Yes	335	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 383080	Northing 385824	
OS grid reference of outfall structure (m)	Easting 382080	Northing 385824	
Outfall number	Network F+RRHIW+AC	List of outfalls in cumulative assessment	Network F; Airport City; RRHIW
Receiving watercourse	Baguley Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 Climatic region: Colder Wet Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0005 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 8.2649 Permeable area draining to outfall (ha): 0.65057

Base Flow Index (BFI): 0.33 Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: High = >200mg CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 0.75 Manning's n: 0.035 Side slope (m/m): 0.1 Long slope (m/m): 0.008

Step 3 Mitigation

	Brief description	Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
		Estimated effectiveness					
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	2.76	9.06	ug/l
Step 3	1.38	4.53	ug/l

Copper	Zinc
River Fails Toxicity Test. Try more mitigation	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.10	Low flow Vel m/s
Extensive?	No	67	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 383080	Northing	385824
OS grid reference of outfall structure (m)	Easting 383080	Northing	385824
Outfall number	Network F+RRHIW+AC	List of outfalls in cumulative assessment	Network F; Airport City; RRHIW
Receiving watercourse	Baguley Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	06/08/2013	Version of assessment	v3.1.1
Notes	Mitigation with potential swale		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0005 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 8.2649 Permeable area draining to outfall (ha): 0.65057

Base Flow Index (BFI): 0.33 Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: High = >200mg CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 0.75 Manning's n: 0.035 Side slope (m/m): 0.1 Long slope (m/m): 0.008

Step 3 Mitigation

	Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Swale taking 100% of the runoff from Network F	50	Unlimited D	80

Estimated effectiveness

Predict Impact

Show Detailed Results

Exit Tool

Network L

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Summary of predictions

Soluble - Acute Impact | **Sediment - Chronic Impact**

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1 (Soluble)

RST24	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper (ug/l)	Zinc (ug/l)
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1 (Sediment)

Toxicity Threshold	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**0.7**	**0.4**
No. of exceedances/worst year	2	2
No. of exceedances/summer	0.7	0.4
No. of exceedances/worst summer	2	2

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	0.57	1.99

		Copper (ug/l)	Zinc (ug/l)
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	2.60	7.63
	90%ile	6.64	19.92
	95%ile	10.30	31.06
	99%ile	17.90	70.68

Step 2

Velocity 0.17 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-

RST6	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-

		Copper (ug/l)	Zinc (ug/l)
Thresholds hresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	-	-
	90%ile	-	-
	95%ile	-	-
	99%ile	-	-

DI -

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse					
D2	Length of road draining to outfall *(m)*	1,825	600	50					
D3	Road Type *(A-road or Motorway)*	A	A	A					
D4	If A road, is site urban or rural?	Urban	Urban	Urban					
D5	Junction type	No junction	Slip road	Roundabout					
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes					
D7	Traffic flow (AADT two way)	38,881	38,881	4,604					
D8	% HGV	11	14	14					
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	0.36	5.35					
D9	Risk of accidental spillage	0.00088	0.00043	0.00006	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45					
D11	Risk of pollution incident	0.00040	0.00019	0.00003	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**					
D13	Return period without pollution reduction measures	0.00040	0.00019	0.00003	0.00000	0.00000	0.00000	0.0006	1616
D14	Existing measures factor	1	1	1					
D15	Return period with existing pollution reduction measures	0.00040	0.00019	0.00003	0.00000	0.00000	0.00000	0.0006	1616
D16	Proposed measures factor	1	1	1					
D17	Residual with proposed Pollution reduction measures	0.00040	0.00019	0.00003	0.00000	0.00000	0.00000	0.0006	1616

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool

version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.57	1.99	ug/l
Step 3	-	-	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.17	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 386152	Northing	383998
OS grid reference of outfall structure (m)	Easting 386152	Northing	383998
Outfall number	Network L	List of outfalls in cumulative assessment	
Receiving watercourse	Spath Brook d/s		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000

Climatic region: Colder Wet

Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00509

(Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.18

Permeable area draining to outfall (ha): 2.42

Base Flow Index (BFI): 0.35

Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only

Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only

Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 1 — Manning's n: 0.035 — Side slope (m/m): 1 — Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Network L+A555

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Summary of predictions

Prediction of impact	Soluble - Acute Impact Copper	Zinc	Sediment - Chronic Impact Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

DETAILED RESULTS

In Runoff

Step 1

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**37.10**	**35.20**
No. of exceedances/worst year	47	47

RST6

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**10.10**	**12.10**
No. of exceedances/worst year	17	20

		Copper	Zinc
		(ug/l)	(ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1

Toxicity Threshold

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

RST24

	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**2.7**	**1.4**
No. of exceedances/worst year	5	4
No. of exceedances/summer	1.4	1
No. of exceedances/worst summer	4	4

RST6

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.3**	**0.1**
No. of exceedances/worst year	2	1
No. of exceedances/summer	0.3	0.1
No. of exceedances/worst summer	2	1
Annual average concentration (ug/l)	1.04	3.52

		Copper	Zinc
		(ug/l)	(ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	4.57	13.31
	90%ile	11.11	33.48
	95%ile	17.15	52.97
	99%ile	26.45	104.28

Step 2

Velocity 0.17 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

RST24

	Copper	Zinc
Allowable Exceedances/year	2	2
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-

DI -

RST6

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-

		Copper	Zinc
		(ug/l)	(ug/l)
Thresholds hresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	-	-
	90%ile	-	-
	95%ile	-	-
	99%ile	-	-

Details of the chosen rainfall site

SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse					
D2	Length of road draining to outfall *(m)*	2,365	2,080	570					
D3	Road Type *(A-road or Motorway)*	A	A	A					
D4	If A road, is site urban or rural?	Urban	Urban	Urban					
D5	Junction type	No junction	Slip road	Roundabout					
D6	Location	< 20 minutes	< 20 minutes	< 20 minutes					
D7	Traffic flow (AADT two way)	41,196	41,196	44,821					
D8	% HGV	11	15	15					
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	0.36	5.35					
D9	Risk of accidental spillage	0.00121	0.00169	0.00748	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45					
D11	Risk of pollution incident	0.00055	0.00076	0.00337	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**					
D13	Return period without pollution reduction measures	0.00055	0.00076	0.00337	0.00000	0.00000	0.00000	0.0047	214
D14	Existing measures factor	1	1	1					
D15	Return period with existing pollution reduction measures	0.00055	0.00076	0.00337	0.00000	0.00000	0.00000	0.0047	214
D16	Proposed measures factor	1	1	1					
D17	Residual with proposed Pollution reduction measures	0.00055	0.00076	0.00337	0.00000	0.00000	0.00000	0.0047	214

Justification for choice of existing measures factors:

Network L+A555

Justification for choice of proposed measures factors:

Table D1

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

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Highways Agency Water Risk Assessment Tool

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.04	3.52	ug/l
Step 3	-	-	ug/l

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.17	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 386152	Northing	383998
OS grid reference of outfall structure (m)	Easting 386152	Northing	383998
Outfall number	Network L+A555 PS3	List of outfalls in cumulative assessment	Network L
Receiving watercourse	Spath Brook d/s		Network A555 PS3
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00509 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 11.88 | Permeable area draining to outfall (ha): 2.42

Base Flow Index (BFI): 0.35 | Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): 1 | Manning's n: 0.035 | Side slope (m/m): 1 | Long slope (m/m): 0.003

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Network M

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Summary of predictions

Soluble - Acute Impact | **Sediment - Chronic Impact**

Prediction of impact		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1										
	Step2										
	Step3										

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**37.10**	**35.20**
No. of exceedances/worst year		47	47
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**10.10**	**12.10**
No. of exceedances/worst year		17	20
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	22.90	68.73
	90%ile	43.63	142.38
	95%ile	59.00	198.46
	99%ile	89.58	353.10

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Toxicity Threshold							
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**48.50**	**66.50**	**0.80**	**28.10**	**67.70**	**28.10**	**13.50**	**55.60**
No. of exceedances/worst year	58	77	3	38	83	38	23	72
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	304	1156	1	15514	2684	2575	164	726
90%ile	675	2742	1	28184	4876	4679	299	1319
95%ile	882	3758	2	35481	6138	5890	376	1661
99%ile	1210	6050	3	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**5.1**	**2.4**
No. of exceedances/worst year		9	5
No. of exceedances/summer		4.3	1.9
No. of exceedances/worst summer		8	5
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.4**	**0.2**
No. of exceedances/worst year		2	1
No. of exceedances/summer		0.3	0.2
No. of exceedances/worst summer		2	1
Annual average concentration (ug/l)		1.39	4.65
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	6.02	17.50
	90%ile	14.33	42.78
	95%ile	22.15	65.30
	99%ile	34.28	130.70

Step 2

Velocity 0.11 m/s

Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**1.70**	**0.90**
No. of exceedances/worst year		4	3
No. of exceedances/summer		1.6	0.7
No. of exceedances/worst summer		4	2
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.20**	**0.10**
No. of exceedances/worst year		2	1
No. of exceedances/summer		0.2	0.1
No. of exceedances/worst summer		2	1
Annual average concentration (ug/l)		0.97	3.25
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	4.22	12.25
	90%ile	10.03	29.94
	95%ile	15.50	45.71
	99%ile	24.00	91.49

DI -

Details of the chosen rainfall site	
SAAR (mm)	**830**
Altitude (m)	**20**
Easting	**3610**
Northing	**3885**
Coastal distance (km)	**15**

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	225	430						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Urban	Urban						
D5	Junction type	No junction	Cross road						
D6	Location	< 20 minutes	< 20 minutes						
D7	Traffic flow (AADT two way)	38,881	38,881						
D8	% HGV	11	11						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.31	1.46						
D9	Risk of accidental spillage	0.00011	0.00098	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.45	0.45						
D11	Risk of pollution incident	0.00005	0.00044	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**						
D13	Return period without pollution reduction measures	0.00005	0.00044	0.00000	0.00000	0.00000	0.00000	0.0005	2041
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00005	0.00044	0.00000	0.00000	0.00000	0.00000	0.0005	2041
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00005	0.00044	0.00000	0.00000	0.00000	0.00000	0.0005	2041

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Table 7.1

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

HIGHWAYS AGENCY

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.39	4.65	ug/l
Step 3	0.97	3.25	ug/l

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.11	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number	SEMMMS	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 384179	Northing	385901
OS grid reference of outfall structure (m)	Easting 384179	Northing	385901
Outfall number	Network M	List of outfalls in cumulative assessment	
Receiving watercourse	Gatley Brook		
EA receiving water Detailed River Network ID		Assessor and affiliation	Peter Greatbanks, Mouchel
Date of assessment	12/07/2013	Version of assessment	v3.1
Notes	Mitigation uses HA treatment efficiency values		

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Warrington (SAAR 830mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00047 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.72 Permeable area draining to outfall (ha): 0

Base Flow Index (BFI): 0.33 Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m): 5

Tier 2 Bed width (m): .75 Manning's n: 0.035 Side slope (m/m): 1 Long slope (m/m): 0.01

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	First Flush Wetland	30		Unlimited	D	60	

Predict Impact

Show Detailed Results

Exit Tool

Appendix 16D - Mitigation

16.1 Routine Runoff

Treatment Principles

16.1.1 Where preliminary HAWRAT and EQS calculations indicate that a road drainage outfall will fail these assessments and that a significant impact will result, treatment will be provided wherever practicable.

16.1.2 The water quality mitigation proposed for each drainage network has been dictated by the level and type of treatment required, either for soluble and/or sediment bound pollutants. The preliminary calculations indicated that concentrations of sediment bound pollutants were acceptable in all networks and therefore did not require specific treatment; however a number of the networks were failing the soluble pollutants element of HAWRAT.

16.1.3 There are two primary options for the mitigation of acute impacts from soluble pollutants: flow attenuation which ensures there is sufficient dilution in the receiving watercourse, or treatment to reduce the concentration of soluble pollutants in the road runoff before discharge.

16.1.4 In this case attenuation of the road runoff discharge rate has not been used, as where mitigation is required the watercourses are generally very small with very low 95%ile flows (flows exceeded 95% of the time). In these instances the discharge rate would have to be restricted to an impractically low rate for attenuation to be effective.

16.1.5 Treatment of soluble pollutants was considered the only practical solution in these cases. The principal processes that will remove soluble metal pollutants from road runoff are adsorption, where pollutants bind to soil particles, or uptake by plants.

16.1.6 There are a variety of SUDS techniques and specialist proprietary systems that can provide varying levels of treatment for soluble pollutants. For each of the networks conventional SUDS have been considered in the first instance as they have a longer track record in the UK than the proprietary systems, with greater information on effectiveness, reliability, costs and maintenance requirements.

16.1.7 SUDS components that provide soluble pollutant treatment and can be used in a roads context are limited to surface flow wetlands, swales, ponds and infiltration basins. Infiltration basins have been excluded from the SEMMMS treatment proposals as EA has indicated that they are opposed to discharge to groundwater. For the same reason any ponds or wetlands proposed will be lined to prevent infiltration to groundwater.

16.1.8 There is relatively little information available on the effectiveness of the various SUDS components at reducing the different categories of pollutants that the HAWRAT assessment considers. Most guidance provides a general indication of overall water quality performance, which does not differentiate clearly the performance against different types of pollutants. Often performance levels are presented using low, moderate and high categories which correspond to broad efficiency ranges of typically <30%, 30%-60% and >60% reductions respectively.

16.1.9 The HAWRAT assessment requires a single numerical figure for efficiency to be entered into the software for the different pollutant types. For the purposes of this assessment single figures have been derived from research carried out by the HA, which following agreement with the EA will be published for use on HA highways schemes. Table 16D.1 lists the treatment efficiencies used for this assessment. A conservative approach has been taken in choosing these single figures for soluble heavy metals, as the HA guidance distinguishes between dissolved zinc and copper. Where these figures differ, the lower of the two is used

Table 16D.1 Expected Pollutant Removal Performance of SUDS Components

SUDS Component	Pollutant Removal Efficiency	
	Suspended Solids	Soluble Heavy Metals
Swale	*High* **80%**	*Moderate* **50%**
Surface Flow Wetland	*High* **60%**	*Low - Moderate* **30%**
Wet / Retention Pond	*High* **60%**	*Low - Moderate* **30%**

16.1.10 The SUDS component(s) selected for each network have been dependant primarily on the pollution removal efficiency required, as calculated in HAWRAT, but also on a variety of constraints such as the proposed vertical alignment of the road, drainage gradients and available land.

16.1.11 Where wetlands are proposed these have been specified as first flush wetlands, due to landtake constraints. Due to the shallow depth of wetlands they would require significant landtake if designed to hold all the road runoff from a storm event. However during a rainfall event the build-up of pollutants on the road surface is generally washed off the road early in the event,and therefore the runoff from the first 10mm of rain is often the most seriously polluted. This is referred to as the 'first flush' effect. The landtake required for wetlands can be significantly reduced, without compromising the treatment efficiency of the wetland or the water quality of the receiving watercourse, if they are designed to treat the first flush only.

16.1.12 In some instances it has not been possible to provide SUDS treatment for the entire network due to these constraints discussed above. In these cases sufficient treatment has been provided to the proportion of the network being treated, that the overall effective treatment for the entire network meets the requirements. For example a network requires 22% reduction in soluble pollutants. It is only possible to divert 50% of the network runoff into a surface flow wetland. The wetland provides 50% reduction in pollutants, therefore the effective treatment for the entire network is a 25% reduction in soluble pollutants.

16.1.13 In this way it has been possible to provide sufficient SUDS treatment for each of the networks to pass the HAWRAT and EQS assessments.

16.1.14 A number of the SEMMMS networks have required cumulative assessments, due to their interactions either with each other or with adjacent networks associated with the existing A555, the proposed RRHIW and the proposed Airport City development. It has been technically infeasible to provide sufficient SUDS treatment to ensure the cumulative assessments pass all aspects of the HAWRAT and EQS assessments.

16.1.15 Additional treatment may be possible using proprietary systems, however there is limited data on the long-term effectiveness of these systems in treating soluble pollutants. In addition there may be considerable costs and maintenance burden associated with proprietary systems. For these reasons no further treatment for cumulative routine runoff is currently proposed. However further investigations into proprietary systems will be undertaken, in consultation with the EA, during the detailed design of the proposed scheme. This will include a benefit-cost analysis to help determine which system, if any, is appropriate for the proposed scheme.

16.1.16 It should be noted that neither the HAWRAT or EQS assessments considers the impacts from insoluble hydrocarbons which float on the water surface, and therefore does not consider the need for bypass oil separators or similar treatment requirements. The research conducted by the HA when developing the HAWRAT assessment found that in general this fraction of hydrocarbons in routine runoff is very small, and therefore specific treatment was not required unless it was found that there was a high risk of accidental spillage associated with the relevant network.

Summary of Proposed Network Treatment

16.1.17 The treatment required and proposed for each network is summarised in the tables below.

Table 16D.2 Summary of Individual Routine Runoff Treatment Proposals

Network ID	Required Treatment (% pollutant reduction)			Proposed Treatment / Mitigation	Proposed Treatment (% pollutant reduction)		
	Cu[1]	Zn[2]	Sed[3]		Cu[1]	Zn[2]	Sed[3]
A	0	0	0	Attenuation pond	30	30	60
B	0	0	0	Attenuation pond	30	30	60
C	0	0	0	Attenuation pond	30	30	60
D&E	30	9	0	Wetland & attenuation pond treating 60% of network	31	31	50
L	0	0	0	None	0	0	0
M	0	0	0	Wetland	30	30	60
F	39	0	10	None	0	0	0

16.1.18 [1] Cu – soluble copper, [2] Zn – soluble zinc, [3] Sed - sediment

Table 16D.3 Summary of Cumulative Routine Runoff Treatment Proposals

Network ID	Required Treatment (% pollutant reduction)			Proposed Treatment / Mitigation	Proposed Treatment (% pollutant reduction)		
	Cu[1]	Zn[2]	Sed[3]		Cu[1]	Zn[2]	Sed[3]
B + C	0	0	0	2 x attenuation ponds	30	30	60
D&E + A555/PS4	56	44	0	Wetland & attenuation pond treating 27% of cumulative network area	14	14	23
L + A555/PS3	8	0	0	None	0	0	0
F + RRHIW + Airport City	72	0	77	None	0	0	0

16.1.19 [1] Cu – soluble copper, [2] Zn – soluble zinc, [3] Sed - sediment