

PART 10 : ROAD DRAINAGE AND THE WATER ENVIRONMENT

10.1 Methodology

10.1.1 This section of the Environmental Statement (ES) provides a summary of the findings of the environmental assessment of hydrology (surface water), drainage and hydrogeology (groundwater), conducted following the methodology and guidance stated in the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 10 (HA 216/06), May 2006. The assessment identifies the likely implications of the proposed A453 Widening improvements upon water quality and drainage. Sensitive hydrological and hydrogeological features within the study area have been identified and the potential impacts arising from the construction and operation of the scheme are assessed.

10.1.2 The road drainage and water environment impact assessment was undertaken in accordance with guidance given in the DMRB Volume 11, Section 3, Part 10, Annex I. The assessment comprises the following methodologies:

- Method A – Simple Assessment of Pollution Impacts from Routine Runoff;
- Method B - Detailed Assessment of Pollution Impacts from Routine Runoff;
- Method C - Assessment of Pollution Impacts from Routine Runoff on Groundwaters;
- Method D - Assessment of Pollution Impacts from Accidental Spillages.

10.1.3 DMRB Volume 11, Section 3, Part 10 also describes methodologies for assessing hydrological impacts of design floods (Method E) and for undertaking a Hydrological Assessment (Method F). These are beyond the scope of this assessment and have been undertaken separately as reported in the Flood Risk Assessment report, ref. A021959-REP-E-FL-229.

10.1.4 Information describing the baseline environment was compiled from site surveys, consultation with appropriate organisations and the review of published documents and maps. Reference to specific sources is made where appropriate, in particular the Water Quality Desk Based Study (report ref. A021959-REP-E-WQ-097, September 2008) and the A453 Environmental Assessment: Road Drainage and the Water Environment report, ref. A021959-REP-E-WQ-228, 2008. In addition to the Environment Agency the principal sources consulted were:

- Ordnance Survey (OS) Maps;
- British Geological Survey (BGS) Maps;
- Environment Agency Groundwater Vulnerability Maps;
- Envirocheck Report (Envirocheck is the industry standard desk study information service providing accurate site-specific information);
- Previous Site Visits and Site Investigations;

- Local Authorities (North West Leicestershire District Council; Rushcliffe Borough Council; Nottingham City Council).

10.1.5 An understanding of the existing baseline water environment allows an evaluation of the importance of key features and attributes and an assessment of the sensitivity of receptors to the proposed A453 Widening scheme. The DMRB provides criteria for estimating the importance of water environment attributes (see paragraph 10.5.16 and Table 2.10.1).

10.1.6 The DMRB also provides criteria for estimating the magnitude of impacts on attributes (see Table 2.10.11).

10.1.7 The significance of effects on the water environment is assessed by following the standard formulaic approach within the matrix in DMRB as described in Section 1 Part 3 of the ES (Table 1.3.4). This ensures a consistent approach to arriving at significance by considering the value or sensitivity of the environmental resource together with the scale of magnitude of impacts resulting from the scheme. The significance is assigned after consideration of the effectiveness of the design and committed mitigation measures.

10.2 Key Guidance and Legislation

10.2.1 Legislation relevant to the A453 improvements comprises numerous UK Acts and Regulations, EC Directives and regulatory guidance. This guidance includes:

- Water Resources Act 1991;
- UK Town and Country Planning Act 1990;
- Land Drainage Act 1991;
- Environment Act 1991;
- Control of Pollution Act 1974;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, and EC Water Framework Directive 2000 (2000/60/EC);
- The Surface Water (River Ecosystem) Regulations 1994;
- The Groundwater Regulations 1998 and EC Groundwater Directive 1980 (80/68/EEC);
- Surface Waters (Dangerous Substances) Regulations 1992, 1997 and 1998; and Surface Water (Classification) Regulations 1989, and EC Dangerous Substances Directive (76/464/EEC);
- The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996, and EC Surface Water Abstraction Directive (75/440/EEC);
- The Surface Waters (Fishlife) (Classification) Regulations 1997, and EC Freshwater Fisheries Directive 1978 (78/659/EEC);

- Salmon and Freshwater Fisheries Act 1975.

10.2.2 The proposed A453 Widening scheme would also be required to comply with Environment Agency Pollution Prevention Guidelines (PPG) which provide guidance on statutory responsibilities and good environmental practice. The following Environment Agency PPG's are relevant to the A453 improvement scheme:

- PPG1 – General guide to the prevention of pollution of controlled waters;
- PPG3 – The use and design of oil separators;
- PPG5 – Works in, near or liable to affect watercourses;
- PPG6 – Working at construction or demolition sites;
- PPG8 – Safe storage and disposal of used oils;
- PPG21 – Pollution incident response planning;
- PPG22 – Dealing with spillages on highways;

10.2.3 The following Planning Policy Statements (PPS) also apply to the proposed scheme:

- PPS23 – Planning and Pollution Control – Annex I: Pollution Control, Air and Water Quality, Draft RSS8 (2006);
- PPS25 – Development and Flood Risk (2006).

10.2.4 The section of A453 carriageway to which the proposed improvements apply straddles the border between Nottinghamshire and Leicestershire and passes through Clifton, a suburb of the City of Nottingham. Relevant local planning policy documents are as follows:

- Regional Spatial Strategy 8 for the East Midlands (RSS8) (2005);
- Leicestershire, Leicester and Rutland Structure Plan 1996 to 2016, Written Statement;
- Nottinghamshire and Nottingham Joint Structure Plan, Written Statement – Adopted February 2006;
- Nottingham Local Plan (2005).

10.2.5 More details on the relevant national, regional and local plans and policies are given in the A453 Widening Environmental Assessment: Planning Policy Report, (ref. A021959-REP-E-PL-232, 2008) and summarised in this ES Volume 1, Section 2, Part 13.

10.3 Consultations

10.3.1 During the assessment of potential impacts on the water environment the Environment Agency was approached with requests for the following data:

- Flow data of Nethergate Stream and Fairham Brook;

- Water quality data for Nethergate Stream and the River Trent;
- Status of Nethergate Stream;
- Data on flows and water quality for ditches in the vicinity of Lockington Marsh.

10.3.2 Average Annual Daily Traffic (AADT) and % HGV flows were obtained for the existing and proposed A453 schemes.

10.3.3 The following Local Authorities were consulted for details of private potable groundwater abstractions within the route corridor:

- Nottingham City Council;
- Rushcliffe Borough Council;
- North West Leicestershire District Council.

10.3.4 Throughout the assessment process, consultations have been held with the Highways Agency's maintaining agent (AMScott), Severn Trent Water, the Kingston Internal Drainage Board and the Environment Agency (EA). A letter from the EA confirming their satisfaction with the proposed pollution measures is included within the A453 Environmental Assessment: Road Drainage and the Water Environment report, ref. A021959-REP-E-WQ-228.

10.4 The Study Area

10.4.1 The 12 km section of the A453 for which the improvement scheme is proposed extends north-eastwards from M1 Junction 24 to the A52 near West Bridgford, Nottingham. A regional overview of the hydrological and hydrogeological characteristics was considered during the preparation of the baseline environment. The road drainage and water quality assessment conducted in accordance with the DMRB guidance was focused on the carriageway and surrounding land within a 1 km corridor either side of the proposed route of the improved A453. The environmental database search was limited to a route corridor 250 m either side of the A453 carriageway.

10.5 Baseline Conditions

10.5.1 As mentioned above, information on the hydrology and hydrogeology of the scheme (hereafter referred to as the water environment) has been obtained from published sources including Ordnance Survey (OS) and British Geological Survey (BGS) maps of the region, Environment Agency archives and an environmental database search focusing on a 250 m route corridor along the length of the carriageway. Site reconnaissance and consultations with the Environment Agency also provided data for the assessment of the existing hydrological and hydrogeological characteristics.

10.5.2 A full list of information sources is provided within the specialist technical reports mentioned in paragraph 10.1.4 above.

Surface Water

- 10.5.3 The River Soar, River Trent, Fairham Brook and Nethergate Stream are main rivers under Environment Agency jurisdiction which will receive runoff discharges from the A453 carriageway.
- 10.5.4 The revised A453 will cross the River Soar, Fairham Brook and Nethergate Stream, all of which discharge into the River Trent.
- 10.5.5 Runoff is initially discharged into named and unnamed roadside ditches, classified as ordinary watercourses, which deliver flows to the main receiving watercourses.
- 10.5.6 The water quality of the main receiving watercourses is generally good according to the Environment Agency General Quality Assessment (GQA) classification. Thus, these watercourses are expected to be able to support abstractions for all purposes and very good salmonid and cyprinid fisheries, with ecology at close to natural conditions.
- 10.5.7 There are two recorded abstractions from surface water within the 250 m route corridor. There are three recorded discharge consents within the 250 m route corridor permitting the release of effluents to surface watercourses.

Groundwater

- 10.5.8 The geology underlying the A453 carriageway and surrounding area comprises the Mercia Mudstone Group which is overlain in parts by superficial drift deposits including alluvium and river terrace deposits. The Sherwood Sandstone Formation and Carboniferous Coal Measures underlie the Mercia Mudstone Group at depth.
- 10.5.9 Approximately 40% of the strata underlying the route is classified as a Non-Aquifer and 60% is classified as Minor Aquifer of intermediate and high soil leaching potential. A Groundwater Vulnerability Map is shown in the ES Volume 2 as Figure 2.10.1.
- 10.5.10 The A453 route corridor does not lie within a groundwater Source Protection Zone (SPZ).
- 10.5.11 The outcrop of the Sherwood Sandstone Formation is classified as a Nitrate Vulnerable Zone (NVZ). Groundwater quality in this region is generally good.
- 10.5.12 Groundwater information is based primarily on the findings of site investigations undertaken by White Young Green Environment, which indicated that groundwater levels within the Minor Aquifers are generally within 5 m of the ground surface.
- 10.5.13 There are no records of licensed groundwater abstractions within the 250m route corridor. There are 189 BGS recorded boreholes within 250m of the A453; however the absence of a SPZ indicates that these do not contribute to public water supply (PWS). The nearest PWS abstraction is located approximately 4 km to the north of

the centre of Clifton. Consultation with the relevant local authorities indicates that there are no private potable abstractions within the route corridor.

Description of the Baseline Prior to Construction or in the 2012 Do-Minimum Scenario without the Scheme (See 10.7.1 below)

10.5.14 The hydrological and hydrogeological baseline environments in the opening year (2012) are not expected to vary significantly from the existing conditions as summarised above.

10.5.15 The key receptors identified during the consideration of the baseline environment are the main watercourses receiving runoff discharges, namely the River Soar, River Trent, Fairham Brook and Nethergate Stream. These watercourses are of good water quality and provide significant ecological and amenity value. Groundwater is a less significant receptor as sections of the underlying strata comprise Non-Aquifers and are of limited permeability, and discharge of runoff to ground is not proposed. There are no known groundwater abstractions within the route corridor and BGS recorded boreholes do not contribute to public water supply. Correspondence with the Environment Agency also highlights Lockington Marsh as an area of potential sensitivity because it is a Site of Special Scientific Interest (SSSI).

10.5.16 The significance of the hydrological and hydrogeological features which may be affected by the A453 widening proposals is established based upon the following criteria published in the DMRB as Table 5.3 – Estimating the Importance of Water Environment Attributes. This table is reproduced below as Table 2.10.1

Table 2.10.1: Criteria for Estimating the Importance of Water Environment Attributes

| Importance | Criteria | Typical Examples |
|------------|--|--|
| Very High | Attribute has a high quality and rarity on a regional or national scale. | Surface Water: EC Designated Salmonid/Cyprinid Fishery, RQO River Ecosystem Class RE1, Site protected under EU or UK wildlife legislation (SAC, SPA, SSSI, Ramsar Site). Groundwater: Major Aquifer providing a regionally important resource or supporting site protected under wildlife legislation, SPZ I. Flood Risk: Floodplain or defence protecting more than 100 residential properties from flooding. |
| High | Attribute has a high quality and rarity on a local scale. | Surface Water: RQO River Ecosystem Class RE2, Major Cyprinid Fishery, Species protected under EU or UK wildlife legislation. Groundwater: Major Aquifer providing locally important resource or supporting river ecosystem, SPZ II Flood Risk: Floodplain or defence protecting between 1 and 100 residential properties of industrial properties from flooding. |

| Importance | Criteria | Typical Examples |
|------------|---|--|
| Medium | Attribute has a medium quality and rarity on a local scale. | Surface Water: RQO River Ecosystem Class RE3 or RE4. Groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water, SPZ III Flood Risk: Floodplain or defence protecting 10 or fewer industrial properties from flooding. |
| Low | Attribute has a low quality and rarity in a local scale. | Surface Water: RQO River Ecosystem Class RE5. Groundwater: Non-Aquifer Flood Risk: Floodplain with limited constraints and a low probability of flooding of residential and industrial properties. |

10.5.17 The above criteria indicate that the main surface watercourses in the vicinity of the A453 are of High to Very High importance and groundwaters are classified as Low to Medium importance. For a comprehensive description of the water quality of both groundwater and surface waters likely to be affected by the proposed scheme, please refer to the A453 Widening Water Quality Desk Based Study (Document Reference A021959-REP-E-WQ-097).

10.6 Potential Impacts

10.6.1 Potential impacts to the water environment arising from the scheme can be considered as those occurring during the construction phase and those occurring during the operational phase of the scheme. The foremost temporary impacts likely to occur during the construction scheme are summarised as follows:

- Surface water quality impacts
 - Spillage of fuels, oils and other construction materials including paints, lubricants and adhesives used and stored on site;
 - Disturbance of silt / soil generating surface runoff with high suspended solid content;
 - Dewatering of excavations and discharge of water with high suspended solid content to receiving watercourses.
- Surface water flow impacts:
 - Unregulated and poorly designed discharges result in significant variation to the natural flow regime of the receiving watercourse.

10.6.2 The main long-term impacts likely to occur during the construction period are summarised as follows:

- Surface water quality / flow impacts:
 - Water discharged from dewatering operations is likely to contain elevated concentrations of suspended solids and contaminants. Release of this water into receiving watercourses may result in a

- reduction in water quality and erosion of the channel banks and bed leading to loss or impairment of habitats;
- Changes to local topography are likely to affect the runoff regime and subsequently the channel flow.
- Groundwater Quality Impacts:
 - Construction of boreholes creates potential pathways for the migration of contaminated surface water or lower quality groundwater to enter an Aquifer and contaminate groundwater;
 - Working of previously contaminated land may increase leaching and infiltration of contaminated water to the Aquifer;
 - Excavation of the upper section of the unsaturated zone decreases the contaminant pathway from surface to Aquifers thus reducing the potential for attenuation of contaminants during infiltration;
 - Potential for groundwater contamination as a result of spillage or misuse of fuels, oils and other construction materials and fluids such as paints, lubricants and adhesives.
- Groundwater flow impacts:
 - Dewatering of excavations may alter groundwater flow paths potentially resulting in contamination by inflows of lower quality groundwater;
 - Over abstraction of groundwater may result in drawdown of the groundwater table and potentially ingress of lower quality groundwater or saline water to replace the abstracted volume;
 - Dewatering operations may compromise the yield of nearby groundwater abstractions.

10.6.3 The major potential impacts which could arise during the operational phase of the proposed A453 Widening improvements are summarised as follows:

- Surface Water Quality:
 - Surface water quality impacts arising from the operation of the road are largely concerned with the discharge of routine runoff to receiving surface watercourses and groundwater. Figure 2.10.2 shows drainage discharge outfalls and key watercourses. Routine runoff contains contaminants washed from the road surface during a rainfall event including the following:
 - Combustion products of hydrocarbons;
 - Fuel and fuel additives;
 - Catalytic converter materials;
 - Metals from friction and wear of vehicle parts;

- Lubricants;
- Gritting and de-icing materials;
- Particulate contaminants originating from vehicles and vehicle related activities including: carbon, organic solids, rubber, plastics, grit, asbestos, rust and metal filings.
- Carriageway runoff may result in acute or chronic impacts. Acute impacts are likely to be caused as a result of a spillage accident whilst ongoing discharges of lower concentration routine runoff can result in chronic impacts.
- Surface Water Flows:
 - Three main watercourses (River Soar, Fairham Brook and Nethergate Stream) are to be crossed by the A453 carriageway, however flows are to be maintained during construction, thus significant impact upon surface water flows is unlikely (Figure 2.10.2 illustrates key watercourses along the A453);
 - Five balancing ponds are incorporated in the proposed scheme to restrict discharge flows to the receiving watercourses and prevent exacerbation of flooding potential ;
 - Surface watercourses will receive greater volumes of routine runoff resulting in increased channel flows. The increase will be most significant in Nethergate Stream.
- Groundwater Quality:
 - The DMRB assessment indicates that groundwater is likely to undergo negligible to moderate impacts resulting from the operation of the scheme and the discharge of routine runoff to ditches which do not maintain permanent surface flows.
- Groundwater Flows:
 - Deep foundations may intercept the shallow water table along the route and disrupt local groundwater flow paths;
 - Infiltration to groundwater may be reduced by the increased area of low permeability groundcover.

Potential Pollution of Surface Water – Additional Sources

10.6.4 In addition to the pollution generated from vehicles using the road there are a number of additional sources of pollution associated with the operational phase of road developments – largely as a result of routine maintenance. The following Table 2.10.2 is reproduced from the DMRB and gives an overview of the potential for adverse impacts on water quality linked to each activity.

Table 2.10.2: Potential for Pollution during Each Phase of a Road Development

| | Construction | Operation | Maintenance |
|---|--------------|-----------|-------------|
| Sediment | A | B | A |
| Metals | | A | A |
| Hydrocarbons | C | A | B |
| De-icing Compounds | | A | |
| A = Major Potential, B = Some Potential, C = Minor Potential | | | |

10.6.5 Table 2.10.2 above suggests that there is major potential for both sediment and metals and some potential for hydrocarbon contamination during highways maintenance. The gritting and de-icing of the carriageway is included during the operational phase, resulting in major contamination potential. The DMRB lists the following potential pollutant sources which are associated with carriageway maintenance:

- Flushing out of gully pots and similar entrapment structures – thought to be as damaging as some accidental spillage impacts;
- Use of herbicides in the maintenance of plant growth along road verges and central reservations.

10.7 Design and Mitigation Measures

10.7.1 Assessment of impacts in accordance with DMRB requires the consideration of three scenarios:

- The existing ‘baseline’ situation; for the purposes of this assessment AADT traffic figures for 2006 have been used;
- The ‘do-minimum’ scenario at year of opening, without the proposed widening scheme but making an assumption that some developments will have occurred (as listed in Section 1, Part 1 of this ES); AADT traffic forecasts for 2012 have been used;
- The ‘do-something’ scenario for the ‘design year’, including the proposed A453 Widening scheme and mitigation measures; AADT traffic forecasts for the design year 2027 (15 years after opening) have been used in the assessment.

10.7.2 The existing and proposed scheme drainage strategies are shown in Figures 2.10.3 and 2.10.4 of the ES Volume 2, respectively. Drainage will be via a combination of open surface water channels, combined kerb drainage systems and filter drains for the main A453 carriageway, with a combination of filter drains, kerbs and gullies for the side roads. Five balancing ponds and extensive lengths of highway drainage ditches will attenuate and clean storm water runoff prior to discharge at the rural outfalls. The balancing ponds will also have secondary functions to enhance ecological habitat and provide visual amenity for travellers.

Mitigation for Changes in Peak Runoff Rates and Flooding

- 10.7.3 Within the rural section, it is necessary to mitigate against the potential of unrestricted flows to cause erosion, flooding damage to the receiving watercourse or potential flooding damage to properties downstream. To provide this mitigation, balancing ponds are proposed at draining zones F, H, L, M and N and roadside attenuation ditches at drainage zones A and B (see Figure 2.10.4). This will provide attenuation which includes the drained areas of the existing road as well as the new road.
- 10.7.4 At the above locations, new surface water discharges from the scheme are to be restricted as far as reasonably practicable to not exceed the existing undeveloped (i.e. 'Greenfield') runoff rates occurring at 1 in 10, 50 and 100 year return periods (,a recurrence interval describing the probability of a storm happening in any given year), with temporary attenuation (storage) of excess flows. Discharge rates at these outfalls will therefore be less than for the existing situation. Sizing of the balancing ponds and attenuation ditches has been designed as far as reasonably practicable for a 100 year return period rainfall and increased by 20% to allow for climate changes caused by global warming.
- 10.7.5 For Drainage Zones A, B, F, H, L, M and N, the restricted discharge rates are of a very low magnitude and will therefore not result in erosive or flooding damage to the receiving local ditch network. Any works to clean out the existing local ditch network will be through agreement with the respective landowners. For Drainage Zones C and K the proposed roadside drainage ditches will provide for some mitigation of flow rates before discharge to the receiving watercourse. For Drainage Zones D and E, unrestricted discharge rates are of a very low magnitude compared to flow rates in the receiving main rivers, therefore there is no need to mitigate flows. For Drainage Zones G and J, the proposed side roads junction arrangements represent a reconfiguration of the existing side roads, therefore no mitigation is considered necessary at these locations.
- 10.7.6 Within the urban section of the scheme, for Drainage Zones Q and P it is proposed that carriageway run-off is attenuated equivalent to the additional impermeable drained area only up to a 1 in 100 year return period +20% increase for climate change. For Drainage Zone R it is proposed that the carriageway run-off is discharged directly without any attenuation of flow rates. To mitigate the small increase in unrestricted flows from this section, improvement works along the upstream open reach of the Nethergate Stream watercourse are proposed. The proposed works include the removal / replacement of an existing footbridge culvert, some reprofiling of the watercourse cross-section and localised lowering of the adjacent verge areas to provide additional flood storage.
- 10.7.7 Within the urban section of the scheme for Drainage Zone S, it is proposed that carriageway run-off is discharged directly to the main watercourse, Fairham Brook. Discharge will be through the existing highway drainage system and outfalls.

Mitigation for Pollution from Routine Runoff

10.7.8 During operation of the road, chronic pollution from carriageway runoff which comprises hydrocarbons, metals and other organic pollutants may enter the watercourses. The following mitigation measures are incorporated into the A453 drainage systems:

- Catchpits are to be provided at 100m centres along the road. These will result in the removal of coarse suspended solids settlement;
- Wet balancing ponds with vegetation will facilitate removal of suspended solids, heavy metals, organic compounds, oil and grease through the settlement, absorption and filtering of particulate matter;
- Drainage Zones P and R which outfall into Nethergate Stream will include bypass oil separators which will facilitate removal of oils and hydrocarbons, followed by penstocks in manholes upstream of the outfalls;
- Drainage Zone S which outfalls into Fairham Brook will include interceptors and penstocks in manholes upstream of the outfalls.

Mitigation for Pollution from Accidental Spillages

10.7.9 New or improved roads are designed to reduce the accident rate subsequently resulting in fewer acute pollution impacts. However on all roads there exists a risk of accidental spillage resulting from collisions, major leaks and vehicle fires and it is generally accepted that the risk on any road is proportionate to the risk of a HGV road traffic accident. When spillages resulting from an accident reach a surface watercourse the resultant pollutant impact can be severe but is usually of short duration. The following mitigation measures are incorporated into the proposed A453 drainage system as follows:

- Within the rural section, balancing ponds and linear ditches will allow for containment of spillages by use of sandbags or other non-mechanical means to close off the outlet pipes;
- Within the urban section, oversize pipes and penstocks will allow for the containment of spillages within the pipe network and bypass separators are proposed prior to discharge at the headwalls.

Temporary Mitigation during the Construction Phase

10.7.10 Procedures for managing water resource implications during the construction of the proposed A453 carriageway improvements are defined in an Outline Construction Environmental Management Plan (OCEMP). This will include details of compliance with Environment Agency Pollution Prevention Guidelines.

10.7.11 The following general mitigation measures will also be followed to minimise the potential for adverse impacts on the water environment during the construction phase:

- Minimise areas of bare soil. Vegetation will be established as soon as possible where appropriate;
- Pumping / dewatering will have a valid Discharge Consent issued by the Environment Agency and the stipulations of that consent, such as restrictions on the volume, quality, rate and timing of discharges will be adhered to. For short term discharges the Environment Agency are more likely to issue "Duty of Care" letters that would contain general guidelines rather than consent limits for specific determinands (e.g. "the discharge should contain no visible grease or oil");
- Permission of the water service provider (Severn Trent Water) will be obtained prior to the pumping of discharges into surface water drains;
- Pumping of discharges into the foul sewer will not be undertaken without the permission of the water service provider (Severn Trent Water);
- The Environment Agency will be consulted prior to any temporary works which may interfere with the bed, banks or floodplain of any watercourse;
- Worker-generated sewage effluents will be managed either by connection to the local main network or removal from site by an appropriate road tanker or effluent treatment unit;
- Water removed from excavations will be transported the minimum practical distance from site before discharge.

10.7.12 Potential for other adverse impacts to the water environment during construction will be avoided by adopting best practice measures with regard to the storage of materials, works over or adjacent to watercourses, disturbance of silt, contamination by cement, oils or other liquids, accidental spillages, impacts to groundwater during earthworks and avoiding impacts during the building of culverts. Further details are given in the technical reports listed in paragraph 10.1.4.

10.8 Assessment of Impacts

DMRB Assessment

10.8.1 This section describes the results of models produced in accordance with DMRB Methods A, B, C and D assessment guidance, as listed in paragraph 10.1.2 above. The 'do-minimum' 2012 scenario and the 2027 'do-something' scenario are compared with the 2006 existing baseline scenario. The 2027 'do-something' scenario is the A453 Widening scheme incorporating the mitigation measures as described in section 10.7 above.

10.8.2 The DMRB methodology cannot be applied to the named and unnamed drainage ditches which convey discharge from the carriageway to main watercourses as the methodology is only valid for permanently wet watercourses. The Environment Agency advise that a number of ditches in this area partially or completely dry up in the summer months. In the absence of a more suitable modelling tool, the DMRB

Method C for assessing the impact to groundwater has been used for the watercourses that may dry up.

Method A – Simple Assessment of Pollution Impacts from Routine Runoff

10.8.3 A full water quality assessment was carried out for the main surface watercourses under Environment Agency jurisdiction in accordance with the methodologies outlined in the DMRB. Table 2.10.3 below summarises the results of the Method A – Simple Assessment which determines the in-channel dilution capacity of each receiving watercourse for the 2012 Do-Minimum scenario and the 2027 Do-Something scenario, using a runoff coefficient of 0.5.

10.8.4 Dilution was calculated as described in the assessment guidance in the DMRB Method A – Simple Assessment which provides a conservative assessment of available in-channel dilution.

Table 2.10.3: Summary of Method A Assessment Results

| Watercourse / Reach | River Ecosystem Classification | Worst-Case AADT [†] | Required Minimum Dilution | Calculated Dilution | Method A Pass | Action Required |
|---------------------|--------------------------------|------------------------------|---------------------------|---------------------|---------------|--|
| Baseline 2006 | | | | | | |
| Watercourse C1 | RE4 | 23,000 | 1.7 | 9.7 | ✓ | Low Risk – No Further Assessment |
| River Soar | RE2 | 24,000 | 3.45 | 2023 | ✓ | Low Risk – No Further Assessment |
| River Trent | RE2 | 24,000 | 4.1 | 10290 | ✓ | Low Risk – No Further Assessment |
| Fairham Brook | RE1 | 30,6000 | 8 | 65 | ✓ | Low Risk – No Further Assessment |
| Nethergate Stream | RE1 | 29,000 | 7.8 | 2.6 | ✗ | High Risk – Detailed Method B Assessment Required |
| Do –Minimum 2012 | | | | | | |
| Watercourse C1 | RE4 | 25,000 | 1.8 | 9.7 | ✓ | Low Risk – No Further Assessment |
| River Soar | RE2 | 25,000 | 3.5 | 1346 | ✓ | Low Risk – No Further Assessment |
| River Trent | RE2 | 24,000 | 3.45 | 10290 | ✓ | Low Risk – No Further Assessment |
| Fairham Brook | RE1 | 31,500 | 8.2 | 65 | ✓ | Low Risk – No Further Assessment |
| Nethergate Stream | RE1 | 30,000 | 8 | 2.6 | ✗ | High Risk – Detailed Method B Assessment Required |
| Do –Something 2027 | | | | | | |
| Watercourse C1 | RE4 | 47,000 | 2.7 | 3.2 | ✓ | Low Risk – No Further Assessment |

| Watercourse / Reach | River Ecosystem Classification | Worst-Case AADT [†] | Required Minimum Dilution | Calculated Dilution | Method A Pass | Action Required |
|---------------------|--------------------------------|------------------------------|---------------------------|---------------------|---------------|--|
| River Soar | RE2 | 47,000 | 5.3 | 641 | ✓ | Low Risk – No Further Assessment |
| River Trent | RE2 | 42,000 | 4.9 | 2404 | ✓ | Low Risk – No Further Assessment |
| Fairham Brook | RE1 | 64,000 | 13 | 46 | ✓ | Low Risk – No Further Assessment |
| Nethergate Stream | RE1 | 48,000 | 10.4 | 1.3 | ✗ | High Risk – Detailed Method B Assessment Required |

[†] Worst-case refers to the maximum AADT recorded (or predicted) within any drainage zone contributing to each receiving watercourse to the nearest thousand vehicles.

10.8.5 As Table 2.10.3 indicates, Nethergate Stream is not predicted to have sufficient in-channel dilution to attenuate the routine runoff discharges to within acceptable levels. Thus, Nethergate Stream is classified as High Risk by the Method A assessment and the more substantial Method B assessment has been applied.

10.8.6 The River Soar, River Trent and Fairham Brook passed the Method A assessment and do not require further assessment, as these watercourses fall within acceptable dilution limits and consequently no further assessment is required. Tables containing the results of the Method A assessment are reproduced in full in Appendix D of report ref. A021959-REP-E-WQ-228.

Method B – Detailed Assessment of Pollution Impacts from Routine Runoff

10.8.7 Table 2.10.4 summarises the results of the Method B assessment for the proposed A453 carriageway for the 2012 Do-Minimum and 2027 Do-Something scenarios respectively. Values presented in Table 2.10.4 have been calculated in accordance with guidance provided in the DMRB Volume 3, Section 11, Part 10 HA216/06 Annex I, Method B which describes a methodology for the calculation of a conservative upper bound estimate of dissolved copper and total zinc concentrations which would only be expected to be exceeded for 5 % of the time.

Table 2.10.4: Method B Assessment Results

| Drainage Zone | Outfall | C _R Cu (µg/l) | Cu EQS (µg/l) | Method B Pass Copper | C _R Zn (µg/l) | Zn EQS (µg/l) | Method B Pass Zinc |
|---------------------------------------|---------|--------------------------|---------------|----------------------|--------------------------|---------------|--------------------|
| 2006 Baseline | | | | | | | |
| 14 | N1 | 9.83 | 112 | ✓ | 20.98 | 500 | ✓ |
| 15(a) | | 20.97 | 112 | ✓ | 85.22 | 500 | ✓ |
| 15(b) | | 19.79 | 112 | ✓ | 79.12 | 500 | ✓ |
| 16 | | 18.59 | 112 | ✓ | 72.87 | 500 | ✓ |
| Nethergate Stream Overall Reach Value | | 39.84 | 112 | ✓ | 183.27 | 500 | ✓ |

| 2012 Do-Minimum | | | | | | | |
|---------------------------------------|----|--------|-----|---|--------|-----|---|
| 14 | N1 | 9.83 | 112 | ✓ | 20.98 | 500 | ✓ |
| 15(a) | | 20.97 | 112 | ✓ | 85.22 | 500 | ✓ |
| 15(b) | | 19.79 | 112 | ✓ | 79.12 | 500 | ✓ |
| 16 | | 18.59 | 112 | ✓ | 72.87 | 500 | ✓ |
| Nethergate Stream Overall Reach Value | | 39.84 | 112 | ✓ | 183.27 | 500 | ✓ |
| 2027 Do-Something | | | | | | | |
| P(a) | N1 | 78.73 | 112 | ✓ | 315.53 | 500 | ✓ |
| P(b) | | 72.62 | 112 | ✓ | 289.81 | 500 | ✓ |
| Q | | 9.83 | 112 | ✓ | 20.98 | 500 | ✓ |
| R | | 72.62 | 112 | ✓ | 289.81 | 500 | ✓ |
| Old A453 (c) | | 9.19 | 112 | ✓ | 19.70 | 500 | ✓ |
| Nethergate Stream Overall Reach Value | | 161.64 | 112 | × | 664.60 | 500 | × |

10.8.8 The predicted concentrations of dissolved copper and total zinc in the recipient main watercourses were compared to the appropriate Environmental Quality Standard (EQS). EQS values for the downstream receiving watercourses have been determined using data obtained from the Environment Agency and the criteria provided in the DMRB. All receiving main watercourses likely to be affected by the proposed scheme have hardness values in excess of 100 mg/l CaCO₃ corresponding to EQS values of dissolved copper and total zinc of 112 µg/l and 500 µg/l respectively.

10.8.9 The Environment Agency suggests that EQS values should only be applied to downstream watercourses which have permanent water flows. Thus this assessment cannot be applied to the drainage ditches which convey runoff to the main watercourse from the carriageway discharge point as these ditches have been known to partially or totally dry up in hot summers.

10.8.10 Drainage zones A to L inclusive ultimately drain to the River Soar at four outfall locations (S1, S2, S3 and S4) within the same reach. However the Method B assessment was not required for the River Soar as the Method A assessment indicated that routine runoff discharged to the River Soar is not anticipated to impact upon the water quality downstream of the discharge points. However, the network of drainage ditches conveying the runoff discharges from the carriageway to the River Soar are likely to partially or completely dry up in summer months. EQS concentrations are not directly applicable to watercourses which do not support a permanent flow. It is considered feasible that the concentrations of dissolved copper and total zinc may be exceeded in these ditches during periods of low or no ditch flow, however the concentrations of dissolved copper and total zinc downstream are within acceptable limits and as such are not considered to pose a significant threat to water quality, ecology or amenity value.

10.8.11 Lockington Marsh SSSI is located amongst this network of drainage ditches adjacent to the River Soar, approximately 2 km downstream of the A453 carriageway (see Figure 2.4.1). Given the distance of Lockington Marsh

downstream of the carriageway and the expectation that the ditches will dry up in summer months when runoff concentration is greatest, it is unlikely that Lockington Marsh will be significantly impacted by runoff discharges as pollutants will settle out or simply not reach the marsh. The two aquatic units of the Lockington Marshes SSSI are situated on another drainage ditch to that which receives the road runoff. Therefore groundwater within the underlying Minor Aquifer is considered to be at greater risk of adverse impacts resulting from the discharge of runoff to dry or partially dry ditches likely to result in the dissipation and eventual infiltration of the runoff to ground. The balancing ponds included in the proposed scheme for flood alleviation purposes will also have a mitigating effect on the water quality of runoff discharges entering the River Soar, thus further reductions in the impact of discharges from routine runoff and accidental spillage events is likely to be gained.

10.8.12 Drainage Zones M and N discharge runoff into ditches which flow into the River Trent at one outfall location (T1). The Method B assessment indicates downstream water quality impacts are not anticipated from the discharge of routine runoff to the River Trent. Ditches conveying the discharge to the River Trent may partially or completely dry up in summer months, however designated features of ecological significance are not associated with these ditches. Thus impacts to groundwater within the sections of Minor Aquifer which underlie Drainage Zones M and N resulting from the infiltration rather than surface flow of discharges are more significant, although the risk of impact is considered to be minor. Balancing ponds are also proposed for Drainage Zones M and N which will contribute to further reductions in the impact on the water quality of the River Trent by discharges arising from routine runoff and accidental spillages.

10.8.13 Routine runoff discharges from Drainage Zone S ultimately feed Fairham Brook. The Method B assessment indicates that Fairham Brook will not be adversely affected by the discharges. Discharges from the urban Drainage Zone S will be mitigated by the inclusion of a penstock valve in a manhole upstream of the two outfall headwalls at the brook.

10.8.14 The Method B assessment was required to assess routine runoff from proposed Drainage Zones P(a), P(b), Q and R, and a remnant section of the existing A453 used for local traffic movements to the north of the proposed new carriageway. These drainage zones discharge into Nethergate Stream, either directly or via the highways drainage infrastructure. The Method B assessment indicates that the downstream water quality of Nethergate Stream is likely to be significantly affected by routine runoff discharges as overall concentrations of both dissolved copper and total zinc exceed the EQS values which should only be exceeded for 5 % of the time. The existing A453 carriageway (2006 Baseline) and the 2012 Do-Minimum scenario (based on these calculations) do not breach the EQS for dissolved copper or total zinc within the Nethergate Stream. However, the proposed 2027 Do-Something scenario is predicted to result in downstream dissolved copper and total zinc concentrations of 166.41µg/l and 661.60µg/l respectively which are in excess of the permitted downstream EQS values.

10.8.15 Further consultation has been carried out with the Environment Agency which is satisfied with the pollution prevention measures proposed (see Appendix H of report ref. A021959-REP-E-WQ-228).

10.8.16 Full results of the Method B assessment are reproduced in Appendix E of report ref. A021959-REP-E-WQ-228.

Method C – Assessment of Pollution Impacts from Routine Runoff on Groundwaters

10.8.17 An assessment of the potential impacts of road runoff on groundwater quality has been conducted in accordance with the methodology stated in the DMRB Volume 11, Section 3, Part 10, HA216/06 Annex I, Method C. The Method C assessment is based upon the Source-Pathway-Receptor conceptual model and provides a semi-quantitative prediction of the potential impact to groundwater. An assessment matrix comprising a range of site specific parameters including traffic density, rainfall, unsaturated zone depth, drainage system, flow type, grain size and lithology is used to determine the risk to groundwater within each drainage zone. Table 2.10.6 summarises the results of the Method C groundwater assessment, conducted assuming a worst case scenario that all runoff is discharged to ground. This scenario is unlikely to occur but represents the potential for runoff discharges released to surface water drainage channels to enter groundwater via infiltration during the warmer summer months when the small ditches may partially or completely dry up.

Table 2.10.5: Significance of Impact on Groundwater Resources

| Resource | Risk of Impact | | |
|--------------------------|------------------|--------------------|--------------------|
| | Low | Medium | High |
| Source Protection Zone 1 | Large | Very Large | Very Large |
| Source Protection Zone 2 | Moderate | Large | Large |
| Source Protection Zone 3 | Slight | Moderate | Moderate |
| Major Aquifer | Moderate / Large | Large / Very Large | Large / Very Large |
| Minor Aquifer | Slight | Moderate | Large |
| Non Aquifer | Slight | Slight | Moderate |

Table 2.10.6: Method C Assessment Results Summary – 2027 Do-Something Scenario

| Drainage Zone | Risk Score | Risk of Impact | Groundwater Sensitivity | Significance of Effect on Groundwater Resources |
|---------------|------------|----------------|-------------------------|---|
| A | 192.5 | Medium | Minor Aquifer | Moderate |
| B | 192.5 | Medium | Minor Aquifer | Moderate |
| C | 192.5 | Medium | Minor Aquifer | Moderate |

| Drainage Zone | Risk Score | Risk of Impact | Groundwater Sensitivity | Significance of Effect on Groundwater Resources |
|---|------------|----------------|-------------------------|---|
| D | 192.5 | Medium | Minor Aquifer | Moderate |
| E | 192.5 | Medium | Minor Aquifer | Moderate |
| F | 210 | Medium | Non-Aquifer | Slight |
| G | 165 | Medium | Non-Aquifer | Slight |
| H | 222.5 | Medium | Minor Aquifer | Moderate |
| J | 165 | Medium | Non-Aquifer | Slight |
| K | 180 | Medium | Non-Aquifer | Slight |
| L | 210 | Medium | Non-Aquifer | Slight |
| Old A453 (a) | 205 | Medium | Non-Aquifer | Slight |
| M | 250 | Medium | Minor Aquifer | Moderate |
| N | 250 | Medium | Minor Aquifer | Moderate |
| Old A453 (b) | 205 | Medium | Minor Aquifer | Moderate |
| P(a) | 180 | Medium | Non-Aquifer | Slight |
| P(b) | 165 | Medium | Non-Aquifer | Slight |
| Q | 180 | Medium | Non-Aquifer | Slight |
| R | 180 | Medium | Non-Aquifer | Slight |
| Old A453 (c) | 205 | Medium | Non-Aquifer | Slight |
| S | 242.5 | Medium | Minor Aquifer | Moderate |
| Overall Risk Score < 150 = Low Risk of Impact | | | | |
| Overall Risk Score 150 – 250 = Medium Risk of Impact | | | | |
| Overall Risk Score > 250 = High Risk of Impact | | | | |
| † Refer to Table 2.10.5 Groundwater Impact Significance taken from the DMRB | | | | |

10.8.18 Given the longer residence times of pollutants in groundwater relative to surface watercourses, it is recognised that all groundwater should be afforded protection from pollution. As such, the sensitivity and relative importance of different aquifers and groundwater resources is an important factor in determining risk posed to groundwater. Table 2.10.5 above is reproduced from the DMRB and indicates the significance of the impact depending on the status of the groundwater resource.

10.8.19 Potential for significant adverse impacts to groundwater are considered to be moderate at worst. Surface watercourses represent the more sensitive key receptor. Full results of the Method C assessment are reproduced in Appendix F of report ref. A021959-REP-E-WQ-228.

Method D – Assessment of Pollution Impacts from Accidental Spillages

10.8.20 Risk of an accident resulting in a serious pollution incident on the new A453 carriageway has been assessed for each proposed drainage zone contributing to each drainage reach using the Method D assessment outlined in the DMRB Volume 11, Section 3, Part 10 HA216/06 Annex I Method D. This assessment was carried out using the proposed general strategy for the scheme and the design year (2027) AADT flows. Results of the Method D assessment are summarised in Tables 2.10.7, 2.10.8 and 2.10.9.

Table 2.10.7: Method D Assessment Results 2006 Baseline

| Drainage Zone | Outfall | Drainage Zone Total Risk (%) | Outfall Risk (%) | Watercourse Reach Risk (%) |
|---------------|---------|------------------------------|------------------|----------------------------|
| 1 | S1 | 0.0229 | 0.0454 | 0.1517 |
| 2 | | 0.0001 | | |
| 3 | | 0.0001 | | |
| 4 | S2 | 0.0118 | 0.0018 | |
| 5 | S3 | 0.0026 | 0.0026 | |
| 6 | S4 | 0.0213 | 0.0919 | |
| 7 | | 0.0012 | | |
| 8 | | 0.0391 | | |
| 9 | | 0.0005 | | |
| 10 | | 0.0287 | | |
| 11 | | 0.0010 | | |
| 12 | T1 | 0.0597 | 0.1304 | 0.1304 |
| 13 | | 0.0707 | | |
| 14 | N1 | 0 | 0.3651 | 0.3651 |
| 15(a) | | 0.0620 | | |
| 15(b) | | 0.1684 | | |
| 16 | | 0.1348 | | |
| 17 | F1 | 0.0349 | 0.0349 | 0.0349 |

Table 2.10.8: Method D Assessment Results 2012 Do-Minimum

| Drainage Zone | Outfall | Drainage Zone Total Risk (%) | Outfall Risk (%) | Watercourse Reach Risk (%) |
|---------------|---------|------------------------------|------------------|----------------------------|
| 1 | S1 | 0.0249 | 0.0493 | 0.3971 |
| 2 | | 0.0002 | | |
| 3 | | 0.0001 | | |
| 4 | S2 | 0.0129 | 0.0129 | |
| 5 | S3 | 0.0165 | 0.0165 | |
| 6 | S4 | 0.0204 | 0.3184 | |
| 7 | | 0.0014 | | |
| 8 | | 0.2654 | | |
| 9 | | 0.0006 | | |
| 10 | | 0.0293 | | |
| 11 | | 0.0014 | | |
| 12 | T1 | 0.0597 | 0.1304 | 0.1304 |
| 13 | | 0.0707 | | |
| 14 | N1 | 0 | 0.3598 | 0.3598 |
| 15(a) | | 0.0614 | | |
| 15(b) | | 0.1706 | | |
| 16 | | 0.1278 | | |
| 17 | F1 | 0.0359 | 0.0359 | 0.0359 |

Table 2.10.9: Method D Assessment Results 2027 Do-Something

| Drainage Zone | Outfall | Drainage Zone Risk (%) Pre-Mitigation | Outfall Risk (%) Pre-Mitigation | Watercourse Reach Risk (%) |
|---------------|---------|---------------------------------------|---------------------------------|----------------------------|
| A | S1 | 0.0280 | 0.0524 | 0.2163 |
| B | | 0.0179 | | |
| C | | 0.0064 | | |
| D | S2 | 0.0091 | 0.0091 | |
| E | S3 | 0.0187 | 0.0187 | |

| Drainage Zone | Outfall | Drainage Zone Risk (%) Pre-Mitigation | Outfall Risk (%) Pre-Mitigation | Watercourse Reach Risk (%) |
|---------------|---------|--|------------------------------------|----------------------------|
| F | S4 | 0.0262 | 0.1361 | |
| G | | 0.0026 | | |
| H | | 0.0657 | | |
| J | | 0.0132 | | |
| K | | 0.0076 | | |
| L | | 0.0208 | | |
| M | T1 | 0.0841 | 0.2158 | 0.2158 |
| N | | 0.1317 | | |
| Q | N1 | 0 | 0.4909 | 0.4909 |
| P(a) | | 0.0935 | | |
| P(b) | | 0.2303 | | |
| R | | 0.1671 | | |
| S | | F1 | | |

10.8.21 Acceptable risk of a pollution incident is stated by the DMRB to be an annual probability of less than 1 % which is equivalent to a return period of 1 in 100 years for discharges to reaches of sensitive watercourses classified as RE1 and RE2, or to Aquifers. As illustrated in Tables 2.10.7, 2.10.8 and 2.10.9 above the probability that a spillage would cause a pollution incident is less than 1 % for outfalls draining all sections of the A453, which indicates that specific mitigation measures are not required.

10.8.22 Risk of a pollution incident is further reduced by consideration of mitigation measures which are to be included in the proposed 2027 Do-Something carriageway improvements. Results of the Method D assessment which incorporates the proposed mitigation measures are summarised in Table 2.10.10.

Table 2.10.10: Mitigated Method D results – 2027 Do-Something

| Drainage Zone | Outfall | Mitigated Drainage Zone Risk (%) | Mitigated Outfall Risk (%) | Mitigated Watercourse Reach Risk (%) |
|---------------|---------|----------------------------------|----------------------------|--------------------------------------|
| A | S1 | 0.0196 | 0.0386 | 0.1450 |
| B | | 0.0125 | | |
| C | | 0.0064 | | |
| D | S2 | 0.0091 | 0.0091 | |
| E | S3 | 0.0187 | 0.0187 | |
| F | S4 | 0.0131 | 0.0786 | |
| G | | 0.0026 | | |
| H | | 0.0328 | | |
| J | | 0.0120 | | |
| K | | 0.0076 | | |
| L | | 0.0104 | | |
| M | T1 | 0.0421 | 0.1079 | 0.1079 |
| N | | 0.0658 | | |
| P(a) | N1 | 0.0374 | 0.1964 | 0.1964 |
| P(b) | | 0.0921 | | |
| Q | | 0 | | |
| R | | 0.0668 | | |
| S | | F1 | | |

10.8.23 Tables containing the results of the Method D assessment are reproduced in full in Appendix G of report ref. A021959-REP-E-WQ-228.

Criteria for Assessing Magnitude of Impact

10.8.24 As described in paragraph 10.1.6, DMRB provides criteria for estimating the magnitude of impacts. This is reproduced here in Table 2.10.11 below:

Table 2.10.11: Estimating the Magnitude of an Impact on an Attribute

| Magnitude | Criteria | Typical Example |
|------------------|--|---|
| Major Adverse | Results in loss of attribute and / or quality and integrity of the attribute | <p>Surface Water: Potential high risk in Method A (Annex I) <i>and</i> potential failure of Total Zinc and Dissolved Copper in Method B</p> <p>Calculated risk of pollution from an accidental spillage >2% annual (Method D Annex I)</p> <p>Loss or extensive change to a fishery</p> <p>Loss or extensive change to a Nature Conservation Site</p> <p>Groundwater: Loss of an Aquifer</p> <p>Potential high risk in Method C (Annex I) of pollution to groundwater from routine runoff risk score >250</p> <p>Calculated risk of pollution from an accidental spillage >2% annual (Method D Annex I)</p> <p>Flood Risk: Increase in peak flood level (1% annual probability) >100 m</p> |
| Moderate Adverse | Results in effect on integrity of attribute, or loss of part of attribute | <p>Surface Water: Potential high risk in Method A (Annex I) and <i>either</i> potential failure of Total Zinc and Dissolved Copper in Method B</p> <p>Calculated risk of pollution from accidental spillages >1% annually and <2% annually (Method D Annex I)</p> <p>Partial loss of productivity of a fishery</p> <p>Groundwater: Partial loss or change to an Aquifer</p> <p>Potential medium risk in Method C (Annex I), of pollution to groundwater from routine runoff – risk score 150-250</p> <p>Calculated risk of pollution from accidental spillages >1% annually and <2% annually (Method D Annex I)</p> <p>Flood Risk: Increase in peak flood level (1 % annual probability) > 50 mm</p> |
| Minor Adverse | Results in some measurable change in attributes quality or vulnerability | <p>Surface Water: Potential high risk in Method A (Annex I) and no change in Total Zinc and Dissolved Copper in Method B (Annex I)</p> <p>Calculated risk of pollution from accidental spillage >0.5% annually and <1% annually (Method D Annex I)</p> <p>Groundwater: Potential low risk, in Method C (Annex I), of pollution to groundwater from routine runoff score < 150</p> <p>Calculated risk of pollution from accidental spillage >0.5% annually and <1% annually (Method D Annex I)</p> <p>Flood Risk: Increase in peak flood level (1% annual</p> |

| Magnitude | Criteria | Typical Example |
|---------------------|--|---|
| | | probability) >10mm (Methods E and F Annex I) |
| Negligible | Results in effect on attribute, but of insufficient magnitude to affect the use or integrity | The proposed scheme is unlikely to affect the integrity of the water environment Surface Water: Low risk in Method A (Annex I) and risk of pollution from accidental spillages <0.5% Groundwater: No measurable impact upon an Aquifer and risk of pollution from accidental spillages <0.5% Flood Risk: Negligible change in peak flood level (1 % annual probability) < ± 10 mm |
| Minor Beneficial | Results in some beneficial effect on attribute or a rescued risk of negative effect of negative effect occurring | Surface Water: Calculated reduction in existing spillage risk by 50 % or more (when existing spillage risk is <1% annually) (Method D Annex I) Groundwater: Calculated reduction in existing spillage risk by 50 % or more (when existing spillage risk <1% annually) (Method D Annex I) Flood Risk: Reduction in peak flood level (1% annual probability) >10mm (Methods E and F Annex I) |
| Moderate Beneficial | Results in moderate improvement of attribute quality | Surface Water: Calculated reduction in existing spillage risk by 50 % or more (when existing spillage risk is >1% annually) (Method D Annex I) Groundwater: Calculated reduction in existing spillage risk by 50 % or more (when existing spillage risk >1% annually) (Method D Annex I) Flood Risk: Reduction in peak flood level (1% annual probability) >50mm (Methods E and F Annex I) |
| Major Beneficial | Results in major improvement of attribute quality | Surface Water: Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse Groundwater: Removal of existing polluting discharge to an Aquifer or removing the likelihood of polluting discharges occurring Recharge of an Aquifer Flood Risk: Reduction in peak flood level (1% annual probability) >100mm (Methods E and F) |

10.9 Significance of Effects

10.9.1 The significance of the potential effects of the proposed 2027 Do-Something A453 improvement upon road drainage and the water environment have been considered through the application of the DMRB assessment methodologies to determine the risk posed to surface watercourses and groundwaters by routine runoff and accidental spillages. The importance of each resource has been determined by comparing the baseline data to the criteria given in Table 2.10.1 which is reproduced from the DMRB.

10.9.2 The magnitude of the residual impact (including mitigation) has been determined through reference to the criteria in Table 2.10.11 reproduced from the DMRB guidance. Assessment 'scores' are assigned by using reasoned argument, professional judgement and liaison with relevant organisations.

10.9.3 Final significance of effect on each feature and attribute of the water environment is given by following the standard matrix shown in Table 1.3.4 in Section 1 Part 3 of this ES.

Construction Phase

10.9.4 Table 2.10.12 below summarises the significance of environmental effects during the construction phase with implementation of mitigation measures. The Highways Agency DMRB process for assigning values allows a worse case assessment which needs some interpretation in order to give an accurate picture of the likely significance of effects. For example the score in Table 2.10.12 for Nethergate Stream is based upon the water quality of Fairham Brook (as required by the DMRB process), whereas in practice it will be of inferior quality and the impact of the activities upon Nethergate Stream is unlikely to be Moderate Adverse. Similarly a highly precautionary significance value is shown in Table 2.10.13 for the fisheries quality of Moderate Adverse which might be applicable to Fairham Brook but is over precautionary for the River Trent and River Soar.

Table 2.10.12: Significance of Environmental Effects during the Construction Phase with Implementation of Mitigation Measures

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|--|------------------------------|---|--------------------------------------|--|---|---------------------------------|
| Construction Phase | | | | | | |
| 1. SURFACE WATERCOURSE: Water supply, transport and dilution of waster products | (i) Chemical Water Quality | Regional / Local: River Soar, River Trent, Fairham Brook and Nethergate Stream all GQA Grade B (Good) | High | Pollution; Local works in, over or within vicinity of watercourses | Minor Adverse, Direct / Indirect, Temporary | Moderate Adverse |
| | | Local: Status of other ordinary watercourses not recorded | Low | | Minor Adverse, Direct / Indirect, Temporary | Neutral |
| | (ii) Non-Potable Abstraction | Local: 2 surface water abstractions within 250 m route corridor | Medium – High | Pollution; Local works in, over or within vicinity of watercourses | Minor Adverse, Direct / Indirect, Temporary | Slight Adverse |
| | (iii) Drinking Water Supply | Regional / Local: No Public Water Supply (PWS) abstraction within 250 m route corridor downstream of the A453 but within the River Trent corridor | Medium – High | None | Negligible | Neutral |
| 2. WATERCOURSE: Biodiversity | (i) Biological Water Quality | Regional / Local: GQA Grade B (Good) for River Soar, River Trent, and Fairham Brook. | High | Pollution; Local works in, over or within vicinity of watercourses | Minor Adverse, Direct / Indirect, Temporary | Slight Adverse |

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|---|-----------------------------|--|--------------------------------------|--|--|---------------------------------|
| | (ii) Fisheries Quality | Local: Status of Nethergate Stream and other ordinary watercourses not recorded. | Low | | Minor Adverse, Direct / Indirect, Temporary | Neutral |
| | | Regional: River Soar, River Trent and Fairham Brook are all of suitable quality to support Cyprinid and Salmonid Fisheries | High | Pollution; Local works in | Moderate Adverse, Direct / Indirect, Temporary | Moderate Adverse |
| | | Local: Status of Nethergate Stream and ordinary watercourses not recorded, assumed undesignated / non fishery | Low | Pollution; Local works in | Minor Adverse, Direct / Indirect, Temporary | Neutral |
| 3. WATERCOURSE: Conveyance of flow and material | (i) Nature of Watercourses | Regional: River Soar and River Trent are main rivers > 10 m wide | Medium | Disruption: Local works in, over and within vicinity of watercourses (but of short duration) | Minor Adverse, Direct, Temporary | Neutral |
| | | Local: Ordinary Watercourses and Fairham Brook and Nethergate Stream are main rivers < 5 m wide. | Low | | Minor Adverse, Direct, Temporary | Slight Adverse |
| 4. FLOODPLAIN: Conveyance of Flow | (i) Surface Waters | Regional / Local: | Low | Low: Scheme unlikely to result in significant impediment of the floodplain | Minor Adverse during construction phase | Neutral |
| | (ii) Groundwater | Local: | Low | Increased impermeable area within catchment | Minor Adverse permanent | Neutral |
| 5. GROUNDWATER Water supply, transport and dilution of waste products | (i) Non-Potable Abstraction | Local: No recorded licensed groundwater abstractions within 250 m route corridor. | Low | Negligible Impact: Scheme unlikely to result in reduction in quality or supply | Negligible | Neutral |
| | (ii) Drinking Water Supply | National / Regional: No PWS abstractions within 250 m route corridor. SPZ located approximately 4 km to north of centre of Clifton | High | Low: Scheme unlikely to result in reduction in quality or supply | Minor Adverse, Indirect, Temporary | Slight Adverse |

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|---------------------------------|------------------------|---|--------------------------------------|--|------------------------------------|---------------------------------|
| | (iii) Vulnerability | Local: 189 BGS recorded boreholes within 250 m route corridor – potential for some to be private groundwater abstractions | Low – Medium | Low: Scheme unlikely to result in reduction in quality or supply | Minor Adverse, Indirect, Temporary | Slight Adverse |
| | | National / Regional: No SPZ or Major Aquifer | Low | None | Negligible | Neutral |
| | | Local: Minor Aquifer and alluvial and river terrace gravel deposits with intermediate-high soil leaching vulnerability | Low | Pollution resulting in reduction in groundwater quality | Minor Adverse, Direct, Permanent | Neutral |
| | | Local: Non Aquifer | Low | None | Negligible | Neutral |

Main effects are as follows:

Effects on Surface Water Quality

- 10.9.5 Potential impacts to surface water quality occurring during the construction phase of a road project including spillages of construction materials (oils, fuel and other contaminating fluids) and the disturbance and release of silt are all likely to have a significant impact upon the quality of receiving watercourses. All watercourses, as well as any abstractions supported by those watercourses within the vicinity of the A453 carriageway are potentially at risk. The nearest surface water abstractions are taken from the River Trent at Barton in Fabis and Thrumpton. However the River Trent is unlikely to be significantly affected by construction impacts as it is not crossed by the carriageway although roadside drainage ditches do ultimately discharge to the River Trent. The main watercourses in the vicinity of the A453 are classified as RE1 and RE2, with generally good chemical and biological water quality (GQA Grade B where data is available). Overall significance of effects is moderate adverse (see Table 2.10.12, 1(i)).
- 10.9.6 The main watercourses are classified as being of high importance. The significance of residual effects on the surface water resource as a result of construction and following the implementation of mitigation measures is considered to be slight adverse (see Table 2.10.12, 2(i)). The fisheries quality of the River Trent, River Soar and Fairham Brook are of high importance and are of suitable quality to support salmonid and cyprinid fisheries. The significance of residual effect on the fisheries resource following the implementation of mitigation measures is considered to be moderate adverse (see Table 2.10.12, 2(ii)).

Effects on Surface Water Flows

- 10.9.7 Construction has the potential to change flow regimes of watercourses and drains within the vicinity of the A453 due to siltation, changes to runoff regime and receipt of additional pumped discharges, including the dewatering of excavations. With regard to the status of the main watercourses which are classified as medium-low importance, and the presence of flood risk zones in the vicinity, the magnitude of impacts to surface water flow following the implementation of mitigation measures is regarded as minor adverse. Overall significance of residual effects is slight adverse (see Table 2.10.12, 3(i)).

Effects on Groundwater Quality

- 10.9.8 Potential adverse impacts upon groundwater quality may occur through the creation of groundwater pathways by the construction of boreholes, the excavation of protective groundcover, spillages of contaminative liquids and the working of contaminated land. However as the strata underlying the route comprises Non-Aquifers and Minor Aquifers and does not support any groundwater abstractions within the vicinity of the carriageway, groundwater is classified as low to medium importance. Overall the magnitude of potential impacts on the quality of groundwaters following the implementation of mitigation measures is regarded as negligible. Overall significance of effects is slight adverse (see Table 2.10.12, 5(ii)).

Effects on Groundwater Flow

- 10.9.9 Potential adverse impacts upon groundwater flow may occur through dewatering of excavations which have the potential to lower the groundwater table and result in inflows of lower quality groundwater and possibly saline groundwaters. The yield of local groundwater abstractions may also be compromised. Given that much of the route is underlain by Non-Aquifers and Minor Aquifers, and there are no licensed groundwater abstractions or SPZs within a 1 km radius of the carriageway, groundwater along the route is regarded as being of low to medium importance. The magnitude of impact adversely affecting groundwater flow following the implementation of mitigation measures is regarded overall as negligible. Overall significance of effects is neutral (see Table 2.10.12, 5(i)).

Operation Phase

- 10.9.10 Table 2.10.13 summarises the significance of environmental effects during operations of the A453 widening scheme following implementation of mitigation measures.

Table 2.10.13: Significance of Environmental Effects during the Operational Phase with Implementation of Mitigation Measures

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|---|------------------------------|--|--------------------------------------|---|--|---------------------------------|
| Operational Phase | | | | | | |
| 1. SURFACE WATERCOURSE: Water supply, transport and dilution of water products | (i) Chemical Water Quality | Regional / Local: River Soar, River Trent, Fairham Brook and Nethergate Stream all GQA Grade B (Good) | High | Reduction in quality of discharges | Nethergate Stream – Routine Major Adverse, Direct, Permanent | Large Adverse |
| | | | | | Fairham Brook Routine Runoff and River Soar and River Trent Routine Runoff and Accidental Spillage relating to all main receiving watercourses Negligible, Direct, Permanent | Neutral |
| | | Local: Status of other ordinary watercourses not recorded | Medium – Low | | Minor Adverse, Direct, Permanent | Slight Adverse |
| | (ii) Non-Potable Abstraction | Local: 2 surface water abstractions within 250 m route corridor downstream of the A453 but within the River Trent corridor | Medium – High | Reduction in quality of discharges | Minor Adverse, Direct / Indirect, Temporary | Slight Adverse |
| | (iii) Drinking Water Supply | Regional / Local: No Public Water Supply (PWS) abstraction within 250 m route corridor | Medium – High | None | Negligible | Neutral |
| 2. WATERCOURSE: Biodiversity | (i) Biological Water Quality | Regional / Local: GQA Grade B (Good) for River Soar, River Trent, and Fairham Brook. | High | Reduction in quality of discharges, and increased discharge volumes | Minor Adverse, Direct, Permanent (Nethergate Stream Routine Runoff) | Slight Adverse |
| | | | | | Negligible, Direct, Permanent (Fairham Brook Routine Runoff, River Soar and River Trent Routine Runoff) | Neutral |
| | | Local: Status of Nethergate Stream and other ordinary watercourses not recorded. | Low | | Minor Adverse, Direct, Permanent | Neutral |

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|--|-----------------------------|--|--------------------------------------|--|-------------------------------------|---------------------------------|
| | (ii) Fisheries Quality | Regional: River Soar, River Trent and Fairham Brook are all of suitable quality to support Cyprinid and Salmonid Fisheries | High | Reduction in quality of discharges and increased discharge volumes | Moderate Adverse, Direct, Permanent | Moderate Adverse |
| | | Local: Status of Nethergate Stream and ordinary watercourses not recorded, assumed undesignated / non fishery | Low | | Minor Adverse, Direct, Permanent | Neutral |
| 3. WATERCOURSE: Conveyance of flow and material | (i) Nature of Watercourses | Regional: River Soar and River Trent are main rivers > 10 m wide | Medium | Disruption: Local works in, over and within vicinity of watercourses (but of short duration) | Minor Adverse, Direct, Permanent | Neutral |
| | | Local: Ordinary Watercourses and Fairham Brook and Nethergate Stream are main rivers < 5 m wide. | Low | | Minor Adverse, Direct, Permanent | Slight Adverse |
| 4. FLOODPLAIN: Conveyance of Flow | (i) Surface Waters | Regional / Local: | Low | Negligible not in floodplain but could affect surface water runoff | Negligible | Neutral |
| | (ii) Groundwater | Local: | Low | Increased impermeable area within catchment | Minor Adverse | Slight Adverse |
| 5. GROUNDWATER: Water supply, transport and dilution of waste products | (i) Non-Potable Abstraction | Local: No recorded licensed groundwater abstractions within 250 m route corridor. | Low | Negligible Impact: Scheme unlikely to result in reduction in quality or supply | Negligible | Neutral |
| | (ii) Drinking Water Supply | National / Regional: No PWS abstractions within 250 m route corridor. SPZ located approximately 4 km to north of centre of Clifton | High | Low: Scheme unlikely to result in reduction in quality or supply | Minor Adverse, Indirect, Temporary | Slight Adverse |
| | | Local: 189 BGS recorded boreholes within 250 m route corridor – potential for some to be private groundwater abstractions | Low – Medium | Low: Scheme unlikely to result in reduction in quality or supply | Minor Adverse, Indirect, Temporary | Slight Adverse |

| Feature and Attribute / Service | Quality Indicator | Scale, Details and Grading | Importance / Sensitivity of Receptor | Potential Impact | Magnitude of Impact | Significance of Residual Effect |
|---------------------------------|---------------------|--|--------------------------------------|---|-------------------------------------|---------------------------------|
| | | National / Regional: No SPZ or Major Aquifer | Low | None | Negligible | Neutral |
| | (iii) Vulnerability | Local: Minor Aquifer and alluvial and river terrace gravel deposits with intermediate-high soil leaching vulnerability | Low | Pollution resulting in reduction in groundwater quality | Moderate Adverse, Direct, Permanent | Neutral |
| | | Local: Non Aquifer | Low | None | Negligible | Neutral |

Main effects are as follows:

Effects on Surface Water Flows and Flood Risk

10.9.11 Following completion and opening of the improved A453 scheme, surface runoff flows are expected to increase due to larger volumes of routine runoff generated by increased carriageway area. With the exception of Nethergate Stream, flows in the main rivers receiving discharge are such that increased runoff flows will not form a significant volume of the channel flow, thus magnitude of adverse impacts upon the River Soar, River Trent and Fairham Brook are regarded as minor adverse. Overall significance of residual effect is slight adverse (see Table 2.10.13, 3(i)).

10.9.12 Runoff into Nethergate Stream contributes a greater proportion of the flow than to the three other main watercourses and thus has a greater impact upon the watercourse. Mitigation measures are proposed to attenuate and stabilise the runoff discharges from Drainage Zones P and Q entering Nethergate Stream. Further mitigation measures to be included in the scheme comprise improvement work to the watercourse. The magnitude of adverse impact to the surface flow of Nethergate Stream, following the implementation of the proposed mitigation measures, is considered to be negligible. Overall significance of effects is neutral.

10.9.13 Balancing ponds and attenuation ditches are included in the proposed scheme design within the rural section of the route. The incorporation of these measures into the design will ensure that the runoff discharges to the receiving watercourses are maintained and that there would be no exacerbation of flooding potential within those watercourses. However, as the balancing ponds are proposed in the rural section of the route the magnitude of adverse impact is reduced but classification of the magnitude of the impact remains negligible. Overall significance of effects is neutral (see Table 2.10.13, 4(i)).

Effects on Groundwater Quality

10.9.14 In the rural section of the A453 carriageway routine runoff will be discharged to surface watercourses and drainage ditches (via balancing ponds in five drainage

zones) and ultimately flowing into main watercourses. However, as previously stated, a number of the ditches into which the carriageway runoff would be discharged are dry or intermittently dry in the summer months. It is therefore considered probable that road runoff would dissipate and infiltrate to the ground within these ditches (particularly associated with drainage ditches D1-3 (Drainage Zone B), D2-1 (Drainage Zone C) and Ratcliffe Dyke (Drainage Zones H, L and K)). Whilst this reduces the potential for surface water impacts it increases the potential for impacts on groundwater quality.

10.9.15 The Method C assessment indicated that the potential risk to groundwater posed by the scheme was medium for the sections of the route overlying a Minor Aquifer and low for the sections overlying a Non-Aquifer. The magnitude of the impact on groundwater resources was indicated by the assessment to be negligible for Non-Aquifers and moderate adverse for Minor Aquifers. Overall significance of residual effects is neutral for Minor Aquifers and Non-Aquifers (see Table 2.10.13, 5(iii)).

Effects on Groundwater Flow

10.9.16 Strata underlying the route corridor are comprised of Non-Aquifers and Minor Aquifers and do not support any known groundwater abstractions. The groundwater resource is regarded as being of low to medium importance, in accordance with Table 2.10.1. Given that much of the structure of the road would lie above the water table, other than for the area around S8 Parkway Bridge, where permanent groundwater lowering will be maintained as at present, the magnitude of the impacts on groundwater flow are considered to be minor adverse. Overall significance of effects is slight adverse (see Table 2.10.13, 5(ii)).

Effects on Surface Water Quality

10.9.17 The Method A and B assessment carried out in accordance with the DMRB guidelines indicated that the River Soar, River Trent and Fairham Brook are not at risk of significant water quality impact as a result of the discharge of routine runoff. Nethergate Stream was found to be at high risk of significant adverse impact with dissolved copper and total zinc concentrations predicted to exceed the EQS values using the water quality data for Fairham Brook. However, as Nethergate Stream is of low ecological and amenity value, the adverse impacts are less significant than those which would occur if it were a higher quality watercourse.

10.9.18 Local watercourses in the vicinity of the proposed A453 improvements generally have a good water quality and are classified as RE1 watercourses (based on most recent data, however long term averages of the data suggest the River Trent and River Soar are compatible with the RE2 classification). The main surface watercourses receiving runoff discharges are regarded as being of high importance. Thus the high risk of significant adverse impacts affecting the water quality of Nethergate Stream equates to an impact magnitude of major adverse. The magnitude of the potential surface water impacts upon the River Soar, River Trent

and Fairham Brook are regarded as negligible. Overall significance of effects, taking Nethergate Stream into account, is large adverse (see Table 2.10.13, 1(i)).

10.9.19 De-icing of the carriageway during winter months also represents a significant potential source of water quality impacts. De-icing salt enters watercourses via carriageway runoff and has the potential to impact upon the aquatic ecosystems of receiving watercourses where there is limited dilution. However, as de-icing occurs in the winter months when the flow in the watercourse is greater, in-channel dilution is available to attenuate the de-icing salts and the risk of significant pollution impact is reduced. The main watercourses in the rural section are unlikely to be significantly affected however the risk is greater in the drainage ditches which feed the main rivers although the drainage ditches are not considered to be of significant environmental importance. Salinity of water can have an adverse affect upon fish within a watercourse. Overall, the magnitude of the impact is regarded as minor adverse and the overall significance of residual effects will be neutral (see Table 2.10.13, 2(i) & 2(ii)).

10.9.20 The risk of significant impact in the urban section of the route is greater as the watercourses are likely to receive runoff containing de-icing salts from the A453 carriageway, side roads and residential and pedestrian areas. Routine runoff is discharged to existing highways drains and thus enters the receiving watercourse more rapidly with less attenuation than in a meandering partially vegetated channel. The potential impact from de-icing is relatively localised and generally of short duration. Therefore the magnitude of the impact of de-icing on surface waters is regarded as minor adverse. Overall significance of effects is slight adverse (see Table 2.10.13, 2(i)).

Effects Resulting from Accidental Spillages

10.9.21 Road schemes generally improve road safety, thus reducing the environmental risks associated with accidental spillages. Improved road safety on the new A453 carriageway is expected to reduce the environmental risk associated with accidents.

10.9.22 The DMRB Method D assessment indicates that all drainage zones comprising the proposed 2027 Do-Something A453 carriageway improvements which deliver runoff to each reach of the receiving watercourses are within the acceptable risk limit of 1% for sensitive watercourses. The magnitude of the impact of accidental spillage pollution events on the River Soar, River Trent, Fairham Brook and Nethergate Stream is negligible.

10.9.23 Five balancing ponds are included in the 2027 Do-Something scenario drainage design proposals and the linear ditches which initially receive carriageway runoff discharges also contribute significant mitigation effects. Mitigation measures proposed for the urban drainage zones discharging to Nethergate Stream comprise penstock valves in manholes and bypass oil separators prior to the outlet. Mitigation for Drainage Zone S discharging into Fairham Brook will comprise penstock valves in manholes upstream of the outlet.

10.9.24 Incorporation of these mitigation measures will reduce the magnitude of risk of impact to the main receiving watercourses, thus the magnitude of impacts resulting from accidental spillages is negligible for all main watercourses receiving carriageway runoff discharges. Overall significance of effects is neutral taking into account all relevant aspects in Table 2.10.13, 1(i), 1(iii) & 2(i).

Cumulative Effects

10.9.25 Several other developments close to the A453 could have an impact upon water quality, in particular the quality of the Fairham Brook downstream of the confluence with the Nethergate Stream. The Environment Agency will have considered discharges from these when planning permission was granted and has not suggested that there would be any significant cumulative impacts with the A453. It is not considered that the impacts from other developments in combination with those from the A453 will result in significant cumulative effects. Other major developments in the vicinity of the A453 carriageway improvement include:

- East Midlands Parkway Station: a new railway station is under development to the west of Ratcliffe Power Station. Together with the station itself, the new roadways and car parks will have an impact upon the volume of surface water to be accommodated and potentially upon the quality of the recipient watercourse. It is likely that the surface water will be directed into the River Soar at this stage and unlikely to have an effect upon the quality of the river;
- NET (Nottingham Express Transit) is to site a new Park and Ride terminus south east of the new Mill Hill Roundabout. At present, there are few detailed plans for the terminus, but it will inevitably have surface water runoff from the impermeable areas which will include park and ride facilities. Drainage will be to the Fairham Brook;
- Also, to the east of the new roundabout, south of Clifton, the new Lark Hill Retirement Village is under construction. This will comprise of 327 dwellings, associated shops and entertainment facilities. The built area will be 14 acres with a further 10 acres of parkland. Surface water will naturally drain to the Fairham Brook.

10.10 Summary

10.10.1 An assessment of impacts on the water environment has been undertaken in accordance with guidance in DMRB Volume 11, Section 3, Part 10 (HA216/06), May 2006.

10.10.2 Three scenarios have been considered within the assessment: the existing 'baseline' 2006 situation, the do-minimum 2012 situation without the proposed scheme; and the 'design year' 2027 situation with the scheme including mitigation measures.

- 10.10.3 The A453 crosses seven watercourses within the study area, including three main watercourses, the River Soar, Fairham Brook and Nethergate Stream, and smaller ordinary watercourses and ditches. The River Trent lies to the north-west of the A453 and receives runoff via the other watercourses. Water quality of the main watercourses is good, which are considered of high / very high importance.
- 10.10.4 Approximately 40% of the route corridor passes over a Non-Aquifer, and 60% overlies Minor Aquifers of intermediate / high soil leaching potential. The proposed scheme is not located within a Source Protection Zone. Groundwaters are considered of low / medium importance.
- 10.10.5 Drainage will be via a combination of open surface water channels, combined kerb drainage systems and filter drains for the main A453 carriageway, with a combination of filter drains, kerbs and gullies for the side roads. Five balancing ponds and extensive lengths of highway drainage ditches will attenuate and clean storm water runoff prior to discharge at the rural outfalls. The balancing ponds will also have secondary functions to enhance ecological habitat and provide visual amenity for travellers.
- 10.10.6 To mitigate the small increase in unrestricted flows from the scheme improvements along the upstream open reach of the Nethergate Stream, proposed works include removal of an existing footbridge culvert, some reprofiling of the watercourse cross-section and some localised lowering of the adjacent verge areas to provide additional flood storage.
- 10.10.7 Other mitigation measures proposed within the urban section are the provision of penstock valves and bypass oil separators, and catchpits at regular intervals will allow removal of coarse suspended solids.
- 10.10.8 The Method A assessment found that the River Soar, River Trent and Fairham Brook are at low risk of adverse impacts from the discharge of runoff, and therefore require no further assessment. Modelling of Nethergate Stream, however, suggests that it does not have sufficient in-channel dilution to attenuate pollutants in routine road runoff from the urban drainage zones. A Method B assessment was therefore necessary for the Nethergate Stream.
- 10.10.9 Results of the Method B assessment indicate that water quality of Nethergate Stream in the baseline 2006 and 2012 Do-Minimum scenarios pass the Method B assessment with respect to both dissolved copper and total zinc. However, the 2027 design year traffic flow results in a significant increase in the concentrations of both dissolved copper and total zinc in Nethergate Stream such that both fail the Environmental Quality Standard (EQS).
- 10.10.10 The results of the Method C assessment show that potential discharges of routine runoff to groundwater are unlikely to result in significant adverse impacts on the water quality of underlying groundwater. Impacts are predicted to be moderate at worst, affecting Minor Aquifers which do not provide public water supply.

- 10.10.11 The Method D assessment results show that the risk of pollution from accidental spillage is low (<1.0% per annum) and therefore no specific mitigation is required for spillage containment. Other mitigation measures installed for flow attenuation and water quality improvement will provide some containment by default.
- 10.10.12 Overall it is predicted that during the construction phase the significance of effects on groundwater flow will be neutral; on groundwater quality and surface water flows the significance of effects will be neutral / slight adverse; and on surface water quality the significance of effect will be moderate adverse.
- 10.10.13 Overall it is predicted that during operation of the widened road the significance of effects will be neutral for groundwater flow, groundwater quality in Non-Aquifer areas, surface water flow and quality of main watercourses (with the exception of Nethergate Stream), and the floodplain. The significance of effects resulting from accidental spillages is also neutral.
- 10.10.14 The significance of operational effects are predicted to be neutral / slight adverse on groundwater quality where runoff is discharged to dry drainage ditches, and groundwater flow and surface water quality of main watercourses (with the exception of Nethergate Stream).
- 10.10.15 The significance of operational effects will be neutral on surface water flow of Nethergate Stream and on groundwater quality in Minor Aquifers.
- 10.10.16 The significance of operational effects will be large adverse on surface water quality of Nethergate Stream, however the inclusion of mitigation measures better protect the quality of the stream than current provisions.
- 10.10.17 The Environment Agency is satisfied with the pollution prevention measures within the scheme design.
- 10.10.18 Without the implementation of mitigation measures routine runoff is expected to have a major adverse impact upon the water quality of Nethergate Stream, however the inclusion of mitigation measures in the proposed 2027 Do-Something scheme results in a predicted minor adverse impact. The River Soar, River Trent and Fairham Brook are not predicted to be affected by discharges of routine runoff or in the event of an accidental spillage. Nor is Nethergate Stream predicted to be adversely affected by pollution incidents resulting from accidental carriageway spillages. Groundwater is not likely to be significantly affected by discharge of routine runoff or accidental spillage.

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