# Appendix 11.2

## Water Quality Assessment

# Contents



## Tables



## Figures

# 1 Introduction

1.1.1 Potential impacts on surface and ground water may result from the Proposed Scheme both during construction and later during operation. Impacts may occur, for example, from pollution from site runoff (construction) or accidental spillage (operation). Further details of potential impacts are provided in **Chapter 11**. Pollutants associated with road surface runoff, such as heavy metals (copper and zinc), suspended solids, and hydrocarbons, can enter watercourses damaging sensitive species, and/ or enter groundwater contaminating potable water supplies.

1.1.2 The Proposed Scheme is located within areas designated for their protected species or habitats (i.e. Special Areas of Conservation (SAC), Special Protection Areas (SPA), and Sites of Special Scientific Interest (SSSIs)); therefore, treatment of road runoff must satisfy the requirements of statutory bodies such as Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH). Further detail on protected species and habitats is provided in **Chapter 12**.

1.1.3 Design development has been environmentally led. Details of the initial assessments undertaken in a pre-mitigation scenario are provided in this appendix. These findings informed the design development by identifying potential impacts of a preliminary design on the water environment (as well as adverse impacts to the Proposed Scheme by the water environment), from which appropriate mitigation requirements were established and 'embedded' into the design that is assessed in **Chapter 11**.

# 2 Approach and Methods

2.1.1 Water quality has been assessed in line with Design Manual for Roads and Bridges (DMRB) HD45/09 guidance. Methods outlined in DMRB are used to determine potential pollution impacts from:

- Routine Runoff to Surface Waters (Method 'A')
- Detailed Assessment of Pollution Impacts from Routine Runoff to Surface Waters (Method 'B')
- Assessment of Pollution Impacts from Routine Runoff on Groundwater (Method 'C')
- Assessment of Pollution Impacts from Spillages (Method 'D')

2.1.2 The assessment focuses on outfalls from the A9 mainline and local or side roads which have been identified in Scottish Planning Policy (SPP) as sources of pollution to rivers and streams requiring appropriate treatment in the form of Sustainable Drainage Systems (SuDS).

2.1.3 Outfalls from accommodation tracks and NMUs (surfaced or unsurfaced) will not be assessed individually but will normally require a basic single level of treatment. Guidance on the appropriate treatment for tracks and NMUs has been followed as per *'Side Road and Accommodation Track SUDS' – Technical Note,* AMJV (2015) (see **Annex 2**: Technical Note).

2.1.4 SEPA has been consulted on the design approach for SuDS and been discussed on a scheme-wide basis at Environmental Steering Group meetings. The current enhanced SuDS design (within Project 9 area) is as follows:

- First stage of treatment will mainly comprise stone-filled filter drains at the roadside (over-edge drainage) – swales or grassed filter strips may be provided as an alternative at some locations.
- Second stage of treatment will normally comprise a detention basin (including sediment forebay and often micro-pool), or retention pond

- Enhanced stage biological treatment can be provided through halophyte vegetation in the retention basin or micro-pools, which then require regular maintenance including removal of cuttings.

2.1.5 Filter drains with catch-pits and detention basins with a sediment fore-bay maximises sediment containment. Outlet controls on detention basins detain first flush events and discharge at pre-development rates or attenuated to 'greenfield' discharge, thus first flush does not discharge directly to the watercourse but is held back enabling dilution of the flow helping to minimise risks of 'shock load' due to salt and/ or other road surface contaminants. Flows in receiving watercourses will also be elevated due to the same precipitation or thaw events, further increasing dilution.

2.1.6 Vegetated basins also enable surface adsorption of potential contaminants, which may then either degrade in sunlight (e.g. oil residues) or be more gradually removed by later drainage flows and/ or periodic vegetation clearance. Vegetated swale outfalls are also considered to enhance the overall treatment provided via an additional vegetated area before discharge to the receiving watercourse.

2.1.7 Extended basins including micro-pools (bio-retention zones) will also improve dilution potential and shut-off valves are included on SuDS outlets to facilitate accidental spillage containment which will typically represent the most significant advantage in terms of overall pollution risk reduction when compared to existing conditions

2.1.8 Where insufficient space or other engineering constraints inhibits the use of conventional SuDS, proprietary systems such as a hydrodynamic vortex separator (in combination with tank sewers and/ or modular treatment systems) may be used to provide appropriate alternative treatment and attenuation.

2.1.9 A summary of proposed treatment for Project 9 drainage networks is outlined in **Table 1** and **Table 2**.

*Table 1: Summary of proposed SuDS features for drainage networks*

| SuDS ID | 1st Level SuDS | 2nd Level SuDS | Inclusion of Micro-pool | Outfall Form | Outfall receiving water | Outfall Co-ordinates | |
|---|---|---|---|---|---|---|---|
| | | | | | | Easting | Northing |
| 417 | Filter Drain | Basin | Yes | Grass-lined channel | River Spey (MW9.1) | 269009 | 796782 |
| 427 | Filter Drain | Pond | No | Grass-lined channel | Unnamed watercourse (W9.49a) | 270400 | 796968 |
| 434 | Filter Drain | Basin | Yes | Pipe to Pre-earthworks drainage ditch | River Spey (MW9.1) | 270683 | 797609 |
| 458 | Filter Drain | Basin | Yes | Grass-lined channel | Allt Eoghainn (MW9.4) | 272877 | 798391 |
| 461 | Filter Drain | Basin | Yes | Grass-lined channel | Unnamed watercourse (W9.11) | 273108 | 798450 |
| 474 | Filter Drain | Basin | Yes | Pipe to pre-earthworks drainage ditch | Milton Burn/ Inverton Burn (MW 9.6) | 274467 | 798916 |
| 487 | Filter Drain | Basin | Yes | Pipe to pre-earthworks drainage ditch | River Spey (MW9.1) | 275646 | 799395 |

| SuDS ID | 1st Level SuDS | 2nd Level SuDS | Inclusion of Micro-pool | Outfall Form | Outfall receiving water | Outfall Co-ordinates | |
|---|---|---|---|---|---|---|---|
| | | | | | | Easting | Northing |
| 490 | Filter Drain | Basin | Yes | Grass-lined channel | River Spey (MW9.1) | 275980 | 799758 |
| 493 | Filter Drain | Basin | Yes | Grass-lined channel | River Spey (MW9.1) | 275980 | 799758 |
| 502 | Filter Drain | Swale | No | Grass-lined channel | River Spey (MW9.1) | 276605 | 800509 |
| 507 | Filter Drain | Basin | No | Grass-lined channel | Unnamed Drain (MW9.10) | 276705 | 801059 |
| 509 | Filter Drain | Pond | No | Grass-lined channel | Unnamed Drain (MW9.10) | 276770 | 801087 |
| 513 | Filter Drain | Pond | No | Grass-lined channel | Unnamed watercourse (W9.26) | 277081 | 801545 |
| 530 | Filter Drain | Pond | No | Grass-lined channel | Unnamed watercourse (W9.27) | 278505 | 801918 |
| 534 | Filter Drain | Basin | Yes | Grass-lined channel | Raitts Burn (MW 9.14) | 278954 | 802096 |
| 537 | Filter Drain | Basin | Yes | Grass-lined channel | Unnamed Drain (W9.33) | 279290 | 802326 |
| 561 | Filter Drain | Tank Sewer & Vortex separator[1] | No | Swale | Unnamed watercourse (MW9.17) | 281209 | 803669 |
| 563 | Filter Drain | Tank Sewer & Vortex separator | No | Swale | Unnamed watercourse (MW9.17) | 281202 | 803687 |

Note: the SuDS 'management train' included in the Proposed Scheme design is one of several equivalent options derived from the SuDS Manual (CIRIA, 2015).

2.1.10 **Table 2** highlights the variety of depths associated with micro-pool within each basin (ponds provide permanent water retention and hence do not include a micro-pool). Basins and ponds can have various layouts, varying types of halophyte vegetation (a plant adapted to growing in saline conditions) and inflow/ outflow control devices specific to their location.

*Table 2: SuDS Design Summary*

| SuDS ID | Dry Sediment Forebay | Main Treatment Bay | | Micro-pool | | |
|---|---|---|---|---|---|---|
| | | Dry Basin | Permanent Pool (pond) | 0.3m | 0.6m | 1.0m |
| 417 | ✓ | ✓ | | ✓ | ✓ | |
| 427 | ✓ | | ✓ | | ✓ | ✓ |
| 434 | ✓ | ✓ | | ✓ | | |
| 458 | ✓ | ✓ | | ✓ | ✓ | |

[1] Due to spatial constraints, Networks 561 and 563 have one stage of treatment through filter drains and retained within a tank sewer before discharging via a swale.

| SuDS ID | Dry Sediment Forebay | Main Treatment Bay | | Micro-pool | | |
|---|---|---|---|---|---|---|
| | | Dry Basin | Permanent Pool (pond) | 0.3m | 0.6m | 1.0m |
| 461 | ✓ | ✓ | | ✓ | | |
| 474 | ✓ | ✓ | | ✓ | ✓ | |
| 487 | ✓ | ✓ | | ✓ | | |
| 490 | ✓ | ✓ | | ✓ | ✓ | |
| 493 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 502 | SWALE AND GRASS-LINED CHANNEL | | | | | |
| 507 | ✓ | ✓ | | | | |
| 509 | ✓ | | ✓ | | ✓ | |
| 513 | ✓ | | ✓ | | ✓ | ✓ |
| 530 | ✓ | | ✓ | | ✓ | ✓ |
| 534 | ✓ | ✓ | | ✓ | ✓ | |
| 537 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 561 | ATTENUTATION TANK, VORTEX SEPARATOR AND SWALE OUTFALL | | | | | |
| 563 | ATTENUTATION TANK, VORTEX SEPARATOR AND SWALE OUTFALL | | | | | |

### HAWRAT

2.1.11 Potential impacts from routine runoff and accidental spillage risk to watercourses have been assessed using the Highways Agency (now Highways England) Water Risk Assessment Tool (HAWRAT) in line with DMRB HD45/09 which is applicable to trunk roads in Scotland. HAWRAT is a spreadsheet tool designed to evaluate risks related to the intermittent nature of routine road runoff. It assesses the acute pollution impacts on aquatic ecology associated with soluble pollutants, and the chronic impacts associated with sediment bound pollutants. This is undertaken using the parameters outlined below.

#### *Runoff Pollutant Models*

2.1.12 The HAWRAT assessment uses statistically based models for predicting the runoff quality for each pollutant. The models use traffic density, climate region and event rainfall characteristics to predict runoff quality in terms of Event Mean Concentrations (EMCs) and Event Mean Sediment Concentrations (EMSCs). Using long-term rainfall data, the models generate distributions of runoff quality.

*Impact Model*

2.1.13 The tool also uses models to predict the impact of runoff on receiving rivers. For soluble pollutants (that cause acute impacts), the assessment involves a simple mass balance approach accounting for river flows. For sediment related pollutants, the model considers both the likelihood and extent of sediment accumulation.

*Threshold Analysis*

2.1.14 The tool holds a number of ecologically based thresholds with which it compares the predicted impacts to evaluate the toxicity risks.

Assessment Thresholds

- Soluble (Acute) – Look-up tables show Runoff Specific Thresholds (RSTs) for dissolved copper and zinc and the allowable number of exceedances of these thresholds
- Sediments (Chronic) – Look-up tables show Threshold Effect levels (TELs) and Probable Effect Levels (PELs)

Method A – Simple Assessment of Pollution Impacts from Routine Runoff to Surface Waters

2.1.15 Method 'A' uses HAWRAT to assess the short-term and long-term risks to the receiving watercourses based on the impacts from soluble pollutants and sediment-bound pollutants. The assessment is first carried out for individual outfalls, thereafter, when more than one outfall discharges into the same stretch of watercourse, the combined effects are also assessed.

2.1.16 HAWRAT tests for a suite of pollutants identified through the Highways Agency (Highways England) and Environment Agency research programme as the key contaminants in road runoff, either because of their abundance and/ or they are the most harmful in terms of species sensitivity in the water environment. These pollutants are:

- Soluble pollutants associated with acute pollution impacts, expressed as EMCs (µg/l) for dissolved copper (Cu) and zinc (Zn)
- Sediment related pollutants associated with chronic pollution impacts, expressed as EMSCs (mg/kg) for total copper, zinc, cadmium, and (in µg/kg) for pyrene, fluoranthene, anthracene, phenanthrene and total PAH (Polycyclic Aromatic Hydrocarbons)

2.1.17 HAWRAT allows the user to assess the potential effects of short-term risks on water quality related to the intermittent nature of road runoff, as well as the effectiveness of any recommended mitigation measures. It does so by predicting road runoff pollutant loading at each step of the assessment and comparing it against runoff specific thresholds, for example Environmental Quality Standards (EQSs), based on annual average concentrations.

2.1.18 For the assessment of potential impacts from routine runoff to surface waters, HAWRAT uses three steps as follows: Quality of Runoff; In-River Impacts; and Mitigation. A 'pass' result at one step negates the requirement of a subsequent step.

*Step 1 – Quality of Runoff*

2.1.19 This is an initial first step to assess the quality of the direct road runoff against toxicity thresholds prior to treatment and discharge to the water body. Toxicity thresholds based on Environmental Quality Standards (EQS) for the protection of freshwater aquatic life have been derived from

SEPA's Supporting Guidance (WAT-SG-53) (2014). The relevant EQSs for the protection of freshwater aquatic life are given as 1.0µg/l for copper and 10.9µg/l for zinc.

2.1.20 HAWRAT displays a 'pass' or 'fail' and the corresponding concentrations. If the toxicity levels yield a 'pass' then no further assessment is required. The parameters used in Step 1 are:

- The design traffic flow of the road (two-way Annual Average Daily Traffic) (AADT)
- The climatic region of the site
- The nearest rainfall site within that climatic region

*Step 2 – In River Impacts*

2.1.21 If Step 1 yields a 'fail', the assessment continues to Step 2. Step 2 takes account of the acute impacts of soluble pollutants and the chronic impacts of sediment pollutants after dilution and dispersion in the watercourse prior to mitigation.

2.1.22 For sediment-bound pollutants, Step 2 provides two tiers of assessment; the first is a desk-based assessment; the second is a more detailed assessment allowing the entry of estimated or measured dimensions of a watercourse. Passing the first tier avoids a second-tier assessment. The parameters used in Step 2 are:

- The annual 95%ile river flow ($m^3/s$)
- Base Flow Index (BFI)
- The impermeable road area which drains to the outfall (ha)
- Any permeable (non-road surface) area which also drains to the outfall (ha)
- The hardness of the receiving water (mg $CaCO_3$/l)
- Whether the discharge is likely to impact on a protected site for conservation
- Whether there is a downstream structure, lake or pond that reduces the river velocity near the point of discharge
- For Tier 1 assessments, an estimate of the river width
- For Tier 2 assessment details of channel dimensions, side slope, long slope and an estimation of Manning's *n*

*Step 3 – Mitigation*

2.1.23 If the outfall point fails Step 2 after discharge to the water body, the assessment continues to Step 3. This requires the input of any existing and proposed mitigation measures in order to assess whether the mitigation will be sufficient to reasonably treat the runoff.

A brief description of the existing and proposed measures, and their associated estimated removal capability (expressed as a percentage), is input to the tool. Estimated removal capacity is required for treatment of soluble pollutants and settlement of sediments.

2.1.24 Information on estimates of pollutant removal capability for various Sustainable Drainage Systems (SuDS) management systems is derived from DMRB HD33/16 (Table 8.1).

2.1.25 If a combined approach is proposed, the mitigation techniques are combined to determine the total removal capacity. The procedure to calculate the removal capacity is carried out in line with SuDS Manual (C753). The efficiency value of the first level of treatment is calculated as 100% effective; thereafter, secondary and tertiary (where applicable) levels are assumed to perform at

50% effectiveness due to already reduced inflow concentrations. If the outfall point fails Step 3, HAWRAT can provide an indication of the scale of additional mitigation required.

*Cumulative Assessment*

2.1.26 In line with DMRB HD45/09, cumulative assessments have also been undertaken for multiple discharges to single tributaries of larger watercourses where drainage outfalls are located within 1km along a river reach. In the context of this assessment, a reach is defined as a length of watercourse between two confluences. HD45/09 states *"the reason for this is that the available dilution and stream velocity will naturally change at confluences and influence the assessment".* The three-stage process described above is also followed for the cumulative assessment. Long-term concentrations are also calculated using the HD45/09 procedure.

### Method B – Detailed Assessment of Pollution Impacts from Routine Runoff to Surface Waters

2.1.27 If the in-river annual average concentrations of soluble pollutants exceed the EQS values (i.e. a failure at Step 2), and appropriate mitigation is not being provided in the form of SuDS, the bioavailability of the soluble pollutants can be reassessed using a Biotic Ligand Model (BLM). The three steps outlined in the Simple Assessment are also followed for the Detailed Assessment.

2.1.28 The BLM refines the EQS on a site-specific basis and then compares the copper and zinc concentrations predicted by HAWRAT to the BLM derived 'Probable Non-Effect Concentration' (PNEC). If the annual average concentrations exceed the EQS, it is highly likely that the Runoff Specific Thresholds (RSTs) are also being exceeded.

2.1.29 As mitigation (Step 3) is employed to treat the pollutants in order for them to meet the RSTs, this results in a reduction in annual average concentrations, which in turn may result in compliance with the EQS.

### Method C – Assessment of Pollution Impacts from Routine Runoff on Groundwater

2.1.30 Method C assesses the pollution impacts from routine runoff on groundwater. This involves assessing the overall risk to groundwater quality posed by the disposal of road runoff to the ground, either by direct discharge or through infiltrations.

2.1.31 The assessment is based on an examination of the 'Source-Pathway-Receptor protocol' (S-P-R). The principle applied in this assessment is that all components of the S-P-R linkage have to be present to create a pollutant linkage. The receptor in the assessment is groundwater. The presence of the pollutant in itself does not pose a threat to groundwater if there is no identifiable pathway. Further details of groundwater are provided in **Chapter 10**.

2.1.32 Each component is identified and given a weighting factor. This is to recognise that each may have a greater or lesser influence on the magnitude of the risk to groundwater. Each component is given a risk score (low, medium or high) and multiplied by the weighing factor. The overall cumulative assessment of risk score is obtained and classed using suggested ratings from HD45/09:

- Overall risk score <150 = Low Risk of Impact
- Overall risk score 150 – 250 = Medium Risk of Impact
- Overall risk score >250 = High Risk Impact

### Method D – Assessment of Pollution Impacts from Spillages

2.1.33 Method D assesses the impact of accidental spillages on the road network and is carried out using HAWRAT. It estimates the risk of a collision (involving spillage) occurring and the risk, that if a spillage has occurred, of the pollutant reaching and impacting onto the receiving waterbodies.

2.1.34 It is initially assessed without any mitigation and the risk is expressed as the probability of an incident in any one year. If the results show that mitigation is required, the risk is reduced using a pollution risk reduction factor for each mitigation measure. The following information is required for assessing the risk:

- Road and junction type and urban/ rural setting
- The length of road draining to an outfall in each category
- The Annualised Average Daily Traffic (AADT) two-way flow for each vehicle category
- The percentage of AADT flow that comprises Heavy Good Vehicles (HGVs)
- The probability of a serious pollution incident occurring as a result of a serious spillage (expressed as a factor based on the response time to the site)

#### *Spillage factor*

2.1.35 The normal acceptable risk of a serious pollution risk occurring is anywhere the annual probability is predicted to be less than 1%. In areas where road discharges are within close proximity to a natural wetland, designated wetland, SSSI, SAC, SPA, Ramsar sites or where important drinking water supplies and abstraction, the acceptable spillage risk threshold is much lower at 0.5% annual probability (i.e. 1 in 200 years).

2.1.36 The probability of a serious accidental spillage is calculated as follows:

$$P_{SPL} = RL \times SS \times (AADT \times 10^{-9}) \times (\%HGV \div 100)$$

Where:

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

RL = road length, within each drainage catchment draining to each watercourse

SS = Serious spillage rate, based on the type of junction and the road setting

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

Where:

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

$P_{POL}$ = the probability, given a spillage, that a serious pollution incident will take place. This takes into account a risk reduction factor, dependent upon emergency response times and the type of watercourse

2.1.37 The risk is initially assessed without any mitigation and subsequently and re-assessed on the basis of embedded mitigation being incorporated into the Proposed Scheme design. The initial risk without mitigation was found to be P, and the risk of the final design with embedded mitigation ($P_{EMB}$) was calculated as:

$$P_{EMB} = P \times R_F$$

Where:

$R_F$ is the reduction factor based on assumptions about the type of SuDS system incorporated as embedded mitigation within the final design. Based on DMRB guidance a prescribed reduction factor of 0.8 was used, as this is considered a conservative estimate of a 20% reduction in pollutants which may be achieved by a short length of filter drain.

2.1.38 The acceptable risk of a serious pollution incident will be where the annual probability ($P_{SPL}$) is predicted to be less than 0.5%. This suggested threshold level is referenced within DMRB as being applicable for proposed schemes where road runoff discharges in close proximity (<1km) to designated SSSIs SPAs and SACs.

# 3 Results of Potential Impacts

3.1.1 The assessment results presented below assume pre-mitigation conditions to determine worst-case scenarios and inform mitigation requirements to the Proposed Scheme.

3.1.2 Within each of the assessment subheadings, details of the assessments are first presented; thereafter, the potential magnitude and significance of impacts are given for each drainage network based on the methodology and criteria described in **Chapter 11**.

### Pre-mitigation Routine Runoff to Surface Waters (Method A)

3.1.3 The assessment for routine runoff to surface waters has been undertaken using the three step HAWRAT process. As detailed in **section 2** if the toxicity levels yield a 'pass' at any stage of the process, no further assessment is required. In Scotland, however, it is a statutory requirement to provide two levels of SuDS to control and treat surface water runoff. Therefore, filter drains and SuDS basins have been incorporated into the Proposed Scheme drainage design as 'embedded mitigation' for each drainage network, including those which predicted a 'pass' at Step 2. In cases where a 'fail' has been predicted at Step 2, Step 3 has been applied.

3.1.4 Step 3 is repeated with 'enhanced' treatment until all failures are eliminated. HAWRAT spreadsheet outputs are provided in **Annex 1**: Calculations of this Appendix. Results of the assessment are summarised in **Table 3**.

*Table 3: Method A Results Table*

| Network | Receiving Water Course $Q_{95}$ ($m^3/s$) | Drained Road Area (incl. verges) (ha) | Step | Impact (Average Annual Concentration) | | | | | Required mitigation to produce 'Pass' result |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Average Annual Concentration Soluble Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| 417 | River Spey (MW9.1) | 8.75 | 2/1 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes without mitigation – two levels still included in design |
| | 2.021 | | | 0.00 | 0.01 | | 0.08 | 6 | |
| 427 | Unnamed watercourse (W9.49a) | 2.77 | 3 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes with two levels of treatment i.e. filter drain and pond |
| | 0.0013 | | | 0.58 | 1.40 | | 0.10 | 12 | |
| 434 | River Spey (MW9.1) | 6.26 | 2/1 | Pass | Pass | Pass (Alert Protected Area) | No | No | Passes without mitigation – two levels still included in design |
| | 2.55 | | | 0.00 | 0.01 | | 0.19 | - | |
| 458 | Allt Eoghainn (MW9.4) | 5.36 | 2/1 | Pass | Pass | Pass | Yes | No | Passes without mitigation – two levels still included in design |
| | 0.013 | | | 0.18 | 0.57 | | 0.06 | 98 | |
| 461 | Unnamed watercourse (W9.11) | 0.206 | 2/1 | Pass | Pass | Pass | Yes | No | Passes without mitigation – two levels still included in design |

| Network | Receiving Water Course $Q_{95}$ ($m^3/s$) | Drained Road Area (incl. verges) (ha) | Step | Impact (Average Annual Concentration) | | | | | Required mitigation to produce 'Pass' result |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Average Annual Concentration Soluble Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| | 0.0036 | | | 0.27 | 0.83 | | 0.01 | 18 | |
| 474 | Milton/ Inverton Burn (MW9.6) | 7.64 | 2/1 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | Yes | No | Passes without mitigation – two levels still included in design |
| | 0.137 | | | 0.05 | 0.14 | | 0.09 | 25 | |
| 487 | River Spey (MW9.1) | 1.1 | 2/1 | Pass | Pass | Pass (Alert Protected Area) | No | No | Passes without mitigation – two levels still included in design |
| | 3.1 | | | 0.00 | 0.00 | | 0.13 | - | |
| 490 | River Spey (MW9.1) | 0.85 | 2/1 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes without mitigation – two levels still included in design |
| | 3.1 | | | 0.00 | 0.00 | | 0.35 | - | |
| 493 | River Spey (MW9.1) | 3.1 | 2/1 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes without mitigation – two levels still included in design |
| | 3.1 | | | 0.00 | 0.00 | | 0.33 | - | |
| 502 | River Spey (MW9.1) | 1.91 | 2/1 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes without mitigation – two levels still included in design |

| Network | Receiving Water Course $Q_{95}$ ($m^3/s$) | Drained Road Area (incl. verges) (ha) | Step | Impact (Average Annual Concentration) | | | | | Required mitigation to produce 'Pass' result |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Average Annual Concentration Soluble Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| | 3.24 | | | 0.00 | 0.00 | | 0.08 | 1 | |
| 507 | Unnamed watercourse (W9.21) | 0.545 | 3 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes with two levels of treatment i.e. filter drain and SuDS basin |
| | 0.001 | | | 0.45 | 0.77 | | 0.08 | 50 | |
| 509 | Unnamed watercourse (W9.21) | 1.73 | 3 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes with two levels of treatment i.e. filter drain and pond |
| | 0.001 | | | 0.58 | 1.39 | | 0.09 | 23 | |
| 513 | Unnamed watercourse (W9.26) | 2.75 | 3 | Pass | Fail | Pass (Alert Protected Area) | No | No | Passes with two levels of treatment (i.e. filter drain and pond) for sediment-bound pollutants and soluble Cu; however, enhanced treatment required for soluble Zn. Passes with swale incorporated as second stage of treatment |
| | 0.001 | | | 0.73 | 1.74 | | 0.13 | - | |
| 530 | Unnamed watercourse (W9.27) | 0.22 | 3 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes without mitigation – two levels still included in design |
| | 0.001 | | | 0.14 | 0.43 | | 0.00 | 37 | |

| Network | Receiving Water Course $Q_{95}$ ($m^3/s$) | Drained Road Area (incl. verges) (ha) | Step | Impact (Average Annual Concentration) | | | | | Required mitigation to produce 'Pass' result |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Average Annual Concentration Soluble Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| 534 | Raitts Burn (MW9.14) | 1.65 | 2/1 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | Yes | No | Passes without mitigation – two levels still included in design |
| | 0.034 | | | 0.03 | 0.09 | | 0.02 | 36 | |
| 537 | Unnamed watercourse (W9.33) | 5.88 | 3 | Fail | Fail | Pass (Alert Protected Area) | Yes | No | Passes with two levels of treatment (i.e. filter drain and pond) for sediment-bound pollutants; however, enhanced treatment required for soluble Cu & Zn Passes with swale incorporated as second stage of treatment |
| | 0.001 | | | 1.12 | 2.73 | | 0.10 | 44 | |
| 561 | Unnamed watercourse (MW9.17) | 3.3 | 3 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes with two levels of treatment i.e. filter drain and vortex separator |
| | 0.006 | | | 0.36 | 0.56 | | 0.30 | - | |
| 563 | Unnamed watercourse (MW9.17) | 4.05 | 2/1 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes with two levels of treatment i.e. filter drain and vortex separator |
| | 0.006 | | | 0.38 | 0.59 | | 0.30 | - | |

*Table 4: Method A cumulative assessments results (Soluble Pollutants – 1km)*

| Cumulative Network (within 1km) | Approx. distance between outfalls (m) | Receiving Watercourse $Q_{95}$ ($m^3/s$) | Combined Drained Road Area (incl. verges) (ha.) | Step | Impact (Average Annual Concentration) | | | | | Proposed Mitigation (incl. minimum two levels requested by SEPA) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average Annual Concentration Soluble-Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| 490 + 493 | 0m (same outfall) | River Spey (MW9.1) | 3.9 | 2 | Pass | Pass | N/A | N/A | N/A | Passes without mitigation – two levels still included in design |
| | | 3.0 | | | 0.00 | 0.00 | | N/A | N/A | |
| 507 + 509 | 73m | Unnamed watercourse (W9.21) | 2.3 | 3 | Pass | Pass | N/A | N/A | N/A | Passes with two levels of treatment i.e. filter drain and pond |
| | | 0.001 | | | 0.65 | 1.55 | | N/A | N/A | |
| 561 + 563 | 2m (adjacent outfalls) | Unnamed watercourse (MW9.17) | 7.3 | 3 | Fail | Pass | N/A | N/A | N/A | Passes with two levels of treatment (i.e. filter drain and tank & vortex separator) for sediment-bound pollutants and soluble Zn; however, enhanced treatment required for soluble Cu. Passes with swale incorporated as second stage of treatment |
| | | 0.006 | | | 0.60 | 0.93 | | N/A | N/A | |

*Table 5: Method A cumulative assessments results (Sediment-bound Pollutants – outfalls within 100m)*

| Cumulative Network (within 100m) | Distance between outfalls (m) | Receiving Watercourse $Q_{95}$ ($m^3/s$) | Combined Drained Road Area (incl. verges) (ha.) | Step | Impact (Average Annual Concentration) | | | | | Proposed Mitigation (incl. minimum two levels requested by SEPA) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average Annual Concentration Soluble-Soluble – Acute Impact | | Sediment – Chronic Impact | | | |
| | | | | | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | HAWRAT Threshold Pass/Fail | Sediment Accumulating? Yes/No | Extensive? Yes/No | |
| | | | | | Copper concentration (µg/l) | Zinc concentration (µg/l) | | Low flow velocity (m/s) | Deposition Index | |
| 490 + 493 | 0m (same outfall) | River Spey (MW9.1) | 3.9 | 2 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes without mitigation – two levels still included in design |
| | | 3.0 | | | 0.00 | 0.00 | | 0.32 | - | |
| 507 + 509 | 73m | Unnamed watercourse (W9.21) | 2.3 (0.545 + 1.76) | 3 | Pass | Pass | Pass (Alert Protected Area) | Yes | No | Passes with two levels of treatment i.e. filter drain and pond |
| | | 0.001 | | | 0.65 | 1.55 | | 0.09 | 23 | |
| 561 + 563 | 2m (adjacent outfalls) | Unnamed watercourse (MW9.17) | 7.1 (3.3 + 3.8) | 3 | Pass | Pass | Pass (Alert Protected Area & D/S Structure) | No | No | Passes with treatment i.e. filter drain, tank and vortex separator |
| | | 0.005 | | | 0.32 | 0.99 | | 0.30 | - | |

3.1.5 The results in **Table 3**, **Table 4** and **Table 5** highlight that, where necessary, incorporation of appropriate levels of mitigation reduces risk from routine runoff on receiving watercourses. The resulting magnitude of impact from routine runoff on each receiving watercourse is, therefore, predicted to be **Negligible**.

### Detailed Assessment from Routine Runoff to Surface Waters (Method B)

3.1.6 This is no requirement for a detailed assessment as the Proposed Scheme incorporates SuDS (typically two treatment levels) on all networks and outfalls. SuDS provision will be in line with national and local planning policy and SEPA 'best-practice' guidance for trunk road drainage.

### Assessment of Pollution Impacts from Routine Runoff on Groundwater (Method C)

3.1.7 Assessments of potential impacts to groundwater were undertaken for both embedded mitigation techniques that are incorporated into the design (i.e. filter drains and SuDS basins). Details of ground conditions were obtained using information outlined in **Chapter 10**, along with British Geological Survey (BGS) data and ground investigation (GI) data. The site locations are those proposed for the SuDS basins for each drainage network.

*Table 6: Method C Results Table*

| Network | Overall Risk of Impact Score for Filter Drains | Overall Risk of Impact Score for SuDS Basin |
|---|---|---|
| 417 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 427 | 200 (Medium Risk of Impact) | 230 (Medium Risk of Impact) |
| 434 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 458 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 461 | 160 (Medium Risk of Impact) | 190 (Medium Risk of Impact) |
| 474 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 487 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 490 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 493 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 502 | 160 (Medium Risk of Impact) | 190 (Medium Risk of Impact) |
| 507 | 200 (Medium Risk of Impact) | 230 (Medium Risk of Impact) |
| 509 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 513 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 530 | 185 (Medium Risk of Impact) | 215 (Medium Risk of Impact) |

| Network | Overall Risk of Impact Score for Filter Drains | Overall Risk of Impact Score for SuDS Basin |
|---|---|---|
| 534 | 200 (Medium Risk of Impact) | 230 (Medium Risk of Impact) |
| 537 | 180 (Medium Risk of Impact) | 210 (Medium Risk of Impact) |
| 561 | 200 (Medium Risk of Impact) | N/A |
| 563 | 200 (Medium Risk of Impact) | N/A |

3.1.8 The summary of results in **Table 6** supported by detailed results in **Annex 1**: Calculations, show that the risk for potential impacts to groundwater is **Medium** due to the presence of higher permeable soil and drift geology conditions within the Proposed Scheme extents; thus SuDS should be lined or part-lined to restrict infiltration.

### Assessment of Pollution Impacts from Spillages (Method D)

3.1.9 Assessments of potential pollution impacts from spillages impacts to groundwater were undertaken using a conservative approach; the calculations are based on the longest road drainage catchment area of the Proposed Scheme (Network 434) and details for the proposed junctions at Newtonmore and Kingussie. The results have been presented (in years) for a system without mitigation and for the final design incorporating SuDS as 'embedded' mitigation. The Annual Spillage Probability (ASP) has been presented as a percentage output on the basis of the final design. Results from the HAWRAT excel spreadsheet are provided in **Annex 1:** Calculations to this Appendix.

*Table 7: Method D Results Table*

| Return period scenario / Road section assessment | Return period without pollution reduction measures (years) | Return Period with Embedded Pollution reduction measures (years) | ASP based on Final Design Incorporating Embedded Mitigation (%) |
|---|---|---|---|
| Longest outfall (surface water spillage) | 2233 | 2791 | 0.04 |
| Longest outfall (groundwater spillage) | 3349 | 4186 | 0.02 |
| Newtonmore Junction (surface water spillage) | 2665 | 3331 | 0.03 |
| Newtonmore Junction (groundwater spillage) | 3859 | 4823 | 0.02 |
| Kingussie Junction (surface water spillage) | 10727 | 13409 | 0.007 |
| Kingussie Junction (groundwater spillage) | 16091 | 20114 | 0.005 |

3.1.10 **Table 7** indicates that calculated ASP for the Proposed Scheme is considerably less than the accepted 0.5% value for serious pollution incident for protected areas. The magnitude of risk

from accidental spillages on surface water and groundwater is predicted to be negligible, but given that the sensitivity of the receiving watercourses, spillage containment has been provided as 'embedded' mitigation (shut-off valves) within the Proposed Scheme design.

# 4 Potential Impact Assessment

4.1.1 This section provides an overview of the potential impacts on water quality that may arise as a result of the Proposed Scheme. The potential impact assessment has been carried out on the assumption that the final design incorporates embedded mitigation as described in **Section 3**.

4.1.2 **Table 8** presents a summary of the potential water quality impacts for a range of water features which were identified for surface water and groundwater receptors. Note that each water feature has been assigned a sensitivity classification on the basis of the baseline information presented in **Appendix 11.1**. In accordance with the approach outlined in **section 11.2** of **Chapter 11**, the assessment applies the sensitivity classification along with the predicted magnitude of change to produce an overall significance of impact for each water feature.

*Table 8: Potential Water Quality Impacts*

| Drainage Network | Water Feature Location | Receptor Water Quality Sensitivity | HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation | Magnitude | Significance of Impact |
|---|---|---|---|---|---|
| **Receptor: Surface Water Quality** | | | | | |
| 417 | River Spey (MW9.1) ch. 41,800 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 427 | Unnamed watercourse (W9.49a) ch. 42,940 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 434 | River Spey (MW9.1) ch. 43,450 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 458 | Allt Eoghainn (MW9.4) ch. 45,800 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 461 | Unnamed watercourse (W9.11) ch. 43,050 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 474 | Milton/ Inverton Burn (MW9.6) ch. 47,400 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 487 | River Spey (MW9.1) ch. 48,550 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 490 | River Spey (MW9.1) ch. 49,250 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 493 | River Spey (MW9.1) ch. 49,250 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 502 | River Spey (MW9.1) ch. 50,450 | Very High | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 507 | Unnamed watercourse (MW9.10) ch. 50,750 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 509 | Unnamed watercourse (MW9.10) ch. 50,750 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 513 | Unnamed watercourse (W9.26) ch. 51,460 | Low | Failure of soluble Zn from routine runoff risk identified by HAWRAT (Method A). ASP <0.5% (Method D) | Minor Adverse | Neutral |

| Drainage Network | Water Feature Location | Receptor Water Quality Sensitivity | HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation | Magnitude | Significance of Impact |
|---|---|---|---|---|---|
| 530 | Unnamed watercourse (W9.27) ch. 52,850 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 534 | Raitts Burn (MW9.14) ch. 53,450 | Medium | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 537 | Unnamed watercourse (W9.33) ch. 53,800 | Low | Failure of soluble Cu and Zn from routine runoff risk identified by HAWRAT (Method A). EQS value for Cu is exceeded ASP <0.5% (Method D) | Minor Adverse | Neutral |
| 561 | Unnamed watercourse (MW9.17) ch. 56,160 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| 563 | Unnamed watercourse (MW9.17) ch. 56,160 | Low | No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D) | Negligible | Neutral |
| **Receptor: Groundwater Quality** | | | | | |
| 417 | River Spey (MW9.1) ch. 41,800 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 427 | Unnamed watercourse (W9.49a) ch. 42,940 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 434 | River Spey (MW9.1) ch. 43,450 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 458 | Allt Eoghainn (MW9.4) ch. 45,800 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 461 | Unnamed watercourse (W9.11) ch. 43,050 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 474 | Milton/ Inverton Burn (MW9.6) ch. 47,400 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 487 | River Spey (MW9.1) ch. 48,550 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 490 | River Spey (MW9.1) ch. 49,250 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 493 | River Spey (MW9.1) ch. 49,250 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 502 | River Spey (MW9.1) ch. 50,450 | Very High | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 507 | Unnamed watercourse (W9.21) ch. 50,750 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 509 | Unnamed watercourse (W9.21) ch. 50,750 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 513 | Unnamed watercourse (W9.26) ch. 51,460 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 530 | Unnamed watercourse (W9.27) ch. 52,850 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 534 | Raitts Burn (MW9.14) ch. 53,450 | Medium | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 537 | Unnamed watercourse (W9.33) ch. 53,800 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |

| Drainage Network | Water Feature Location | Receptor Water Quality Sensitivity | HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation | Magnitude | Significance of Impact |
|---|---|---|---|---|---|
| 561 | Unnamed watercourse (MW9.17) ch. 56,160 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |
| 563 | Unnamed watercourse (MW9.17) ch. 56,160 | Low | No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D) | Negligible | Neutral |

# 5 Conclusion and Recommendations

5.1.1 This appendix has presented further information on the water quality assessments undertaken during the EIA to support the findings reported in **Chapter 11**.

*Surface Water*

5.1.2 Adverse impacts (failures) of water quality assessments can be appropriately mitigated typically using two-level SuDS management for treatment for road surface water runoff. Two point source discharges were found to produce a 'Fail' result for acute pollution impacts after inclusion of two levels of treatment in the Proposed Scheme design (i.e. filter drains and pond).

5.1.3 Network 513 failed for soluble copper but did not exceed EQS values. Network 537 failed for copper and zinc and exceeded the EQS values for copper. However, using the assessment methodology **in section 11.2** of **Chapter 11**, the Low sensitivity value of these watercourses, coupled with the Minor Adverse magnitude of impact, results in an overall **Neutral** significance of impact.

5.1.4 In these instances a 'Fail' of the HAWRAT routine runoff assessments does not necessarily require a redesign or adoption of further mitigation; however, supplementary assessments were carried out using alternate treatment measures (i.e. filter drain and grass-lined channel/ swale) and were found to produce 'Pass' results (see **Annex 1**: Calculations) . It is therefore recommended that alternate SuDS measures are incorporated at these locations to optimise treatment efficiency.

5.1.5 As outlined in **Table 8**, it is considered that there is no likely significant water quality impacts associated with the Proposed Scheme if appropriate mitigation measures are included, as set out in **section 11.5** of **Chapter 11**. This information has been further presented in an evaluation of residual effects for each of the receptors within **Chapter 11**.

*Groundwater*

5.1.6 Medium risk values have been determined for all drainage networks throughout the Project 9 Proposed Scheme extent. This is translated into a pre-mitigation magnitude of impact vale of Moderate Adverse.

5.1.7 Slight to Very Large Adverse significance of impact can be mitigated to a **Neutral** value by lining SuDS to prevent infiltration. It is noted that infiltration is a favoured SuDS solution by SEPA; however, at present there is insufficient information regarding local conditions to design bespoke solutions which might otherwise allow infiltration.

5.1.8 As permanent water is required at several SuDS outlets (for water quality treatment and/ or ecological enhancement), the soil below the pool area should be sufficiently impermeable to maintain the pool. As Project 9 is located in an area of highly permeable strata, a liner should be required to prevent pools drying out.

### *Cumulative Impacts*

5.1.9 Cumulative impact assessments have found a 'Fail' result for acute pollution (copper) at one location post-mitigation (Networks 561/ 563). Both networks comprise filter drains, tank sewer and vortex separator, and discharge to the watercourse via a swale. However, as the swale is not equal to, or greater than, the roadway length draining to it (and therefore not considered to be a fully effective stage of treatment), a precautionary approach has been taken and their treatment efficiency have not been included in the overall assessment.

5.1.10 Further assessment has been carried out that does incorporate the treatment efficiency for swales/ grassed channels (provided in HD33/16) to demonstrate that optimising swale length, and therefore treatment, would suitably treat runoff to produce a 'Pass' result. A recommendation is made to further investigate options to maximise length of swale at detailed design stage.

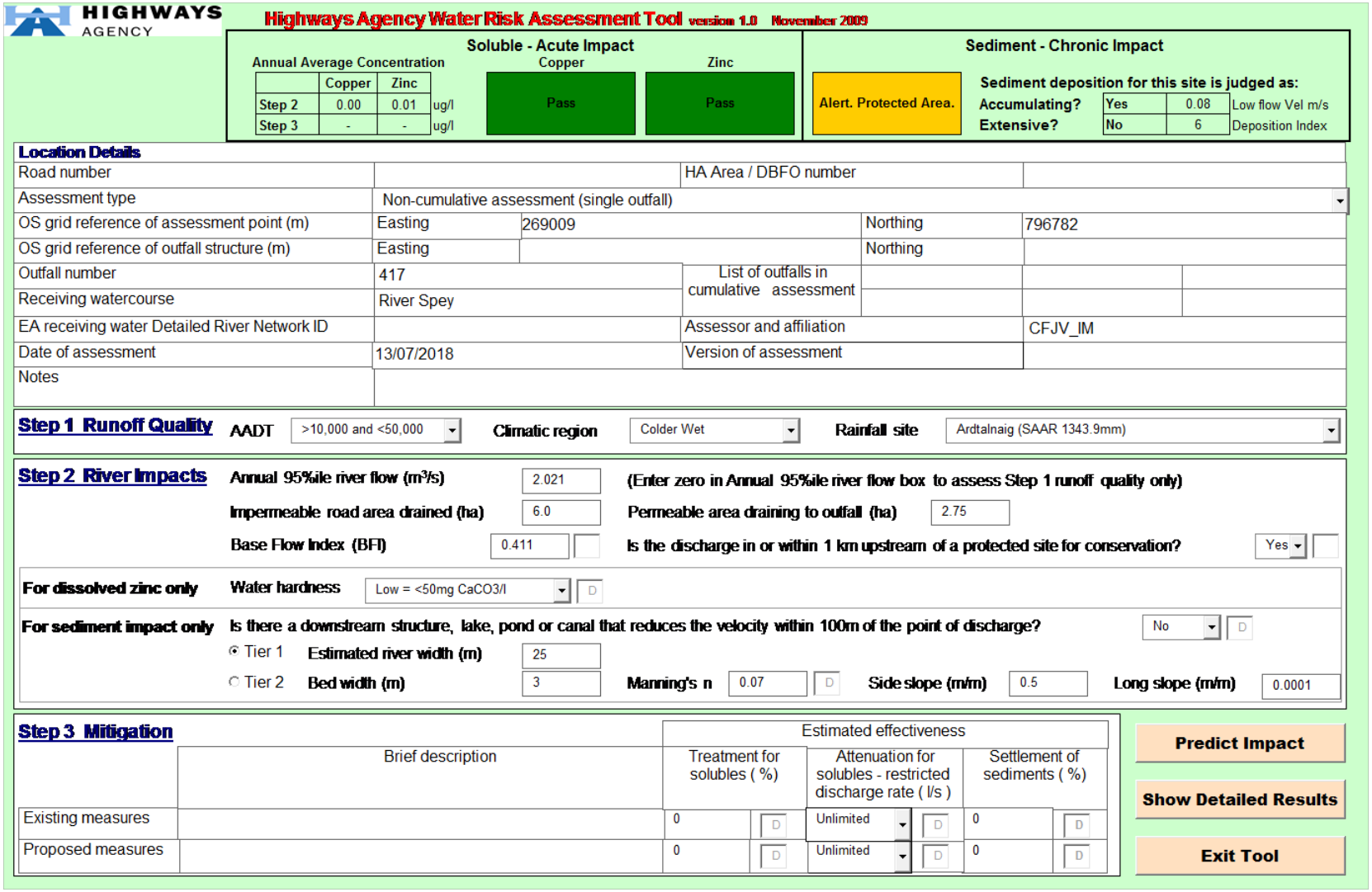
5.1.11 Using the assessment methodology in **section 11.2** of **Chapter 11**, the Low sensitivity value of the receiving watercourse from both Networks 561 and 563, coupled with the Minor Adverse magnitude of impact, results in a **Neutral** significance of impact. Overall, an improvement in water quality is predicted compared with the baseline conditions due to the first-time application of SuDS.

### *Residual Impacts*

5.1.12 As the existing drainage system throughout the Proposed Scheme extent considerably predates the employment of SuDS techniques, and any treatment currently provided is incidental and does not meet the requirements of current standards, there is no facility to control and treat routine road surface runoff effectively or contain accidental spillages of oil or other contaminants. Consequently, an overall improvement in water quality is predicted compared with the baseline conditions due to the first-time application of SuDS resulting in a residual **Slight Beneficial** impact.

# Annex 1: Calculations

*Figure 1: Method A Calculations for SuDS 417*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.01 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.08 | Low flow Vel m/s |
| Extensive? | No | 6 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 269009 | | Northing | 796782 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 417 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | River Spey | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM | |
| Date of assessment | 13/07/2018 | Version of assessment | | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 2.021 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 6.0 Permeable area draining to outfall (ha): 2.75

Base Flow Index (BFI): 0.411 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 25

Tier 2 Bed width (m): 3 Manning's n: 0.07 D Side slope (m/m): 0.5 Long slope (m/m): 0.0001

**Step 3 Mitigation**

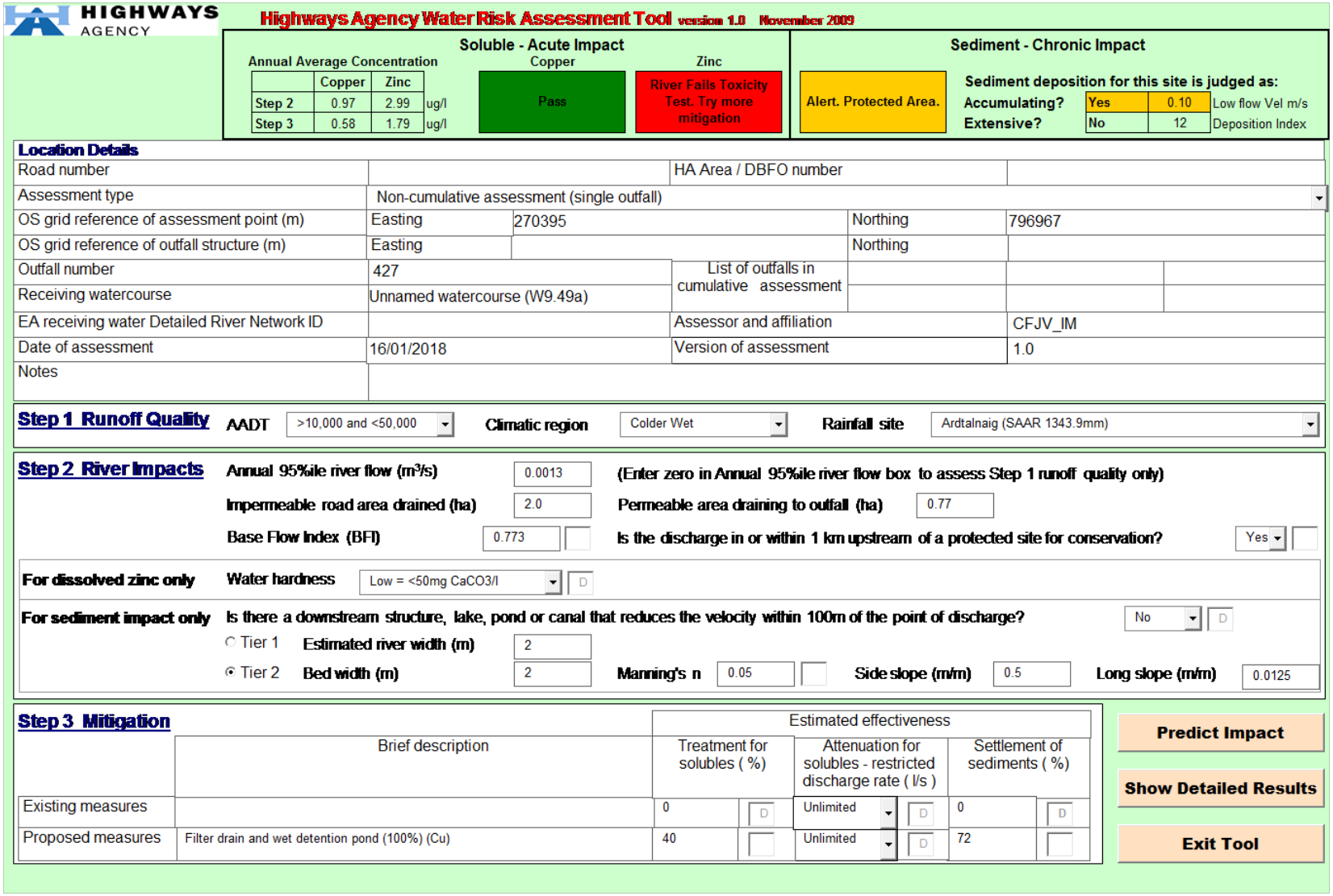
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | | Attenuation for solubles - restricted discharge rate ( l/s ) | | Settlement of sediments ( %) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | | 0 | D |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

Predict Impact

Show Detailed Results

Exit Tool

*Figure 2: Method A Calculations for SuDS 427 (copper)*



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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.97 | 2.99 | ug/l |
| Step 3 | 0.58 | 1.79 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.10 | Low flow Vel m/s |
| Extensive? | No | 12 | Deposition Index |

**Location Details**

| | | | | |
|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | |
| OS grid reference of assessment point (m) | Easting 270395 | | Northing | 796967 |
| OS grid reference of outfall structure (m) | Easting | | Northing | |
| Outfall number | 427 | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.49a) | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 16/01/2018 | Version of assessment | 1.0 | |
| Notes | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.0013 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.0 | Permeable area draining to outfall (ha): 0.77

Base Flow Index (BFI): 0.773 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 2

Tier 2 — Bed width (m): 2 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0125

**Step 3 Mitigation**

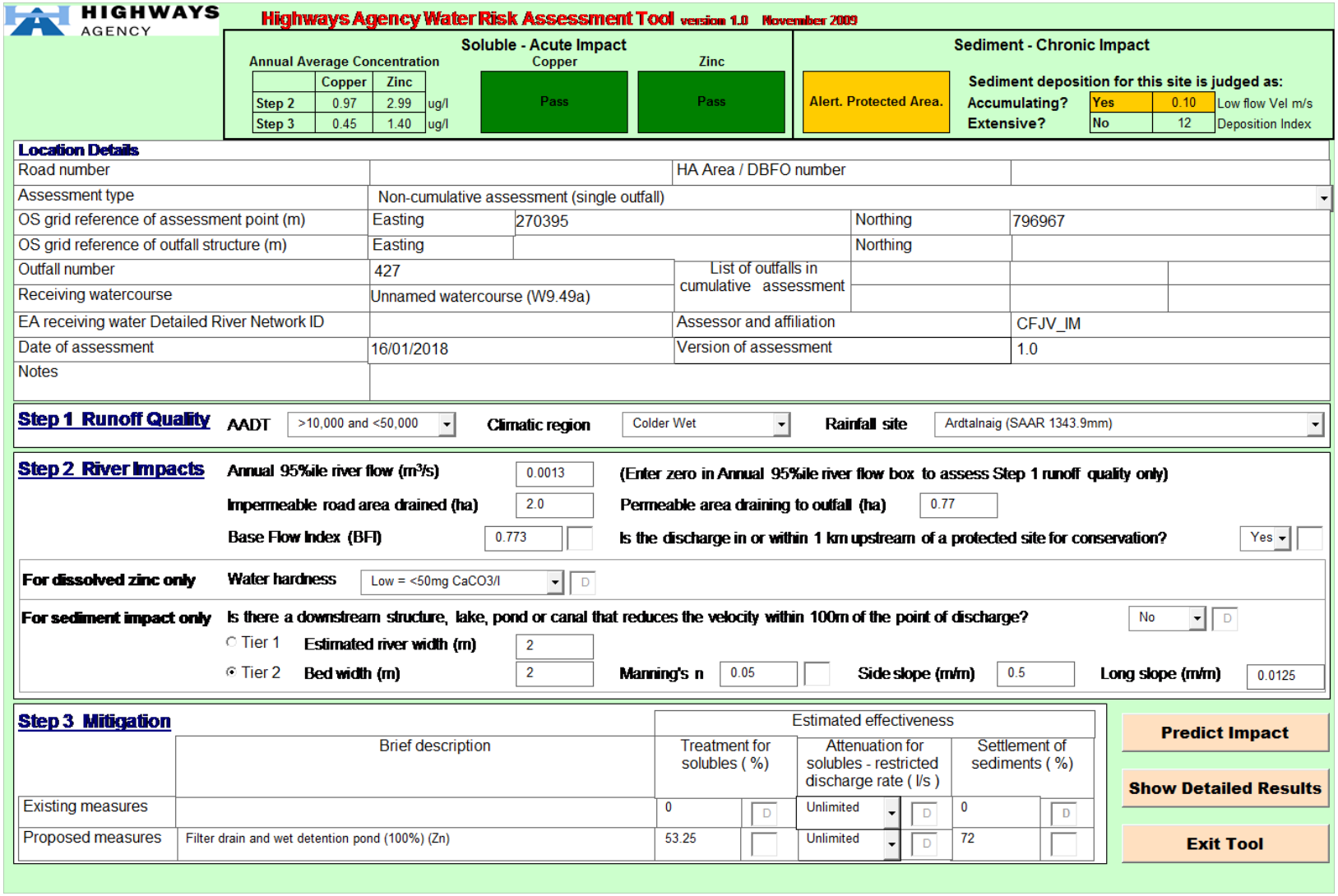
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Cu) | 40 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 3: Method A Calculations for SuDS 427 (zinc)*



HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.97 | 2.99 | ug/l |
| Step 3 | 0.45 | 1.40 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.10 | Low flow Vel m/s |
| Extensive? | No | 12 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 270395 | Northing | 796967 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 427 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (W9.49a) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM | |
| Date of assessment | 16/01/2018 | Version of assessment | | 1.0 | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.0013 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.0 | Permeable area draining to outfall (ha): 0.77

Base Flow Index (BFI): 0.773 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 2

Tier 2 — Bed width (m): 2 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0125

**Step 3 Mitigation**

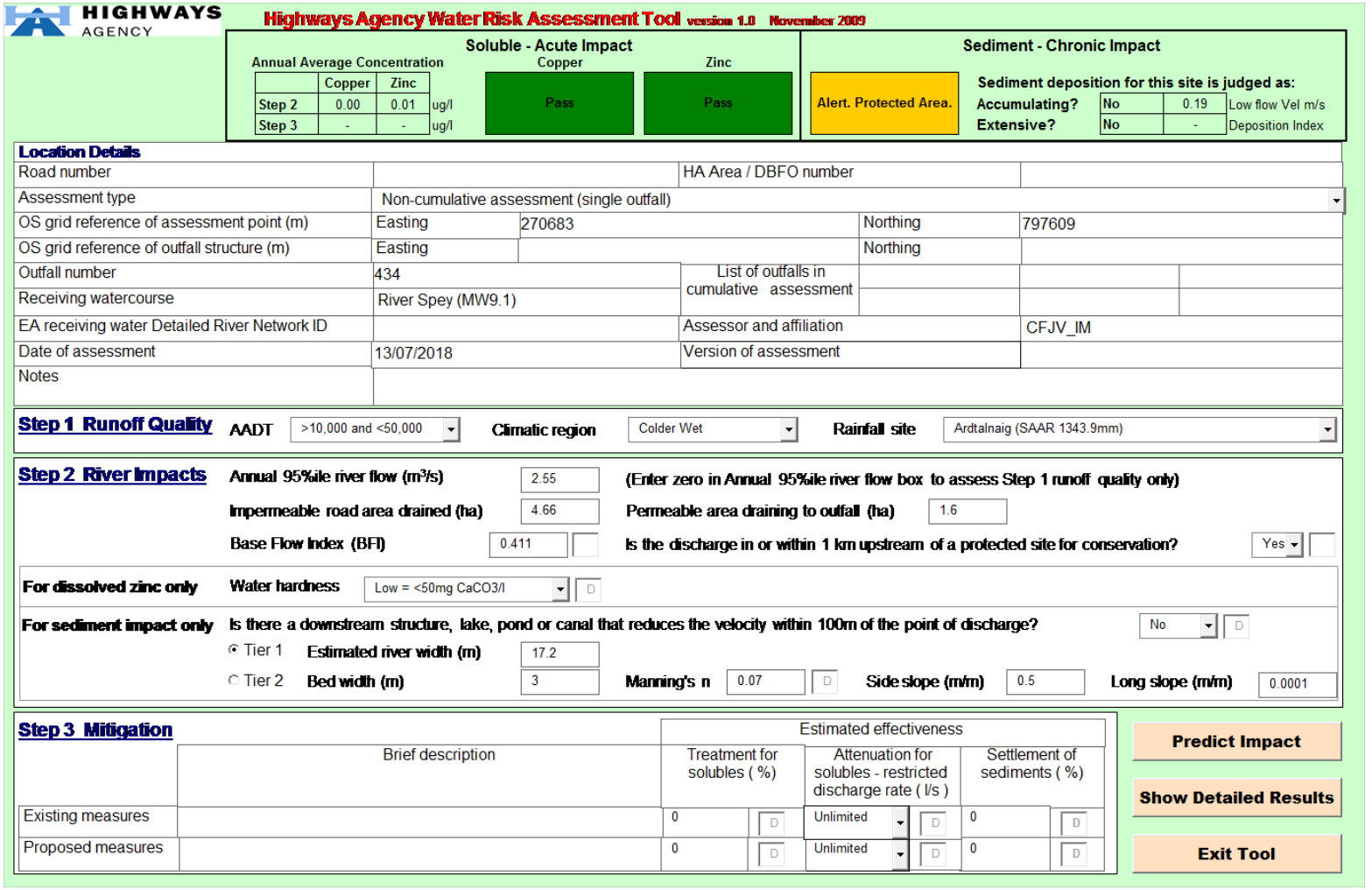
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Zn) | 53.25 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 4: Method A Calculations for SuDS 434*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.01 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.19 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 270683 | Northing | 797609 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 434 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 13/07/2018 | Version of assessment | | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 2.55 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.66 | Permeable area draining to outfall (ha): 1.6

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

**For dissolved zinc only** — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 17.2

Tier 2 — Bed width (m): 3 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

**Step 3 Mitigation**

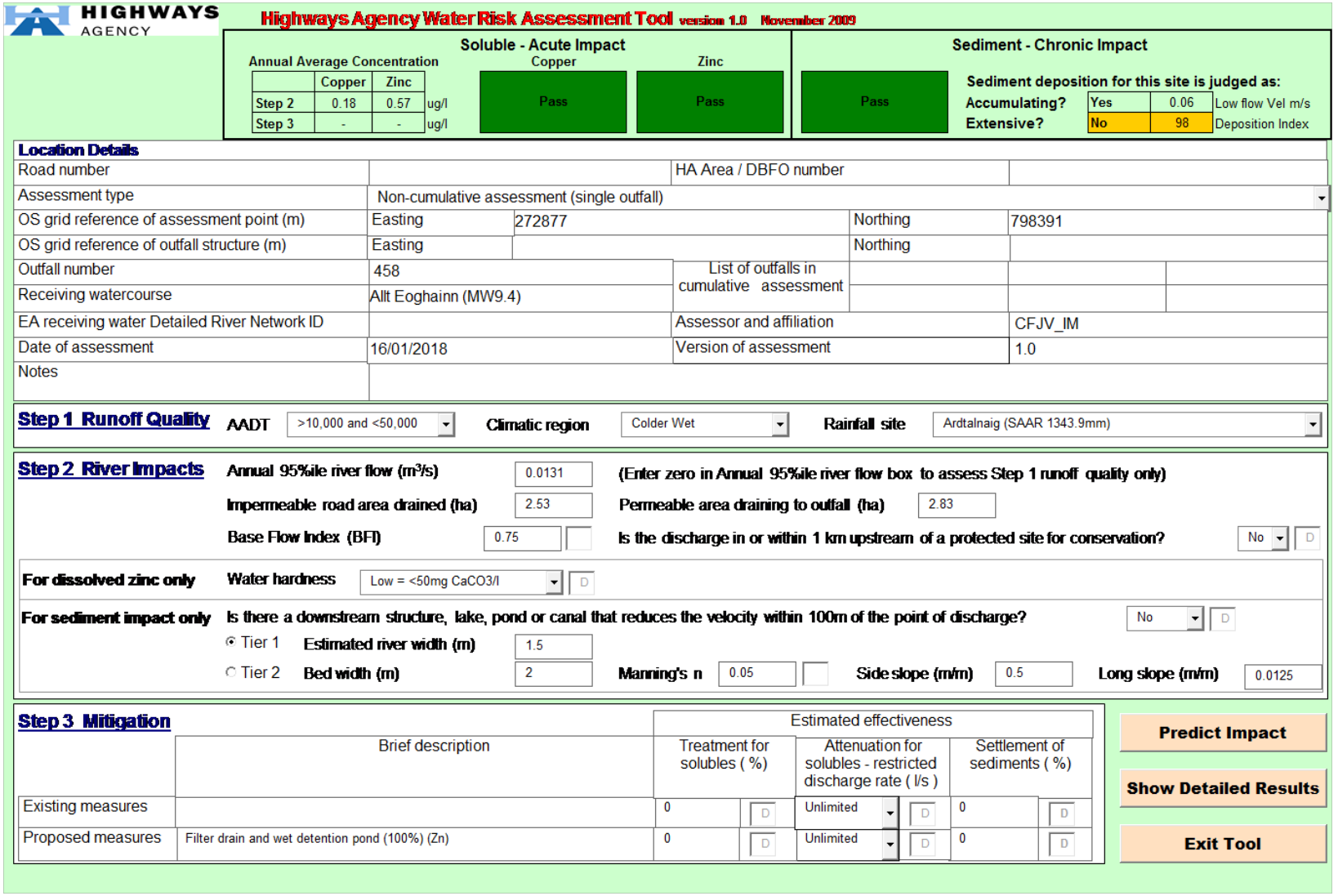
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 5: Method A Calculations for SuDS 458*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.18 | 0.57 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Pass

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.06 | Low flow Vel m/s |
| Extensive? | No | 98 | Deposition Index |

**Location Details**

| | | | |
|---|---|---|---|
| Road number | | HA Area / DBFO number | |
| Assessment type | Non-cumulative assessment (single outfall) | | |
| OS grid reference of assessment point (m) | Easting 272877 | Northing | 798391 |
| OS grid reference of outfall structure (m) | Easting | Northing | |
| Outfall number | 458 | List of outfalls in cumulative assessment | |
| Receiving watercourse | Allt Eoghainn (MW9.4) | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM |
| Date of assessment | 16/01/2018 | Version of assessment | 1.0 |
| Notes | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.0131 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.53 | Permeable area draining to outfall (ha): 2.83

Base Flow Index (BFI): 0.75 | Is the discharge in or within 1 km upstream of a protected site for conservation? No

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.5

Tier 2 — Bed width (m): 2 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0125

**Step 3 Mitigation**

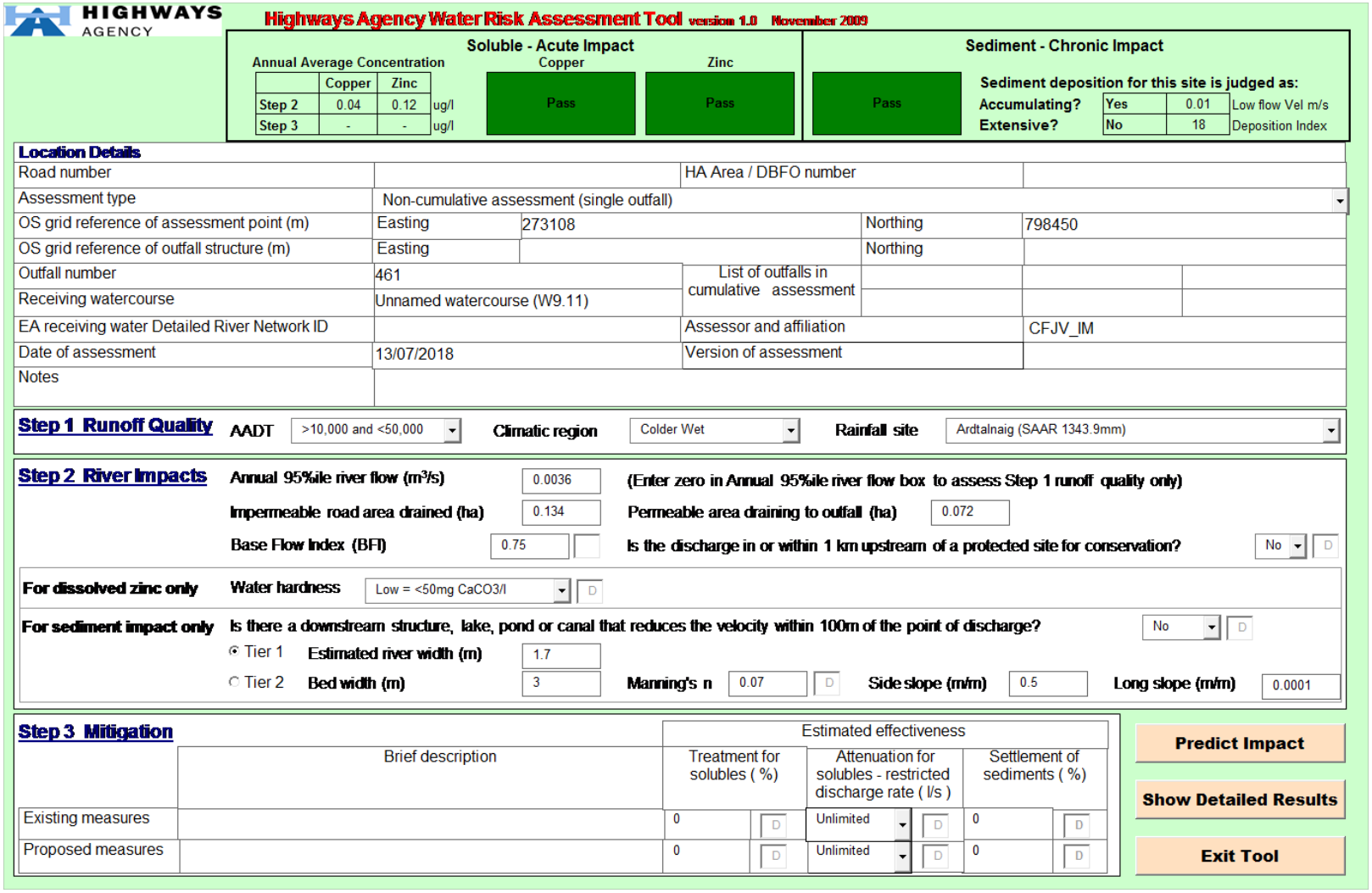
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Zn) | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 6: Method A Calculations for SuDS 461*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.04 | 0.12 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Pass

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.01 | Low flow Vel m/s |
| Extensive? | No | 18 | Deposition Index |

**Location Details**

| | | | |
|---|---|---|---|
| Road number | | HA Area / DBFO number | |
| Assessment type | Non-cumulative assessment (single outfall) | | |
| OS grid reference of assessment point (m) | Easting 273108 | Northing | 798450 |
| OS grid reference of outfall structure (m) | Easting | Northing | |
| Outfall number | 461 | List of outfalls in cumulative assessment | |
| Receiving watercourse | Unnamed watercourse (W9.11) | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM |
| Date of assessment | 13/07/2018 | Version of assessment | |
| Notes | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.0036 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.134 | Permeable area draining to outfall (ha): 0.072

Base Flow Index (BFI): 0.75 | Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.7

Tier 2 — Bed width (m): 3 | Manning's n: 0.07 D | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

**Step 3 Mitigation**

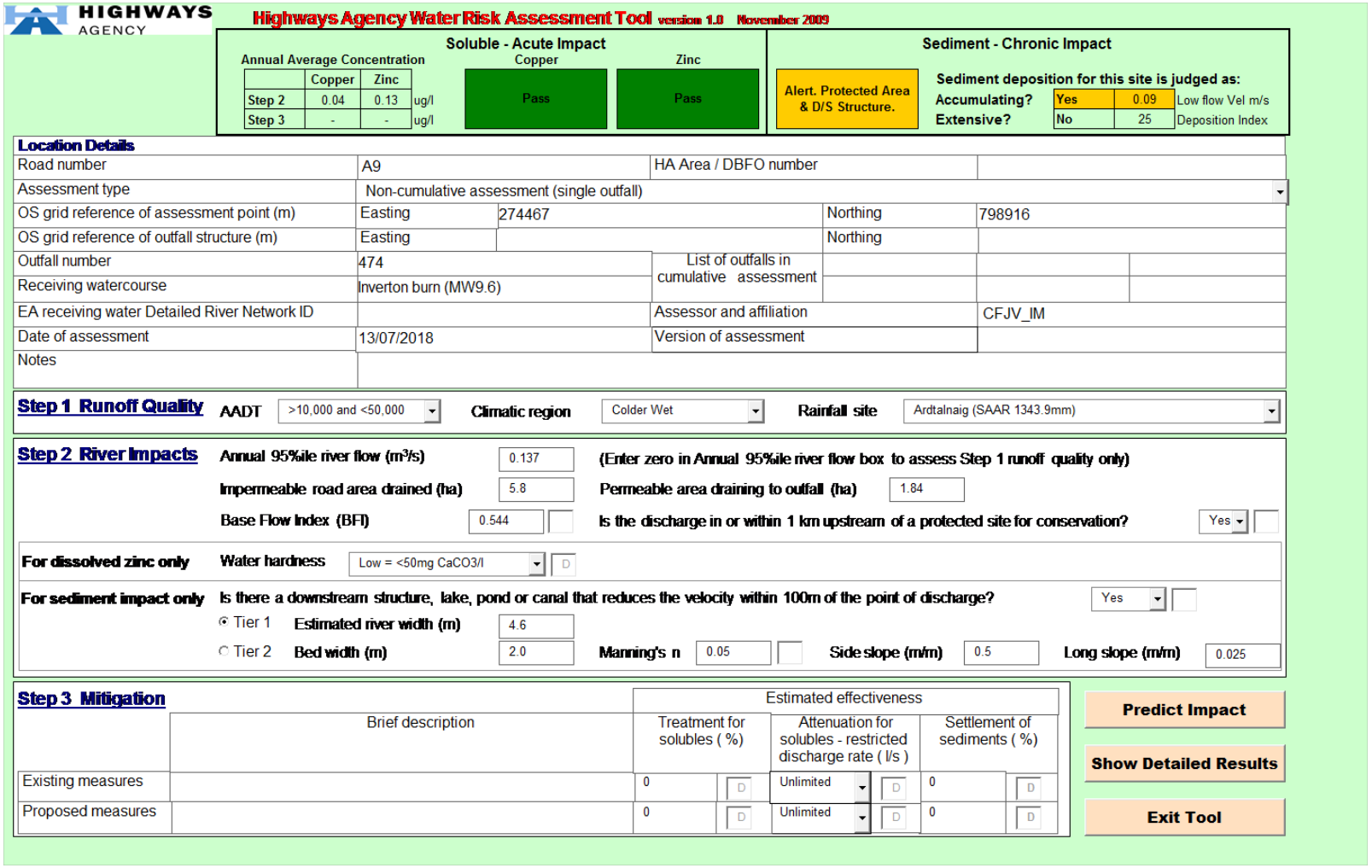
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | | Attenuation for solubles - restricted discharge rate (l/s) | | Settlement of sediments (%) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | | 0 | D | Unlimited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

Predict Impact

Show Detailed Results

Exit Tool

*Figure 7: Method A Calculations for SuDS 474*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.04 | 0.13 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.09 | Low flow Vel m/s |
| Extensive? | No | 25 | Deposition Index |

**Location Details**

| | | | | |
|---|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | |
| OS grid reference of assessment point (m) | Easting 274467 | | Northing | 798916 |
| OS grid reference of outfall structure (m) | Easting | | Northing | |
| Outfall number | 474 | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Inverton burn (MW9.6) | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | Version of assessment | | |
| Notes | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.137 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.8 Permeable area draining to outfall (ha): 1.84

Base Flow Index (BFI): 0.544 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 4.6

Tier 2 Bed width (m): 2.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.025

**Step 3 Mitigation**

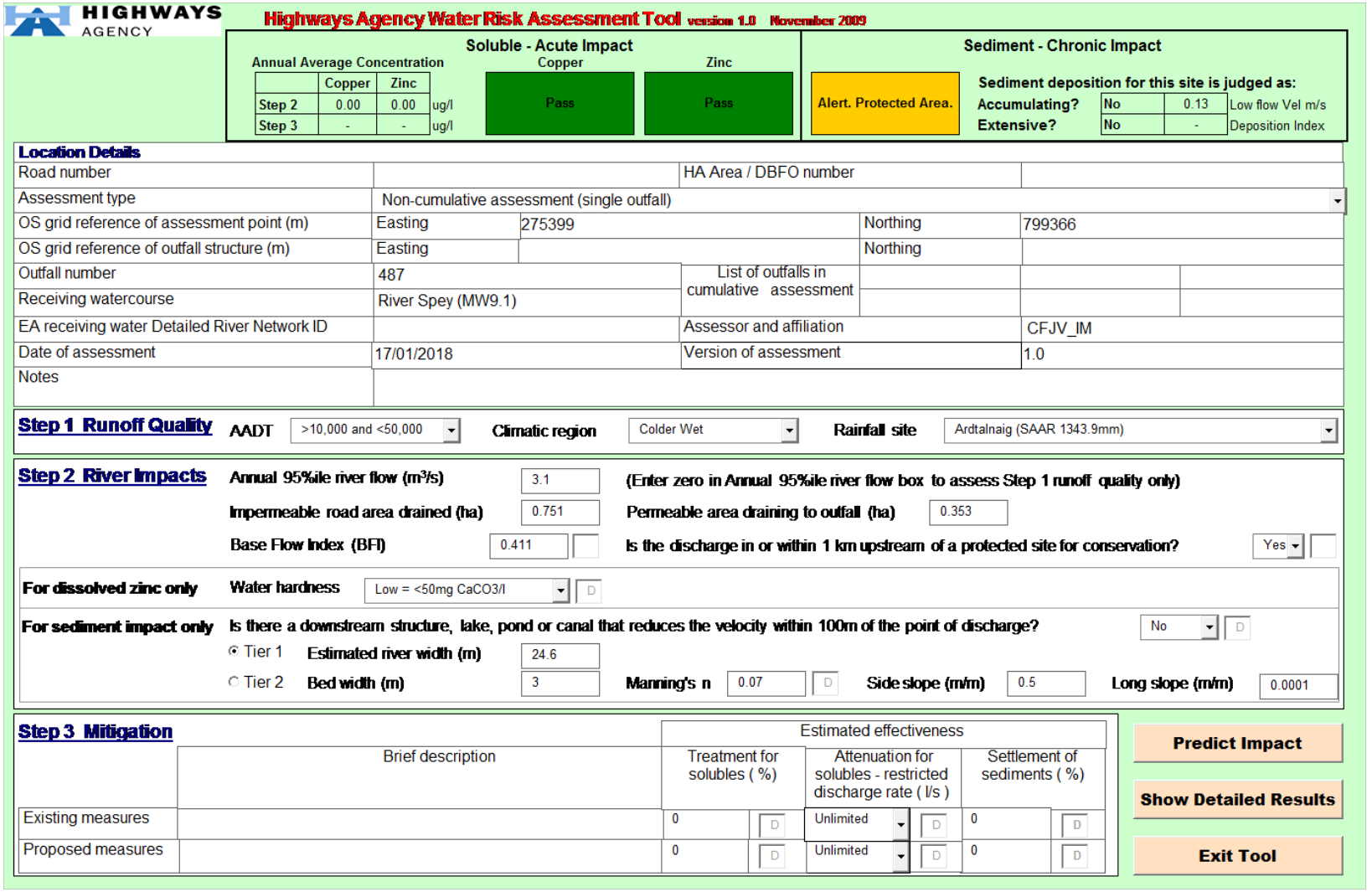
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 8: Method A Calculations for SuDS 487*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.00 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.13 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 275399 | Northing | 799366 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 487 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 17/01/2018 | Version of assessment | 1.0 | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 3.1 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.751 | Permeable area draining to outfall (ha): 0.353

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 24.6

Tier 2 — Bed width (m): 3 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

**Step 3 Mitigation**

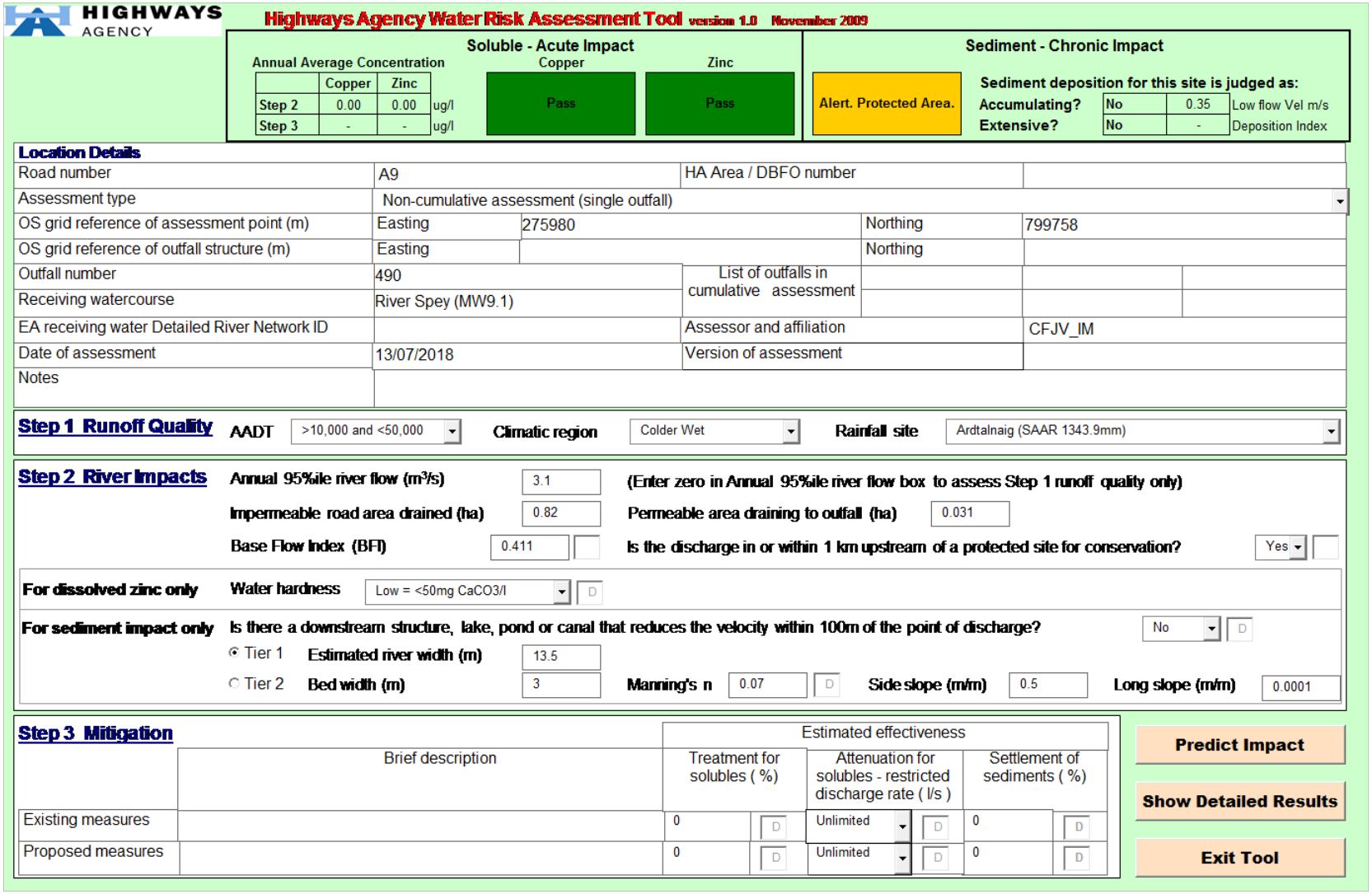
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 9: Method A Calculations for SuDS 490*



HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.00 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.35 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 275980 | | Northing | 799758 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 490 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 3.1 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.82 | Permeable area draining to outfall (ha): 0.031

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 13.5

Tier 2 — Bed width (m): 3 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

**Step 3 Mitigation**

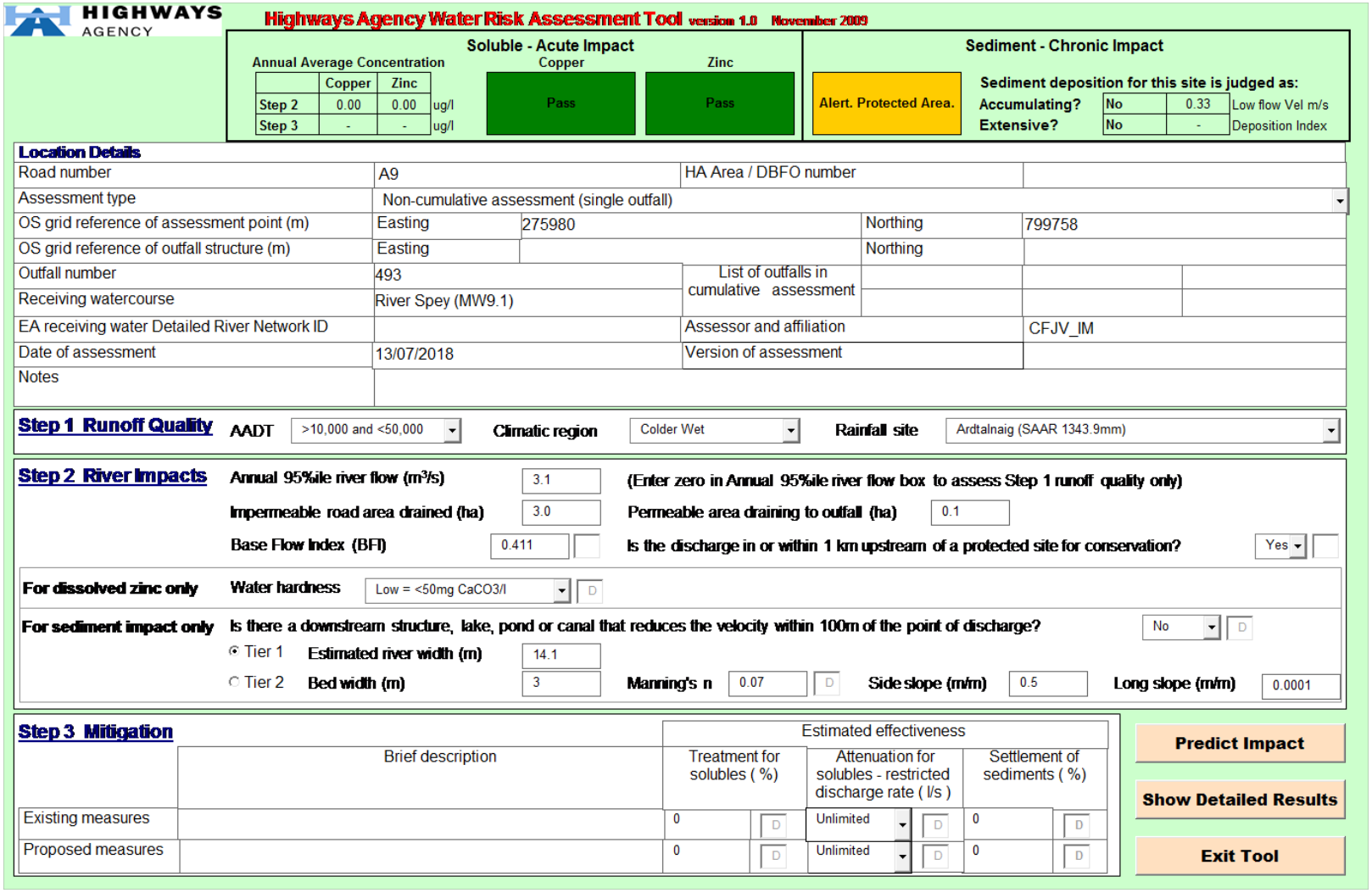
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | Attenuation for solubles - restricted discharge rate (l/s) | Settlement of sediments (%) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 10: Method A Calculations for SuDS 493*



HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.00 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.33 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 275980 | | Northing | 799758 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 493 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 3.1 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.0 Permeable area draining to outfall (ha): 0.1

Base Flow Index (BFI): 0.411 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 14.1

Tier 2 Bed width (m): 3 Manning's n: 0.07 D Side slope (m/m): 0.5 Long slope (m/m): 0.0001

**Step 3 Mitigation**

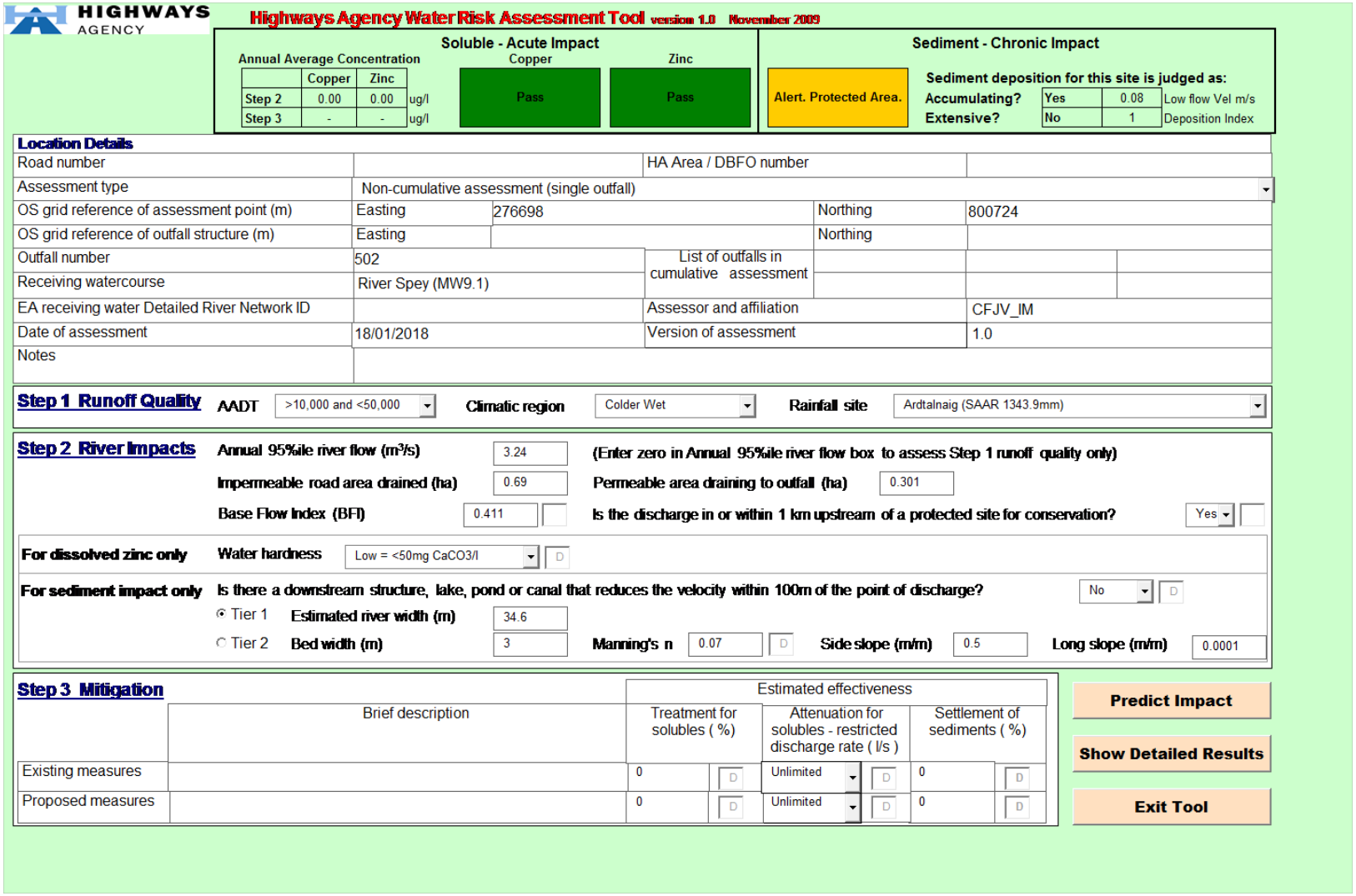
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | | Attenuation for solubles - restricted discharge rate (l/s) | | Settlement of sediments (%) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | | 0 | D | Unlimited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

Predict Impact

Show Detailed Results

Exit Tool

*Figure 11: Method A Calculations for SuDS 502*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

| Soluble - Acute Impact | | | | Sediment - Chronic Impact | | | | |
|---|---|---|---|---|---|---|---|---|
| Annual Average Concentration | Copper | Zinc | | Copper | Zinc | | | Sediment deposition for this site is judged as: |
| | Copper | Zinc | | Pass | Pass | Alert. Protected Area. | Accumulating? | Yes 0.08 Low flow Vel m/s |
| Step 2 | 0.00 | 0.00 | ug/l | | | | Extensive? | No 1 Deposition Index |
| Step 3 | - | - | ug/l | | | | | |

| Location Details | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 276698 | Northing | 800724 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 502 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM | |
| Date of assessment | 18/01/2018 | Version of assessment | | 1.0 | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

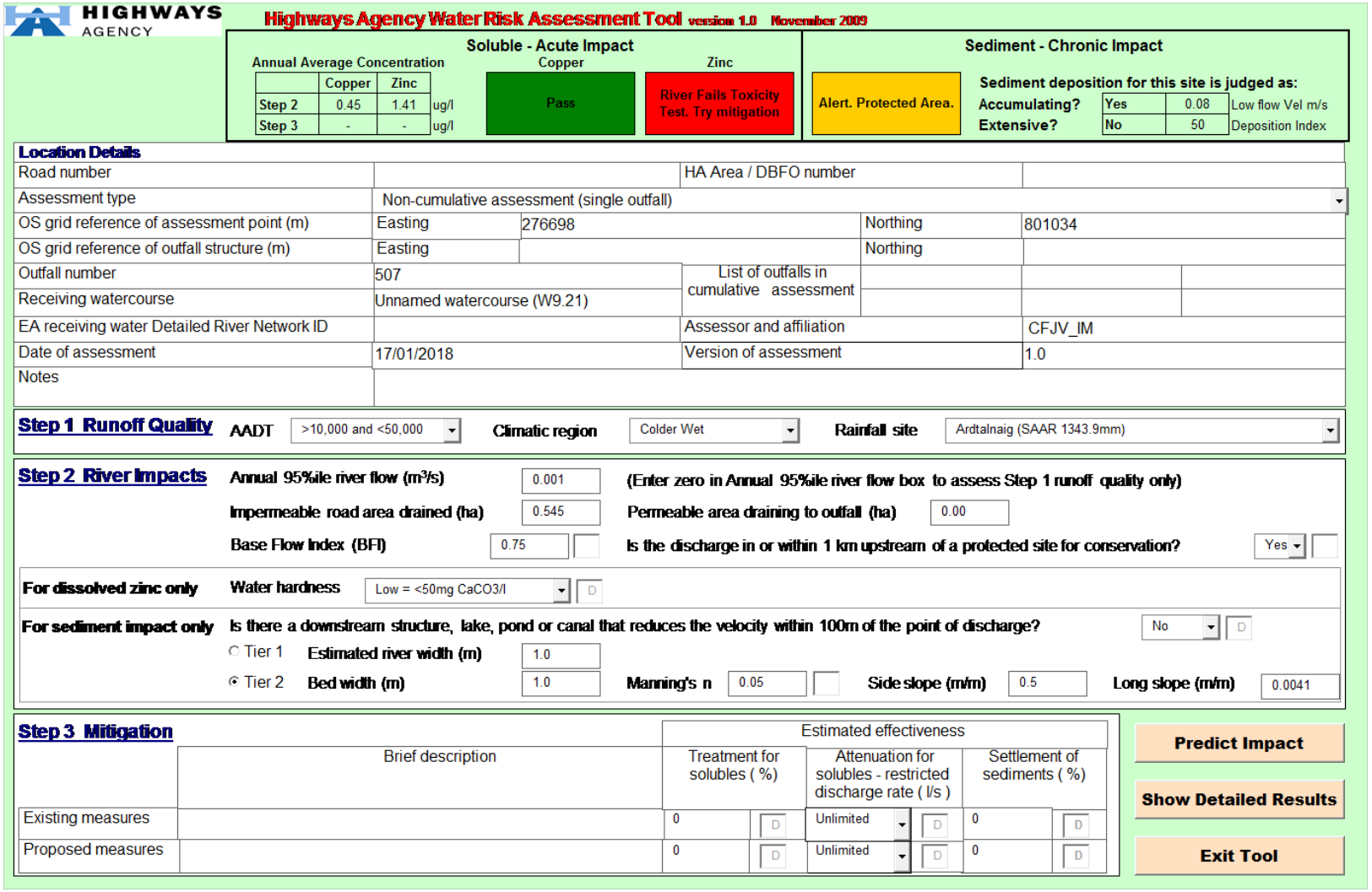
- Annual 95%ile river flow (m³/s): 3.24 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)
- Impermeable road area drained (ha): 0.69 | Permeable area draining to outfall (ha): 0.301
- Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes
- For dissolved zinc only — Water hardness: Low = <50mg 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
  - Tier 1: Estimated river width (m): 34.6
  - Tier 2: Bed width (m): 3 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

**Step 3 Mitigation**

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

Predict Impact | Show Detailed Results | Exit Tool

*Figure 12: Method A Calculations for SuDS 507 (copper)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.45 | 1.41 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.08 | Low flow Vel m/s |
| Extensive? | No | 50 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 276698 | Northing | 801034 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 507 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (W9.21) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 17/01/2018 | Version of assessment | 1.0 | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.545 | Permeable area draining to outfall (ha): 0.00

Base Flow Index (BFI): 0.75 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.0

Tier 2 — Bed width (m): 1.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0041

**Step 3 Mitigation**

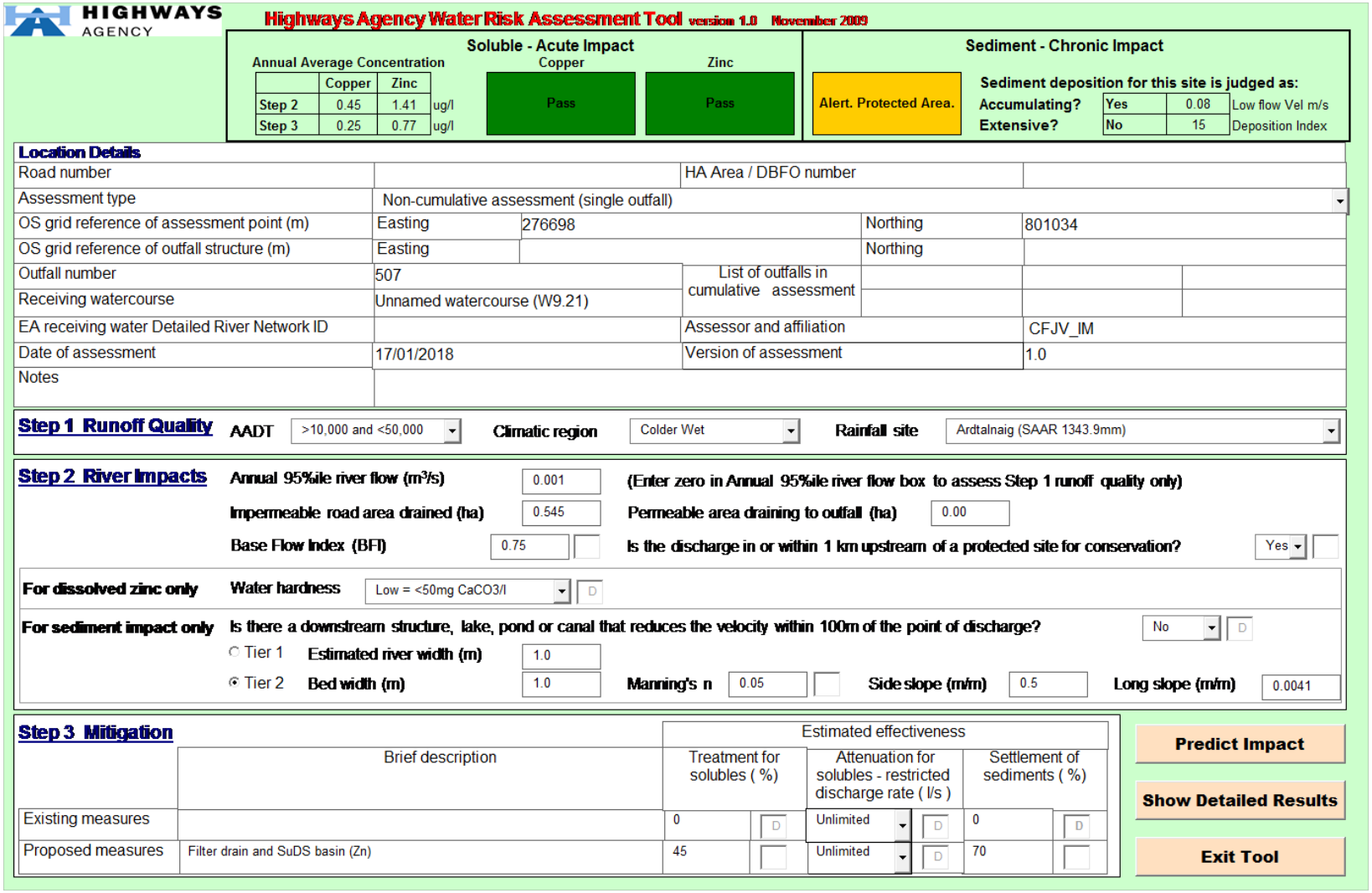
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 13: Method A Calculations for SuDS 507 (zinc)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.45 | 1.41 | ug/l |
| Step 3 | 0.25 | 0.77 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.08 | Low flow Vel m/s |
| Extensive? | No | 15 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 276698 | Northing | 801034 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 507 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (W9.21) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 17/01/2018 | Version of assessment | 1.0 | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.545 Permeable area draining to outfall (ha): 0.00

Base Flow Index (BFI): 0.75 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.0

Tier 2 Bed width (m): 1.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0041

**Step 3 Mitigation**

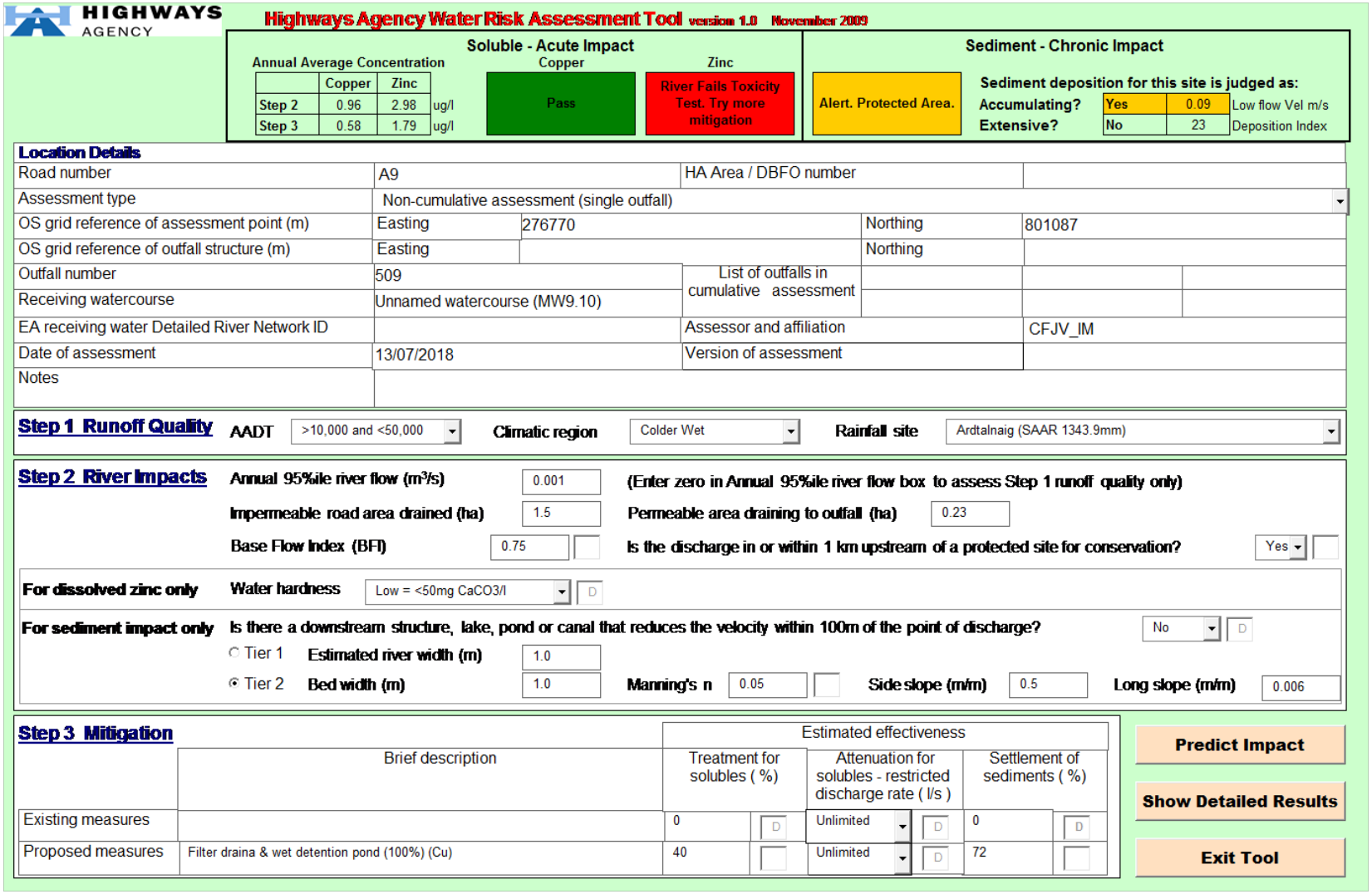
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 D | Unlimited D | 0 D |
| Proposed measures | Filter drain and SuDS basin (Zn) | 45 | Unlimited D | 70 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 14: Method A Calculations for SuDS 509 (copper)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.96 | 2.98 | ug/l |
| Step 3 | 0.58 | 1.79 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.09 | Low flow Vel m/s |
| Extensive? | No | 23 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 276770 | | Northing | 801087 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 509 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 Climatic region: Colder Wet Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.5 Permeable area draining to outfall (ha): 0.23

Base Flow Index (BFI): 0.75 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.0

Tier 2 Bed width (m): 1.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.006

**Step 3 Mitigation**

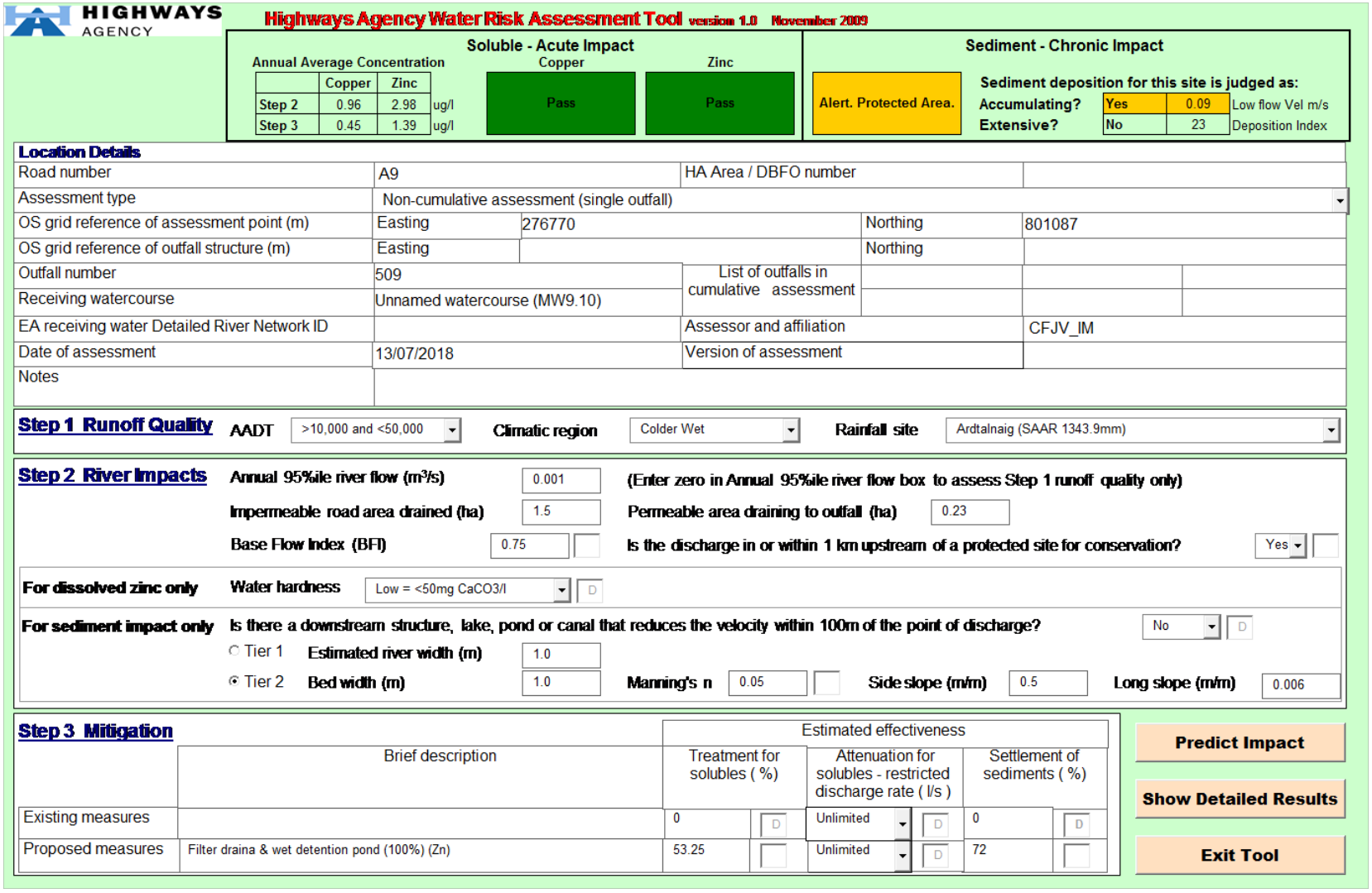
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | | Attenuation for solubles - restricted discharge rate ( l/s ) | | Settlement of sediments ( %) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | Filter draina & wet detention pond (100%) (Cu) | 40 | | Unlimited | D | 72 | |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 15: Method A Calculations for SuDS 509 (zinc)*



HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.96 | 2.98 | ug/l |
| Step 3 | 0.45 | 1.39 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.09 | Low flow Vel m/s |
| Extensive? | No | 23 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 276770 | | Northing | 801087 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 509 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 Climatic region: Colder Wet Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.5 Permeable area draining to outfall (ha): 0.23

Base Flow Index (BFI): 0.75 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.0

Tier 2 Bed width (m): 1.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.006

**Step 3 Mitigation**

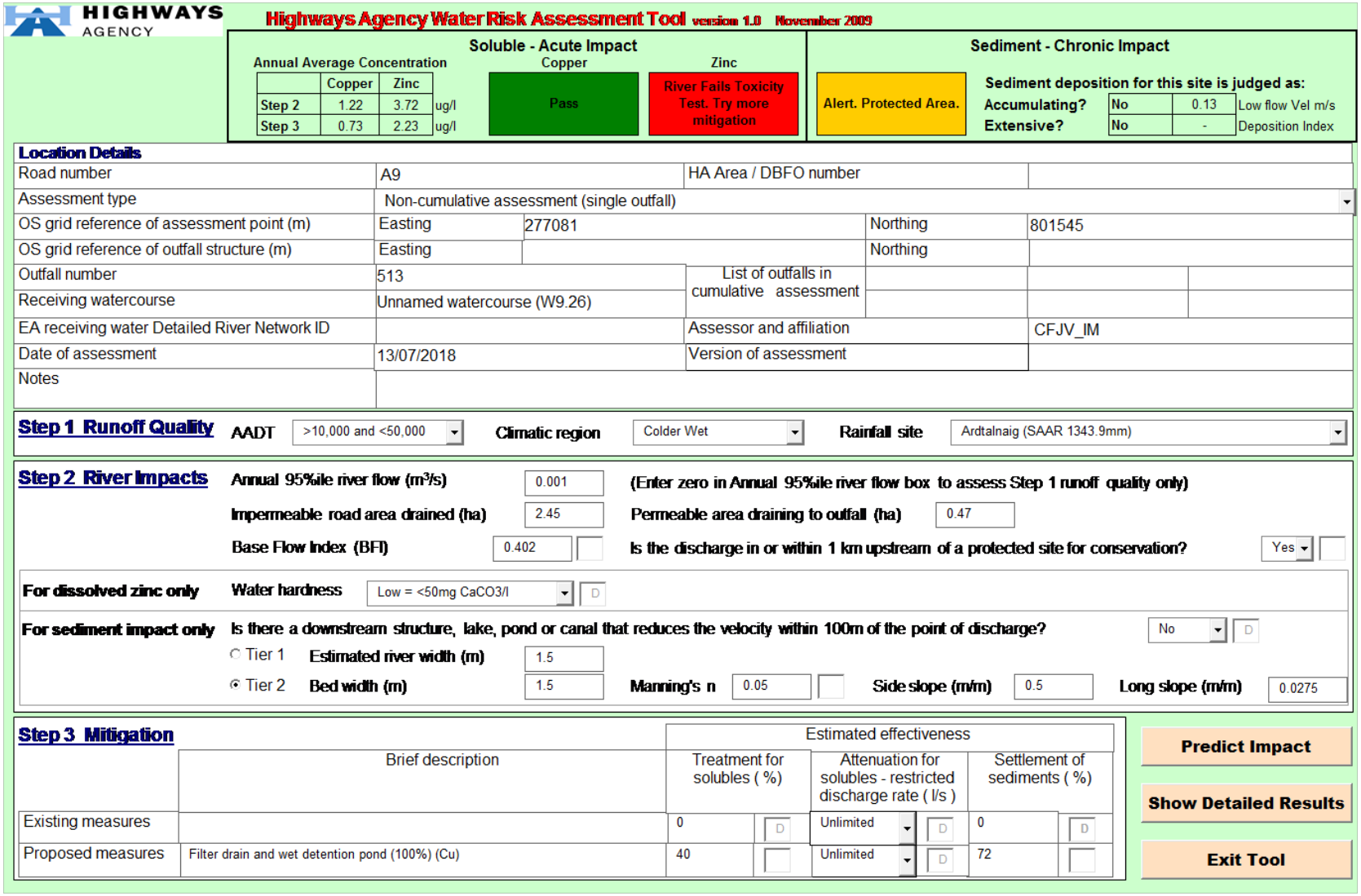
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 D | Unlimited D | 0 D |
| Proposed measures | Filter draina & wet detention pond (100%) (Zn) | 53.25 | Unlimited D | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 16: Method A Calculations for SuDS 513 (copper)*



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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.22 | 3.72 | ug/l |
| Step 3 | 0.73 | 2.23 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.13 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 277081 | Northing | 801545 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 513 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (W9.26) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 13/07/2018 | Version of assessment | | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.45 Permeable area draining to outfall (ha): 0.47

Base Flow Index (BFI): 0.402 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 Estimated river width (m): 1.5

Tier 2 Bed width (m): 1.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0275

**Step 3 Mitigation**

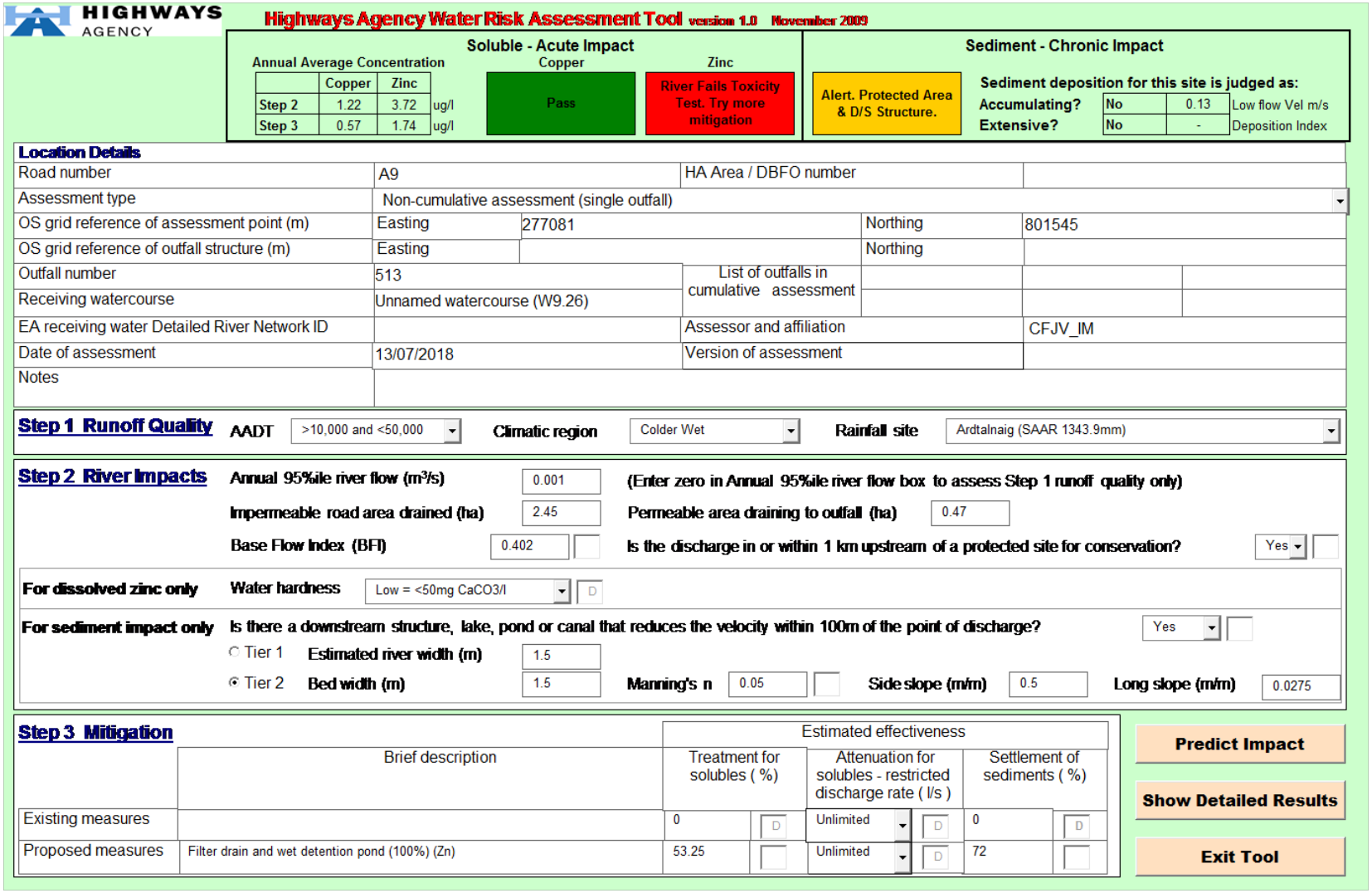
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | Attenuation for solubles - restricted discharge rate (l/s) | Settlement of sediments (%) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Cu) | 40 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 17: Method A Calculations for SuDS 513 (zinc)*



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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.22 | 3.72 | ug/l |
| Step 3 | 0.57 | 1.74 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.13 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 277081 | | Northing | 801545 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 513 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.26) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.45 | Permeable area draining to outfall (ha): 0.47

Base Flow Index (BFI): 0.402 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 1.5

Tier 2 — Bed width (m): 1.5 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0275

**Step 3 Mitigation**

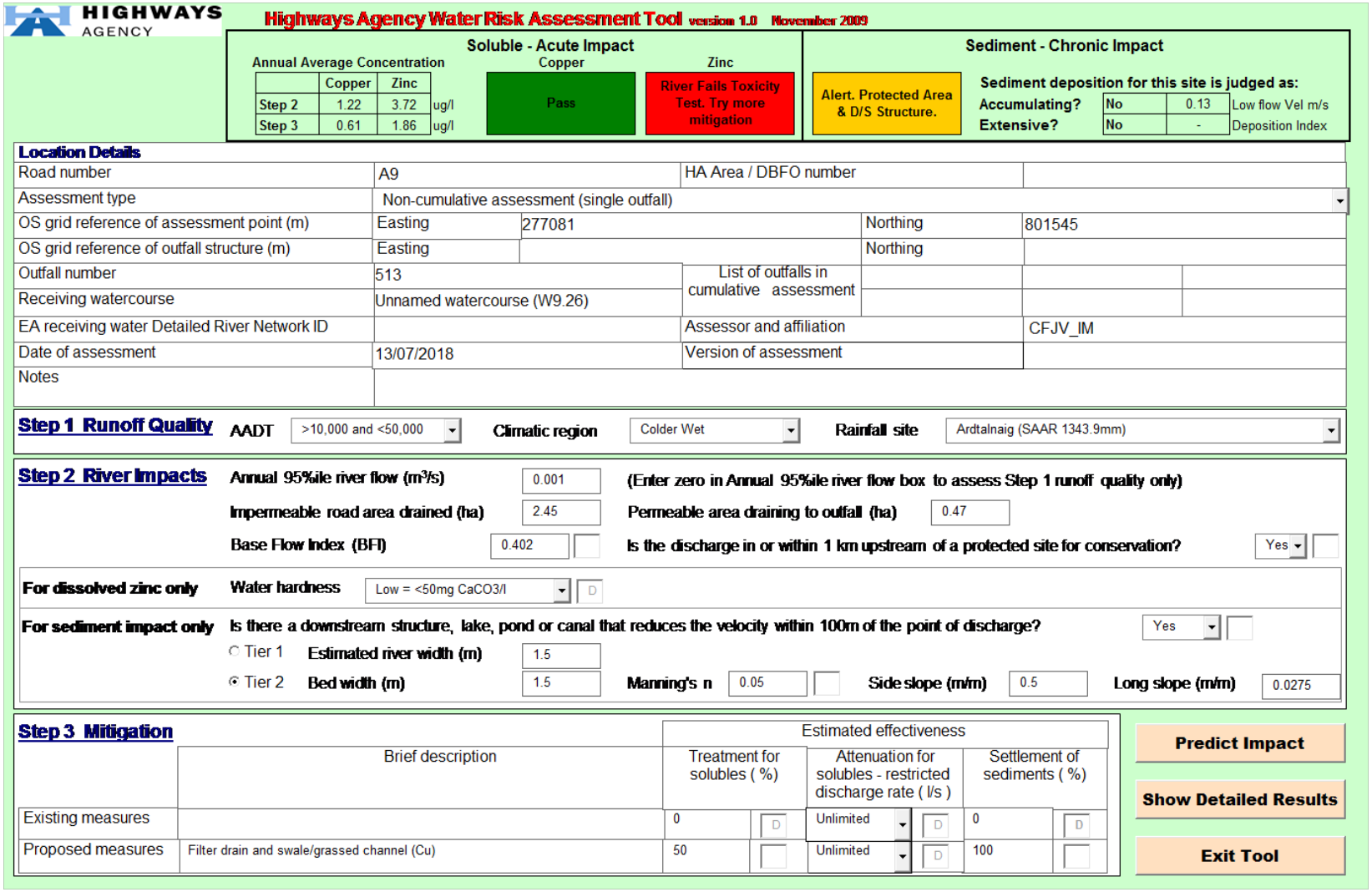
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Zn) | 53.25 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 18: Method A Calculations for SuDS 513 (copper) Filter Drain & Swale*



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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.22 | 3.72 | ug/l |
| Step 3 | 0.61 | 1.86 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.13 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | |
|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | |
| Assessment type | Non-cumulative assessment (single outfall) | | |
| OS grid reference of assessment point (m) | Easting 277081 | Northing | 801545 |
| OS grid reference of outfall structure (m) | Easting | Northing | |
| Outfall number | 513 | List of outfalls in cumulative assessment | |
| Receiving watercourse | Unnamed watercourse (W9.26) | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM |
| Date of assessment | 13/07/2018 | Version of assessment | |
| Notes | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.45 Permeable area draining to outfall (ha): 0.47

Base Flow Index (BFI): 0.402 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.5

Tier 2 Bed width (m): 1.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0275

**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 | Filter drain and swale/grassed channel (Cu) | 50 | Unlimited D | 100 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 19: Method A Calculations for SuDS 513 (zinc) Filter Drain & Swale*

HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.22 | 3.72 | ug/l |
| Step 3 | 0.37 | 1.12 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.13 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 277081 | | Northing | 801545 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 513 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.26) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.45 | Permeable area draining to outfall (ha): 0.47

Base Flow Index (BFI): 0.402 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 1.5

Tier 2 — Bed width (m): 1.5 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0275

**Step 3 Mitigation**

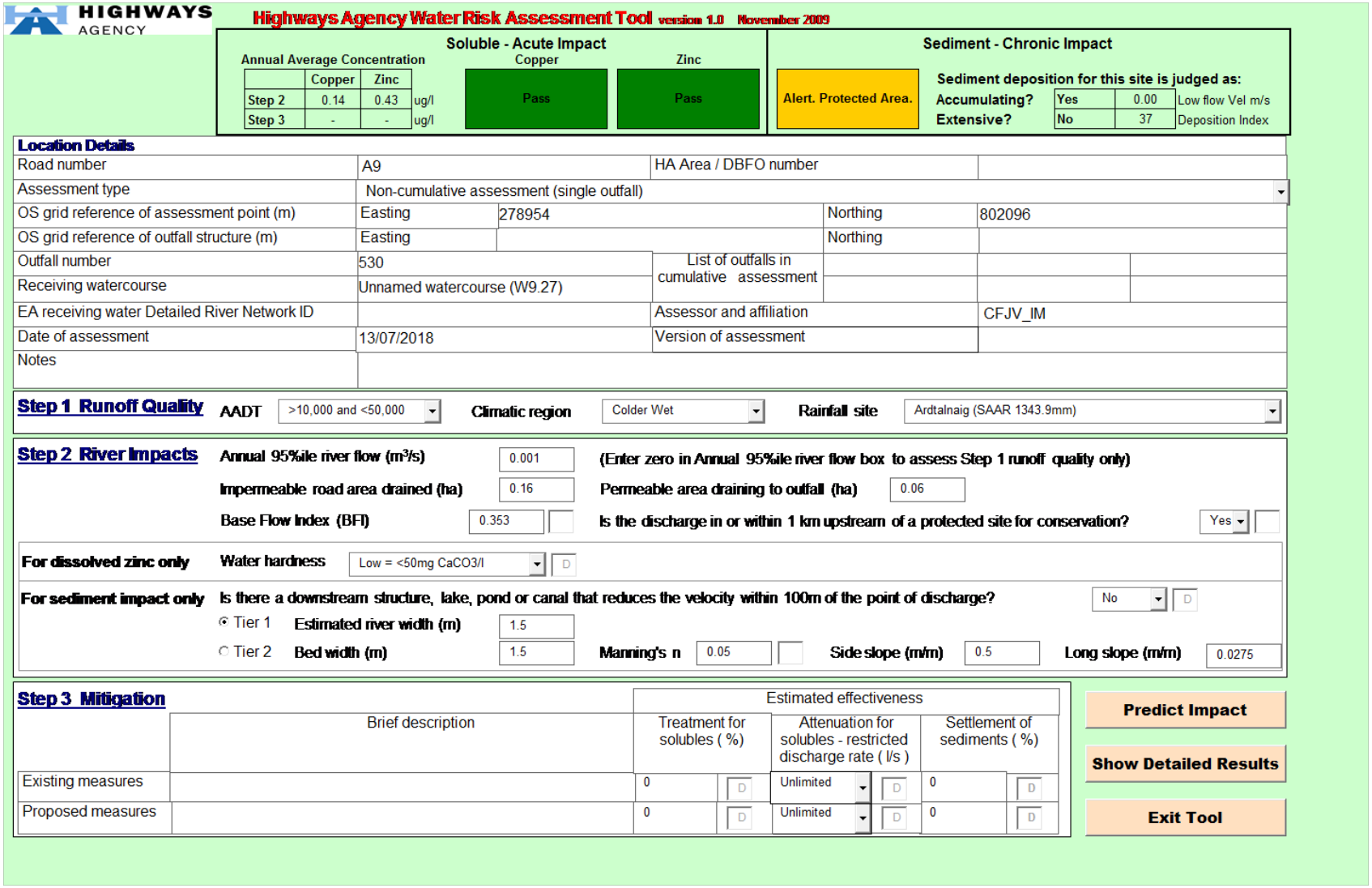
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and swale/grassed channel (Zn) | 70 | Unlimited | 100 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 20: Method A Calculations for SuDS 530*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.14 | 0.43 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.00 | Low flow Vel m/s |
| Extensive? | No | 37 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 278954 | | Northing | 802096 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 530 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.27) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.16 | Permeable area draining to outfall (ha): 0.06

Base Flow Index (BFI): 0.353 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.5

Tier 2 — Bed width (m): 1.5 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0275

**Step 3 Mitigation**

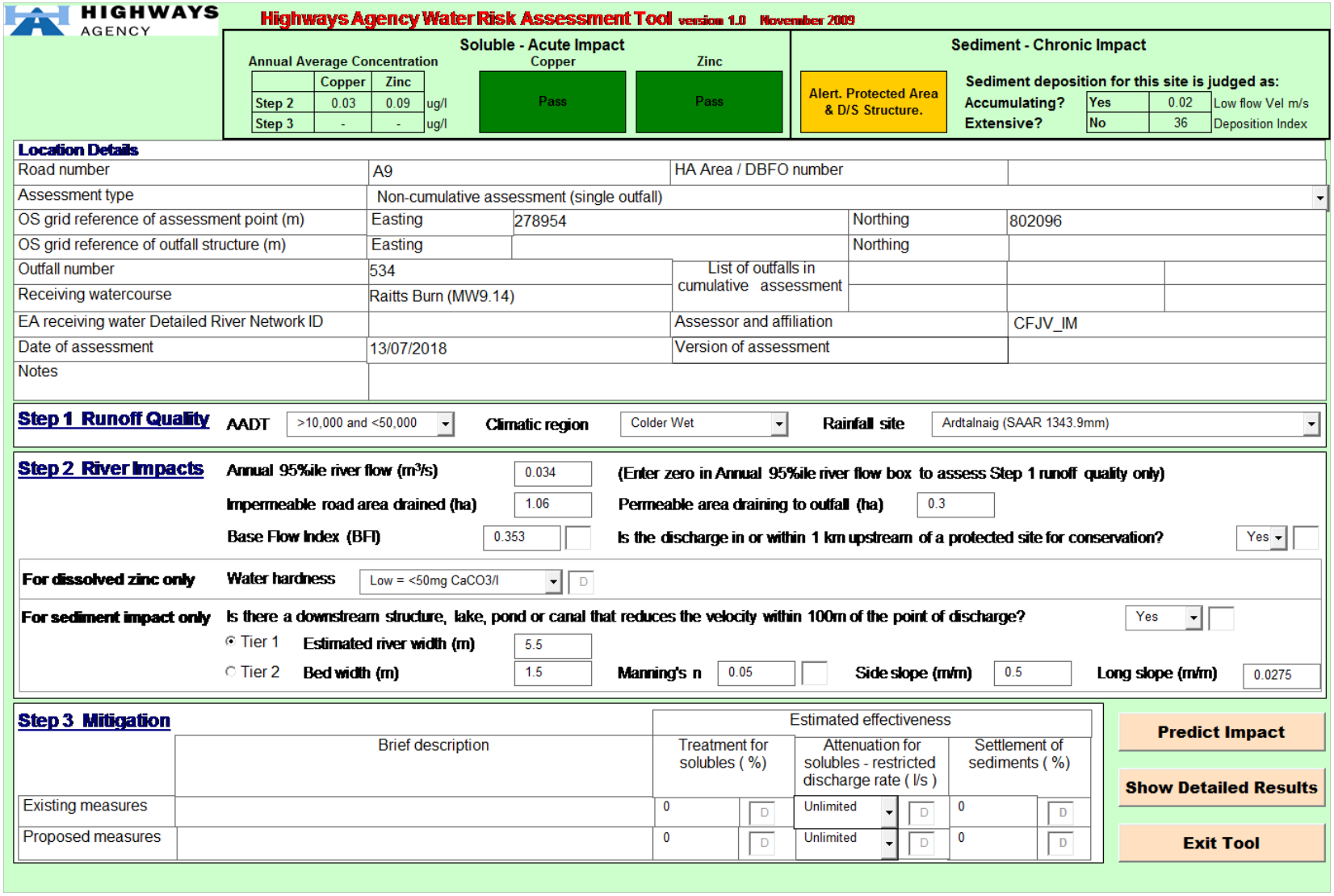
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 21: Method A Calculations for SuDS 534*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.03 | 0.09 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.02 | Low flow Vel m/s |
| Extensive? | No | 36 | Deposition Index |

**Location Details**

| | | | |
|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | |
| Assessment type | Non-cumulative assessment (single outfall) | | |
| OS grid reference of assessment point (m) | Easting 278954 | Northing | 802096 |
| OS grid reference of outfall structure (m) | Easting | Northing | |
| Outfall number | 534 | List of outfalls in cumulative assessment | |
| Receiving watercourse | Raitts Burn (MW9.14) | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM |
| Date of assessment | 13/07/2018 | Version of assessment | |
| Notes | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.034 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.06 Permeable area draining to outfall (ha): 0.3

Base Flow Index (BFI): 0.353 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 5.5

Tier 2 Bed width (m): 1.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0275

**Step 3 Mitigation**

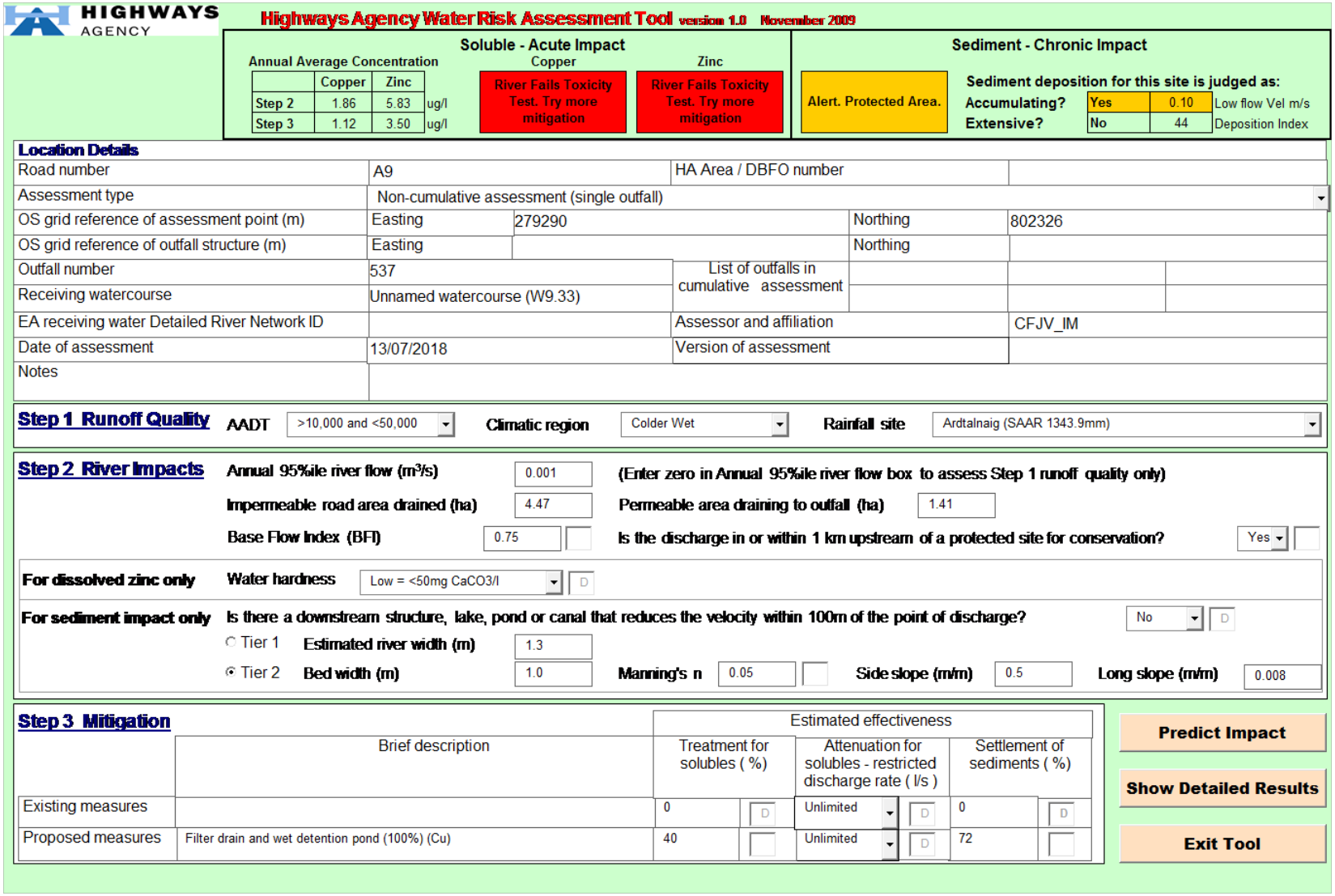
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 D | Unlimited D | 0 D |
| Proposed measures | | 0 D | Unlimited D | 0 D |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 22: Method A Calculations for SuDS 537 (copper)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.86 | 5.83 | ug/l |
| Step 3 | 1.12 | 3.50 | ug/l |

Copper: River Fails Toxicity Test. Try more mitigation

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.10 Low flow Vel m/s

Extensive? No 44 Deposition Index

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 279290 | | Northing | 802326 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 537 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.33) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.47 Permeable area draining to outfall (ha): 1.41

Base Flow Index (BFI): 0.75 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.3

Tier 2 Bed width (m): 1.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.008

**Step 3 Mitigation**

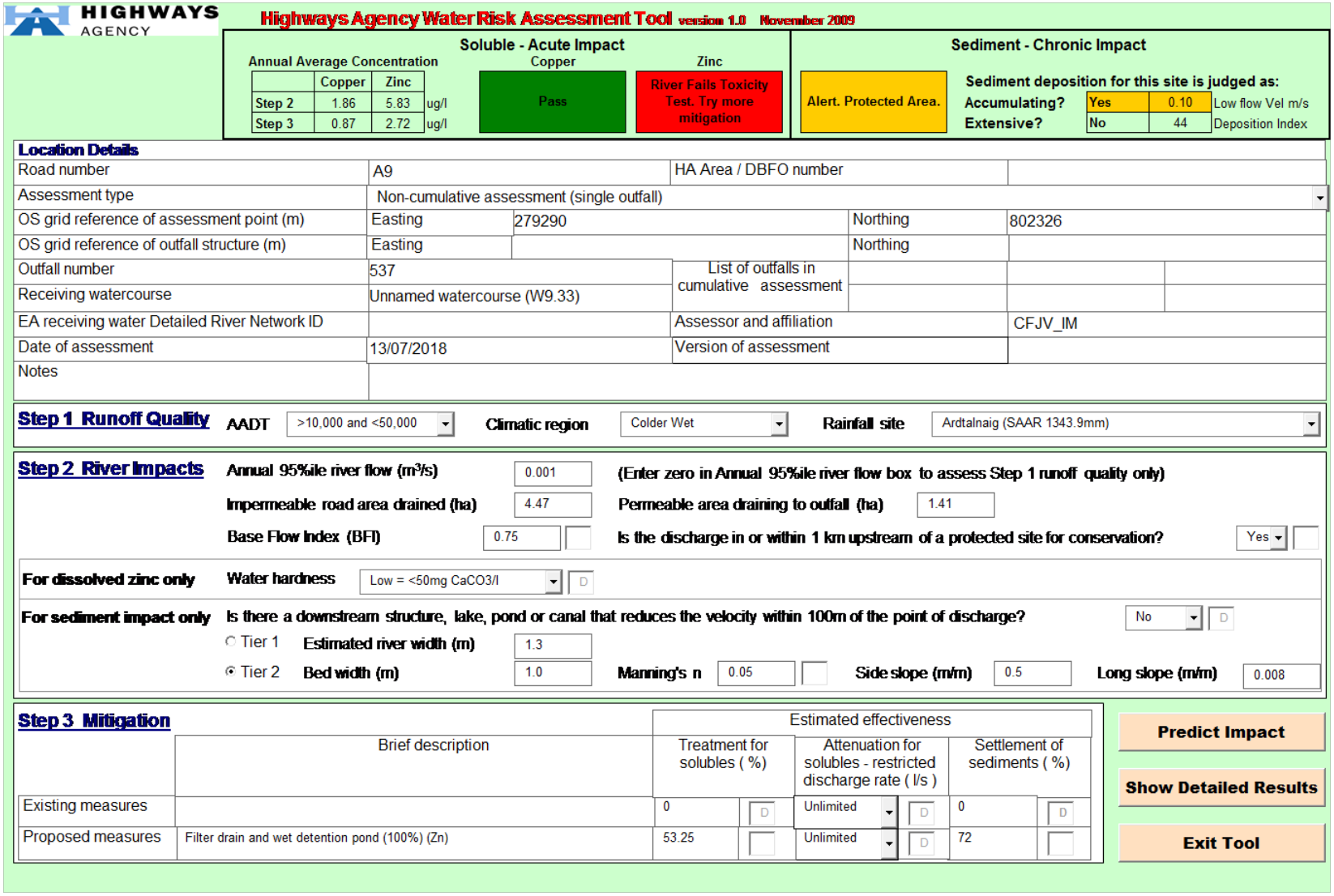
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 D | Unlimited D | 0 D |
| Proposed measures | Filter drain and wet detention pond (100%) (Cu) | 40 | Unlimited D | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 23: Method A Calculations for SuDS 537 (zinc)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.86 | 5.83 | ug/l |
| Step 3 | 0.87 | 2.72 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | |
|---|---|---|
| Accumulating? | Yes | 0.10 Low flow Vel m/s |
| Extensive? | No | 44 Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 279290 | Northing | 802326 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 537 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (W9.33) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM | |
| Date of assessment | 13/07/2018 | Version of assessment | | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.47 Permeable area draining to outfall (ha): 1.41

Base Flow Index (BFI): 0.75 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 Estimated river width (m): 1.3

Tier 2 Bed width (m): 1.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.008

**Step 3 Mitigation**

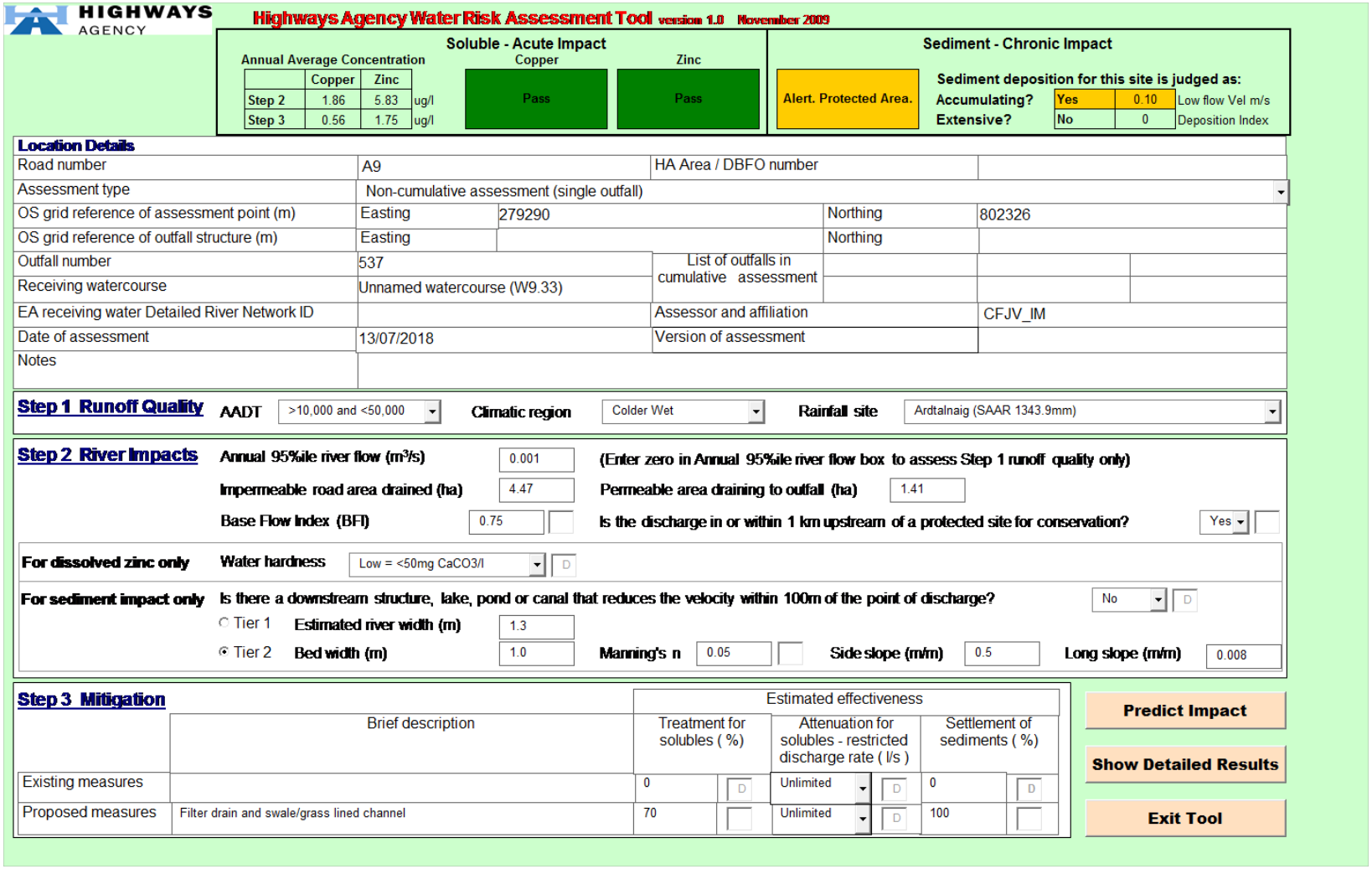
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | Attenuation for solubles - restricted discharge rate (l/s) | Settlement of sediments (%) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Zn) | 53.25 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 24: Method A Calculations for SuDS 537 Swale*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.86 | 5.83 | ug/l |
| Step 3 | 0.56 | 1.75 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.10 | Low flow Vel m/s |
| Extensive? | No | 0 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 279290 | | Northing | 802326 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 537 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (W9.33) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.47 | Permeable area draining to outfall (ha): 1.41

Base Flow Index (BFI): 0.75 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.3

Tier 2 — Bed width (m): 1.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.008

**Step 3 Mitigation**

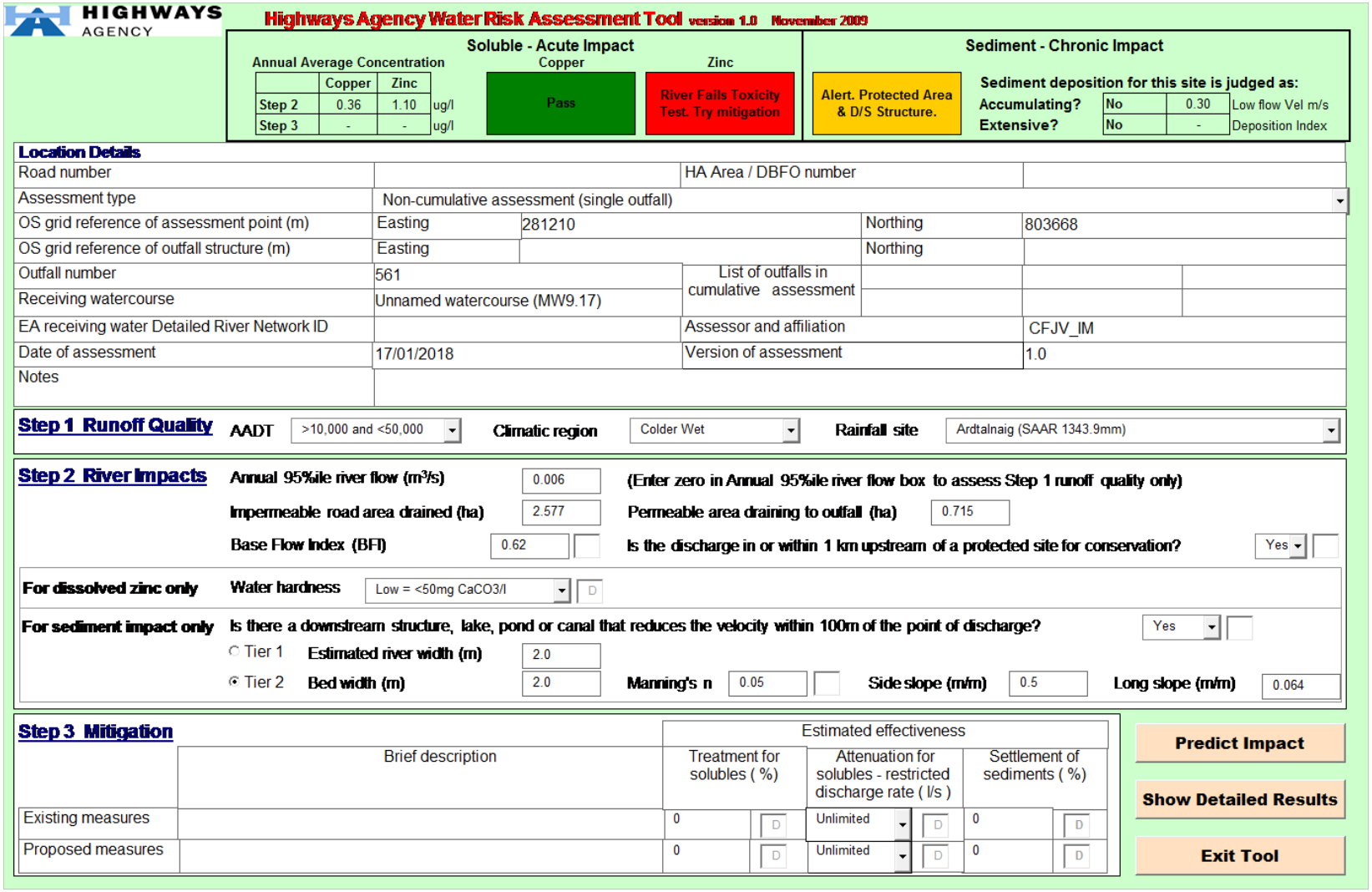
| | Brief description | Estimated effectiveness: Treatment for solubles (%) | Attenuation for solubles - restricted discharge rate (l/s) | Settlement of sediments (%) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and swale/grass lined channel | 70 | Unlimited | 100 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 25: Method A Calculations for SuDS 561 (copper)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.36 | 1.10 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try mitigation

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 281210 | Northing | 803668 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 561 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 17/01/2018 | Version of assessment | 1.0 | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow (m³/s): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.577 Permeable area draining to outfall (ha): 0.715

Base Flow Index (BFI): 0.62 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 2.0

Tier 2 Bed width (m): 2.0 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.064

**Step 3 Mitigation**

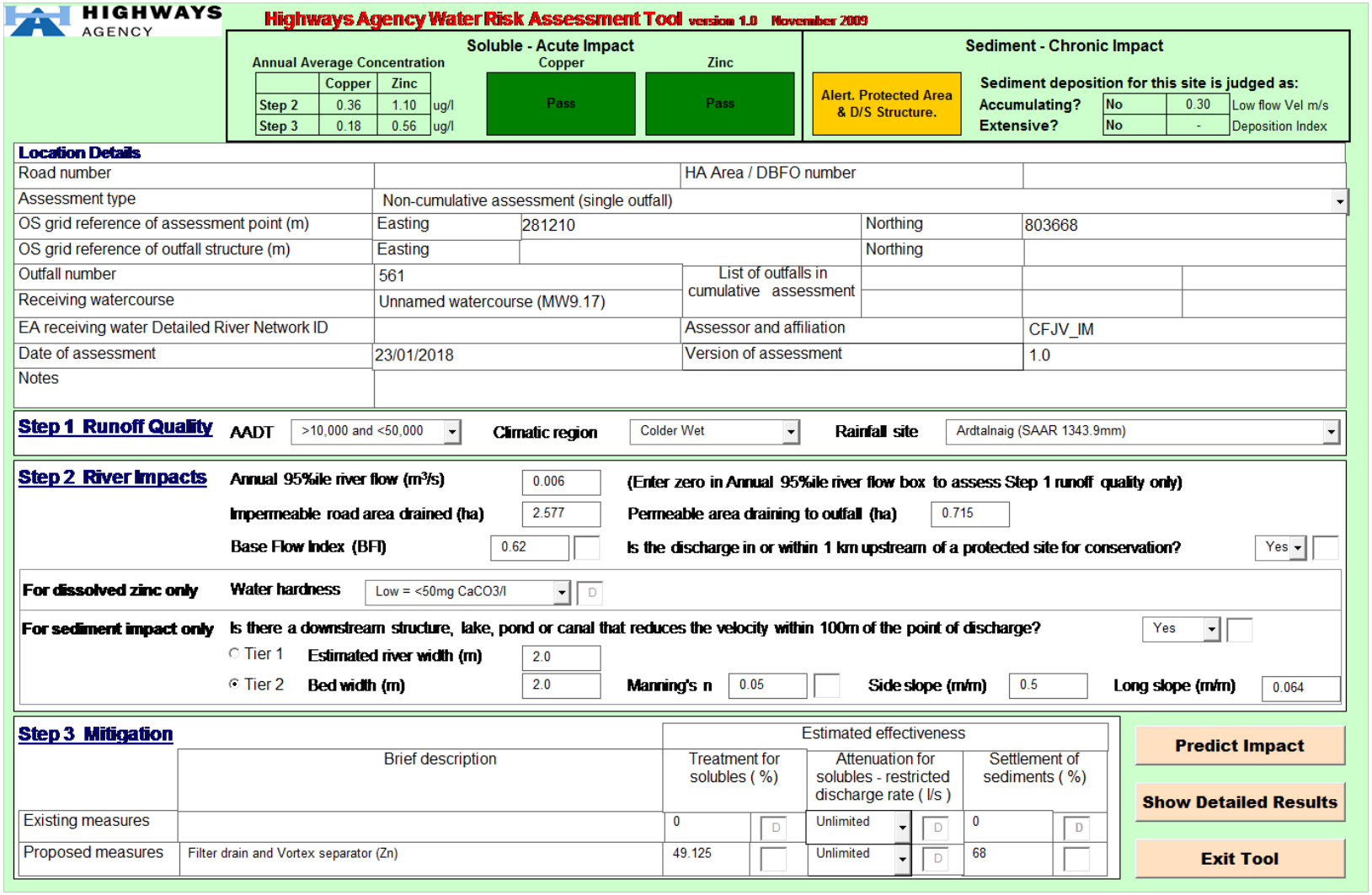
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | | Attenuation for solubles - restricted discharge rate ( l/s ) | | Settlement of sediments ( %) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | | 0 | D |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

Predict Impact

Show Detailed Results

Exit Tool

*Figure 26: Method A Calculations for SuDS 561 (zinc)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.36 | 1.10 | ug/l |
| Step 3 | 0.18 | 0.56 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | | HA Area / DBFO number | | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 281210 | Northing | 803668 | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 561 | List of outfalls in cumulative assessment | | | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | CFJV_IM | | |
| Date of assessment | 23/01/2018 | Version of assessment | 1.0 | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.577 | Permeable area draining to outfall (ha): 0.715

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**Step 3 Mitigation**

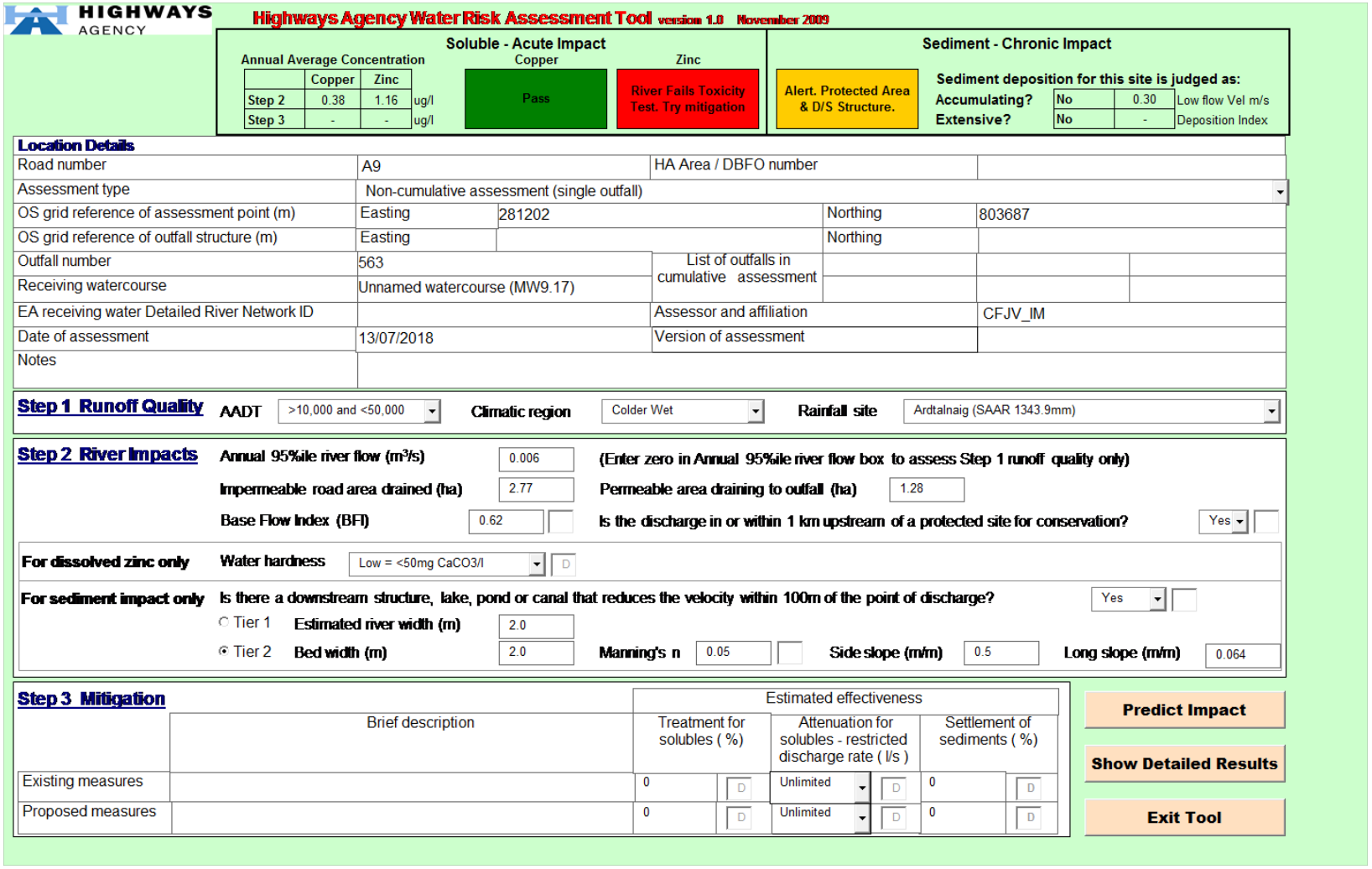
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and Vortex separator (Zn) | 49.125 | Unlimited | 68 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 27: Method A Calculations for SuDS 563 (Copper)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.38 | 1.16 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try mitigation

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 281202 | | Northing | 803687 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 563 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.77 | Permeable area draining to outfall (ha): 1.28

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**Step 3 Mitigation**

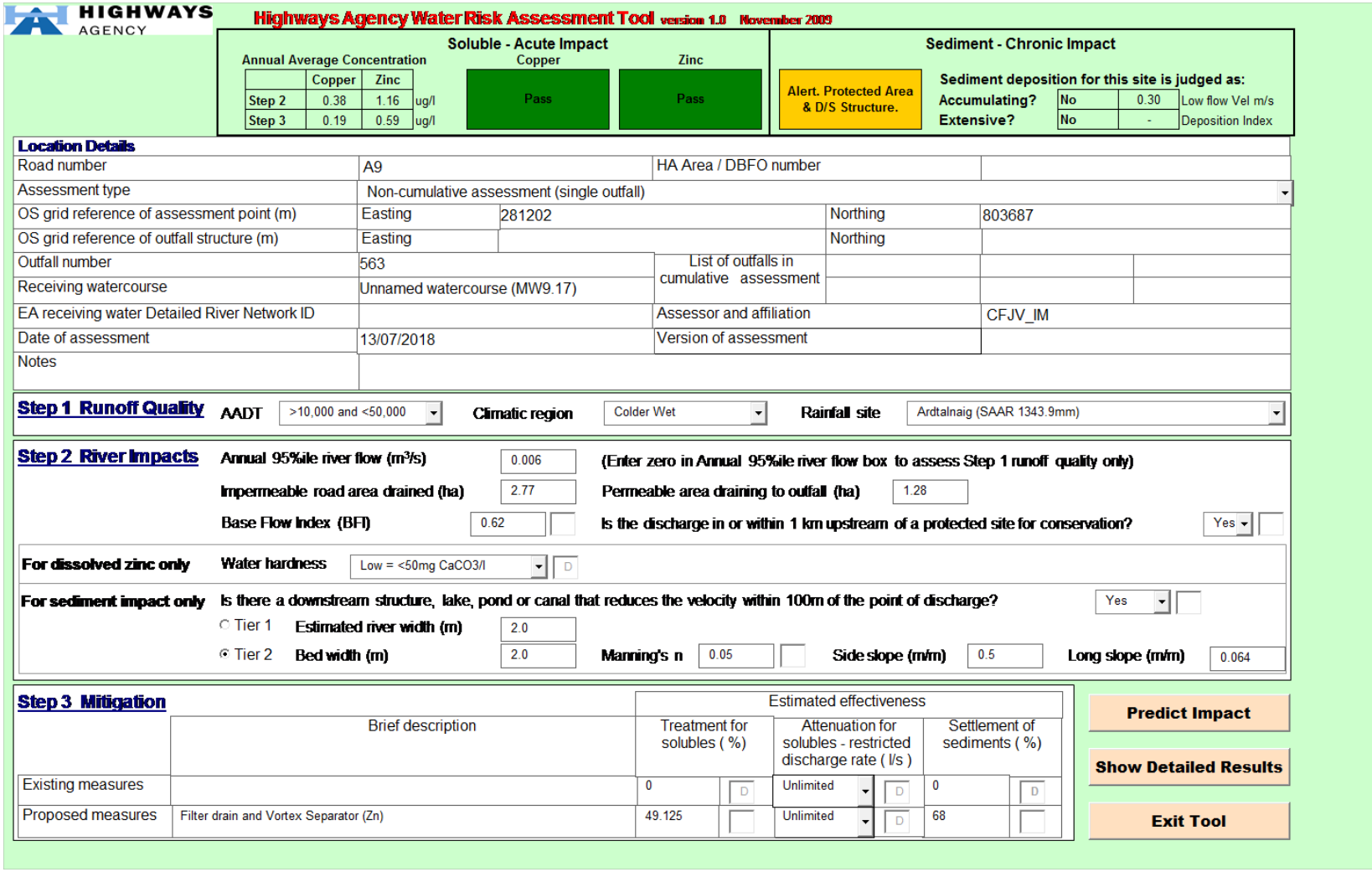
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | | 0 | Unlimited | 0 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 28: Method A Calculations for SuDS 563 (Zinc)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.38 | 1.16 | ug/l |
| Step 3 | 0.19 | 0.59 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Non-cumulative assessment (single outfall) | | | | |
| OS grid reference of assessment point (m) | Easting | 281202 | | Northing | 803687 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 563 | | List of outfalls in cumulative assessment | | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.77 | Permeable area draining to outfall (ha): 1.28

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**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 | Filter drain and Vortex Separator (Zn) | 49.125 | | Unlimited | D | 68 | |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 29: Method A HAWRAT output for SuDS 490 & 493 cumulative assessment excluding sediments (outfalls between 100m and 1km apart)*

HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.00 | 0.00 | ug/l |
| Step 3 | - | - | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Sediment deposition for this site is judged as:

Accumulating? Low flow Vel m/s

Extensive? Deposition Index

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment excluding sediments (outfalls between 100m and 1km apart) | | | | |
| OS grid reference of assessment point (m) | Easting | 275980 | | Northing | 799758 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 490 | | List of outfalls in cumulative assessment | 493 | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 3.0 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.82 Permeable area draining to outfall (ha): 0.127

Base Flow Index (BFI): 0.411 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 14.1

Tier 2 Bed width (m): 3 Manning's n: 0.07 D Side slope (m/m): 0.5 Long slope (m/m): 0.0001

**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

*Figure 30: Method A HAWRAT output for SuDS 507 & 509 cumulative assessment excluding sediments (outfalls between 100m and 1km apart)*

HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.09 | 3.31 | ug/l |
| Step 3 | 0.65 | 1.99 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Sediment deposition for this site is judged as:

Accumulating? Low flow Vel m/s

Extensive? Deposition Index

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment excluding sediments (outfalls between 100m and 1km apart) | | | | |
| OS grid reference of assessment point (m) | Easting | 276761 | | Northing | 801088 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 507 | | List of outfalls in cumulative assessment | | 509 |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 13/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.033 | Permeable area draining to outfall (ha): 0.229

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 1.3

Tier 2 — Bed width (m): 1.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | 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 | Filter drain and wet detention pond (100%) (Cu) | 40 | | Unlimited | D | 100 | |

Predict Impact | Show Detailed Results | Exit Tool

*Figure 31: Method A HAWRAT output for SuDS 507 & 509 cumulative assessment excluding sediments (outfalls between 100m and 1km apart)*

HIGHWAYS AGENCY

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| Soluble - Acute Impact | | | | | Sediment - Chronic Impact | | | |
|---|---|---|---|---|---|---|---|---|
| Annual Average Concentration | Copper | Zinc | | Copper | Zinc | | Sediment deposition for this site is judged as: | | |
| | Copper | Zinc | | Pass | Pass | | Accumulating? | | Low flow Vel m/s |
| Step 2 | 1.09 | 3.31 | ug/l | | | | Extensive? | | Deposition Index |
| Step 3 | 0.51 | 1.55 | ug/l | | | | | | |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | HA Area / DBFO number | | | |
| Assessment type | Cumulative assessment excluding sediments (outfalls between 100m and 1km apart) | | | | |
| OS grid reference of assessment point (m) | Easting 276761 | | Northing 801088 | | |
| OS grid reference of outfall structure (m) | Easting | | Northing | | |
| Outfall number | 507 | List of outfalls in cumulative assessment | | 509 | |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | Assessor and affiliation | | CFJV_IM | |
| Date of assessment | 13/07/2018 | Version of assessment | | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

| | | | |
|---|---|---|---|
| Annual 95%ile river flow ($m^3/s$) | 0.001 | (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only) | |
| Impermeable road area drained (ha) | 2.033 | Permeable area draining to outfall (ha) | 0.229 |
| Base Flow Index (BFI) | 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? | Yes |

For dissolved zinc only: Water hardness: Low = <50mg CaCO3/l (D)

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) | 1.3 | | | | | |
| Tier 2 | Bed width (m) | 1.0 | Manning's n | 0.05 | Side slope (m/m) | 0.5 | 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 | Filter drain and wet detention pond (100%) (Zn) | 53.25 | | Unlimited | D | 100 | |

Predict Impact | Show Detailed Results | Exit Tool

*Figure 32: Method A HAWRAT output for SuDS 561 & 563 cumulative assessment excluding sediments (outfalls between 100m and 1km apart)*

HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.63 | 1.95 | ug/l |
| Step 3 | 0.32 | 0.99 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Sediment deposition for this site is judged as:

Accumulating? Low flow Vel m/s

Extensive? Deposition Index

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment excluding sediments (outfalls between 100m and 1km apart) | | | | |
| OS grid reference of assessment point (m) | Easting | 281210 | | Northing | 803668 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 561 | | List of outfalls in cumulative assessment | 563 | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.35 | Permeable area draining to outfall (ha): 2.0

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l D

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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**Step 3 Mitigation**

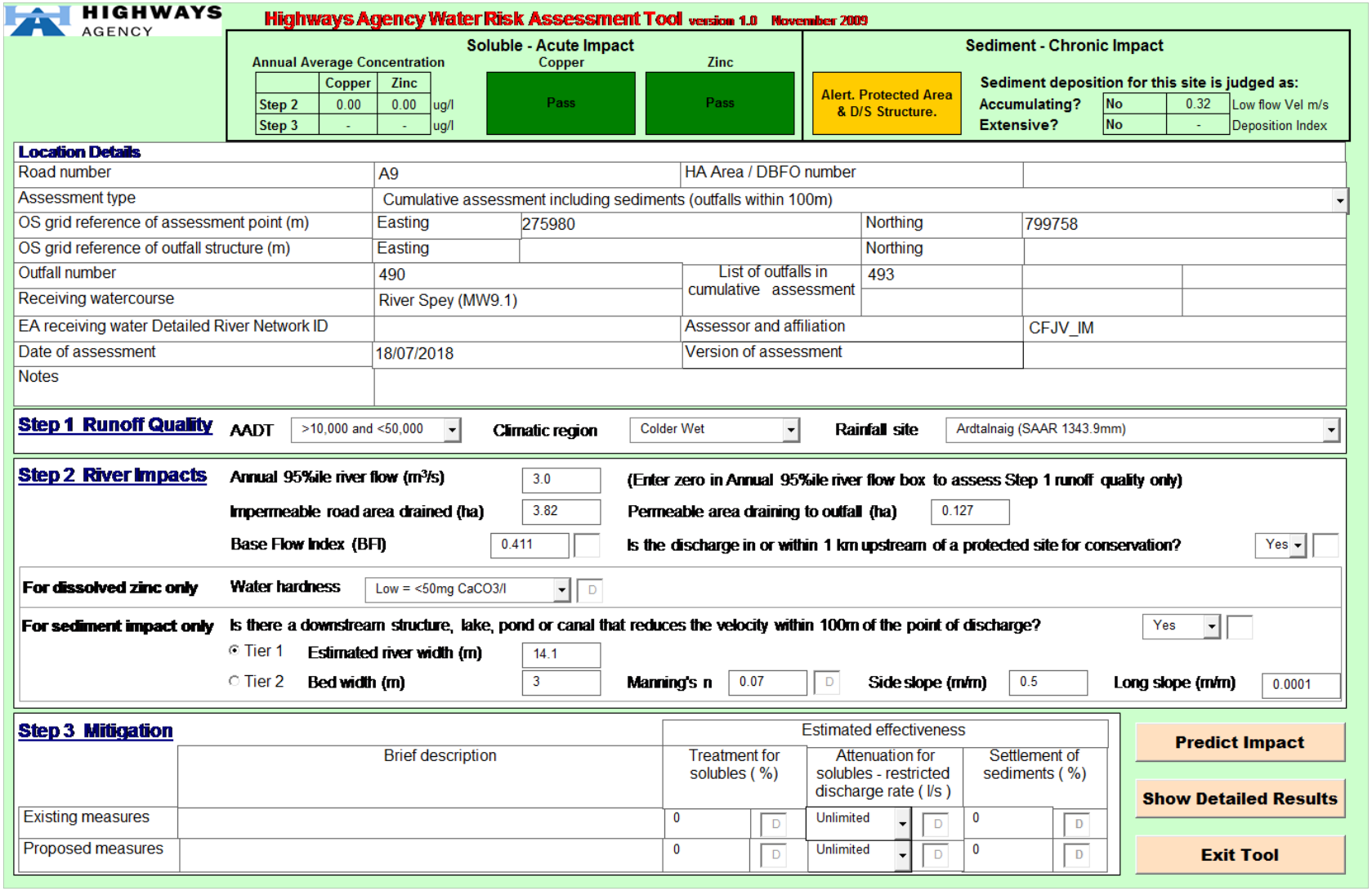
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | | Attenuation for solubles - restricted discharge rate ( l/s ) | | Settlement of sediments ( %) | |
|---|---|---|---|---|---|---|---|
| Existing measures | | 0 | D | Unlimited | D | 0 | D |
| Proposed measures | Filter drain and vortex separator (Zn) | 49 | | Unlimited | D | 68 | |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 33: Method A HAWRAT output for SuDS 490 & 493 cumulative assessment including sediments (outfalls within 100m) (copper)*



HIGHWAYS AGENCY

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| Soluble - Acute Impact | | | | Sediment - Chronic Impact | | | |
|---|---|---|---|---|---|---|---|
| Annual Average Concentration | Copper | Zinc | | Copper: Pass | Zinc: Pass | Alert. Protected Area & D/S Structure. | Sediment deposition for this site is judged as: |
| Step 2 | 0.00 | 0.00 | ug/l | | | | Accumulating? No 0.32 Low flow Vel m/s |
| Step 3 | - | - | ug/l | | | | Extensive? No - Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment including sediments (outfalls within 100m) | | | | |
| OS grid reference of assessment point (m) | Easting | 275980 | | Northing | 799758 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 490 | | List of outfalls in cumulative assessment | 493 | |
| Receiving watercourse | River Spey (MW9.1) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality** AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

| | | | |
|---|---|---|---|
| Annual 95%ile river flow ($m^3/s$) | 3.0 | (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only) | |
| Impermeable road area drained (ha) | 3.82 | Permeable area draining to outfall (ha) | 0.127 |
| Base Flow Index (BFI) | 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? | Yes |

For dissolved zinc only — Water hardness: Low = <50mg 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

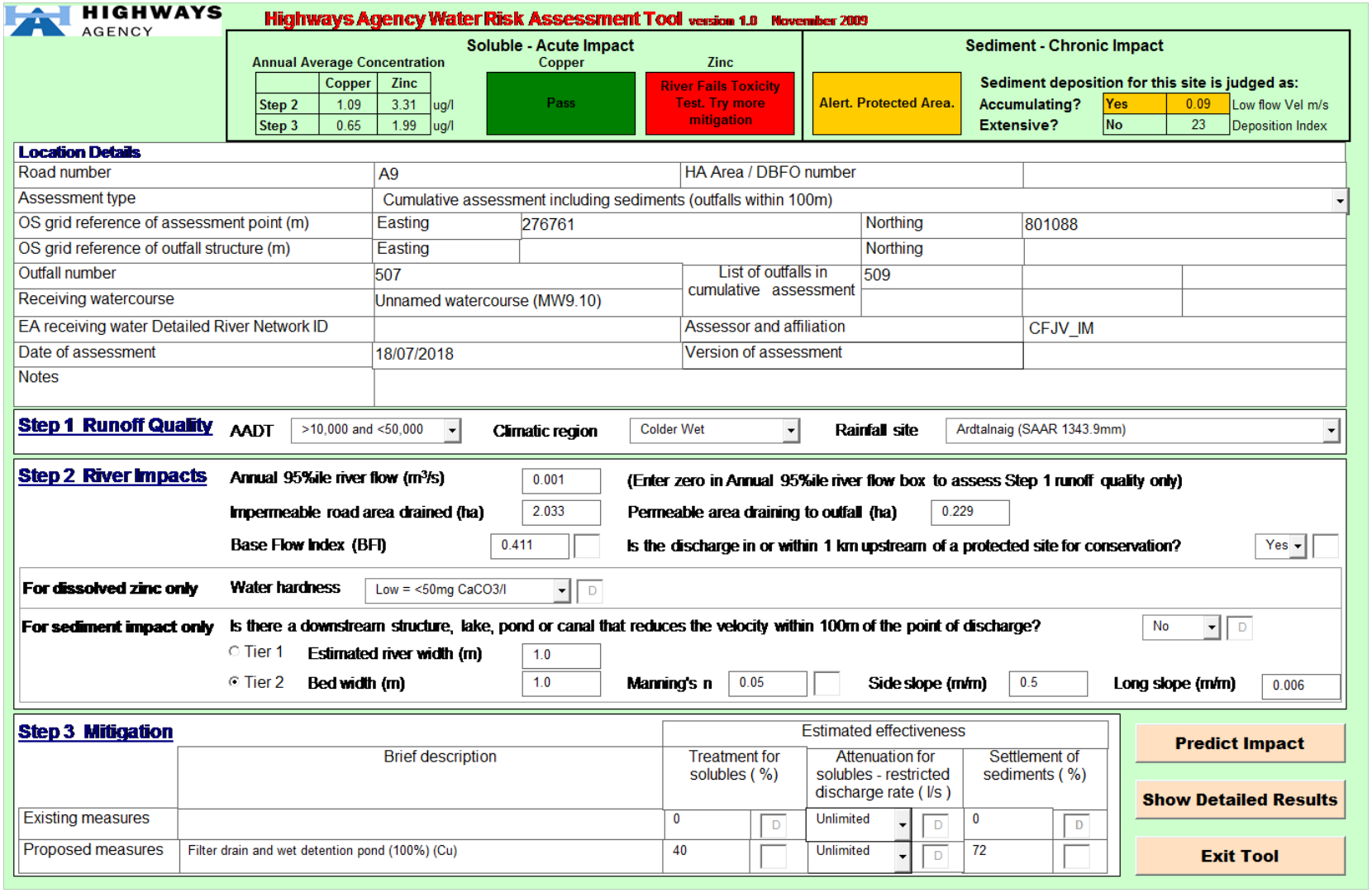
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tier 1 | Estimated river width (m) | 14.1 | | | | | | |
| Tier 2 | Bed width (m) | 3 | Manning's n | 0.07 | Side slope (m/m) | 0.5 | Long slope (m/m) | 0.0001 |

**Step 3 Mitigation**

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

Predict Impact | Show Detailed Results | Exit Tool

*Figure 34: Method A HAWRAT output for SuDS 507 & 509 cumulative assessment including sediments (outfalls within 100m) (copper)*



HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.09 | 3.31 | ug/l |
| Step 3 | 0.65 | 1.99 | ug/l |

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.09 | Low flow Vel m/s |
| Extensive? | No | 23 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment including sediments (outfalls within 100m) | | | | |
| OS grid reference of assessment point (m) | Easting | 276761 | | Northing | 801088 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 507 | | List of outfalls in cumulative assessment | 509 | |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | | CFJV_IM |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.033 | Permeable area draining to outfall (ha): 0.229

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.0

Tier 2 — Bed width (m): 1.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.006

**Step 3 Mitigation**

| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Cu) | 40 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 35: Method A HAWRAT output for SuDS 507 & 509 cumulative assessment including sediments (outfalls within 100m) (zinc)*

HIGHWAYS AGENCY

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**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 1.09 | 3.31 | ug/l |
| Step 3 | 0.51 | 1.55 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | Yes | 0.09 | Low flow Vel m/s |
| Extensive? | No | 23 | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment including sediments (outfalls within 100m) | | | | |
| OS grid reference of assessment point (m) | Easting | 276761 | | Northing | 801088 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 507 | | List of outfalls in cumulative assessment | 509 | |
| Receiving watercourse | Unnamed watercourse (MW9.10) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.033 | Permeable area draining to outfall (ha): 0.229

Base Flow Index (BFI): 0.411 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg 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

Tier 1 — Estimated river width (m): 1.0

Tier 2 — Bed width (m): 1.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.006

**Step 3 Mitigation**

| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and wet detention pond (100%) (Zn) | 53.25 | Unlimited | 72 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 36: Method A HAWRAT output for SuDS 561 & 563 cumulative assessment including sediments (outfalls within 100m) (copper)*

HIGHWAYS AGENCY

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| Annual Average Concentration | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.63 | 1.95 | ug/l |
| Step 3 | 0.32 | 0.97 | ug/l |

**Soluble - Acute Impact**

| Copper | Zinc |
|---|---|
| Pass | Pass |

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment including sediments (outfalls within 100m) | | | | |
| OS grid reference of assessment point (m) | Easting | 281210 | | Northing | 803668 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 561 | | List of outfalls in cumulative assessment | 563 | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.35 | Permeable area draining to outfall (ha): 2.0

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg 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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**Step 3 Mitigation**

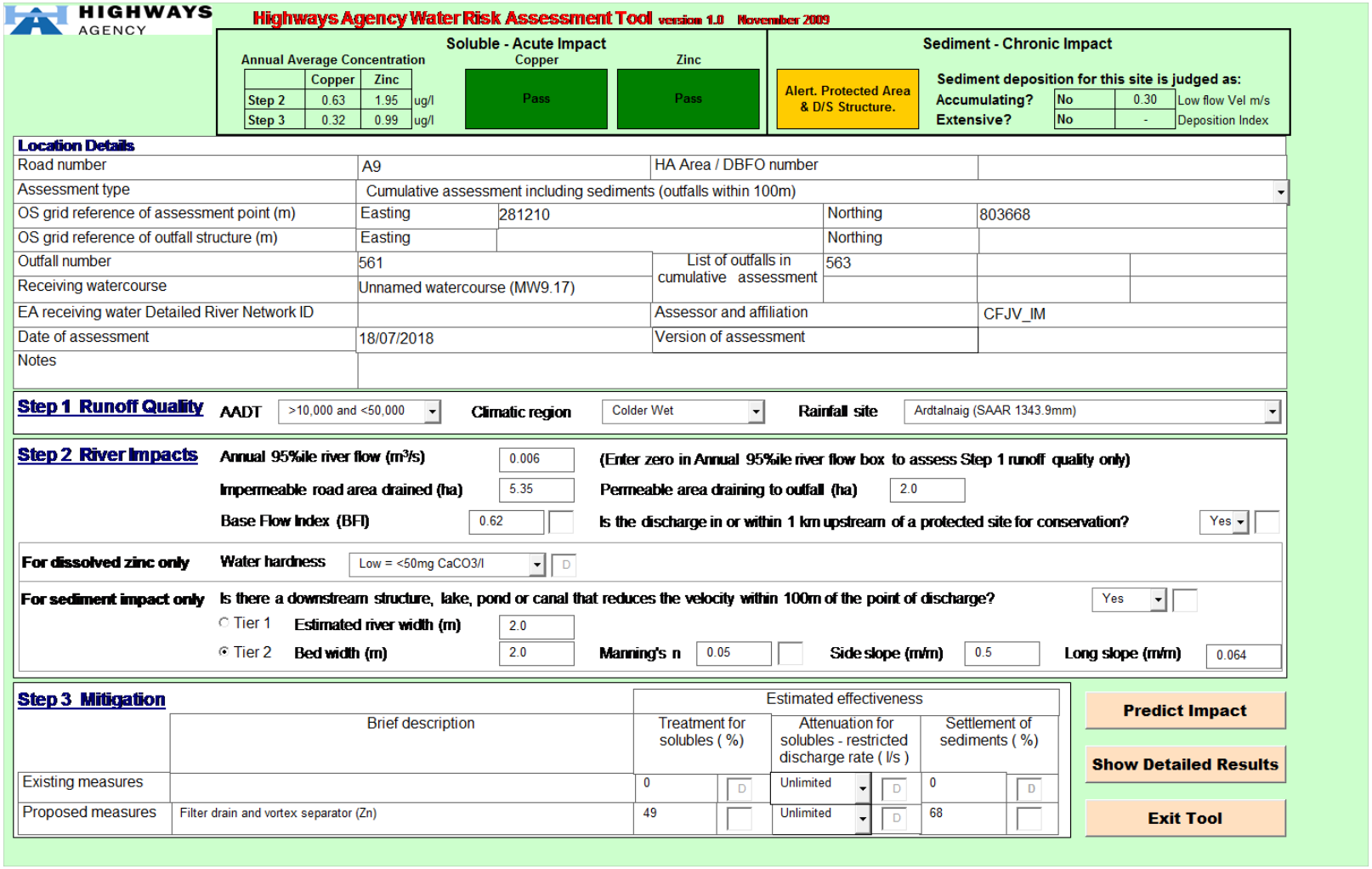
| | Brief description | Estimated effectiveness: Treatment for solubles ( %) | Attenuation for solubles - restricted discharge rate ( l/s ) | Settlement of sediments ( %) |
|---|---|---|---|---|
| Existing measures | | 0 | Unlimited | 0 |
| Proposed measures | Filter drain and vortex separator (Cu) | 50 | Unlimited | 80 |

Predict Impact

Show Detailed Results

Exit Tool

*Figure 37: Method A HAWRAT output for SuDS 561 & 563 cumulative assessment including sediments (outfalls within 100m) (zinc)*



HIGHWAYS AGENCY

**Highways Agency Water Risk Assessment Tool** version 1.0 November 2009

**Soluble - Acute Impact**

Annual Average Concentration

| | Copper | Zinc | |
|---|---|---|---|
| Step 2 | 0.63 | 1.95 | ug/l |
| Step 3 | 0.32 | 0.99 | ug/l |

Copper: Pass

Zinc: Pass

**Sediment - Chronic Impact**

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

| | | | |
|---|---|---|---|
| Accumulating? | No | 0.30 | Low flow Vel m/s |
| Extensive? | No | - | Deposition Index |

**Location Details**

| | | | | | |
|---|---|---|---|---|---|
| Road number | A9 | | HA Area / DBFO number | | |
| Assessment type | Cumulative assessment including sediments (outfalls within 100m) | | | | |
| OS grid reference of assessment point (m) | Easting | 281210 | | Northing | 803668 |
| OS grid reference of outfall structure (m) | Easting | | | Northing | |
| Outfall number | 561 | | List of outfalls in cumulative assessment | 563 | |
| Receiving watercourse | Unnamed watercourse (MW9.17) | | | | |
| EA receiving water Detailed River Network ID | | | Assessor and affiliation | CFJV_IM | |
| Date of assessment | 18/07/2018 | | Version of assessment | | |
| Notes | | | | | |

**Step 1 Runoff Quality**

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

**Step 2 River Impacts**

Annual 95%ile river flow ($m^3/s$): 0.006 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.35 | Permeable area draining to outfall (ha): 2.0

Base Flow Index (BFI): 0.62 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l | D

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): 2.0

Tier 2 — Bed width (m): 2.0 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.064

**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 | Filter drain and vortex separator (Zn) | 49 | | Unlimited | D | 68 | |

Predict Impact

Show Detailed Results

Exit Tool

*Table 9: Method C Calculations*

| SuDS Network 417 | | | | | |
|---|---|---|---|---|---|
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 13,160 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 7.6 ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-009 (located c.150m south east of SuDS 417 earthworks)<br>Depth to water = Dry<br>BH depth = 3.7m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | River Terrace Deposits;<br>Gravel, sand, silt and clay;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | River Terrace Deposits;<br>Gravel, sand, silt and clay;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 427** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 13,024 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 2.7 ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-013 (located at northern edge of SuDS 417 earthworks)<br>Depth to water = 2.5m<br>BH depth = 3.0m | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt; | High – 3 | 22.5 |

| | | | | | |
|---|---|---|---|---|---|
| | | | Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | | |
| Overall Score for Filter Drains | | | | | 200 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 230 Medium Risk of Impact (150 - 250) |
| **SuDS Network 434** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 12,900 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 6.4ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-017 (located c. 115m south of SuDS 434 earthworks)<br>Depth to water = Dry<br>BH depth = 4.2m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210 Medium Risk of Impact (150 - 250) |
| **SuDS Network 458** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 12,905 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 5.3ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | BH9-006 (located c. 195m east of SuDS 458 earthworks)<br>Depth to water = 8.00m<br>BH depth = 23.6m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly | Low – 1 | 20 |

| | | | | | |
|---|---|---|---|---|---|
| | | | intergranular flow) | | |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits; Gravel, sand and silt; Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits; Gravel, sand and silt; Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210 Medium Risk of Impact (150 - 250) |

**SuDS Network 461**

| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
|---|---|---|---|---|---|
| 1 | Traffic Density | 15 | 12,905 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.6ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | BH9-006 (located c. 30m west of SuDS 461 earthworks)<br>Depth to water = 8.00m<br>BH depth = 23.6m | Low – 1 | 20 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits; Gravel, sand and silt; Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits; Gravel, sand and silt; Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 160 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 190 Medium Risk of Impact (150 - 250) |

**SuDS Network 474**

| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
|---|---|---|---|---|---|
| 1 | Traffic Density | 15 | 12,909 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway | 15 | Filter Drains | Low – 1 | 15 |

| | | | | | |
|---|---|---|---|---|---|
| | geometry | | SuDS Basin associated with High Road Area 8.0ha | High – 3 | 45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-027 (located c. 80m west of SuDS 474 earthworks)<br>Depth to water = 2.40m<br>BH depth = 2.40m | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |

**SuDS Network 487**

| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
|---|---|---|---|---|---|
| 1 | Traffic Density | 15 | 12,909 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.1ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-030 (located c. 95m south-west of SuDS 487 earthworks)<br>Depth to water = Dry<br>BH depth = 2.30m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |

| | | | | | |
|---|---|---|---|---|---|
| **SuDS Network 490** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 12,910 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.4ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-059 (located c. 105m south-west of SuDS 490 earthworks)<br>Depth to water = Dry<br>BH depth = 3.80m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits;<br>Gravel, sand and silt;<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 493** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 12,910 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 2.6ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-059 (located c. 440m south-west of SuDS 493 earthworks)<br>Depth to water = Dry<br>BH depth = 3.80m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be | High – 3 | 22.5 |

| | | | | | |
|---|---|---|---|---|---|
| | | | expected to be hydraulically connected to surface waters. | | |
| 7 | Lithology | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |

**SuDS Network 502**

| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
|---|---|---|---|---|---|
| 1 | Traffic Density | 15 | 12,914 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.0ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | BH9-034 (located at southern edge of SuDS 502 earthworks)<br>Depth to water = Dry<br>BH depth = 54.0m | Low – 1 | 20 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 160<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 190<br>Medium Risk of Impact (150 - 250) |

**SuDS Network 507**

| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
|---|---|---|---|---|---|
| 1 | Traffic Density | 15 | 14,076 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall | | 35 – 39mm | Medium – | |

| | | | | | |
|---|---|---|---|---|---|
| | intensity | | | 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 0.54ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | BH9-013 (located c. 30m north-west of SuDS 507 earthworks)<br>Depth to water = 1.0m<br>BH depth = 14.0m | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 200<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 230<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 509** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,149 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.76ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-034 (located c. 40m north-west of SuDS 509 earthworks)<br>Depth to water = Dry<br>BH depth = 4.30m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Deposits<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Deposits<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in | High – 3 | 22.5 |

| | | | | | |
|---|---|---|---|---|---|
| | | | glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | | |
| Overall Score for Filter Drains | | | | | 180 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210 Medium Risk of Impact (150 - 250) |
| **SuDS Network 513** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,148 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 2.75ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-036 (located c. 100m west of SuDS 513 earthworks)<br>Depth to water = Dry<br>BH depth = 2.20m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Glaciofluvial Ice Contact<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Glaciofluvial Ice Contact<br>Clayey, silty and sandy fine to coarse gravel.<br>Moderate to high or high productivity with intergranular flow and good quality and quantity status. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180 Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210 Medium Risk of Impact (150 - 250) |
| **SuDS Network 530** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,150 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 2.6ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated | 20 | TP9-042A (located at northern edge of | High – 3 | 60 |

| | | | | | |
|---|---|---|---|---|---|
| | zone (depth to water) | | SuDS 530 earthworks)<br>Depth to water = 2.3m<br>BH depth = 2.3m | | |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Peat<br>Low value in terms of resource and productivity, but likely variable permeability (depending on decomposition) and variable water contents from rainfall, run-off and groundwater with a variety of important functional roles. | Medium – 2 | 15 |
| 7 | Lithology | 7.5 | Peat<br>Low value in terms of resource and productivity, but likely variable permeability (depending on decomposition) and variable water contents from rainfall, run-off and groundwater with a variety of important functional roles. | Medium – 2 | 15 |
| Overall Score for Filter Drains | | | | | 185<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 215<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 534** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,150 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 1.7ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-044 (located c.53m north of SuDS 530 earthworks)<br>Depth to water = 2m<br>BH depth = 2m | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvial Fan Deposits<br>Sandy gravelly silt and silty fine to coarse gravel.<br>Moderate to high groundwater potential.<br>Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Alluvial Fan Deposits<br>Sandy gravelly silt and silty fine to coarse gravel.<br>Moderate to high groundwater potential.<br>Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 200<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 230 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Medium Risk of Impact (150 - 250) |
| **SuDS Network 537** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,150 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin associated with High Road Area 6.2ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | TP9-045 (located c.25m north of SuDS 537 earthworks)<br>Depth to water = Dry<br>BH depth = 1.2m, assumed ground water level >5m and < 15m | Medium – 2 | 40 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 180<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 210<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 561** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,150 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin/ feature associated with High Road Area 3.3ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | No information so conservative value has been adopted | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel. | High – 3 | 22.5 |

| | | | | | |
|---|---|---|---|---|---|
| | | | Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | | |
| 7 | Lithology | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 200<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 230<br>Medium Risk of Impact (150 - 250) |
| **SuDS Network 563** | | | | | |
| Component Number | Property | Weighting Factor | Site Data | Risk Score | Component Score |
| 1 | Traffic Density | 15 | 15,150 (AADT) | Low – 1 | 15 |
| 2 | Rainfall volume | 15 | 1304.0 | High – 3 | 45 |
| | Rainfall intensity | | 35 – 39mm | Medium – 2 | |
| 3 | Soakaway geometry | 15 | Filter Drains<br><br>SuDS Basin/ feature associated with High Road Area 3.8ha | Low – 1<br><br>High – 3 | 15<br><br>45 |
| 4 | Unsaturated zone (depth to water) | 20 | No information so conservative value has been adopted | High – 3 | 60 |
| 5 | Flow type | 20 | Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow) | Low – 1 | 20 |
| 6 | Effective grain size | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| 7 | Lithology | 7.5 | Alluvium<br>Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.<br>Moderate to high groundwater potential. Groundwater would also generally be expected to be hydraulically connected to surface waters. | High – 3 | 22.5 |
| Overall Score for Filter Drains | | | | | 200<br>Medium Risk of Impact (150 - 250) |
| Overall Score for SuDS Basin (with high road area) | | | | | 230<br>Medium Risk of Impact (150 - 250) |

*Figure 38: Method D results for mainline impact on surface water*

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 | | |
| D1 | Water body type | Surface watercourse | | | | | | | |
| D2 | Length of road draining to outfall *(m)* | 2,300 | | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | | | | | | | |
| D5 | Junction type | No junction | | | | | | | |
| D6 | Location | > 1 hour | | | | | | | |
| D7 | Traffic flow (AADT two way) | 12,910 | | | | | | | |
| D8 | % HGV | 19 | | | | | | | |
| D8 | Spillage factor *(no/$10^9$HGVkm/year)* | 0.29 | | | | | | | |
| D9 | Risk of accidental spillage | 0.00060 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.75 | | | | | | | |
| D11 | Risk of pollution incident | 0.00045 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | | | | | | **Totals** | **Return Period (years)** |
| D13 | Return period without pollution reduction measures | 0.00045 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0004 | 2233 |
| D14 | Existing measures factor | 1 | | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00045 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0004 | 2233 |
| D16 | Proposed measures factor | 0.8 | | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00036 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0004 | 2791 |

**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.

*Figure 39: Method D results for mainline impact on groundwater*

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 | | |
| D1 | Water body type | Groundwater | | | | | | | |
| D2 | Length of road draining to outfall *(m)* | 2,300 | | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | | | | | | | |
| D5 | Junction type | No junction | | | | | | | |
| D6 | Location | > 1 hour | | | | | | | |
| D7 | Traffic flow (AADT two way) | 12,910 | | | | | | | |
| D8 | % HGV | 19 | | | | | | | |
| D8 | Spillage factor *(no/$10^9$ HGV km/year)* | 0.29 | | | | | | | |
| D9 | Risk of accidental spillage | 0.00060 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.50 | | | | | | | |
| D11 | Risk of pollution incident | 0.00030 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | | | | | | **Totals** | **Return Period (years)** |
| D13 | Return period without pollution reduction measures | 0.00030 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0003 | 3349 |
| D14 | Existing measures factor | 1 | | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00030 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0003 | 3349 |
| D16 | Proposed measures factor | 0.8 | | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00024 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0002 | 4186 |

**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.

*Figure 40: Method D results for Newtonmore junction impact on surface water*

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)* | 1,700 | 640 | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | A | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | Rural | | | | | | |
| D5 | Junction type | No junction | Slip road | | | | | | |
| D6 | Location | > 1 hour | > 1 hour | | | | | | |
| D7 | Traffic flow (AADT two way) | 12,900 | 1,033 | | | | | | |
| D8 | % HGV | 20 | 18 | | | | | | |
| D8 | Spillage factor *(no/$10^9$HGVkm/year)* | **0.29** | **0.83** | | | | | | |
| D9 | Risk of accidental spillage | 0.00046 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.75 | 0.75 | | | | | | |
| D11 | Risk of pollution incident | 0.00035 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | **No** | | | | | | |
| D13 | Return period without pollution reduction measures | 0.00035 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0004 | 2665 |
| D14 | Existing measures factor | **1** | **1** | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00035 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0004 | 2665 |
| D16 | Proposed measures factor | **0.8** | **0.8** | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00028 | 0.00002 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0003 | 3331 |

**Justification for choice of existing measures factors:**

**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.

*Figure 41: Method D results for Newtonmore junction impact on groundwater*

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 | Groundwater | Groundwater | | | | | | |
| D2 | Length of road draining to outfall *(m)* | 1,700 | 640 | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | A | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | Rural | | | | | | |
| D5 | Junction type | No junction | Slip road | | | | | | |
| D6 | Location | > 1 hour | > 1 hour | | | | | | |
| D7 | Traffic flow (AADT two way) | 12,900 | 1,033 | | | | | | |
| D8 | % HGV | 20 | 18 | | | | | | |
| D8 | Spillage factor *(no/$10^9$ HGVkm/year)* | **0.29** | **0.83** | | | | | | |
| D9 | Risk of accidental spillage | 0.00046 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.50 | 0.50 | | | | | | |
| D11 | Risk of pollution incident | 0.00023 | 0.00002 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | **No** | | | | | | |
| D13 | Return period without pollution reduction measures | 0.00023 | 0.00002 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0003 | 3998 |
| D14 | Existing measures factor | **1** | **1** | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00023 | 0.00002 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0003 | 3998 |
| D16 | Proposed measures factor | **0.8** | **0.8** | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00019 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0002 | 4997 |

**Justification for choice of existing measures factors:**

**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.

*Figure 42: Method D results for Kingussie junction impact on surface water*

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)* | 442 | 138 | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | A | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | Rural | | | | | | |
| D5 | Junction type | No junction | Slip road | | | | | | |
| D6 | Location | > 1 hour | > 1 hour | | | | | | |
| D7 | Traffic flow (AADT two way) | 14,076 | 1,529 | | | | | | |
| D8 | % HGV | 18 | 9 | | | | | | |
| D8 | Spillage factor *(no/$10^9$ HGVkm/year)* | **0.29** | **0.83** | | | | | | |
| D9 | Risk of accidental spillage | 0.00012 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.75 | 0.75 | | | | | | |
| D11 | Risk of pollution incident | 0.00009 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | **No** | | | | | | |
| D13 | Return period without pollution reduction measures | 0.00009 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0001 | 10727 |
| D14 | Existing measures factor | **1** | **1** | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00009 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0001 | 10727 |
| D16 | Proposed measures factor | **0.8** | **0.8** | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00007 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0001 | 13409 |

**Justification for choice of existing measures factors:**

**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.

*Figure 43: Method D results for Kingussie junction impact on groundwater*

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 | Groundwater | Groundwater | | | | | | |
| D2 | Length of road draining to outfall *(m)* | 442 | 138 | | | | | | |
| D3 | Road Type *(A-road or Motorway)* | A | A | | | | | | |
| D4 | If A road, is site urban or rural? | Rural | Rural | | | | | | |
| D5 | Junction type | No junction | Slip road | | | | | | |
| D6 | Location | > 1 hour | > 1 hour | | | | | | |
| D7 | Traffic flow (AADT two way) | 14,076 | 1,529 | | | | | | |
| D8 | % HGV | 18 | 9 | | | | | | |
| D8 | Spillage factor *(no/$10^9$ HGVkm/year)* | **0.29** | **0.83** | | | | | | |
| D9 | Risk of accidental spillage | 0.00012 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D10 | Probability factor | 0.50 | 0.50 | | | | | | |
| D11 | Risk of pollution incident | 0.00006 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | | |
| D12 | Is risk greater than 0.01? | **No** | **No** | | | | | | |
| D13 | Return period without pollution reduction measures | 0.00006 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0001 | 16091 |
| D14 | Existing measures factor | **1** | **1** | | | | | | |
| D15 | Return period with existing pollution reduction measures | 0.00006 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0001 | 16091 |
| D16 | Proposed measures factor | **0.8** | **0.8** | | | | | | |
| D17 | Residual with proposed Pollution reduction measures | 0.00005 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.0000 | 20114 |

**Justification for choice of existing measures factors:**

**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.

# Annex 2: Technical Note

| | | | |
|---|---|---|---|
| **Project:** | A9 Dualling | **Originated** | PG |
| **Subject:** | Side Road and Accommodation Track SUDS | **Checked** | DP |
| **Date:** | August 2015 | **Reviewed** | RMcE |
| **Document Reference** | A9P0N-AMJ-HDG-Z_ZZZZZ_XX-TN-DE-0001 | **Authorised** | SB |
| **Suitability** | For Review & Comment | **Version** | P3.0 |

## 1. SUDS on Side Roads, Accommodation and NMU Tracks

Section 4.1 of Chapter 3 'Water and Flooding' of the A9 Dualling Programme Environmental Design Guide [1] states that 'All runoff from newly dualled A9 carriageway will be collected and treated via, as a minimum, two levels of sustainable drainage systems (SUDS), prior to discharge.
Dualling of the A9 involves interaction with existing side roads, requiring diversions and realignments as well as creation of accommodation tracks and non-motorised user (NMU) tracks. This Technical Note outlines the proposed approach to SUDS on these side roads and tracks.

### 1.1 Current Guidance on SUDS use with Roads

There is limited guidance on how to approach the SUDS assessment and design for the type of roads and tracks that are beyond the A9 mainline or junctions. Below are extracts from a number of relevant guidance documents referencing SUDS use with roads:

- 'SUDS for Roads' [2] section 2.1 acknowledges the different categories of roads below Trunk Roads, including a number of categories of distributor and access roads. The guidance on the number of SUDS levels for roads in section 2.4.1 states 'It is generally accepted that roads typically require two levels of treatment, although for smaller developments residential roads may require only one level'
- Guidance in SEPA 'Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUDS systems) [3]. Section 7.7 states that 'Levels of treatment required will depend on the volume of traffic using the road; 'One level is appropriate for lightly trafficked and minor roads, two levels of treatment are normally required for all other roads, except motorways which normally require three levels.'
- Highland Council guidance, sections 6.25 to 6.29 'Drainage of the Road' of Flood Risk & Drainage Impact Assessment: Supplementary Guidance [4], refers to individual elements of SUDS for use on roads, but references SUDS for Roads for further guidance (section 6.29).

Perth and Kinross Council guidance, 'Flood Risk and Flood Risk Assessments' [5] does not make any specific reference to SUDS use with roads.

### 1.2 Side Road and Track Classifications

SUDS for Roads (Figures 2.1 and 2.2) classify roads in three broad categories; trunk, distributor and access roads.
'A9 Dualling: Preliminary Engineering Support Services' [6] (PES) report classifies side roads into three tiers for the purposes of the junction strategy: Tier 1; A and B roads, Tier 2; C and unclassified roads and Tier 3; Private and Agricultural access roads. Section 4.10.1 of the PES report identifies that B roads with Annual Average Daily Traffic (AADT) or less than 500 should be considered separately to those with a greater AADT.

Taking both of the above classifications into consideration, it is proposed to group the side roads and tracks in the following classifications. This is so that the most appropriate method of SUDS assessment, selection and guidance can be applied to each group.

- Tier 0: Trunk Road (side road to A9) under the jurisdiction of Transport Scotland.
- Tier 1.1: A and B roads (local roads) with an AADT of over 500.
- Tier 1.2: A and B roads (local roads) with an AADT of under 500.
- Tier 2: C and unclassified roads.
- Tier 3: Private and Agricultural Access Roads (Accommodation Tracks).
- Tier 4: NMU tracks.

### 1.3 Guidance Relevant to each Side Road and Track Classification

- Tier 0 side roads are those under the jurisdiction of Transport Scotland, therefore design standards and advice in the Design Manual for Roads and Bridges (DMRB) [7] applies, as it does for the mainline A9.

- Tier 1 and 2 are local authority roads, therefore guidance on SUDS assessment in the DMRB may not be appropriate. HD45/09 Road Drainage and the Water Environment [8] is the applicable section of guidance in the DMRB. The methods in here, such as Method A (HAWRAT) (HD45/09 Annex 1) for assessing the runoff from roads on receiving watercourses, are aimed at roads with a traffic flow (AADT) of over 10,000 per day. On parts of the A9 mainline the AADT is below this, and on the side roads likely to be lower again, often lower than 10% (1000 AADT) of this. Therefore, more appropriate guidance on SUDS assessment and selection is in SUDS for Roads.

  Guidance in SUDS for Roads is applicable to all types of roads from trunk roads to minor access links (section 1.1.1).
  Section 2.6 of SUDS for Roads sets out a procedure to select the appropriate SUDS features for a road, taking into consideration aspects such as topography, space available and environmental factors. It is proposed to use this procedure to assist in selecting the SUDS for Tier 1 and 2 side roads.

  Tier 1 roads have been sub-divided into two categories, based on the PES Report AADT of 500 as the limit of a lightly trafficked road. The use of 500 AADT as a basis for lightly trafficked roads originates from DMRB TD41/94 [9] as a road with such low traffic flows as to allow an uncontrolled direct access off the trunk road. SEPA guidance 'WAT-RM-08' will be considered in the case of lightly trafficked roads with an AADT of under 500.

  Tier 1.1 A and B roads with an AADT of over 500
  Tier 1.2: A and B roads with an AADT of under 500

- Tier 3 accommodation tracks and access roads vary depending on the use and requirements and the majority will be private. These have been sub-divided into five categories on the basis of applying the most appropriate SUDS guidance to each one.

  Tier 3.1: Agricultural / forestry with an AADT of under 100
  Tier 3.2 Agricultural with an AADT of under 50
  Tier 3.3 Residential with an AADT of under 100
  Tier 3.4 Residential with an AADT of under 10
  Tier 3.5 Road feature maintenance track with and AADT of under 10

  Table 1.1 below shows potential variants within the Tiers. As most tracks will be designed to meet the requirements of the landowner, the tracks can vary between resembling minor roads (Tier 3.1 impermeably surfaced) to less formal accesses (Tier 3.4 permeably paved). Use of permeably paved accesses will be subject to suitability of ground conditions and intended usage.

In addition to guidance in SUDS for Roads and WAT-RM-08, other drainage design guidance specifically for tracks may also be considered. SNH guidance 'Constructed Tracks in the Scottish Uplands' [10] contains guidance on the design and construction of tracks in a rural upland setting, including drainage (section 4.9), which may also be appropriate for some track types.

| Tier | Typical Width* | Surface | Typical Vehicle | AADT | Purpose (dwelling, business, agricultural) |
|---|---|---|---|---|---|
| 3.1 | 6m | Impermeable surfacing | HGV 6 (or more)-axle articulated | <100 | Agricultural /forestry |
| | | Permeable paving | HGV 6 (or more)-axle articulated | <100 | Agricultural/forestry |
| 3.2 | 4m with passing places | Impermeable surfacing | Car /LGV | <50 | Agricultural |
| | | | HGV 6 (or more)-axle articulated | | |
| | | Permeable paving | Car /LGV | <50 | Agricultural |
| | | | HGV 6 (or more)-axle articulated | | |
| 3.3 | 4m with passing places | Impermeable surfacing | Car /LGV | <100 | Residential (multiple properties) |
| | | | HGV (3 axle rigid) – service vehicle | | |
| | | Permeable paving | Car /LGV | <100 | Residential (multiple properties) |
| | | | HGV (3 axle rigid) – service vehicle | | |
| 3.4 | 3m with passing places | Impermeable surfacing | Car / LGV | <10 | Residential (single property) |
| | | Permeable paving | Car / LGV | <10 | Residential (single property) |
| 3.5 | 3m with passing places | Permeable paving | LGV | <10 | SUDS maintenance track |

***** *Actual dimensions will be subject to change following consultation with local authority or the affected landowners*

**Table 1.1 Private and Agricultural Access Roads**

- Tier 4 NMU tracks will also vary depending on the use and requirements. They are likely to be a mix of private and local authority tracks. They have been subdivided into two categories in order to apply the most appropriate SUDS guidance to each one:

  Tier 4.1: Impermeably surfaced NMU tracks
  Tier 4.2: Permeably paved NMU tracks

### 1.3 Water Quality, SUDS, Guidance and Legislation

The drainage of the side roads, accommodation track and NMU track provision will consider the requirements of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 [11] (CAR).

Within the CAR Practical Guide [12], pollution control from surface water discharge is covered by both 'Point Source' (section 3.1) and 'Diffuse Pollution' (section 3.2), for the protection of the water environment.

Point source pollution includes 'surface water from urban areas' and diffuse pollution includes 'discharge of surface water run-off.' Further guidance on SEPA's website [13] identifies run-off from roads as diffuse pollution and should have SUDS applied, in accordance with SUDS for Roads. Roads are identified within the diffuse pollution in urban area, although applicable to rural and urban situations where roads are proposed.

SEPA guidance 'Diffuse Pollution General Biding Rules: Forestry' [14] references rural diffuse pollution, surface runoff:

- Water should be discharged in a way that minimises the risk of polluting the water environment.
- No discharge from drainage should result in the destabilisation of the banks or bed of the receiving water.

SNH 'Constructed Tracks in the Scottish Uplands' (section 4.9 – Drainage) references the CAR practical guide and acknowledges the potential impact of surface water runoff from these tracks on the receiving watercourses.

Point source and diffuse pollution, urban and rural are covered by General Binding Rules (GBR) 10 and 21, which cover surface water drainage, except where a simple licence is required.

- GBR10 addresses discharges relating to construction sites, buildings, roads, yards and other built up areas and requires provision of SUDS.
- GBR21 addresses the discharge of water run-off via a surface water drainage system to the water environment (rural land activities) and requires that run-off must be discharged in a manner that minimises the risk of pollution to any river, burn, ditch or wetland and must not result in the destabilisation of the banks or bed of the receiving river, burn, ditch or wetland. GBR 21 does not specify the requirement for SUDS.

Section c) of GBR10 states 'All reasonable steps must be taken to ensure that the discharge will not result in pollution of the water environment.' Therefore the provision of SUDS for each side road or track will contribute to achieving this.

Section 2, below, identifies the steps to be taken for each Tier of side road or track in order to best meet the requirements of GBR10 and 21.

## 2. Proposed Assessment Procedures

### 2.1 Side Roads (Tier 0)

- Tier 0 roads; where other Transport Scotland trunk roads join the A9 mainline, these shall be assessed in accordance with DMRB guidance and two levels of SUDS as a minimum will generally be proposed.

### 2.2 Side Roads (Tiers 1.1, 1.2 and 2)

All side roads will be reviewed on a case-by-case basis in line with an assessment and selection process based on that outlined in section 2.6 of SUDS for Roads. This includes consideration of location, traffic usage and position relative to any designated environmental sites. To ensure a proportional and risk-based solution, the SUDS approach for each category of side road is as follows:

- Tier 1.1 roads; these will be reviewed in accordance with an assessment based on section 2.6 of SUDS for Roads. It is proposed that two levels of SUDS shall be used, however each road will be reviewed on a case-by-case basis to ensure this is appropriate. Where physical or other site constraints exist that prevent the application of two levels, one level of SUDS may be proposed. If one level of SUDS is proposed, the type of SUDS will be considered to maximise pollutant capture and treatment, and the relevant stakeholders will be consulted.

- Tier 1.2 roads; these will be assessed in the same manner as Tier 1.1 roads. However, consideration will be given to the advice in WAT-RM-08 for roads that are lightly trafficked. Therefore, it is proposed to have one level of SUDS unless they are located in, or discharge to, an aquatic part of a Natura2000 site – Special Protection Area (SPA) or Special Areas of Conservation (SAC) designated under the Birds Directive (79/409/EEC) [15] or the Habitats Directive (92/43/EEC) [16] respectively, whereby use of two levels will generally be proposed.

  Where one level of SUDS is used, the most appropriate type of SUDS should be considered with the aims of maximising pollutant capture and treatment with due regard to ease of maintenance.

- Tier 2 roads; these will be assessed using the same approach as for Tier 1.2 roads.

### 3. Accommodation Tracks (Tier 3)

Each accommodation track in Tiers (Tier 3.1 to 3.5) has an AADT of under 100. Therefore it is appropriate to consider the advice given in WAT-RM-08. The traffic figures are low enough for one level of SUDS generally to be sufficient to give adequate and proportionate protection to the receiving watercourse. The type of SUDS will be considered to maximise pollutant capture and treatment.

However, Table 1.1 indicates that the type of vehicle use may vary significantly, and Tier 3.1 and 3.2 may carry types of industrial vehicle which have a higher risk of generating pollution.

Each track will be assessed on a case-by-case basis, using a process based on that outlined in section 2.6 of SUDS for Roads. It will generally be proposed that one level of SUDS is sufficient; however, where higher risk vehicles are identified as using the tracks, two levels of SUDS may be proposed. Likewise, where the tracks are located in or upstream of a Natura 2000 site (SAC or SPA), an additional level of SUDS may be required to give sufficient protection to the receiving watercourse.

Advice in SNH guidance ‘Constructed Tracks in the Scottish Uplands’ will be considered where applicable. Where permeable paving is used, particularly for Tiers 3.4 and 3.5, and where site conditions allow, the permeable paving may be considered as one level of SUDS.

### 4. NMU Tracks (Tier 4)

NMU tracks will generally not be used by vehicles, and so no vehicle based pollutants will be generated and washed into the run-off. Therefore, specific SUDS features to protect the quality of the receiving watercourses will not generally be provided. Where the tracks are paved, the runoff rates will be assessed and one level of SUDS may be proposed, principally as a conveyance and flood mitigation feature. Where the NMU tracks are constructed with permeable paving, this may be considered as one SUDS level in certain circumstances, depending on paving type, track use and local ground conditions. Otherwise they shall be treated in the same manner as paved NMU tracks.

## 5. References

1. Chapter 3 'Water and Flooding' of the A9 Dualling Programme Environmental Design Guide (CH2M Hill, 2015).
2. SUDS for Roads (WSP, 2009).
3. Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUDS systems) (SEPA, 2014).
4. Flood Risk & Drainage Impact Assessment: Supplementary Guidance (The Highland Council, 2013)
5. 'Flood Risk and Flood Risk Assessments (Developers Guidance Note on Flooding and Drainage) (Perth and Kinross Council, 2014)
6. A9 Dualling: Preliminary Engineering Support Services' DMRB Stage 1 Assessment (Jacobs, 2014)
7. Design Manual for Roads and Bridges (DMRB) (Highways England) www.standardforhighways.co.uk
8. HD45/09 'Road Drainage and the Water Environment' Volume 11, Section 3, Part 10 (DMRB, 2009)
9. TD41/95 'Vehicular Access to All Purpose Trunk Roads' Volume 6, Section 1, Part 7 (DMRB 1995)
10. Constructed Tracks in the Scottish Uplands (SNH, 2013)
11. The Water Environment (Controlled Activities) (Scotland) Regulations 2011
12. The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). A Practical Guide Version 7.2 (SEPA, 2015)
13. http://www.sepa.org.uk/regulations/water/diffuse-pollution/diffuse-pollution-in-the-urban-environment/
14. Reducing the Risk of Water Pollution: Diffuse Pollution General Biding Rules: Forestry (SEPA, 2006)
15. Birds Directive (79/409/EEC) as amended. European Parliament (1979)
16. Habitats Directive (92/43/EEC) as amended. European Parliament (1992)